Appendix A

Alternatives Development

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266B

Long-Term Water Transfers

Environmental Impact Statement/Environmental Impact Report

Alternatives Development Report
Final Draft

Prepared by
United States Department of the Interior
Bureau of Reclamation
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Abbreviations and Acronyms

AF	acre-feet
BARDP	Bay Area Regional Desalination Project
BDCP	Bay Delta Conservation Plan
BMPs	best management practices
CALFED	State (CAL) and Federal (FED) agencies participating in the Bay-Delta Accord
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
Delta	Sacramento-San Joaquin Delta
DWR	Department of Water Resources
EA	Environmental Assessment
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
ETAW	evapotranspiration of applied water
FONSI	Finding of No Significant Impact
IPR	indirect potable reuse
M&I	municipal and industrial
MUD	Municipal Utility District
NEPA	National Environmental Policy Act
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries Service
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
SLDMWA	San Luis & Delta-Mendota Water Authority
SWP	State Water Project
USFWS	U.S. Fish and Wildlife Service
WaterSMART	Sustain and Manage America’s Resources for Tomorrow
WD	Water District
WUE	water use efficiency

Chapter 1 Introduction

This report describes the alternatives development process and proposed alternatives for the Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

1.1 Background

Hydrologic conditions, climatic variability, and regulatory requirements for operation of water projects commonly affect water supply availability in California, making advance planning for water shortages necessary and routine. This variability can strain water supplies in areas that are dependent on delivery of Central Valley Project (CVP) supplies to meet most, if not all, of the water demand. In the past decades, water entities have been implementing water transfers to supplement decreased water supplies and transfers have become a common tool in water resource planning.

The Bureau of Reclamation and the San Luis & Delta-Mendota Water Authority (SLDMWA) are completing a joint EIS/EIR to provide National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) compliance for water transfers from 2015 through 2024. Reclamation is serving as the Lead Agency under NEPA and SLDMWA is the Lead Agency under CEQA. This report refers to Reclamation and SLDMWA jointly as the Lead Agencies.

The EIS/EIR will evaluate water transfers from willing sellers upstream from the Sacramento-San Joaquin Delta (Delta) to buyers that export water from the Delta. Alternatives in this document only analyze transfers of CVP water supplies that require use of CVP or State Water Project (SWP) facilities and transfers of non-CVP water supplies that require use of CVP facilities. The cumulative analysis will include all potential transfers including SWP transfers. The water would be transferred to water users that are at risk of experiencing water shortages and require supplemental water supplies to meet anticipated demands. Water transfers would only be used to help meet existing demands and would not serve any new demands in the buyers' service areas.

In addition to SLDMWA, several other agencies have identified interest in purchasing transfer water to reduce potential water shortages. These agencies have requested to be included in the EIS/EIR. Table 1-1 summarizes all purchasing agencies, further referred to as buyers in this report. Figure 1-1 on the next page shows the location of buyers (referred to as Buyer Service Area) and the sellers (referred to as Seller Service Area).

Table 1-1. Potential Buyers

Contra Costa Water District
East Bay Municipal Utility District
San Luis & Delta Mendota Water Authority Participating Members
Byron-Bethany Irrigation District
Del Puerto Water District
Eagle Field Water District
Mercy Springs Water District
Pacheco Water District
Panoche Water District
San Benito County Water District
San Luis Water District
Santa Clara Valley Water District
Westlands Water District

To make water available, the seller must take an action to reduce beneficial use. Water transfers must be consistent with Federal and State law. Transfers in the Sacramento and San Joaquin area are governed by existing water rights, Delta pumping capacity, and reservoir storage capacity. The following sections describe past water transfers and regulations applicable to implementing water transfers.

1.1.1 History

The Lead Agencies have participated in water transfers through various past programs or agreements. The Central Valley Project Improvement Act (CVPIA), signed into law in 1992, authorizes water transfers between willing parties as long as transferred water is to be used for project purposes or other beneficial uses recognized under State law (Section 3405). As a result, Reclamation has facilitated and implemented CVP-related water transfers between willing sellers and buyers in need of supplemental water supplies. Transfers have included both in-basin and through-Delta transfers.

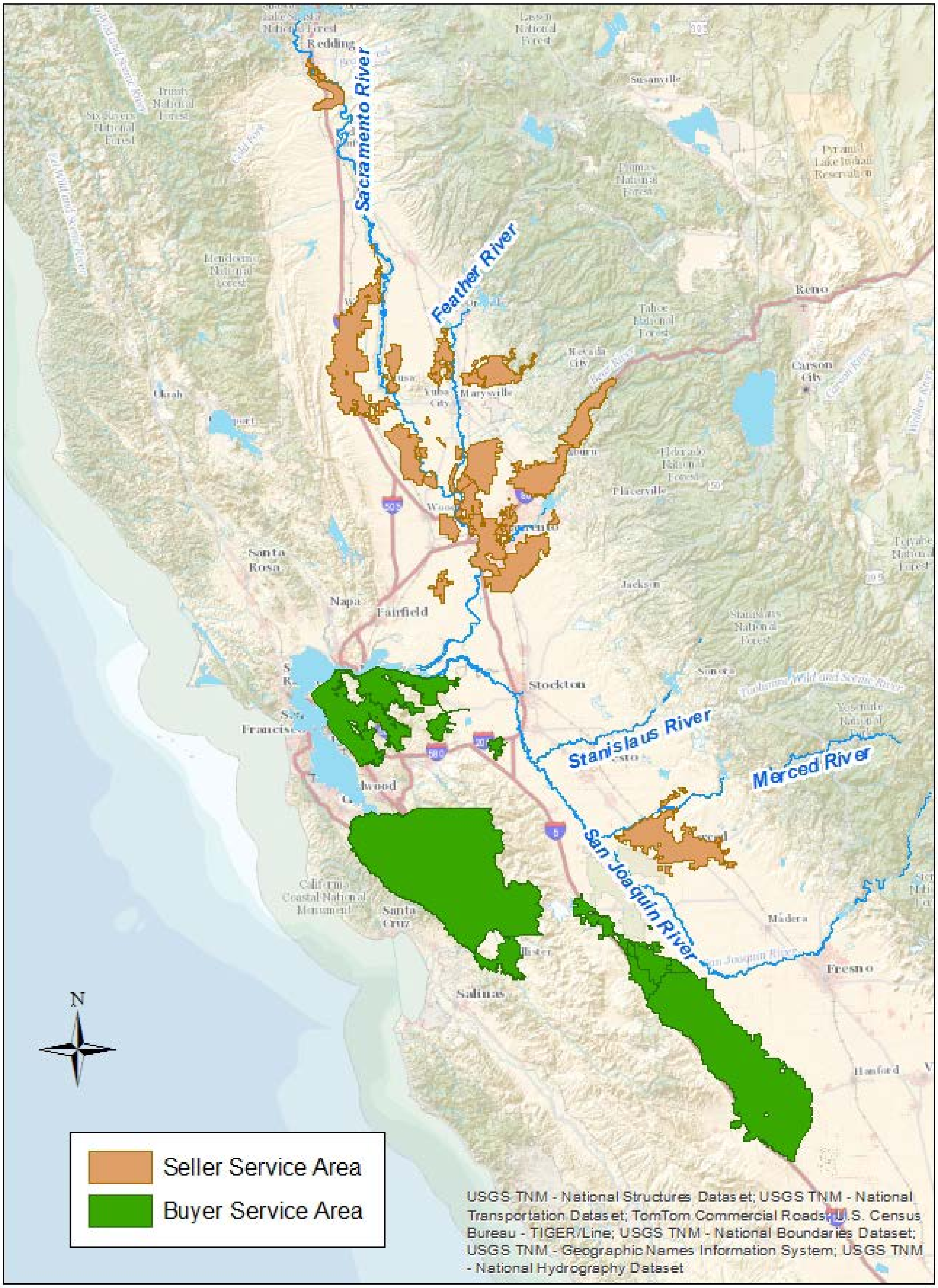

Figure 1-1. Buyer and Seller Service Areas

Reclamation is required to complete NEPA documentation for water transfers. NEPA compliance for transfers has varied in the past decade. Reclamation has developed the following NEPA documents to evaluate multiple through-Delta water transfers:

- Environmental Water Account EIS/EIR - evaluated water transfers from 2003 through 2007.
- Environmental Water Account Supplemental EIS/EIR - evaluated transfers for the 2008 transfer season.
- 2009 Drought Water Bank Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) - evaluated CVP-related transfers that occurred under the 2009 Drought Water Bank.
- 2010-2011 Water Transfer Program EA and FONSI – evaluated through-Delta water transfers for 2010 and 2011 water years. Because of wetter hydrologic conditions, no transfers occurred in 2010 or 2011.
- 2013 Water Transfers EA and FONSI – evaluated through-Delta groundwater substitution transfers in 2013.
- 2014 SLDMWA Water Transfers EA and FONSI – evaluated through Delta transfers made available from groundwater substitution or cropland idling.

Reclamation has also completed multiple EAs that focus on in-basin transfers. In 2010, Reclamation signed two FONSIs for accelerated water transfers and exchanges from 2011 through 2015. One covered transfers between CVP South of Delta Contractors and the other covered transfers between Friant Division and Cross Valley CVP Contractors. Reclamation also worked with the Exchange Contractors, the CEQA lead agency, to complete an EIS/EIR to examine the environmental impacts of the transfer and exchange of the Exchange Contractors CVP water (up to 130,000 acre-feet [AF] per year for the next ten years) within the SLDMWA service area from 2005 through 2014. In 2014, Reclamation completed the 2014 Tehama-Colusa Canal Authority EA and FONSI to assess groundwater substitution and cropland idling transfers within from Sacramento Valley water users to the Tehama-Colusa Canal Authority. Other EAs have been completed for individual, in-basin and out-of-basin transfers.

Reclamation works cooperatively with the California Department of Water Resources (DWR) to develop the *Technical Information for Preparing Water Transfer Proposals* document that provides sellers and buyers with transfer information needed for Reclamation and DWR to facilitate transfers according to CVPIA and State law. Reclamation and DWR have published the paper each year since 2009 and plan to release it annually in the future with updated information on water transfers.

SLDMWA has negotiated water transfers in past years on behalf of the member agencies. SLDMWA member agencies have been identified as a potential buyer in all Reclamation's past transfer programs and many have purchased water in previous years.

While not the subject of this analysis except with regard to cumulative effects, transfers of SWP water have also occurred frequently in the past. DWR facilitates transfers for SWP contractors. DWR has operated several Drought Water Banks to support water transfers during drier hydrologic years, the most recent in 2009. For the 2009 Drought Water Bank, DWR solicited participants and helped connect buyers and sellers. DWR does not plan to implement banks in the future, but continues to facilitate water transfers for SWP contractors. SWP contractors currently identify and negotiate water transfers and submit transfer proposals to DWR.

1.1.2 Regulations Regarding Transfers

1.1.2.1 Federal

The Biological Opinions[1] on the Coordinated Operations of the CVP and SWP (U.S. Fish and Wildlife Service [USFWS] 2008; National Oceanic and Atmospheric Administration Fisheries Service [NOAA Fisheries] 2009) analyze transfers through the Delta from July to September that are up to 600,000 AF in critical and dry years. For all other year types, the maximum transfer amount is up to 360,000 AF. Transfers that exceed these amounts or are outside the transfer window would require new biological opinions. For this EIS/EIR, annual transfers would not reach this capacity and would likely stay in the range of up to 100,000 to 200,000 AF of water transferred annually to buyers.

Several lawsuits were filed challenging the validity of the 2008 USFWS and 2009 NOAA Fisheries Biological Opinions and Reclamation's acceptance of the Reasonable and Prudent Alternative (RPA) included with each (Consolidated Salmonid Cases, Delta Smelt Consolidated Cases). The District Court issued findings that concluded Reclamation had violated NEPA by failing to perform any NEPA analysis before provisionally adopting the 2008 USFWS RPA and 2009 NOAA Fisheries RPA. On December 14, 2010, the District Court found the 2008 USFWS Biological Opinion to be unlawful and remanded the Biological Opinion to USFWS. The District Court issued a similar ruling for the 2009 NOAA Fisheries Biological Opinion on September 20, 2011. On March 13, 2014, the United States Court of Appeals for the Ninth Circuit affirmed in part and reversed in part the finding from the District Court on the USFWS Biological Opinion. The Court of Appeals upheld the determination

[1] A written statement setting forth the opinion of the USFWS or the NOAA Fisheries Service as to whether a federal action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of a critical habitat. See 16 USCA 1536(b).

that Reclamation must complete NEPA analysis, but it reversed the finding that the scientific basis for the Biological Opinion was arbitrary and capricious. The NOAA Fisheries Biological Opinion is the subject of a future review from the Court of Appeals. Until the legal issues are resolved and new biological opinions are completed (if necessary), the 2008 USFWS and 2009 NOAA Fisheries biological opinions will guide operations of potential water transfers.

Reclamation approves transfers consistent with provisions of the CVPIA and State law that protect against injury to third parties as a result of water transfers. According to the CVPIA Section 3405(a), the following principles must be satisfied for any transfer:

- Transfer may not violate the provisions of Federal or state law;
- Transfer may not cause significant adverse effects on Reclamation's ability to deliver CVP water to its contractors;
- Transfer will be limited to water that would be consumptively used or irretrievably lost to beneficial use;
- Transfer will not have significant long-term adverse impact on groundwater conditions;
- Transfer will not adversely affect water supplies for fish and wildlife purposes. Reclamation will not approve any water transfer for which these basic principles have not been adequately addressed; and
- Transfer water must be made available in accordance with the seller's surface water monthly diversion schedule. For example, if the seller's monthly diversion for July is 10,000 AF, then only up to that amount can be transferred in July.

1.1.2.2 State

Several sections of the California Water Code provide authority to carry out transfers. Importantly, Section 1745.07 specifically indicates that transfers fitting within that portion of the Water Code are deemed to be a beneficial use of water and not to interfere with water rights. Section 1745 et seq. also defines types of transfers allowed and protections of water rights and third parties against water transfers. Water Code Section 1810 prohibits owners of conveyance facilities from denying use of unused capacity for transfers upon fair compensation and further specifies that "use of a water conveyance facility is to be made without injuring any legal user of water and without unreasonably affecting fish, wildlife, or other in-stream beneficial uses and without unreasonably affecting the overall economy or the environment of the county from which the water is being transferred."

1.1.2.3 Local

County governments also have requirements related to transferring water outside of the county, primarily related to groundwater extraction. Reclamation requires transfer participants to comply with local requirements (including ordinances relating to well drilling, well spacing, and groundwater extraction) and local groundwater management plans, as well as compliance with adjudications and with the overdraft protections in Water Code Section 1745 et seq.

1.2 Purpose of the Report

This Alternatives Development Report documents the process to develop the EIS/EIR alternatives. The Lead Agencies are using this structured planning process to delineate a reasonable range of alternatives for evaluation in the EIS/EIR in compliance with NEPA and CEQA.

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Chapter 2
Alternatives Development Process

Both NEPA and CEQA require EISs and EIRs, respectively, to identify a reasonable range of alternatives. To identify and screen alternatives, a structured, documented process was developed that included internal and public scoping (Figure 2-1).

Figure 2-1. Alternatives Development and Screening Process

2.1 NEPA Purpose of and Need for Action/CEQA Project Objectives

The purpose and need statement (under NEPA) and project objectives (under CEQA) describe the underlying need for and purpose of a proposed project. This statement is a critical part of the environmental review process because it helps to set the overall direction of an EIS/EIR, identify the range of reasonable alternatives, and focus the scope of analysis. The Lead Agencies developed the following purpose and need/basic project objectives statement.

2.1.1 Purpose and Need

The purpose of the Proposed Action is to facilitate and approve voluntary water transfers from willing sellers upstream of the Delta to water users south of the Delta and in the San Francisco Bay Area. Water users have the need for immediately implementable and flexible supplemental water supplies to alleviate shortages.

2.1.2 Project Objectives

As required by CEQA, a lead agency must identify the objectives sought by the proposed project. SLDMWA has developed the following objectives for long-term water transfers through 2024:

- Develop supplemental water supply for member agencies during times of CVP shortages to meet existing demands.

- Meet the need of member agencies for a water supply that is immediately implementable and flexible and can respond to changes in hydrologic conditions and CVP allocations.

Because shortages are expected due to hydrologic conditions, climatic variability, and regulatory requirements, transfers are needed in most, if not all years.

2.2 Measure Identification

The public provided comments on the scope of the EIS/EIR during the public scoping period. Some of these comments include suggestions for specific measures intended to address the purpose and need/basic project objectives. The Lead Agencies reviewed the purpose and need/basic project objectives, public scoping comments, scientific data, and previous studies in their initial effort to brainstorm measures. This resulted in an initial list of measures in Table 2-1 (described in more detail in Chapter 3).

Table 2-1. Initial Measures

Measures	Measure Description
Agricultural Water Use Efficiency (Buyer Service area)	Increase agricultural water use efficiency in buyer service area to reduce agricultural water use, including improvements to agricultural systems to increase recapture and reuse of irrigation water
Agricultural Water Use Efficiency (Upstream from Delta Region)	Increase agricultural water use efficiency in seller service area to reduce agricultural water use
Conservation – Municipal & Industrial	Increase water conservation for municipal and industrial uses in buyer service area to reduce water demands
Desalination - brackish	Desalinate brackish groundwater supplies and distribute to Buyer Service area to develop new supply
Desalination - seawater	Desalinate seawater and distribute to Buyer Service area to develop new water supply
Reclamation - nonpotable reuse	Treat wastewater for agricultural water use in Buyer Service area
Reclamation - indirect potable reuse (IPR)	Advance treat wastewater and store in groundwater basins for future potable reuse
Cropland Idling Transfers-rice, field crops, and grains	Idle croplands and transfer irrigation water to buyers
Cropland Idling Transfers-pasture and alfalfa	Idle pasture and alfalfa fields and transfer irrigation water to buyers
Land retirement in San Joaquin Valley	Permanently retire lands in San Joaquin Valley and transfer irrigation water to other croplands
Groundwater substitution	Pump groundwater for irrigation rather than use surface water supplies, and transfer surface water to buyers
New surface storage	Build new surface storage facilities to store water for buyers
Groundwater storage	Build new facilities to recharge and extract groundwater for use in Buyer Service area, or expand existing groundwater storage programs by expanding recharge and extraction facilities
Water rights purchase	Purchase water rights for permanent transfer of water

Measures	Measure Description
Crop shifting	Shift from a higher water use crop to a lower water use crop and transfer incremental decrease in water use to buyers
Rice decomposition water	Use alternate method to decompose rice straw and transfer rice decomposition water to buyers
Reservoir release	Transfer available water stored in existing, non-CVP or SWP reservoirs
Transfers within the Buyer Service Area	Implement water transfers between buyers and sellers within the Buyer Service area
Groundwater development	Develop new groundwater supplies by constructing new wells and pumps in the Buyer Service area
Modify CVP and SWP contracts	Change CVP and SWP contracts to limit water use in the Buyer Service area
Change cropping patterns in San Joaquin Valley	Plant lower water use crops or increase fallowed land in the Buyer Service area
Limit dairy and cattle ranches in San Joaquin Valley	Limit dairy and cattle ranches in San Joaquin Valley to decrease water use
Enforce seniority system to manage deliveries	Deliver water supplies based on seniority of water rights
Implement policy of no net increase in water availability for expansion	Prohibit use of CVP supplies for newly developed urban or agricultural lands
Pipe water from Canada and northern states	Purchase water and build distribution system to deliver water from northern states to buyers
Fix Owens Valley	Increase water supply available from Owens Valley

2.3 Screening Methods

The Lead Agencies determined that they should screen the initial list of measures before combining the measure into alternatives. The agencies wanted to carry forward measures that had some potential to contribute to the purpose and need/basic project objectives. They based the measure evaluation and screening on NEPA and CEQA guidance:

- NEPA requires that agencies shall “rigorously explore and objectively evaluate all the reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated” (40 Code of Federal Regulations [CFR] Part 1502.14(a)). The Department of the Interior NEPA procedures (43 CFR Part 46.420(b)) define reasonable alternatives as “alternatives that are technically and economically practical or feasible and meet the purpose and need of the proposed action.”

- CEQA Guidelines section §15126.6(a) states, “An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project…” An EIR need not consider every conceivable alternative to a project or alternatives that are infeasible. (CEQA Guidelines, §15126.6(a).) State CEQA Guidelines section 15364

> defines feasible as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors."

Both NEPA and CEQA include provisions that alternatives meet (or meet most of) the purpose and need/basic project objectives, and be potentially feasible. Some alternatives do not fully meet the purpose and need/project objectives, but may be carried forward for additional analysis because they have potential to minimize some types of environmental effects or help create a reasonable range of alternatives for consideration by decision-makers.

The Lead Agencies determined that they would screen the alternatives based on their ability to meet key elements of the purpose and need/basic project objectives:

- Immediate: the term proposed for this EIS/EIR is 2015 through 2024. This period is relatively short, and measures need to be able to provide some measurable benefit within this time period.
- Flexible: project participants need water in some years, but not in others. They need measures that have the flexibility to be used only when needed.
- Provide Water: project participants need measures that have the capability of providing additional water to regions that are experiencing shortages.

Measures need to meet these three criteria to move forward for further evaluation.

2.4 Alternatives Development

The Lead Agencies screened the measures by applying the screening criteria to each measure based on available information and best professional judgment. The measures that will move forward for more detailed analysis in the EIS/EIR are those that best meet the NEPA purpose and need and CEQA basic project objectives, minimize negative effects, are feasible, and represent a range of reasonable alternatives. Chapter 4 describes the screening results in more detail.

The Lead Agencies combined the remaining measures into alternatives. The remaining measures represent potential methods to transfer water. The alternatives examine different combinations of transfer types, with different potential maximum quantities of transfers.

Chapter 3 Measures

This chapter describes measures identified for the alternatives development process. As described in Section 2.2, these measures were developed based on existing studies, past water transfer actions, and public comments received during the scoping period. Chapter 4 includes an evaluation of the measures relative to the purpose and need for long-term water transfers.

3.1 Agricultural Water Use Efficiency (Buyer Service Area)

For the agricultural water use efficiency (WUE) measure in the Buyer Service Area, districts or farmers would increase irrigation efficiency by implementing best management practices (BMPs) to reduce applied water on crops. This measure would also include improvements to agricultural systems to increase recapture and reuse of irrigation water. Reclamation requires CVP contractors to implement cost-effective, BMPs to manage water use. The CVPIA of 1992 and Section 210(b) of the Reclamation Reform Act of 1982 requires the preparation and submittal of a Water Management Plan from certain entities that enter into a repayment contract or water service contract with the Reclamation. Each plan is required to be updated every five years. Reclamation develops criteria to evaluate plans prepared by CVP contractors to meet the water conservation requirements. Criteria require contractors to identify BMPs for efficient water use and an implementation plan.

This measure would increase WUE above current and proposed practices identified in the water management plans. Districts and farmers would need to identify and invest in additional district-level or on-farm practices to improve irrigation efficiencies.

3.2 Agricultural Water Use Efficiency (Upstream from Delta)

Under this measure, districts or farmers could implement agricultural WUE practices and transfer water savings to the Buyer Service Area. Water savings would be transferrable only if it is considered irrecoverable. Irrecoverable losses include water that currently flows to a salt sink, the ocean, an inaccessible or degraded aquifer, or the atmosphere (CALFED 2000). If the water saving is recoverable, the water can be reused and is not a true savings. Water can only be transferred if there is a reduction in beneficial use; therefore, recoverable losses do not qualify for a transfer. Sellers must prove that the water savings is irrecoverable in order to sell the water for transfer. This measure would also include improvements to agricultural systems to increase recapture and reuse of irrigation water. This measure would increase WUE above the current practices, and for CVP contractors, above the current and proposed practices identified in the water management plans (see Section 3.1).

3.3 Conservation - Municipal and Industrial

Under this measure, agencies in the Buyer Service Area would implement municipal and industrial (M&I) conservation actions to reduce water demands above those that are ongoing or proposed. Santa Clara Valley Water District (WD), East Bay Municipal Utility District (MUD), and Contra Costa WD serve large urban areas in the San Francisco Bay Area and currently implement M&I conservation programs and include demand reduction measures in long-term planning documents:

- In its *2009 Water Use Efficiency Strategic Plan*, Santa Clara Valley WD set numeric targets for water conservation by year 2030 (Santa Clara Valley WD 2008). To achieve conservation targets, Santa Clara Valley WD launched several programs to encourage conservation in homes, businesses, and for landscaping, including a rebate program. Details can be found on the Water Conservation website (www.scvwd.dst.ca.us/programs/waterconservation.aspx).

- East Bay MUD summarized conservation efforts in the *East Bay Water 2010-A Status report on Local Water Use and Water Supplies* (East Bay MUD 2010). To meet the state-wide goal for a 20 percent reduction in water use by 2040, East Bay MUD has implemented the WaterSmart Center (East Bay MUD 2011a). The WaterSmart Center serves as a platform for residential and commercial rebates and programs focused on conservation.

- Contra Costa WD offers several programs for the water consumer to encourage water conservation practices, including rebates for water-smart appliances, lawn & landscaping schedules, and a home water survey. Water conservation program details can be found on the Contra Costa WD conservation website (www.ccwater.com/conserve).

These agencies have determined that they have a demand for transfers in addition to the actions that they are already undertaking related to conservation. For conservation to address potential shortages, it would need to be above the conservation efforts already planned by each agency.

3.4 Desalination

Desalination would create additional water supply through the treatment of seawater or brackish groundwater. Desalination would require water agencies to either construct a new facility or expand an existing facility. Buyers would use the desalinated water to make up for reduced deliveries of CVP water.

3.4.1 Desalination - Brackish

A brackish groundwater desalination facility would require new wells and a reverse osmosis treatment plant to pump and treat brackish groundwater from a basin within the Buyer Service Area. The treated water then would need to be conveyed to water users through new or existing distribution systems. The desalination facility would need to dispose of brine left over from the treatment process. Brine is typically discharged into the ocean; however, alternative inland brine disposal processes may be available such as evaporation ponds, deep well injection, or disposal to a salt sink.

3.4.2 Desalination - Seawater

Seawater desalination is fundamentally similar to brackish groundwater desalination but utilizes a coastal treatment plant that draws nearby seawater as the source. The Bay Area Regional Desalination Project (BARDP) is currently being developed by the Contra Costa WD, East Bay MUD, San Francisco Public Utilities Commission, and Santa Clara Valley WD. The BARDP evaluation selected three potential locations for desalination. The highest ranking plant would be co-located with the existing Mirant Power Plant near the confluence of the Sacramento River, New York Slough, and the San Joaquin River. A pilot study was conducted at Mallard Slough from October 2008 through April 2009, to evaluate potential treatment types for the BARDP. Results from the study indicated that desalination is feasible in the region and that site selection is an important part of the design process (MWH 2010). Three potential transfer buyers are participating in the BARDP.

3.5 Water Recycling and Reuse

Water recycling creates new water supply through either the treatment of wastewater for non-potable uses or by recharging groundwater aquifers with advanced treated wastewater for future extraction for potable uses (indirect potable reuse [IPR]). Both recycling and reuse options require a wastewater source, treatment, and distribution facilities.

3.5.1 Reclamation - Nonpotable Reuse

This measure would provide recycled water for irrigation, landscaping, or other suitable uses. A new or expanded existing tertiary treatment plant would be needed to treat wastewater. This measure would also require construction of pipelines to convey recycled water to new users. Most of the urban districts in the Buyer Service Area have existing wastewater treatment plants and use recycled water within their service area. Plans also exist to increase recycled water use. East Bay MUD developed the Water Supply Management Program 2040 long-term plan to meet future water supply needs, which includes the goal of increasing recycled water use to 11 million gallons per day (East Bay MUD 2011b). Santa Clara Valley WD works with wastewater authorities that operate four wastewater treatment plants in Santa Clara County. Santa Clara Valley WD also has plans to expand recycled water use in the coming years, including working with the City of San Jose to build an advanced water treatment facility that will produce up to ten million gallons per day (Santa Clara Valley WD 2011).

3.5.2 Reclamation - Indirect Potable Reuse

In an IPR project, wastewater that has undergone advanced treatment is stored in a groundwater basin for future potable use. This measure would require construction of an advanced wastewater treatment plant, groundwater recharge and extraction facilities, and a transmission system to connect the facilities. The term “indirect” implies that the highly-treated recycled water does not enter the potable distribution system directly. The treated wastewater would be injected into the groundwater basin through wells or placed in spreading basins to percolate into an aquifer. With adequate residence time, the treated water and groundwater would blend, undergo natural settling/treatment, and then be extracted for potable water supply. Extracted water quality must meet Regional Water Quality Control Board standards.

3.6 Cropland Idling Transfers

This measure involves idling cropland and transferring the irrigation water to the Buyer Service Area. Cropland idling water would be available on the same pattern throughout the growing season as it would have been consumed had a crop been planted. The quantity of water made available from cropland idling is determined based on the evapotranspiration of applied water (ETAW). ETAW is the portion of applied surface water that is utilized by the crop and evaporated from the soil and plant surfaces.

For this alternatives development process, cropland idling measures are separated into two categories based on type of crops eligible for transfers. The first crop idling measure includes rice, field crops, and grain crops, which have been idled in past transfer programs. The second crop idling measure includes pasture and alfalfa, which Reclamation has generally not allowed to participate in transfers in the past because of water accounting challenges.

3.6.1 Cropland Idling Transfers - Rice, Field Crops, and Grains

Table 3-1 shows ETAW values for rice, field, and grain crops that are eligible for idling. The ETAW value, less carriage water losses, would be transferred to the buyer. The irrigation season generally extends from April through September; surface water could be made available during the entire irrigation period. However, because of the regulated transfer period, water can only be moved through the Delta during July through September. Reclamation does not guarantee water prior to July can be stored in CVP reservoirs; therefore, the buyer may only receive a portion of the cropland idling transfer water (ETAW from July through September).

Table 3-1. Estimated ETAW Values (in AF/acre) For Various Crops Suitable for Idling

Crop	ETAW
Bean	1.5
Corn	1.8
Cotton	2.3
Melon	1.1
Milo	1.6
Onion	1.1
Pumpkin	1.1
Rice	3.3
Sudan Grass	3.0
Sugar Beets	2.5
Sunflower	1.4
Tomato	1.8
Vine Seed/ Cucurbits	1.1
Wild Rice	2.0

Source: DWR and Reclamation 2013

3.6.2 Cropland Idling Transfers - Pasture and Alfalfa

Alfalfa and pasture idling have been excluded from past transfer programs due to regional variation in ETAW values. Alfalfa is a perennial crop, and is typically grown for three to four years until yields decline. An alfalfa transfer program would require managers to follow typical harvest and growing practices in spring and early summer. Fields must then be completely disced by July 1 to prevent deep roots from using groundwater during summer months. Water that would have been used to irrigate in July through September would then be made available for transfer. Alfalfa has an ETAW of 1.7 AF/acre from July through September, but only alfalfa grown in the Sacramento Valley floor north of the American River would be allowed for transfers.

Pasture is also a multi-year crop, but the type and quality of pasture may vary significantly. This makes it difficult to assign a specific ETAW value for pasture idling. Like with alfalfa idling, pasture managers would irrigate through spring and early summer, disc fields by July 1, and then generate transfer water July through September. Pasture ETAW would need to be determined on a case-by-case basis.

3.7 Land Retirement in San Joaquin Valley

Land retirement in San Joaquin Valley involves permanently retiring lands from agricultural production and transferring the irrigation water to the buyer. Reclamation is implementing a land retirement program through the San Luis Unit Drainage Program, which retires land in drainage impaired areas of the San Joaquin Valley. The program aims to retire 194,000 acres of farmland (Reclamation 2006). This measure would retire land in addition to that proposed for the existing program.

3.8 Groundwater Substitution

This measure involves North of Delta sellers pumping groundwater for irrigation in lieu of using their surface water supply. Surface water would then be transferred to the buyer. Transfer water from groundwater substitution would be made available during the irrigation season from April through October. If Reclamation cannot store water prior to the transfer season, irrigators could use surface water from April through June and switch to groundwater in July when surface water can be transferred.

3.9 New Surface Storage

This measure includes building new surface storage facilities to store additional CVP water that could increase CVP deliveries to the Buyer Service Area and reduce potential shortages. Reclamation and DWR are partnering on five surface storage projects that were identified in the CALFED Record of Decision. One project (Los Vaqueros Reservoir Expansion) is already complete and fully utilized; therefore, it does not have available capacity to meet the purpose and need for this effort. The remaining project studies are in various phases of environmental review and feasibility study.

Shasta Lake Water Resources Investigation. This project proposes to raise Shasta Dam to increase water storage for agricultural, M&I, and environmental purposes and encourage Sacramento River salmon population growth. Reclamation has released a public draft EIS/EIR and feasibility report and is working to address comments and finalize these documents (Reclamation 2012).

North-of-the-Delta Offstream Storage. This project proposes to build Sites Reservoir, a new off-stream reservoir in Glenn County, to store additional CVP and SWP water supplies. Reclamation and DWR released a Preliminary Administrative Draft EIS/EIR and Preliminary Engineering Design Report in May 2014 (DWR 2014). The agencies are continuing work towards public draft documents.

In-Delta Storage Project. This project would construct new storage in the Delta region provided by two storage islands and two habitat islands. DWR and Reclamation completed the In-Delta Storage Program State Feasibility Study in 2004 and Draft Supplemental Feasibility Report in 2006. Further work on the In-Delta Storage Project has been suspended since July 2006 (DWR 2013).

Upper San Joaquin River Basin Storage Investigation. This project would construct new storage in the Upper San Joaquin River watershed to expand water storage capacity, increase reliability, and contribute to restoration efforts. Current efforts are focused on a new dam and reservoir between Friant and Kerckhoff dams (Reclamation 2014). Reclamation released a Draft Feasibility Report in February 2014 and is scheduled to complete a Draft EIS/EIR later in 2014 (Reclamation 2014).

3.10 Groundwater Storage

Groundwater storage could include construction of new groundwater storage facilities or becoming a banking partner with an existing groundwater bank. Groundwater banking is defined as the intentional storage of supplies in subsurface aquifers with the expectation of a subsequent retrieval for beneficial use by the depositor (Reclamation 2008). Groundwater storage would allow buyers to acquire and store water throughout the year and carry water over from a wet year to a subsequent dry year when they may experience shortages.

New groundwater storage includes the construction of new facilities to recharge and extract groundwater for use in Buyer Service Area. Groundwater storage requires the ability to recharge water into a groundwater basin and extract it later to return water to the banking partner. Buyers could also increase participation in existing groundwater banks, which would involve negotiating a lease agreement with an entity that operates a groundwater banking program. The agreement would require payment for use of recharge and extraction facilities, as well as charges for occupying or reserving the storage space.

3.11 Water Rights Purchase

A water rights purchase would involve the purchase of an appropriative water right from a private party for the permanent transfer of water to the buyer. The quantity and terms of the water right would become transferrable water. Water rights could either be purchased within the Buyer Service Area or upstream from the Delta. The water rights holder would cease use of the water, which could result in retired agricultural lands. A water rights purchase would require a legal contract and conveyance infrastructure to move water to the Buyer Service Area, if existing infrastructure or exchange agreement is not available. Few water rights purchases have occurred in the region.

3.12 Delta Conveyance

New Delta conveyance includes changes to the existing through Delta CVP and SWP conveyance system to improve water supply deliveries to south of Delta contractors. New conveyance facilities could address restrictions on Delta exports and help reduce associated shortages. The Bay Delta Conservation Plan (BDCP) is investigating potential options for Delta conveyance, including facilities that would divert water from the north Delta and move water it through tunnels to the south Delta. The Draft BDCP and associated Draft EIS/EIR are available for public review.

3.13 Crop Shifting in the Seller Service Area

Crop shifting is the practice of substituting a low water use crop for a high water use crop. The difference in water use from the shift would be available for transfer. Farmers generally rotate between several crops to maintain soil quality, and it may be difficult to predict what would have been planted absent a transfer. To calculate the amount of water made available from crop shifting, agencies would compare the change in consumptive water use (see ETAW values, Table 3.1) during the transfer year to the average water use during a five-year baseline period.

3.14 Rice Decomposition Water

Traditional management practices for rice straw decomposition require surface water diversions in the fall and winter months to flood harvested fields. Under this measure, farmers would use alternate methods to decompose rice straw, such as mechanical chopping and discing or bailing, and would transfer the water that would have been used for flooding to the buyer. About one AF per acre is used for flooding fields. Rice decomposition water is used in the fall and winter after the July-September transfer window. If a transfer occurs, water would need to be stored until the following July, which would put it at risk of spill. The consumptive use of rice decomposition available for transfer is not yet determined.

3.15 Reservoir Release

Reservoir release transfers involve the transfer of available water stored in existing non-CVP or -SWP reservoirs. Transferred water would be limited to the quantity that would not have otherwise been released downstream.

When the willing seller releases stored reservoir water for transfer, these reservoirs are drawn down to levels lower than without the water transfer. To refill the reservoir, a seller must prevent some flow from going downstream.

Sellers must refill the storage at a time when downstream users would not have otherwise captured the water, either in downstream Project reservoirs or with Project pumps in the Delta. Typically, refill can only occur during Delta excess conditions when there is more water than the Projects can pump. Additionally, if the non-Project reservoir has a Project reservoir downstream, refill must occur at a time when the Project reservoir cannot capture the water because of flood storage requirements in the reservoir.

3.16 Transfers within the Buyer Service Area

This measure would transfer water from water users within the Buyer Service Area. Transfer participants would shift CVP water supplies to meet irrigation demand or M&I requirements. Transfers occur frequently within the Buyer Service Area. Reclamation has developed EAs to facilitate implementation of in-basin transfers without additional environmental analysis. The first EA covered transfers from 2006 through 2010 for CVP contractors south of the Delta and in the Friant Division. Reclamation has completed two new EAs to continue in-basin transfers from 2011 through 2015:

- 2011-2015 Accelerated Water Transfers and Exchanges between South of Delta Contractors for Contract Years 2011to 2015 as outlined in 2010 EA (Reclamation 2010a).

- Accelerated Water Transfer Program for Friant Division and Cross Valley CVP Contractors from 2011to 2015 as outlined in 2010 EA (Reclamation 2010b).

Reclamation also worked with the Exchange Contractors, the CEQA lead agency, to complete an EIS/EIR to examine the environmental impacts of the transfer and exchange of the Exchange Contractors CVP water (up to 130,000 AF per year for the next ten years) within the SLDMWA service area from 2005 through 2014. Other EAs have been completed for individual, in-basin transfers.

This measure contemplates transfers above those that are already implemented under existing programs.

3.17 Groundwater Development

Under this measure, additional groundwater development would be used to offset CVP delivery reductions. Groundwater development would require the construction of new wells and pumps in the Buyer Service Area to increase groundwater production.

Much of the groundwater resources in the region are already managed through ongoing activities such as the Westlands Water District Groundwater Management Plan (Westlands Water District 1996) and the Santa Clara Valley WD Groundwater Management Plan (Santa Clara Valley WD 2013). Generally, in the Buyer Service Area, groundwater levels fluctuate over time. Monitoring shows substantial drawdown in drier years when more users turn to groundwater supplies because surface water supplies are limited (Westlands Water District 2012, DWR 2006, Santa Clara Valley WD 2013). This action would include groundwater extraction in addition to what is already occurring under existing conditions.

3.18 Modify CVP Contracts

This measure would change CVP contracts to limit water use in the buyer service area. CVP contract modifications would focus on reducing demands in the Buyer Service Area to reduce potential shortages in the future. Such reduction would likely result in land retirement and reduced agricultural production.

3.19 Change Cropping Patterns in San Joaquin Valley

This measure would encourage farmers to plant lower water use crops or increase fallowed land to reduce water demands in the Buyer Service Area. San Joaquin Valley farmers would alter cropping patterns to reduce water deliveries during shortage periods. Such changes would be in addition to those implemented annually by farmers who select crops in response to both water and market conditions. The number of acres now improved with permanent crops either limits cropping pattern change flexibility in the short term or must consider the economic effects of sacrificing investments in the permanent crops.

3.20 Limit Dairies in San Joaquin Valley

This measure would limit the number of dairies in the Buyer Service Area to decrease water demand. Dairy operations would need to relocate to areas outside of the Buyer Service Area. The land could not be used for a different purpose that would involve consumptive use of water to allow the action to produce water to help address shortages.

3.21 Enforce Seniority System to Manage Deliveries

This measure would enforce seniority systems to manage deliveries and water supply would be delivered based on seniority of water rights. CVP deliveries are based on a seniority system where settlement contractors receive waters first and M&I contractors typically receive a higher allocation than agricultural users when supplies are limited.

3.22 Implement Policy of No Net Increase in Water Availability for Urban or Agricultural Expansion

This measure proposes implementing a policy of no net increase in CVP water availability for urban or agricultural expansion. CVP water could not be used to support new urban development or increase the amount of irrigated land in production. This measure would limit CVP water use to existing urban and agricultural uses.

3.23 Pipe Water from Canada and Northern States

This measure would involve the purchase of water from Washington, Oregon, and Canada. A new water source would need to be identified and a purchase contract would need to be implemented that involves crossing state and/or Federal boundaries. Construction of new distribution facilities would be required to deliver purchased water to the Buyer Service Area.

3.24 Fix Owens Valley

The Owens Valley is a main water source for the City of Los Angeles. The city diverts most of the surface water in the valley into the Owens River–Los Angeles Aqueduct system. Additionally, ground water is pumped or flows from wells to supplement the surface-water diversions to the river–aqueduct system. Increased exports caused water levels in the valley to decline and resulted in substantial losses of native vegetation and habitat degradation. The Los Angeles Department of Water and Power is working with local agencies and stakeholders in Inyo County to restore vegetation and improve water management, including conjunctive use of groundwater and surface water supplies. Under this measure, the city would implement identified restoration programs to maintain water supplies from Owens Valley to serve city demands.

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Chapter 4
Measures Screening Evaluation

4.1 Screening Evaluation

The screening process described in Chapter 2 was applied to all measures. As described in Section 2.3, the Lead Agencies developed three criteria to address the purpose and need statement and basic project objectives:

- Immediate: the term proposed for this EIS/EIR is 2015 through 2024. This period is relatively short, and measures need to be able to provide some measurable benefit within this time period.

- Flexible: project participants need water in some years, but not in others. They need measures that have the flexibility to be used only when needed.

- Provide Substantial Water: project participants need measures that have the capability of providing additional water to regions that are experiencing shortages.

If a measure did not meet a criterion, it was considered a fatal flaw and screened out from further consideration. Measures that met all purpose and need criteria move forward to the alternatives formulation phase. The following sections present the evaluation of each measure relative to the above screening criteria. Chapter 3 defines each measure.

4.1.1 Agricultural Water Use Efficiency (Buyer Service Area)

Immediate: no
Flexible: yes
Provide Substantial Water: no

As described in Section 3.2, CVP contractors currently implement WUE BMPs, as required by CVPIA Section 3405(e). Reclamation also supports WUE through the WaterSMART program. This measure proposes additional WUE to existing and proposed plans. As part of the existing plans, CVP contractors have already implemented (or are currently implementing) WUE measures. Additional measures would generally require substantial infrastructure and investment and would not be immediately implementable. Flexibility depends on how the measures are implemented; WUE could be flexible, but the flexibility decreases when the measures are implemented for permanent crops.

The purpose and need for water transfers is to provide additional water to reduce shortages. Buyers are taking actions to address shortages, such as WUE measures, within the No Action/No Project, and these measures would help users accommodate shortages but would not provide any additional supply. Implementing agricultural WUE in the Buyer Service Area would not provide water to users with existing demands affected by CVP shortages.

4.1.2 Agricultural Water Use Efficiency (Upstream from Delta)

Immediate: yes
Flexible: yes
Provide Substantial Water: yes

This measure would be both immediate and flexible upstream from the Delta for measures such as weed control. Agricultural WUE practices can be implemented relatively quickly. Sellers would need to prove that water saved is irrecoverable and reduces a beneficial use. Water could then be sold to buyers. Buyers could call on the transfer annually as needed. Transfer water would provide water to existing demands in the Buyer Service Area to reduce potential shortages.

4.1.3 Conservation – M&I

Immediate: yes
Flexible: yes
Provide Substantial Water: no

Buyers serving urban demands currently implement M&I conservation measures and have incorporated additional measures in long-range plans to meet conservation goals. Measures could generally be implemented within the project timeframe. Conservation could occur year round and implemented in any year. Similar to agricultural WUE, implementing additional M&I conservation in the Buyer Service Area would not provide water to meet existing demands affected by CVP shortages. Additionally, implementing conservation measures in addition to existing planned measures would be challenging because M&I conservation goals are very high under existing conditions.

4.1.4 Desalination – Brackish

Immediate: no
Flexible: yes
Provide Substantial Water: yes

This measure would not be immediate to provide water to reduce shortages from 2015 to 2024. Planning, pilot testing, design, permitting, and construction of a brackish water desalination plant and distribution system take many years. Brackish water desalination would be flexible if the basin is influenced by seawater and water is available year-round for extraction and treatment. This measure could provide enough water to reduce CVP shortages.

4.1.5 Desalination - Seawater

Immediate: no
Flexible: yes
Provide Substantial Water: yes

Planning, pilot testing, design, permitting, and construction of an ocean water desalination plant and distribution system takes many years. The BARDP is still in the planning process. Therefore, operation of ocean water desalination plant would not occur in time to provide substantial benefits during the 2015 to 2024 timeframe. Ocean water desalination would be flexible as water is available year round and could provide enough water to reduce CVP shortages.

4.1.6 Reclamation - Nonpotable Reuse

Immediate: no
Flexible: yes
Provide Substantial Water: yes

Non-potable reuse requires identifying a wastewater source, planning, design, and construction of a wastewater treatment plant, and conveyance to agricultural distribution systems. This measure would not be implemented to provide benefits during the entire 2015 to 2024 timeframe. This measure would be flexible because recycled water would be available year round. Assuming an adequate wastewater source can be identified, this measure would provide water to reduce shortages.

4.1.7 Reclamation - Indirect Potable Reuse

Immediate: no
Flexible: yes
Provide Substantial Water: yes

An IPR project would provide a new potable water source. IPR projects require feasibility studies, pilot studies, design, construction and often a lengthy public education and outreach program. An IPR project would not be implemented in time to provide benefits during the entire 2015 to 2024 timeframe. Water provided by an IPR project would be flexible because it would be pumped from the groundwater basin as needed. Assuming an adequate wastewater source can be identified, this measure would provide water to reduce shortages.

4.1.8 Cropland Idling Transfers - Rice, Field, Grain Crops

Immediate: yes
Flexible: yes
Provide Substantial Water: yes

Cropland idling transfers can occur immediately in that farmers can choose to idle land generally up to the time of planting. Water would be transferred the starting in July of the same year. Cropland idling transfers are also flexible because buyers can use rainfall in the winter months to help predict CVP water needs for the irrigation season. If the transfer water is no longer needed or export capacity appears to be restrictive, buyers could opt out of the transfer without a very large investment. Multi-year contracts would likely include an option fee, but it would not be as large as if infrastructure were developed and no longer needed. Cropland idling can also provide a substantial amount of water for transfer. The Sacramento Valley has extensive irrigated crop acreage and past transfers actions have shown that farmers are willing to idle land and sell irrigation water.

4.1.9 Cropland Idling Transfers - Pasture and Alfalfa

Immediate: yes
Flexible: yes
Provide Substantial Water: yes

Similar to cropland idling for rice, field, and grain crops, pasture and alfalfa idling would also be immediate, flexible and provide water to reduce CVP shortages. Some areas of alfalfa, including the Delta Region and the Sacramento River area south of the American River confluence, would not be allowed for idling because groundwater levels in these regions are relatively high and fields intended for idling may consume groundwater. In these instances, alfalfa idling would not result in a reduction of consumptive use. Because of water accounting issues, Reclamation must evaluate alfalfa idling transfers on an individual basis.

Pasture idling would have less certainty than alfalfa, and would be difficult to verify that consumptive use has been reduced to make water available for transfer. For this reason, pasture transfers are screened out.

4.1.10 Land Retirement in the San Joaquin Valley

Immediate: no
Flexible: no
Provide Substantial Water: no

Under the San Luis Drainage Feature Re-evaluation, Reclamation is working to retire 194,000 acres of drainage impaired farmland. Irrigation water for retired lands will be distributed to other lands in the San Luis Unit. This measure proposes to retire additional land above the 194,000 acres. Identifying and negotiating land retirement agreements with willing landowners would take several years to implement. This measure is not flexible because land would go out of irrigated agricultural production permanently. Further, land retirement does not provide additional water to address basin-wide CVP shortages, but rather provides a way for users to address shortages in the No Action/No Project Alternative.

4.1.11 Groundwater Substitution

Immediate: yes
Flexible: yes
Provide Substantial Water: yes

Under this measure, sellers in the Upstream from Delta Region would use groundwater in lieu of surface water supplies. Surface water would be transferred to the Buyer Service Area. Groundwater substitution transfers would be both immediate and flexible. Farmers can turn on and off groundwater pumps and switch between surface and groundwater supplies at any time. Similar to cropland idling transfers, buyers can negotiate groundwater substitution transfers in the year of the transfer and have flexibility to opt of out the transfer if water is not needed. Groundwater basins in the Upstream from Delta Region can provide substantial amounts of water for local irrigators and allow for CVP water to be transferred to the Buyer Service Area to reduce potential shortages.

4.1.12 New Surface Storage

Immediate: no
Flexible: yes
Provide Substantial Water: yes

Reclamation is investigating new storage opportunities that could increase CVP deliveries. The studies are in the planning phases and projects would not likely be implemented to provide benefits from 2015 through 2024. Once implemented, storage projects would provide water and be flexible.

4.1.13 Groundwater Storage

Immediate: yes
Flexible: yes
Provide Substantial Water: no

This measure would be implemented in the Buyer Service Area. Developing new groundwater storage would require construction of recharge, extraction, and conveyance facilities and could not occur immediately. Participation in existing banks, however, could move forward immediately with existing facilities. Once fully implemented, the measure could be flexible because farmers can pump groundwater for irrigation when needed. The success of groundwater storage, however, depends on having an available source of water to recharge and withdraw later during shortages. Agencies in the Buyer Service Area face water shortages in most years and would not have additional water available for recharge. Without an adequate source of recharge water, this measure would not provide sufficient water to reduce CVP shortages.

4.1.14 Water Rights Purchase

Immediate: no
Flexible: yes
Provide Substantial Water: no

This measure would require identifying and negotiating water right purchases with interested sellers. Few water rights sales have occurred in past years. It may take several years to identify sellers and provide enough water to provide benefits to CVP contractors and undertake the legal process to purchase the water right. Therefore, this measure would not be immediate or provide water.

4.1.15 Delta Conveyance

Immediate: no
Flexible: yes
Provide Substantial Water: yes

Reclamation is studying Delta conveyance measures through the BDCP process. The BDCP is in the early stages of the planning process. It is not likely that a measure would provide be implemented during the 2015 though 2024 timeframe. New Delta conveyance would be flexible and provide water to south of Delta contractors because it would not have the same pumping restrictions that currently exist at Jones and Banks pumping plants.

4.1.16 Crop Shifting in Seller Service Area

Immediate: yes
Flexible: yes
Provide Substantial Water: yes

Similar to cropland idling, crop shifting would also be immediate and flexible. Crop shifting would generally provide less water than a crop idling transfer on a per acre basis; however, because of the extensive irrigated acreage and crop variability in the Sacramento Valley, crop shifting transfer could potentially provide a substantial amount of water to reduce CVP shortages.

4.1.17 Rice Decomposition Water

Immediate: yes
Flexible: yes
Provide Substantial Water: no

Rice water decomposition transfers would be immediate and flexible. Buyers can negotiate with sellers on an annual basis prior to fall flooding. The transfers would be flexible because buyers could opt out if transfer water is not needed. The Sacramento Valley has extensive rice acreage that is flooded during the fall. The schedule of when this water is available, however, means that it cannot provide substantial water when it is needed. Water would be available in the fall after the irrigation season in which it is needed.

4.1.18 Reservoir Release

Immediate: yes
Flexible: yes
Provide Substantial Water: yes

Some agencies in the Upstream from Delta Region have local (non-CVP) reservoirs that could provide water for transfer. Under this measure, sellers would release water stored in local reservoirs for transfer through the Delta to the Buyer Service Area. Water eligible for transfer would not have otherwise been released downstream. Reservoir release transfers are both immediate and flexible. Water would be released from an existing reservoir and conveyed using existing infrastructure. Buyers would have the option of calling on transfers annually prior to the irrigation season and can opt out if needed. This measure could provide water to reduce potential CVP shortages.

4.1.19 Transfers within Buyer Service Area

Immediate: yes
Flexible: yes
Provide Substantial Water: no

Buyers currently transfer water within the basin to help reduce the effects of CVP delivery reductions. Additional transfers could be immediate and flexible to assist water users in selecting where limited water will be applied but would not provide substantial water to reduce CVP shortages. Even after in-basin transfers occur, CVP contractors continue to face shortages.

4.1.20 Groundwater Development

Immediate: no
Flexible: yes
Provide Substantial Water: no

This measure would be implemented in the Buyer Service Area. Groundwater development would require planning, locating, and installing new wells and conveyance to on-farm systems. Planning and construction of the new system would not likely be developed prior to 2015. Once installed, groundwater use is flexible because farmers can turn pumps on or off as needed. New groundwater development in the Buyer Service Area would not provide a substantial supply to water users to reduce CVP shortages. In response to the previous dry years and reduced CVP water supplies, users have pumped additional groundwater for irrigation. As a result, groundwater levels have reduced and typically do not recover without additional recharge. Therefore, new groundwater development would not provide enough water annually to reduce CVP shortages.

4.1.21 Modify CVP Contracts

Immediate: no
Flexible: no
Provide Substantial Water: no

Reclamation has long-term contracts with CVP contractors and cannot modify contracts to reduce contract water supplies. This measure would not provide any water or flexibility to CVP contractors to meet a potential shortage.

4.1.22 Change Cropping Patterns in San Joaquin Valley

Immediate: yes
Flexible: yes
Provide Substantial Water: no

Changing cropping patterns would not reduce potential CVP shortages. Farmers commonly change cropping patterns as normal farm practices and to respond to reduced water supplies or market prices. In the San Joaquin Valley, many farmers have planted lower water use crops to reduce irrigation needs during a particular year. At the same time, in order to support their investments in WUE equipment and higher priced supplemental supplies, many farmers have now planted permanent crops that create the same demand in all years. This measure would not provide enough benefits to farmers experiencing shortages.

4.1.23 Limit Dairies in San Joaquin Valley

Immediate: no
Flexible: yes
Provide Substantial Water: no

This measure would limit new dairies in the Buyer Service Area. There are not many existing dairies in the Buyer Service Area. In addition, Reclamation would need to work with counties or cities to enforce relocation or a policy to restrict new farms. Furthermore, to the extent such farms have an allocation of irrigation water, removing those uses would not necessarily change the need for water to irrigate the same acres. This measure would not provide much, if any, water to alleviate shortages.

4.1.24 Enforce Seniority System to Manage Deliveries

Immediate: no
Flexible: no
Provide Substantial Water: no

Modifying deliveries would need to occur after long-term contracts have expired. Under current contracts, CVP contractors do receive water based on seniority. Settlement and exchange contractors receive water before other CVP contractors. Regardless of seniority, modifying contracts would not provide any additional water. CVP contractors in the Buyer Service Area would continue to face shortage in dry years and due to regulatory restrictions.

4.1.25 Implement Policy of No Net Increase in Water Availability for Agricultural and Urban Expansion

Immediate: no
Flexible: no
Provide Substantial Water: no

This measure would not be immediate or flexible. Agricultural land in the San Joaquin Valley is considered to be fully developed; therefore, a no net increase policy would not be effective for agricultural water supplies. Buyers have also stated they plan to use water for existing demands and transfers would not be used to meet new demands. This measure would also not provide any water to CVP contractors to meet existing demands during a shortage.

4.1.26 Pipe Water from Canada and Northern States

Immediate: no
Flexible: yes
Provide Substantial Water: yes

This measure requires purchasing a water source from Canada or northern states, including Oregon, Washington, or Idaho, and transporting the water to the Buyer Service Area. Infrastructure would be required to move water. This measure would take years to negotiate and implement and would not provide benefits during the 2015 to 2024 timeframe. This measure would be flexible if the water can be called on when needed. This measure would provide water to reduce CVP shortages in the Buyer Service Area.

4.1.27 Fix Owens Valley

Immediate: no
Flexible: no
Provide Substantial Water: no

CVP contractors do not receive water from Owens Valley; therefore, this measure would not be flexible or provide water to reduce CVP shortages.

4.2 Screening Results

Table 4-1 summarizes the screening evaluation results. An “x” indicates that the measure met the criterion. A “-” indicates the criterion was not met and the measure was screened out for further analysis.

Table 4-1. Screening Evaluation Results

Transfer Measures	Purpose and Need Criteria		
	Immediate	Flexible	Provides water
Agricultural water use efficiency (Buyer Service Area)	-	X	-
Agricultural water use efficiency (Upstream from Delta)	X	X	X
Conservation – municipal & industrial	X	X	-
Desalination - brackish	-	X	X
Desalination - seawater	-	X	X
Reclamation - nonpotable reuse	-	X	X
Reclamation - indirect potable reuse	-	X	X
Cropland idling transfers- rice, field crops, grains	X	X	X
Cropland idling transfers-pasture and alfalfa	X	X	X
Land retirement in San Joaquin Valley	-	-	-
Groundwater substitution	X	X	X
New surface storage	-	X	X
Groundwater storage	X	X	-
Water rights purchase	-	X	-
Delta conveyance	-	X	X
Crop shifting in Seller Service Area	X	X	X
Rice decomposition water	X	X	-
Reservoir release	X	X	X
Transfers within the Buyer Service Area	X	X	-
Groundwater development	-	X	-
Modify CVP contracts	-	-	-
Change cropping patterns in San Joaquin Valley	X	X	-
Limit dairies in San Joaquin Valley	-	X	-
Enforce seniority system to manage deliveries	-	-	-
Implement policy of no net increase in water availability for urban or agricultural expansion	-	-	-
Pipe water from Canada and northern states	-	X	X
Fix Owens Valley	-	-	-

4.3 Measures Carried Forward to Alternatives Formulation

The following measures met all purpose and need criteria and will be combined into alternatives to be analyzed in the EIS/EIR:

- Agricultural WUE (Upstream from Delta)
- Cropland Idling Transfers - rice, field crops, grains
- Cropland Idling Transfers - alfalfa
- Groundwater Substitution
- Crop Shifting
- Reservoir Release

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Chapter 5 Alternatives

This chapter presents alternatives developed based on the evaluation described in Chapter 4. Alternatives for the EIS/EIR include different combinations of potential measures and a No Action/No Project Alternative. Transfers would only be implemented through agreements between willing sellers and buyers. The alternatives propose a menu of measures that buyers and sellers can select from to implement a transfer. Some measures in an alternative may not be implemented if there are no willing sellers or buyers interested in that particular measure. The next steps in alternative development will identify willing sellers, proposed transfer measures, and potential quantities for transfer. The Lead Agencies have identified preliminary sellers and transfer quantities for each alternative.

Reclamation's role would be to facilitate transfers that comply with Federal and state law and would not include negotiating transfer measures among buyers and sellers. SLDMWA, on behalf of its member agencies, and other interested buyers would negotiate transfers with willing sellers, including agreeing upon transfer measures and quantities included in the proposed alternatives.

5.1 Alternative 1 – No Action/No Project

CEQA requires an EIR to include a No Project Alternative. CEQA Guidelines Section 15126.6(e)(2) states that "the "no project" analysis shall discuss the existing conditions at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services." NEPA requires an EIS to "include the alternative of no action" (40 CFR Part 1502.14(d)).

The No Action/No Project Alternative represents the state of the environment without the Proposed Action or any of the alternatives. Under the No Action/No Project Alternative, some agricultural and urban water users may face potential shortages in the absence of water transfers. To the extent transfer water is not available; there will be demand will go unmet by surface water. Demand may be met by increasing groundwater pumping, idling cropland, reducing landscape irrigation, or rationing water.

5.2 Alternative 2 – Full Range of Transfers

This alternative combines all potential transfer measures that met the purpose and need and were carried forward through the screening process, as identified in Chapter 4. Measures in the Full Range of Transfers Alternative include:

- Agricultural WUE (Upstream from Delta Region)
- Cropland idling transfers – rice, field, grains
- Cropland idling transfers – alfalfa
- Groundwater substitution
- Crop shifting
- Reservoir release

Table 5-1 identifies preliminary sellers and transfers under this alternative. The quantities represent the upper limit for transfer. Because of the uncertainty of hydrologic and operating conditions in the future, it is likely that only a portion of the potential transfers identified in Table 5-1 would occur. Additionally, many agencies are uncertain about whether they would participate through groundwater substitution or cropland idling/crop shifting transfers. They have included their potential upper limit for both types of transfers, but they would not sell the maximum amount of both types in the same year. Entities requiring Reclamation approval that are not listed in this table may decide that they are interested in selling water, but those transfers may require supplemental NEPA and Endangered Species Act analysis to allow Reclamation to complete the evaluation of the transfers. This alternative would be the least restrictive for buyers and sellers and provides the most potential water by offering the whole range of transfer measures. No sellers for rice water decomposition transfers have been identified at this time, but could potentially occur in the future under this alternative.

Table 5-1. Alternative 2 Potential Sellers (Upper Limits)

Water Agency	April – June				July - September			
	Groundwater Substitution	Cropland Idling/ Crop Shifting	Stored Reservoir Release	Conservation	Groundwater Substitution	Cropland Idling/Crop Shifting	Stored Reservoir Release	Conservation
Sacramento River Area of Analysis								
Anderson-Cottonwood Irrigation District	2,613				2,613			
Conaway Preservation Group	21,550	7,899			13,450	13,450		
Cordua Irrigation District					12,000			
Cranmore Farms	5,140	925			2,860	1,575		
Eastside Mutual Water Company	1,067				1,163			
Glenn-Colusa Irrigation District	12,500	24,420			12,500	41,580		
Natomas Central Mutual Water Company	15,000				15,000			
Pelger Mutual Water Company	2,151	939			1,599	1,599		
Pleasant Grove-Verona Mutual Water Company	8,000	3,330			10,000	5,670		
Reclamation District 108	7,500	7,400			7,500	12,600		
Reclamation District 1004		3,700			7,175	6,300		
River Garden Farms	4,000				5,000			
Sycamore Mutual Water Company	7,500	3,700			7,500	6,300		
Te Velde Revocable Family Trust	2,700	2,581			4,394	4,394		
American River Area of Analysis								
City of Sacramento					5,000			
Placer County Water Agency							47,000	
Sacramento County Water Agency					15,000			

Water Agency	April – June				July - September			
	Groundwater Substitution	Cropland Idling/ Crop Shifting	Stored Reservoir Release	Conservation	Groundwater Substitution	Cropland Idling/Crop Shifting	Stored Reservoir Release	Conservation
Sacramento Suburban Water District	15,000				15,000			
Yuba River Area of Analysis								
Browns Valley Irrigation District							5,000	3,100
Feather River Area of Analysis								
Butte Water District					5,500	11,500		
Garden Highway Mutual Water Company	6,500				7,500			
Gilsizer Slough Ranch	1,500				2,400			
Goose Club Farms and Teichert Aggregates	4,000	3,700			6,000	6,300		
South Sutter Water District							15,000	
Tule Basin Farms	3,800				3,520			
Merced River Area of Analysis								
Merced Irrigation District							30,000	
Delta Region Area of Analysis								
Reclamation District 2068	2,250	2,775			2,250	4,725		
Pope Ranch	1,400				1,400			
Total[1]	124,171	61,369	0	0	166,324	115,993	97,000	3,100

Note:

[1] These totals cannot be added together. Agencies could make water available through groundwater substitution, cropland idling, or a combination of the two; however, they will not make the full quantity available through both methods. Table 5-1 reflects the total upper limit for each agency.

5.3 Alternative 3 – No Cropland Modifications

The No Cropland Modifications Alternative includes the following measures:

- Agricultural WUE (Upstream from Delta Region)
- Reservoir release
- Groundwater substitution

The Lead Agencies developed this alternative because buyers are not certain they are interested in cropland idling and crop shifting transfers due to operational restrictions. Buyers would need to purchase the entire ETAW for a cropland idling or shifting transfer; however, they may only receive the portion of ETAW during the July through September transfer period.

Table 5-2 identifies preliminary sellers and transfers under Alternative 3. Similar to Table 5-1, the quantities in Table 5-2 are maximum amounts and would not likely be transferred each year. Alternative 3 includes less water to be transferred than Alternative 2.

Table 5-2. Alternative 3 Potential Sellers (Upper Limits)

Water Agency	April – June			July - September		
	Groundwater Substitution	Stored Reservoir Release	Conservation	Groundwater Substitution	Stored Reservoir Release	Conservation
Sacramento River Area of Analysis						
Anderson-Cottonwood Irrigation District	2,613			2,613		
Conaway Preservation Group	21,550			13,450		
Cordua Irrigation District				12,000		
Cranmore Farms	5,140			2,860		
Eastside Mutual Water Company	1,067			1,163		
Glenn-Colusa Irrigation District	12,500			12,500		
Natomas Central Mutual Water Company	15,000			15,000		
Pelger Mutual Water Company	2,151			1,599		
Pleasant Grove-Verona Mutual Water Company	8,000			10,000		
Reclamation District 108	7,500			7,500		
Reclamation District 1004				7,175		
River Garden Farms	4,000			5,000		
Sycamore Mutual Water Company	7,500			7,500		
Te Velde Revocable Family Trust	2,700			4,394		
American River Area of Analysis						
City of Sacramento				5,000		
Placer County Water Agency					47,000	
Sacramento County Water Agency				15,000		
Sacramento Suburban Water District	15,000			15,000		
Yuba River Area of Analysis						
Browns Valley Irrigation District					5,000	3,100
Feather River Area of Analysis						
Butte Water District				5,500		
Garden Highway Mutual Water Company	6,500			7,500		
Gilsizer Slough Ranch	1,500			2,400		
Goose Club Farms and Teichert Aggregates	4,000			6,000		

Water Agency	April – June			July - September		
	Groundwater Substitution	Stored Reservoir Release	Conservation	Groundwater Substitution	Stored Reservoir Release	Conservation
South Sutter Water District					15,000	
Tule Basin Farms	3,800			3,520		
Merced River Area of Analysis						
Merced Irrigation District					30,000	
Delta Region Area of Analysis						
Reclamation District 2068	2,250			2,250		
Pope Ranch	1,400			1,400		
Total	124,171	0	0	166,324	97,000	3,100

5.4 Alternative 4 – No Groundwater Substitution

The No Groundwater Substitution Alternative includes the following measures:

- Agricultural WUE (Upstream from Delta Region)
- Cropland idling transfers– rice, field and grains
- Cropland idling transfers– alfalfa
- Crop shifting
- Reservoir release

Public comment received during the scoping period included many concerns regarding groundwater impacts associated with groundwater substitution transfers. The Lead Agencies have developed this alternative to address these comments and create an alternative that could reduce potential environmental effects of the Proposed Action. Table 5-3 identifies preliminary sellers and transfers under Alternative 3. The quantities in Table 5-3 are maximum amounts and would not likely be transferred each year. This alternative has the smallest quantity of water transferred.

Table 5-3. Alternative 4 Potential Sellers (Upper Limits)

Water Agency	April – June			July - September		
	Cropland Idling/Crop Shifting	Stored Reservoir Release	Conservation	Cropland Idling/Crop Shifting	Stored Reservoir Release	Conservation
Sacramento River Area of Analysis						
Anderson-Cottonwood Irrigation District						
Conaway Preservation Group	7,899			13,450		
Cordua Irrigation District						
Cranmore Farms	925			1,575		
Eastside Mutual Water Company						
Glenn-Colusa Irrigation District	24,420			41,580		
Natomas Central Mutual Water Company						
Pelger Mutual Water Company	939			1,599		
Pleasant Grove-Verona Mutual Water Company	3,330			5,670		
Reclamation District 108	7,400			12,600		
Reclamation District 1004	3,700			6,300		
River Garden Farms						
Sycamore Mutual Water Company	3,700			6,300		
Te Velde Revocable Family Trust	2,581			4,394		
American River Area of Analysis						
City of Sacramento						
Placer County Water Agency					47,000	
Sacramento County Water Agency						
Sacramento Suburban Water District						
Yuba River Area of Analysis						
Browns Valley Irrigation District					5,000	3,100
Feather River Area of Analysis						
Butte Water District				11,500		
Garden Highway Mutual Water Company						
Gilsizer Slough Ranch						
Goose Club Farms and Teichert Aggregates	3,700			6,300		

Water Agency	April – June			July - September		
	Cropland Idling/Crop Shifting	Stored Reservoir Release	Conservation	Cropland Idling/Crop Shifting	Stored Reservoir Release	Conservation
South Sutter Water District					15,000	
Tule Basin Farms						
Merced River Area of Analysis						
Merced Irrigation District					30,000	
Delta Region Area of Analysis						
Reclamation District 2068	2,775			4,725		
Pope Ranch						
Total	61,369	0	0	115,993	97,000	3,100

Appendix B

Water Operations Assessment

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Appendix B
Water Operations Assessment

B.1 Background

Hydrologic conditions, climatic variability, and regulatory requirements for operation of water projects commonly affect water supply availability in California. This variability strains water supplies, making advance planning for water shortages necessary and routine. In the past decades, water entities have been implementing water transfers to supplement available water supplies to serve existing demands and transfers have become a common tool in water resource planning.

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) manages the Central Valley Project (CVP), which includes storage in reservoirs (such as Shasta, Folsom, and Trinity reservoirs) and diversion pumps in the Sacramento-San Joaquin Delta (Delta) to deliver water to users in the San Joaquin Valley and San Francisco Bay area. When these users experience water shortages, they may look to water transfers to help reduce potential impacts of those shortages.

A water transfer involves an agreement between a willing seller and a willing buyer. To make water available for transfer, the willing seller must take an action to reduce the consumptive use of water or reduce reservoir storage. This water would be conveyed to the buyers' service area for beneficial use. Water transfers would only be used to help meet existing demands and would not serve any new demands in the buyers' service areas.

Reclamation and the San Luis & Delta-Mendota Water Authority (SLDMWA) are completing a joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR), in compliance with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), for water transfers from 2015 through 2024. Reclamation is serving as the Lead Agency under NEPA and SLDWMA is the Lead Agency under CEQA. Reclamation would facilitate transfers proposed by buyers and sellers. The SLDMWA, consisting of federal and exchange water service contractors in western San Joaquin Valley, San Benito, Santa Clara, and Stanislaus counties, helps negotiate transfers in years when the member agencies could experience shortages.

This EIS/EIR evaluates water transfers that originate from entities located upstream of the Delta. Purchasing agencies are in areas south of the Delta or in the San Francisco Bay Area. Water transfers are subject to federal and state law.

The transfers included in this EIS/EIR are only those involving CVP supplies or CVP facilities. These transfers require approval from Reclamation, which necessitates compliance with NEPA. Other transfers not involving CVP supplies or use of CVP facilities could occur during the same time period, subject to their own environmental review (as necessary). Non-CVP transfers are analyzed in combination with the potential alternatives in the cumulative analysis.

B.2 Purpose of Water Operations Analysis

An analysis of water operations is necessary to assist in evaluation of potential environmental impacts associated with the Long-Term Water Transfer Project (the Project). Water transfers have the potential to affect both the natural system and operation of the CVP and State Water Project (SWP). The purpose of this analysis is to simulate water made available by various sellers included in the Project, how that water moves through the system and potentially effects operations, and how and where transfer water is diverted by buyers. Output from the water operations analysis for parameters such as stream flow, reservoir storage, Delta outflow, and CVP and SWP Delta exports provides a basis for environmental assessment.

B.3 Analytical Approach

Water transfer analysis is performed with several analytical tools. Separate tools are used to evaluate the surface water and groundwater systems with information and results passed between the tools. Analysis relies on the use and interaction of three different models: CalSim II, the Sacramento Valley Finite Element Groundwater Model (SACFEM2013), and Transfer Operations Model (TOM). Model results of a baseline condition, the No Action/No Project Alternative, without proposed water transfers are compared to model results with proposed water transfers under each Project alternative to determine the extent and significance of any differences resulting from the Project.

CalSim II serves as the basis for simulating the surface water system. A baseline model of CVP/SWP operations for the Sacramento and San Joaquin river systems and the Delta was developed and provided by Reclamation. This model baseline represented the best available model assumptions developed by Reclamation as of January 2014.

Estimated groundwater pumping associated with groundwater substitution transfers was added to baseline groundwater pumping under existing conditions and input to SACFEM2013 to simulate the effects of groundwater substitution transfers on Sacramento Valley aquifers. SACFEM2013 also simulates interaction between groundwater and surface water systems at the streambed interface. Groundwater pumping can affect the surface water system because a hydraulic connection exists between the groundwater and surface water systems in the Sacramento Valley. SACFEM2013 was used to simulate effects on the groundwater system and the change in stream-aquifer interaction. SACFEM2013 model results for the change in stream-aquifer interaction were incorporated into the water operations analysis.

A separate model, TOM, was developed to simulate changes in the surface water system. TOM is a spreadsheet model developed by MBK Engineers to assess how water made available for transfer moves through the river system and is diverted by buyers. Additionally, TOM analyzes how changes in stream-aquifer interaction due to groundwater substitution transfers affect the CVP and SWP. TOM was developed to quickly and effectively assess changes from a variety of transfer sources and mechanisms to a variety of different buyers.

TOM relies on the CalSim II baseline simulation of CVP and SWP operations and then layers on operational changes of water transfers. Post-processing CalSim II results allows for simulation of specific water transfers and their associated constraints while maintaining compliance with the regulatory requirements simulated in CalSim II. TOM uses output from both CalSim II and SACFEM2013 to simulate the operational changes that result from water transfers.

Figure B-1 illustrates the models, input information, and output flow used to in the water operations analysis.

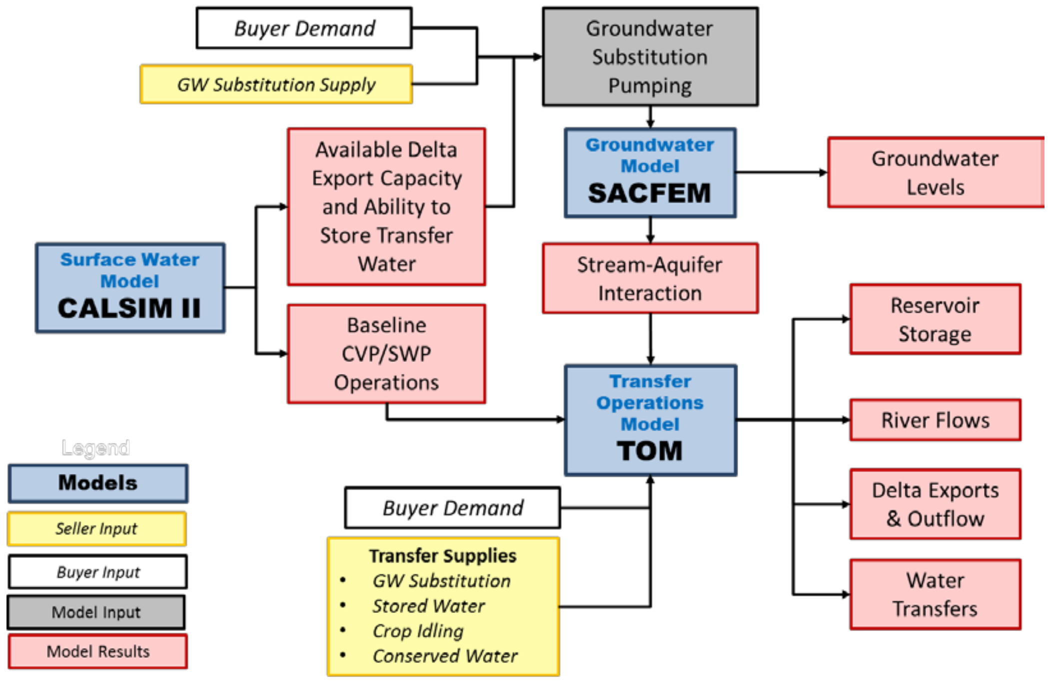

Figure B-1. Analytical Process and Modeling

B.4 Model Descriptions

A description of models used in water operations analysis, primarily CalSim II and TOM, and their underlying assumptions are outlined in more detail in the following sections. A brief description of SACFEM2013 is also provided. Additional documentation and results from SACFEM2013 are presented in Appendix D.

B.4.1 CalSim II

CalSim II is a planning model designed to simulate operations of CVP and SWP reservoirs and water delivery systems. CalSim II simulates flood control operating criteria, water delivery policies, in-stream flow requirements, Delta outflow requirements, and CVP/SWP (Project) Delta export operations. CalSim II is the best available tool for modeling CVP and SWP operations and is the primary system-wide hydrologic model used by Reclamation and the California Department of Water Resources (DWR) to conduct planning and impact analyses of potential projects.

CalSim II is a simulation by optimization model. CalSim II simulates operations by solving a mixed-integer linear program to maximize an objective function for each month of the simulation. CalSim II was developed to simulate operation of the CVP and SWP for defined physical conditions and a set of regulatory requirements. CalSim II simulates these conditions using 82 years of historical hydrology from water year 1922 through 2003.

CalSim II modeling conducted for the Long Term Water Transfer Project is built upon the Common Assumption model package, developed jointly by Reclamation and DWR. This model package has been revised and updated to reflect the operational requirements contained in the U.S. Fish and Wildlife Service (USFWS) 2008 Biological Opinion (BO) on delta smelt and the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) 2009 BO on Chinook salmon. Regulatory requirements included in baseline CalSim II simulation, including those specified in the BOs, are summarized in Attachment 1.

Reclamation provided the project team the CalSim II baseline studies in January 2014. The Reclamation study was at a projected future level of development and was consistent with Reclamation's operating assumptions at that time. The project team worked collaboratively with Reclamation modelers to revise the baseline study for an existing level of development, requirements, and projects. This existing level study is used as the baseline and the basis for TOM.

B.4.2 SACFEM2013

SACFEM2013 is a full water budget based, transient groundwater flow model that incorporates all groundwater and surface water budget components on a monthly time-step over the period of simulation. SACFEM2013 provides very high resolution estimates of groundwater levels and stream flow effects due to groundwater pumping within the Sacramento Valley. SACFEM2013 is an application of the MicroFEM© groundwater modeling package. SACFEM2013 simulates a 41-year period, corresponding to historical hydrology from water year 1970 through 2010, on a monthly time-step. Additional information and description of SACFEM2013 can be found in Appendix D.

B.4.3 TOM

TOM was developed to analyze effects of the Long-Term Water Transfer Project on the CVP, SWP, major rivers, and the Delta. TOM was developed to quickly and effectively simulate water made available from various sellers as it moves through the system, the effects on CVP and SWP operations, and diversion of transfer water by buyers. TOM simulates operations on a monthly time-step for the 34-year period, water year 1970 through 2003, common to both CalSim II and SACFEM2013. TOM relies on output from both SACFEM2013 and CalSim II.

Facilitating water transfers in actual operations presents numerous challenges. In real-time operations, transfer water cannot be tracked separately as it moves through the system in the same way it can be tracked and accounted for in a model. Water made available for transfer is released into the system, or not diverted from the system, and managed as part of the total available water within the system at any given time. This requires an increased level of coordination between CVP and SWP operators. When facilitating actual water transfers, CVP and SWP operators identify the volume of transfer water to be made available in advance of the actual transfer. This volume of water is considered when determining operations before, during, and after the transfer period. Transfer water becomes co-mingled with CVP/SWP water and unregulated flows in the system and re-diverted at downstream locations such as CVP and SWP pumping facilities in the south Delta. Transfer water affects accounting under the Coordinated Operation Agreement (COA) between the CVP and SWP, and can require COA accounting adjustments. Transfer water can also change the timing of when CVP and SWP Project water is moved. A portion of transfer water is typically used as carriage water to maintain Delta water quality when transfer water is moved through the Delta. This requires initial estimates for carriage water that must later be verified and adjusted. All the additional accounting and adjustments for transfers are layered onto the already complex task of operating the CVP and SWP for numerous in-stream flow, water temperature, water quality, and water supply constraints.

TOM was developed in consultation with Reclamation and with an understanding of both actual operations and CalSim II model assumptions. Rules used in TOM to simulate operational responses to water transfers and changes in stream-aquifer interaction were reviewed with CVP operations staff. Assumptions and logic used in TOM are described in the following sections.

B.4.3.1 TOM Operations and Assumptions

TOM begins with a baseline CalSim II simulation of the CVP/SWP system and Delta operations, and then layers on water transfer operations. TOM uses information on the timing and volume of transfer water to be made available from various transfer sources as input and simulates the effects of those transfers.

B.4.3.1.1 Buyer Demands and Seller Supplies

The Project team developed estimates of both buyer’s demand for transfer water and seller’s supplies of transfer water. CVP contractors identified as buyers include East Bay Municipal Utility District (MUD), Contra Costa Water District (WD), and the SLDMWA. Annual transfer demands for East Bay MUD were provided directly by the agency. The volume of annual transfer demand for Contra Costa WD was provided the district and the years when demand for transfer water were identified and discussed with the district.

SLDMWA demand for transfer water often exceeds the available capacity to move the water through the Delta. Therefore, an estimate of annual available Delta export capacity was developed from baseline CalSim II output. Available Delta export capacity was used as a surrogate for SLDMWA demand for transfer water from Sacramento Valley sellers. Additionally, water made available by Merced Irrigation District (ID) can be moved to SLDMWA through a variety of facilities that connect the lower San Joaquin River with the Delta-Mendota Canal (DMC) without going through CVP or SWP Delta export facilities. Therefore, additional demands were assumed for SLDMWA in years when CVP south-of-Delta agricultural water service contract allocations were less than 65 percent. In these years, SLDMWA demand for transfer water exceeded Merced ID's available transfer supply and was assumed to be all of the available supply.

Figure B-2 illustrates the annual demands simulated in TOM for each potential buyer with demands for SLDMWA limited by available Delta export capacity and available supply.

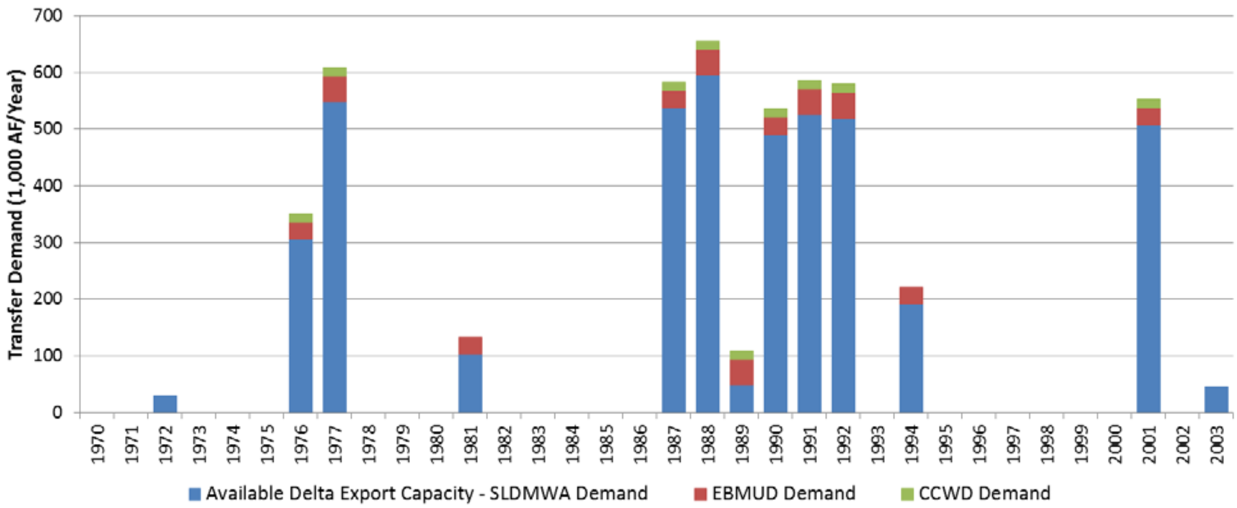

Figure B-2. Annual Demand for Transfer Water by CVP Buyers

The Project team also developed estimates of water supplies that can be made available for transfer from willing sellers interested in participating in the Project. Estimates of available supply were developed in consultation with potential sellers. Sellers include CVP contractors and non-CVP contractors with the ability to provide water to the buyer's points of diversion. Sellers can make water available through several different transfer mechanisms including groundwater substitution, crop idling, conserved water, and reservoir release. Available water transfer supply is typically less than demand for transfer water, and can be less than the available capacity to move the water from seller to buyer. Therefore, the volume of water transferred on an annual basis is typically limited by available water transfer supply. Different alternatives were developed to analyze effects of making transfer water available with different mechanisms. Figure B-3 illustrates annual available supplies for the alternative that includes all transfer mechanisms.

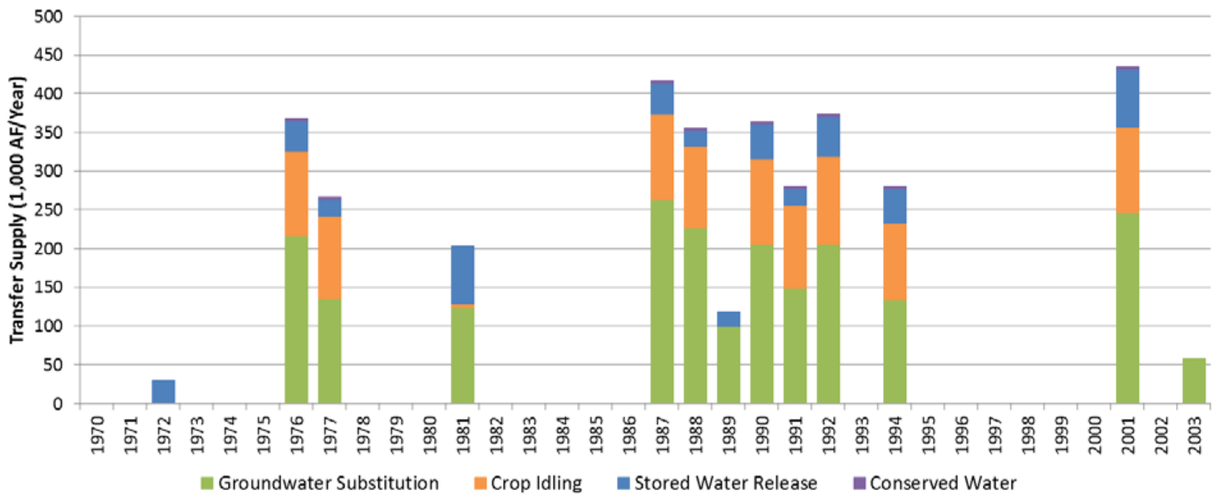

Figure B-3. Annual Available Water Transfer Supply

Comparison of Figure B-2 and Figure B-3 shows demand for transfer water frequently exceeds the available water transfer supply.

B.4.3.1.2 Transfer Operations and Priorities

TOM uses an assumed priority for transfer mechanisms used to make water available under Project alternatives. Transfer mechanisms are prioritized based on the likelihood of the mechanism being utilized and the operational flexibility inherent in the mechanism. For example, groundwater substitution and reservoir release are more likely transfer mechanisms than crop idling and are therefore a higher priority. Groundwater substitution has less operational flexibility than reservoir releases and is given a higher priority. TOM simulates the four transfer mechanisms in the following order:

- Groundwater substitution – for alternatives that include this mechanism
- Reservoir release
- Conserved water
- Crop idling – for alternatives that include this mechanism

Priorities for transfer mechanisms are necessary to develop groundwater pumping inputs to SACFEM2013 and simulate all transfers in TOM. Priorities were developed solely for this purpose.

TOM simulates water made available under each transfer mechanism, subject to various constraints. The following sections describe each transfer mechanism and associated constraints and operational considerations.

B.4.3.1.3 Groundwater Substitution Transfers

Groundwater substitution transfers involve pumping groundwater to meet a demand for water that would otherwise be met from surface water diversion. Surface water not diverted is then available for transfer. The volume of water made available for transfer is the volume of groundwater pumped during the transfer period. Groundwater substitution transfers allow a limited degree of flexibility in the timing of transfer because the transfer period starts and ends based on when groundwater pumping occurs. The Project includes groundwater substitution transfers in the Sacramento Valley. Figure B-4 illustrates annual groundwater substitution transfer supply identified by the sellers for years with available export capacity/transfer demand.

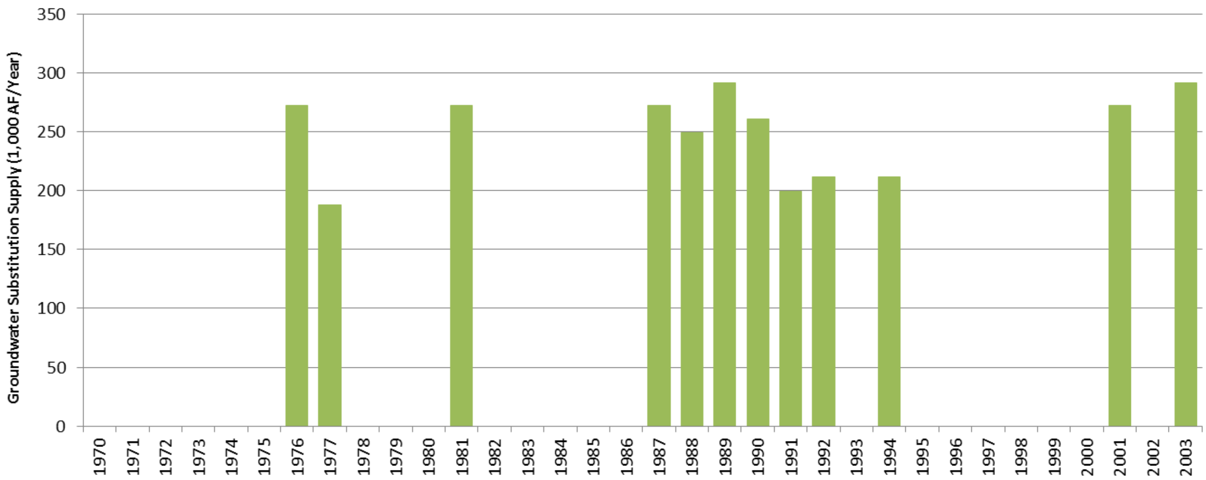

Figure B-4. Annual Groundwater Substitution Transfer Supply

Groundwater substitution transfers included in the analysis were developed based on input from sellers, buyer demand, capacity to convey the water, and an analysis of the ability to potentially store water pumped from April through June in upstream CVP/SWP reservoirs. The ability to store water pumped April through June is described in greater detail in a subsequent section. The result of this analysis is a time-series of pumping that varies by month and year and is significantly less than the volumes illustrated in Figure B-4. Figure B-5 illustrates the range of monthly pumping simulated, and the average monthly pumping for the 12 years when groundwater substitution transfers are simulated. Additional detail on the monthly volume of groundwater substitution transfer simulated for each seller is provided in Attachment 2.

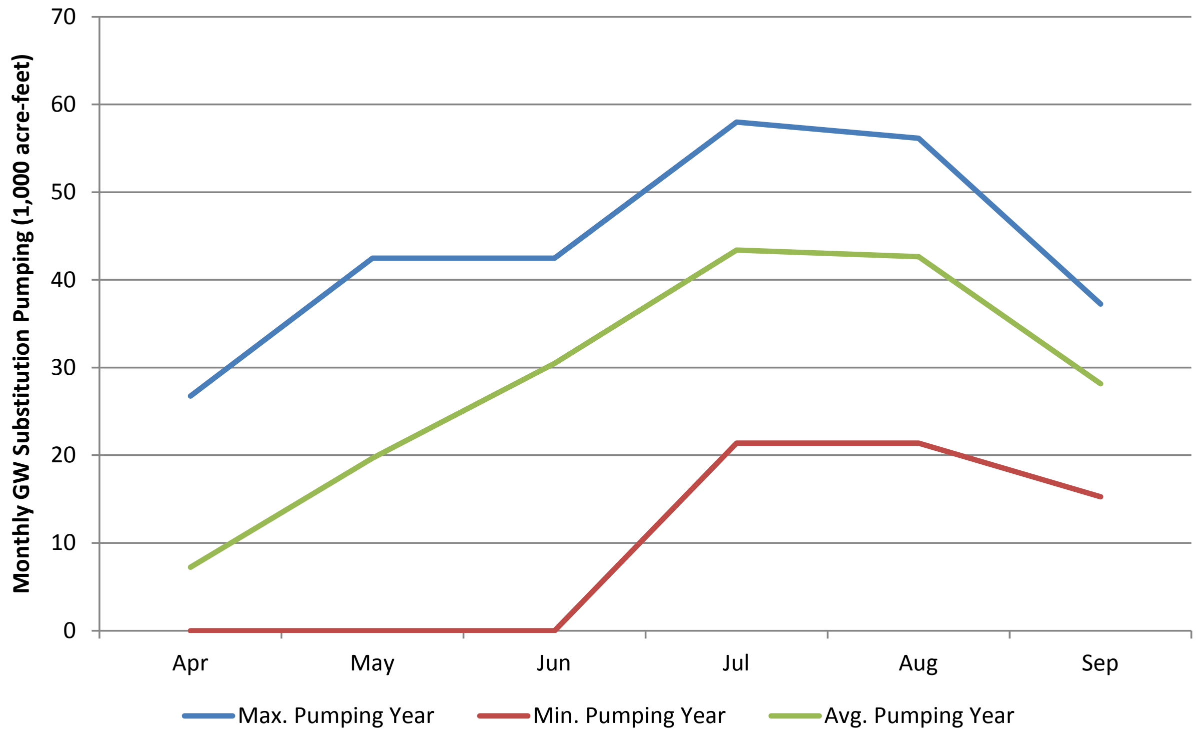

Figure B-5. Range of Monthly Groundwater Substitution Transfers Analyzed

Groundwater substitution transfers from the Sacramento Valley have the potential to create changes in stream-aquifer interaction that affect other parts of the water delivery system. Change in stream-aquifer interaction can be determined by comparing SACFEM2013 results from a baseline, without-transfer simulation to a with-transfer simulation that includes groundwater substitution pumping. Change in stream-aquifer interaction is calculated at each stream node for rivers and streams explicitly modeled in SACFEM2013. Changes are aggregated for nodes above specific locations that affect CVP/SWP operations, such as Wilkins Slough on the Sacramento River or total Delta inflow. Changes in stream-aquifer interaction due to groundwater substitution transfers include increased stream loss to the aquifer and decreased aquifer contribution to stream flow.

Figure B-5 illustrates the time-series of total change in stream-aquifer interaction in the Sacramento Valley (at the Delta) that result from groundwater substitution transfers proposed in the Project. Change in stream-aquifer interaction illustrated in Figure B-~~5~~ 6 is a reduction in Delta inflow.

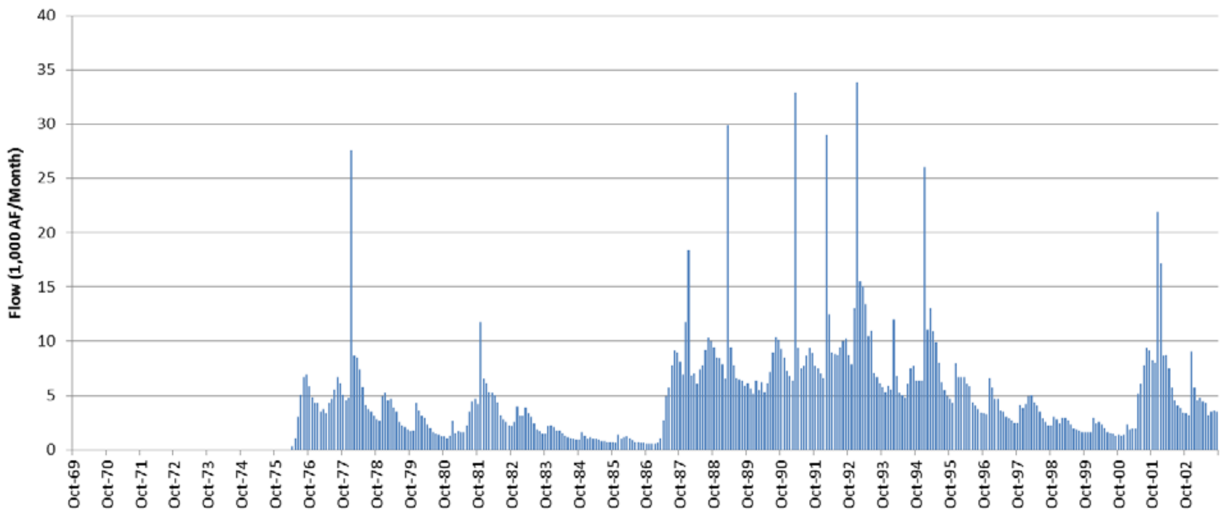

Figure B-~~5~~6. Total Change in Stream-Aquifer Interaction due to Groundwater Substitution Transfers

The timing of when changes in stream-aquifer interaction reduce stream flow is the key to understanding and simulating how changes may affect CVP/SWP operations. CVP/SWP operations will change in response to reduced stream flows under two conditions:

- When stream flow at minimum flow compliance locations (such as the Sacramento River at Wilkins Slough, the lower Feather River, or the American River at H Street) is at minimum levels and controlling upstream reservoir release.
- When the Delta is in balanced conditions.

The Delta can be in either a balanced or surplus condition. Balanced conditions, as defined in COA, are those periods when DWR and Reclamation agree that releases from upstream reservoirs plus unregulated flow approximately equals the water needed to meet Sacramento Valley in-basin uses plus exports. Conversely, excess or surplus conditions are periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses plus exports. Sacramento Valley in-basin uses include Delta water quality.

TOM simulates how changes in stream-aquifer interaction affect CVP and SWP operations. Time-series of the change in stream-aquifer interaction calculated from SACFEM2013 results for specific locations that affect CVP/SWP operations are input to TOM. Logic in TOM simulates changes in CVP/SWP operations that occur as a result of these changes in stream flow.

Stream flow reductions when the Delta is in surplus and river flows exceed minimum flow requirements will not affect CVP/SWP operations. During these periods TOM simulates the reduction in stream flow in the major river systems and Delta outflow. Surplus conditions occur approximately half of the time. Figure B-~~6~~ 7 illustrates changes in stream-aquifer interaction that occur during Delta balanced and surplus conditions.

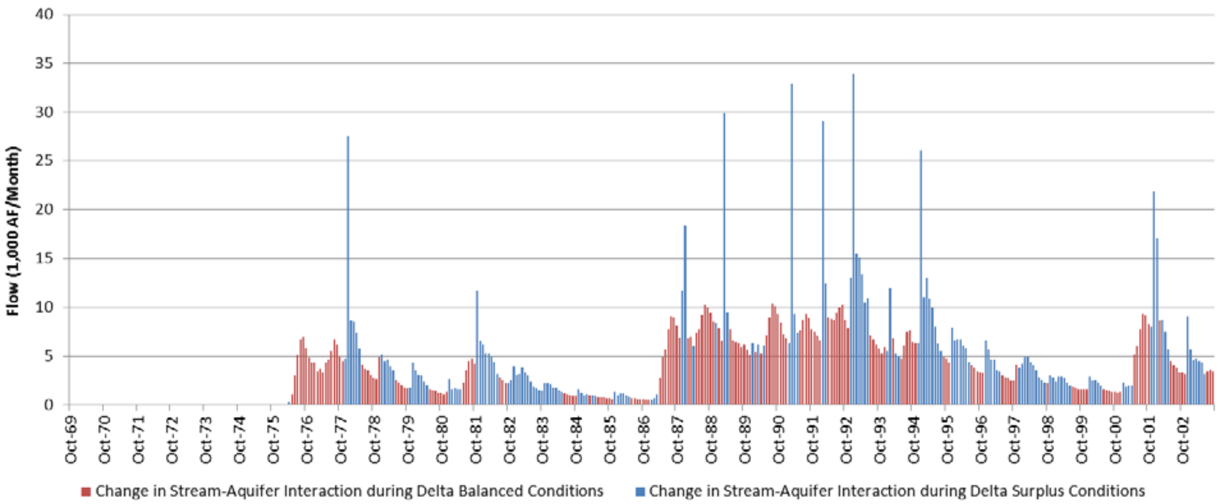

Figure B-~~6~~7. Change in Stream-Aquifer Interaction during Delta Balanced and Surplus Conditions

During periods when the Delta is in balanced conditions and/or flows on affected rivers and streams are at minimum flow requirements the CVP/SWP would respond to stream flow reductions that result from groundwater substitution transfers. TOM assumes the CVP/SWP will fully compensate for changes during these periods to maintain compliance with regulatory requirements. TOM includes logic to simulate the CVP/SWP operational response based on the location of the change in stream flow and CVP/SWP conditions. For example, the CVP would respond to reductions in Sacramento River flow at Wilkins Slough by increasing release from Shasta to comply with minimum flow requirements at that location. TOM simulates these types of operational responses.

There can be a variety of operational responses to changes in Delta inflow. TOM uses assumptions based reservoir storage conditions, minimum flow requirements, the portion of CVP and SWP water in the Delta, COA accounting, and Delta exports to simulate these operational responses by the CVP and SWP. Operational responses include increased release from upstream reservoirs and decreased Delta exports.

Changes in Delta inflow affect the CVP and SWP differently based on system conditions at the time and COA accounting. The obligation of each project to respond to reductions in Delta inflow is generally governed by the accounting split illustrated below in Figure B.~~7~~-8. However, during some periods the CVP may already be providing water in excess of the COA obligation and the CVP's ability to export CVP water at Jones. In these instances, the effects of reductions in Delta inflow as a result of groundwater substitution transfers primarily affect the SWP.

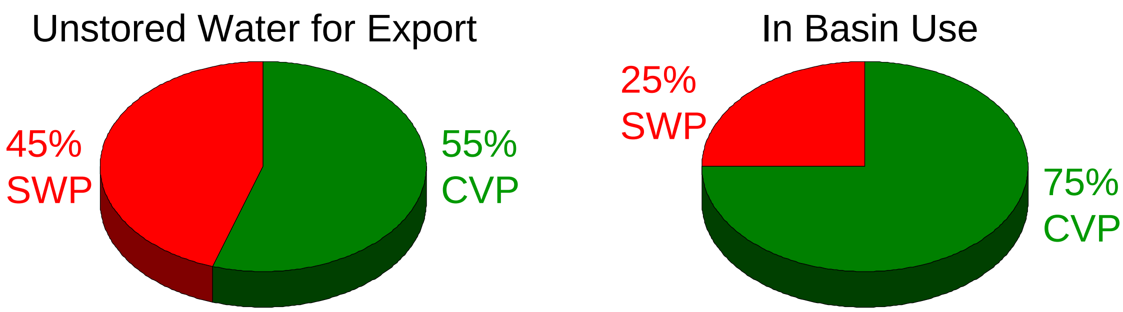

Figure B-~~7~~8. COA Accounting

B.4.3.1.4 Reservoir Release

The Long-Term Water Transfer Project includes reservoir release transfers from four water districts who own and operate reservoirs that can provide water to CVP buyers. These agencies and associated reservoirs are Placer County Water Agency and the Middle Fork Project (MFP) reservoirs of French Meadows and Hell Hole on the American River upstream of Folsom Reservoir, South Sutter WD and Camp Far West Reservoir on the Bear River, Browns Valley ID and Merle Collins Reservoir on French Dry Creek a tributary to the Yuba River, and Merced ID and Lake McClure on the Merced River.

In most instances, reservoir release transfers offer a higher degree of flexibility than other transfer mechanisms. Reservoir releases can be timed to coincide with available capacity and modified to accommodate other regulatory restrictions.

Annual volumes of water available through reservoir release transfers were developed and provided by the sellers. Annual time-series were input to TOM. TOM simulates operation of the seller's reservoirs to analyze the effects on reservoir storage, flow downstream, and reservoir refill. Figure B-~~8~~ 9 illustrates the annual volume of reservoir release water available from each seller in years with available export capacity/transfer demand.

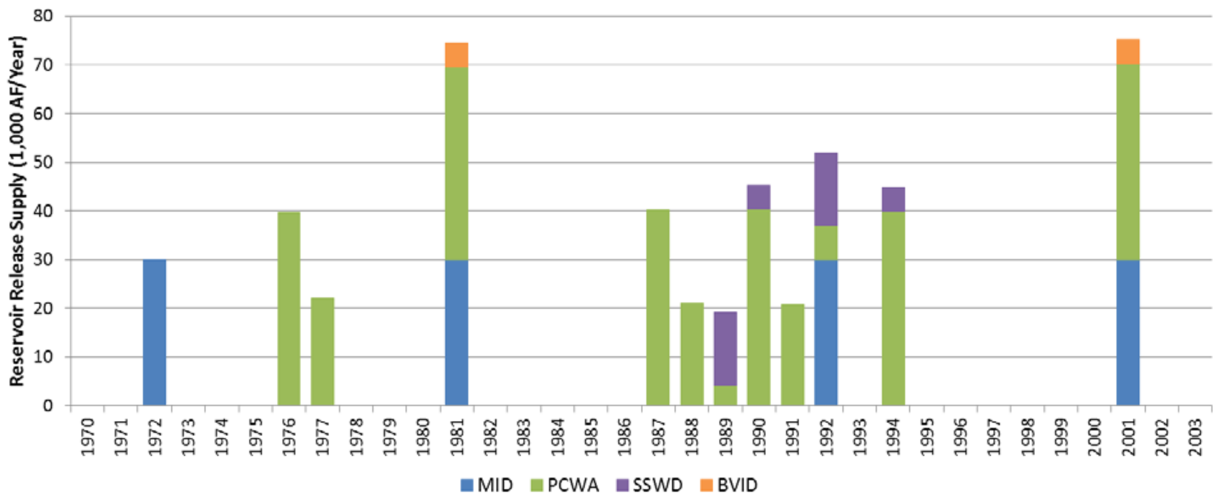

Figure B-~~8~~9. Annual Reservoir Release Transfer Supply

Transfer water released from Placer County Water Agency's MFP reservoirs flows into and through Folsom Reservoir. Transfer water made available from Placer County Water Agency must be in Folsom before being released for transfer, or moved through Folsom during the transfer, i.e. transfer water is not released from Folsom before being released from Placer County Water Agency reservoirs. Placer County Water Agency provided output from their MFP model for both a baseline and with-transfer scenario. Output included reservoir storage in French Meadows and Hell Hole and North Fork American River flow into Folsom. This model output was used to determine when transfer water flowed into Folsom and when MFP reservoirs refilled. Logic in TOM releases transfer water out of Folsom without bypassing hydropower generation.

Transfer water released from South Sutter WD's Camp Far West Reservoir flows down the Bear River, into the Feather River and eventually the Delta. There are no operational constraints that limit South Sutter WD's ability to release transfer water and therefore TOM assumes these transfers occur when there is demand, available capacity to divert the water, and the Delta is in balanced conditions. Logic in TOM for the operation of Camp Far West is based on a CalSim II module of the Bear River and is used to determine when Camp Far West refills.

Reservoir release transfers from Browns Valley ID's Merle Collins Reservoir are simulated in TOM. Browns Valley ID provided a baseline operation of Merle Collins Reservoir from a spreadsheet model owned by the district. Browns Valley ID also provided guidance on the years and conditions when the district would consider making a reservoir release transfer. This information was incorporated into TOM and logic developed to simulate the operation of Merle Collins Reservoir for a with-transfer scenario.

A reservoir release transfer from Merced ID's Lake McClure flows down the Merced River and is conveyed to SLDMWA. There are a variety of potential conveyance options to move transfer water from the Merced River to SLDMWA. Conveyance options include:

- Diversion at Merced ID's Crocker-Huffman Diversion Dam on the Merced River, conveyance through Merced ID's canals and distribution system to the Eastside Canal, through new conveyance facilities and into Turner Island WD and San Luis Canal Company, SLDMWA member agencies.

- Release down the Merced River to the lower San Joaquin River and diversion into facilities that connect the lower San Joaquin River and the Delta-Medota Canal. Three different facilities exist across the following districts: Patterson ID, West Stanislaus ID, and Banta Carbona ID. Connections through Patterson ID and West Stanislaus ID are located off the San Joaquin River upstream of the confluence with the Tuolumne River. The connection through Banta Carbona ID is located on the San Joaquin River downstream from Vernalis.

- Release down the Merced River, into the San Joaquin River for diversion at CVP, SWP, or Contra Costa WD's diversion facilities.

Assumptions input to TOM prioritize utilizing these conveyance options on an upstream to downstream priority, subject to physical capacities. A greater degree of flexibility exists for transfers from Merced ID because transfers can be scheduled based on available capacity to convey the water, and because there are multiple options for conveying transfer water without going through CVP/SWP facilities in the south Delta. However, transfers that affect water quality in the San Joaquin River are limited to periods when New Melones Reservoir is not releasing to meet water quality requirements at Vernalis.

B.4.3.1.5 Conserved Water

Conserved water is made available by Browns Valley ID from their pre-1914 Yuba River water rights. In 1990, Browns Valley ID implemented the Upper Main Water Conservation Project for the purpose of conserving water. Details of this project and documentation of the 3,100 acre-feet of annual conserved water are contained in the report *Analysis of Water Conserved Under the Upper Main Water Conservation Project* (MBK Engineers, 2002). Browns Valley ID's conserved water is available for transfer every year, but is only simulated as transferred in years with demand and available Delta export capacity (see Figure B-3). Conserved water is stored in Yuba County Water Agency's New Bullards Bar Reservoir and released for transfer in years with demand and capacity.

TOM simulates operation of New Bullards Bar Reservoir and Yuba River flow below New Bullards Bar to analyze effects on reservoir storage, Yuba River flow, and reservoir refill.

B.4.3.1.6 Crop Idling

Water can be made available through crop idling by not growing and irrigating a crop with available surface water and instead making that water available for transfer. The volume of water that may be transferred with a crop idling transfer is limited to the evapotranspiration of applied water (ETAW) that would have been consumed by the crop. The ETAW limit is intended to help protect third parties in the area of the seller. Crop idling transfers analyzed for the Project are from the Sacramento Valley only.

Annual volumes of crop idling water to be made available were provided by individual sellers. The volume of crop idling water to be made available can vary between Project alternatives. Figure B-~~9~~ 10 illustrates the maximum annual volumes identified by sellers in the Sacramento Valley for years with available export capacity/transfer demand.

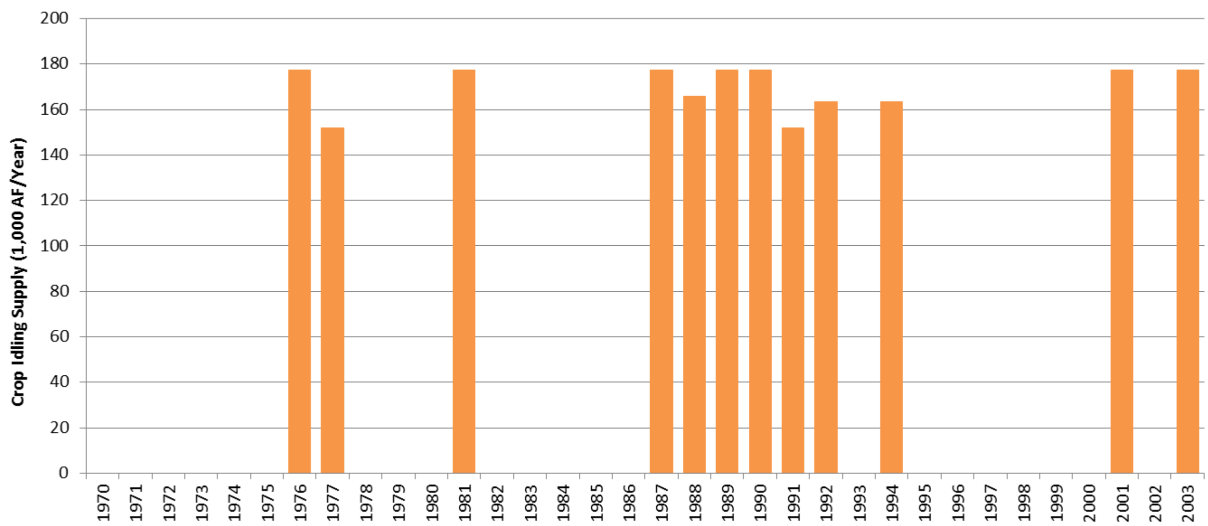

Figure B-~~9~~10. Maximum Annual Crop Idling Transfer Supply

Annual volumes were assumed to be made available on a monthly pattern based on the ETAW of rice, the assumed crop to be idled. Figure B-~~10~~ 11 illustrates the monthly ETAW pattern for rice. This monthly ETAW pattern has been used in the execution of water transfers for numerous years and is referenced in "Cropland Idling, Issue No. 1 – DRAFT Rice Water Transfer Pattern" (Reclamation 2009).

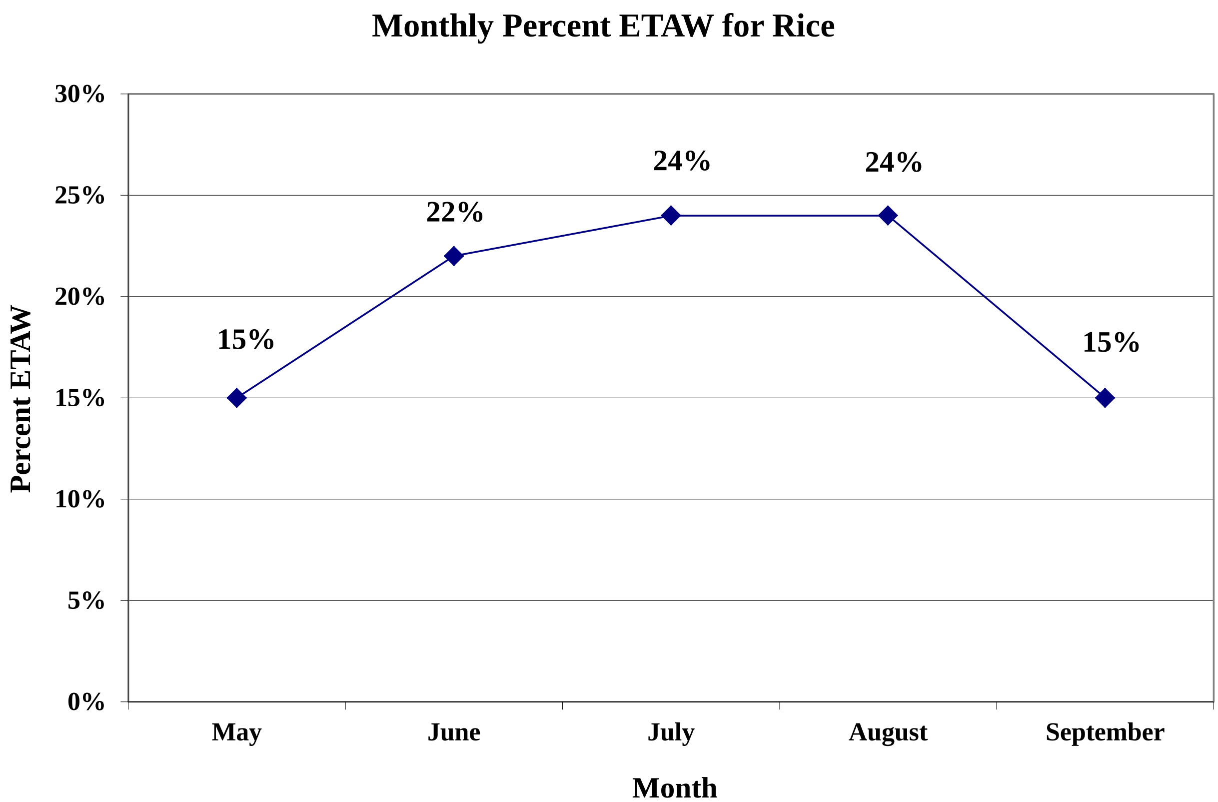

Figure B-~~10~~11. Monthly ETAW Pattern for Rice

Crop idling transfers offer the least flexibility of all transfer mechanisms. The decision to enter into crop idling transfers is typically made in spring months when there is still considerable uncertainty in the water supply forecast and the ability to convey water through the Delta. Crop idling transfers make water available on the fixed schedule illustrated in Figure B-~~10~~11. Therefore, transfer water made available in May and June, a total of 37 percent of the annual volume, can be lost or not diverted by the seller because there is rarely available export capacity at CVP or SWP pumping plants in those months and it may not be held in upstream storage.

B.4.3.1.7 Storing Transfer Water in CVP/SWP Reservoirs Upstream of the Delta

The BOs limit the season for water transfers through the Delta for export at CVP/SWP pumping facilities to July through September (NOAA Fisheries 2009, USFWS 2008). However, it may be possible to make water available prior to July and that water may be stored temporarily in CVP/SWP reservoirs upstream of the Delta. Transfer water stored prior to July would be released and moved through the Delta from July through September. It is difficult to predict when these conditions may occur, and therefore it is not possible to guarantee the ability to store water in every year.

In order for transfer water to be stored in upstream reservoirs two conditions must be met: 1) there must be surplus flow (flow in excess of minimum requirements for flow and temperature) upstream from where the transfer water is made available (the point of non-diversion), and 2) the CVP/SWP reservoir where the water will be stored must be operated to meet a requirement downstream from the point of non-diversion. Under these conditions it may be possible to temporarily store transfer water in CVP or SWP reservoirs. Transfer water would be stored in upstream reservoirs by reducing releases from those reservoirs when transfer water is made available.

Analysis of the baseline CalSim II simulation of CVP and SWP operations was performed to identify potential opportunities to store both groundwater substitution and crop idling transfer water made available from April through June in upstream CVP and SWP reservoirs. This information was used to determine months when groundwater substitution pumping was simulated in SACFEM2013. These same assumptions were incorporated into TOM to simulate the resulting changes in river flows, reservoir levels, and operations. These assumptions are made only for the purpose of analysis conducted for the environmental document to provide a conservative estimate of potential environmental impacts and may not be appropriate or applicable under actual operations in a particular year.

B.4.3.1.8 Shift in CVP/SWP Exports to Facilitate Transfers

As previously described, there are numerous considerations and adjustments made by Project operators to facilitate water transfers through CVP and SWP export facilities. One such adjustment can be to shift the timing of when Project water is moved from north-of-Delta reservoirs through the Delta. The timing of Project water movement can shift to assist in making export capacity for transfers available on a pattern that better matches the period of transfer. These shifts are more common at SWP facilities because the larger capacity at Banks provides greater flexibility.

TOM simulates shifts in timing of Project water movement at SWP facilities by adjusting baseline Oroville releases and Banks pumping from July through September of some years. Logic in TOM adjusts Oroville releases and Banks pumping to create a more regular monthly pattern of available export capacity.

B.4.3.1.9 Diversion of Transfer Water by Sellers

Water made available by sellers is conveyed through the system and diverted by CVP buyers. Diversions by buyers are made at existing points of diversion. A buyer's ability to divert transfer water is subject to available capacity and regulatory constraints as described in the following section.

B.4.3.1.9.1 East Bay MUD

East Bay MUD diverts both CVP Project water and transfer water at the Freeport Regional Water Project on the Sacramento River near Freeport. The location of these diversion facilities may provide additional flexibility for when transfer water may be diverted to East Bay MUD. Diversions at Freeport do not affect the Delta in the same way as CVP/SWP diversions in the southern Delta. Therefore, it may be possible for East Bay MUD to divert transfer water in months when there is typically no available export capacity at CVP/SWP facilities. East Bay MUD's Freeport diversions are limited to 155 cubic feet per second (cfs) capacity, East Bay MUD's share of the total Freeport Regional Water Project capacity.

Additionally, East Bay MUD diversions at Freeport are not subject to a "carriage water" adjustment to the volume of water made available for transfer. Carriage water is defined as the extra water needed to carry a unit of water across the Delta to CVP/SWP export facilities while maintaining a constant salinity. Because the transfer water is made available and diverted at the upstream edge of the Delta it is assumed that there is no change in Delta salinity associated with the transfer.

B.4.3.1.9.2 Contra Costa WD

Contra Costa WD diverts water under existing water rights, a CVP water service contract, and transfer water from multiple points of diversion in the Delta. The baseline CalSim II simulation includes diversions under Contra Costa WD's water rights and CVP contract. Diversion of transfer water is simulated in TOM to occur at three locations: Rock Slough, Old River, and Victoria Canal. Transfer diversions are simulated to occur at the location with the best water quality and available capacity after diversions under Contra Costa WD's water rights and CVP contract. Assumptions on the specific location of transfer diversions are necessary for analysis of Delta water quality performed in the Delta Salinity Model 2. Transfers to Contra Costa WD assume a 20 percent carriage water adjustment to maintain Delta salinity.

B.4.3.1.9.2 SLDMWA

SLDMWA member agencies receive water diverted at CVP/SWP export facilities in the southern Delta. Transfer water purchased by SLDMWA is conveyed through available export capacity at Jones and Banks pumping plants. Transfers from the Sacramento River assume a 20 percent carriage water adjustment to maintain Delta salinity. Transfers from Merced ID that enter the Delta from the San Joaquin River assume a ten percent carriage water adjustment.

Additionally, water made available by Merced ID can be conveyed directly to SLDMWA member agencies through facilities that connect to Merced ID's internal conveyance system and facilities that join the lower San Joaquin River and the DMC without going through CVP/SWP export facilities.

B.4.4 Level of Development

The Long Term Water Transfer Project is intended to provide environmental assessment for water transfers over a ten-year period. Therefore, analysis conducted to support environmental assessments was conducted at an existing level of development with consideration of reasonably foreseeable projects that may be constructed over the next ten years.

CalSim II simulations at a projected Level of Development (LOD) are used to depict how the modeled water system might operate with an assumed physical and institutional configuration imposed on a long-term hydrologic sequence. An existing LOD study assumes that current land use, facilities, and operational objectives are in place for each year of simulation (water year 1922 through 2003). The results are a depiction of the current environment which provides a basis for comparison of project effects for the impact analysis under CEQA. A future LOD study is needed to explore how the system may perform under an assumed future set of physical and institutional conditions and is used for the Future No Action Condition for NEPA analysis. The Project's ten-year period allows simulation of a single level of development under the assumptions that conditions are not likely to change significantly over such a short time horizon.

B.5 Model and Analysis Limitations

There are limitations in the ability of models to accurately address all of the intricacies of complex water management operations. Professional judgment is required to interpret results and determine benefits and impacts. Analysis for the Long Term Water Transfer Project is based on three primary models: CalSim II, SACFEM2013, and TOM. The overall analysis is therefore subject to the individual and combined limitations of all three models. While it is important to recognize and acknowledge the limitations of models as they are applied for this analysis, collectively these three models represent the best available tools for performing the analysis to serve as the basis for determining environmental impacts.

Model limitations and uncertainty for SACFEM2013 is described in Appendix D. Model limitations in CalSim II and TOM stem primarily from challenges of using computer models and fixed algorithms to simulate human decision-making processes. CVP/SWP operations are based on numerous regulatory requirements, a multitude of real-time data, and some degree of discretion on the part of operators. Numerous simplifying assumptions are necessary to simulate these complex operations. Computer models are capable of simulating many, but not all, regulatory requirements. Computer models are typically based on a more limited set of available data and use generalized rules that attempt to represent typical operator decisions. Computer models are far from perfect. However, these imperfections and simplifications do not render models useless. The regular and continued use of CalSim II for planning studies and environmental assessment by Reclamation, DWR, and others indicates the model is adequate for these purposes.

B.6 Project Alternatives and Results

B.6.1 Alternative 1: No Action/No Project Alternative

CEQA requires an EIR to include a No Project Alternative. The No Project Alternative allows for a comparison between the impacts of the proposed project with future conditions of not approving the proposed project. The No Project Alternative may include some reasonably foreseeable changes in existing conditions and changes that would be reasonably expected to occur in the foreseeable future if the project were not approved.

Under the No Action/No Project Alternative CVP related water transfers through the Delta would not occur from 2015-2024. However, other transfers that do not involve the CVP could occur under the No Action/No Project Alternative. Additionally, CVP transfers within basins could continue and would still require Reclamation's approval. Some CVP entities may decide that they are interested in selling water to buyers in export areas under the No Action/No Project Alternative; however, they would need to complete individual NEPA and Endangered Species Act compliance for each transfer to allow Reclamation to complete the evaluation of the transfers for approval.

Alternative 1 is simulated with the baseline CalSim II model provided by Reclamation and other information and model results provided by buyers and sellers. These results represent reasonably foreseeable conditions for the 2015-2024 period and are used for comparison with results from each of the project alternatives.

B.6.2 Alternative 2: Full Range of Transfer Measures

Alternative 2 would involve transfers from potential sellers upstream from the Delta to buyers in the Central Valley and Bay Area. Alternative 2 includes transfers under all potential transfer measures: groundwater substitution, reservoir release, conserved water, and crop idling/crop shifting. The order in which transfer measures are prioritized and simulated to occur is described in previous sections. The following section summarizes the results of Alternative 2 with comparisons to and changes from the No Project Alternative.

Figure B-~~11~~ 12 is a summary of the quantity of transfer water made available (Transfer Supply) under Alternative 2 on an annual basis and illustrates where the water is diverted or used (Transfer Use). A percentage of water to be transferred through the Delta becomes carriage water to maintain Delta water quality. Unused transfer water is from two different sources/transfer measures. In some years there can be unused crop idling water during May and June because there is no ability to store it upstream or available capacity at the export pumps. A second source is reservoir release transfers from Placer County Water Agency that are held in Folsom but spill prior to being delivered to East Bay MUD. Results are summarized by water year and show small amounts of water in wetter years such as 1978, 1982, 1993, etc. These are transfers from Placer County Water Agency to East Bay MUD that extend past September of the year when the transfer begins. East Bay MUD may begin taking delivery of transfer water from Placer County Water Agency as early as March and extend into February of the following year.

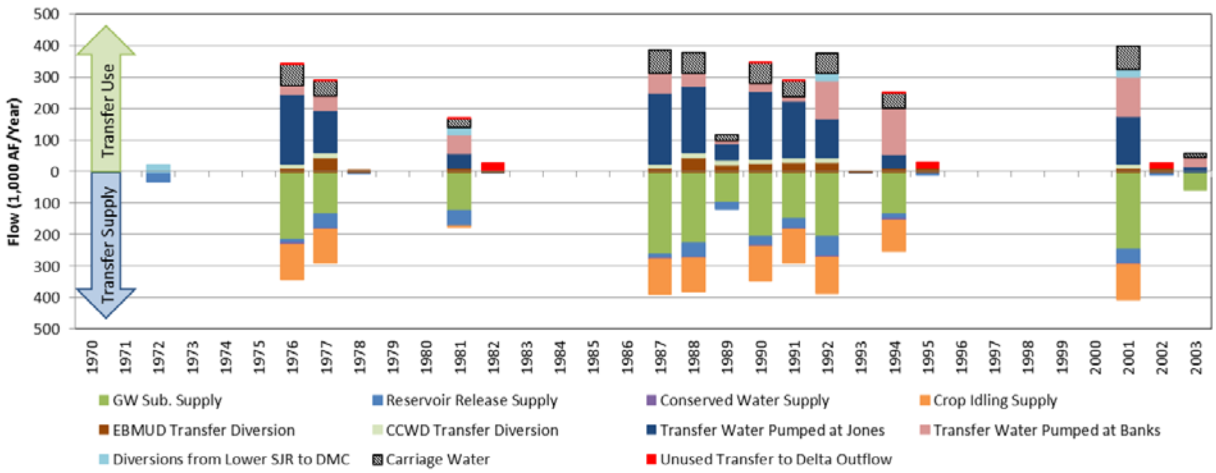

Figure B-~~11~~12. Annual Transfer Summary for Alternative 2

TOM simulates transfer water made available and moved through the system and produces results under each Project alternative for comparison with baseline, without transfers, results. TOM simulates the effects of transfers on reservoir storage, river flows, Delta outflow and exports, and diversions by Contra Costa WD and East Bay MUD. The following sections describe and illustrate these effects for Alternative 2.

B.6.2.1 Storage

Figure B-~~12~~ 13 illustrates the change in operations at Shasta with the Project. Under Alternative 2 release from Shasta can increase or decrease. Decreased releases occur when transfer water is stored in Shasta during the April through June period and create higher storage conditions than under Alternative 1 (Baseline). Releases increase during the July through September period when stored transfer water is released for delivery. These releases bring storage back to Baseline levels. Releases also increase because groundwater substitution transfers reduce stream flow on the Sacramento River, and during times of low-flow, stored water must be released from the reservoir to meet minimum flow requirements at Wilkins Slough.

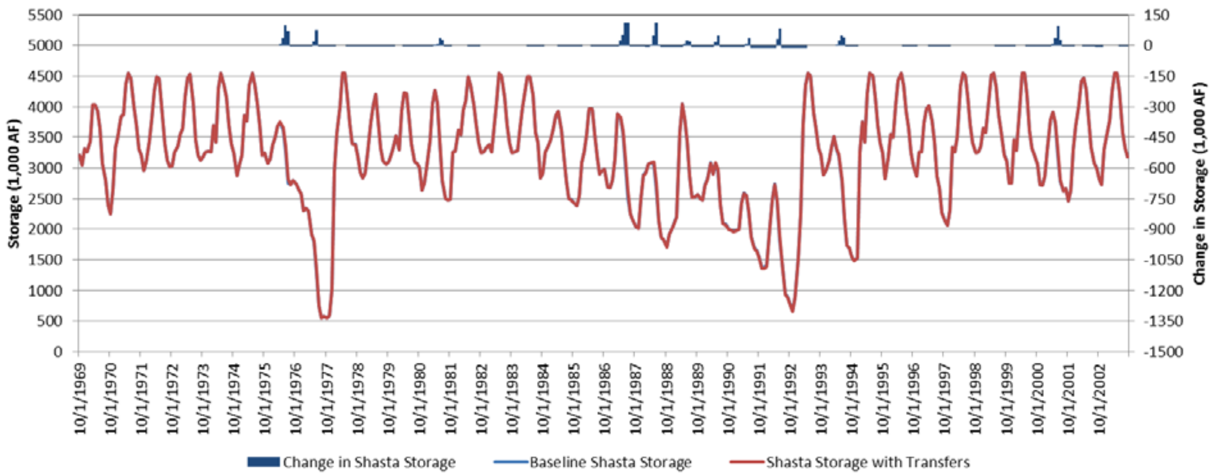

Figure B-~~12~~13. Shasta Operations with and without Alternative 2 Transfers

Operations at Folsom are illustrated below in Figure B-~~13~~14. Transfer water can be temporarily stored in Folsom for release and delivery in subsequent months. This includes transfers from groundwater substitution in the American River Basin, crop idling in the Sacramento Valley, and reservoir release from upstream Placer County Water Agency reservoirs. Releases from Folsom can increase to maintain minimum flow requirements downstream on the American River at H Street.

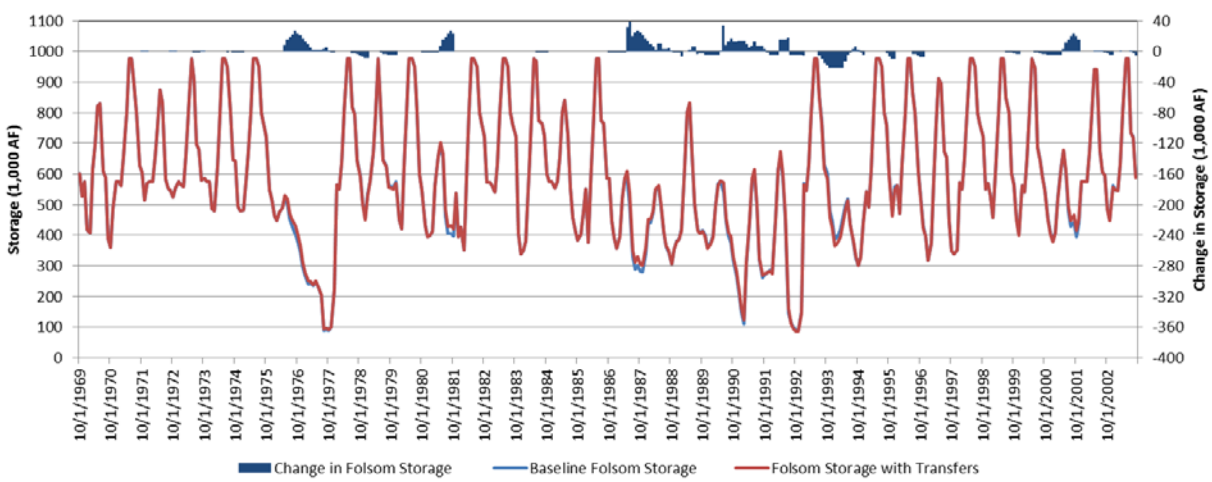

Figure B-~~13~~14. Folsom Operations with and without Alternative 2 Transfers

Figure B-~~14~~ 15 illustrates changes in Oroville storage with and without the Project. Larger changes in Oroville storage result from shifting the timing of delivery of SWP water to accommodate transfers. There are also decreases in storage when additional water is released to maintain minimum flow requirements on the Lower Feather River. These additional releases from

Oroville are made to account for reductions in Feather River flows due to groundwater substitution transfers.

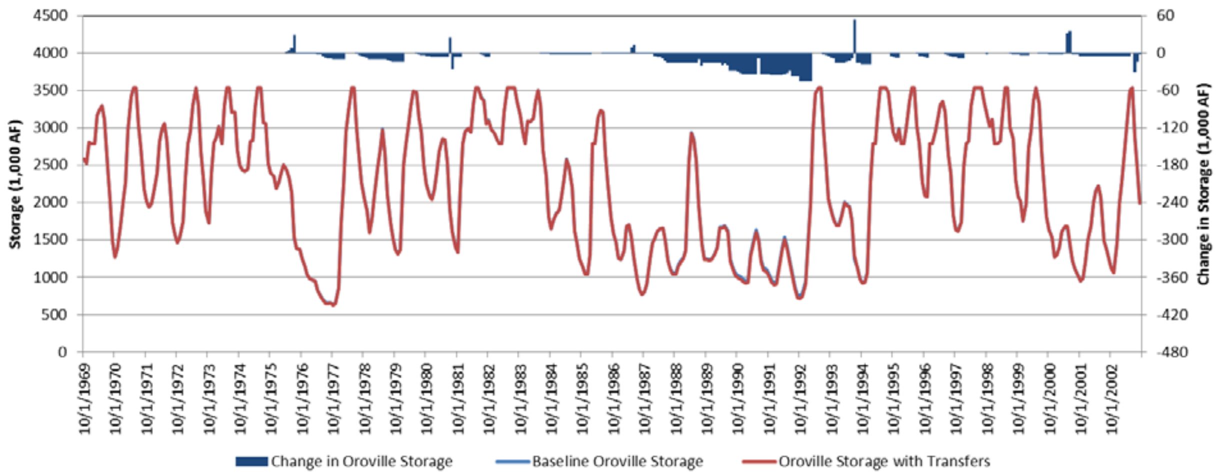

Figure B-~~14~~15. Oroville Operations with and without Project

South Sutter WD releases water from Camp Far West Reservoir to participate in reservoir release transfers. Figure B-~~15~~ 16 illustrates the only change in reservoir storage from baseline conditions as the quantity released for transfer, a volume of five or 15 thousand acre-feet (TAF). Camp Far West Reservoir storage returns to baseline levels when the reservoir refills.

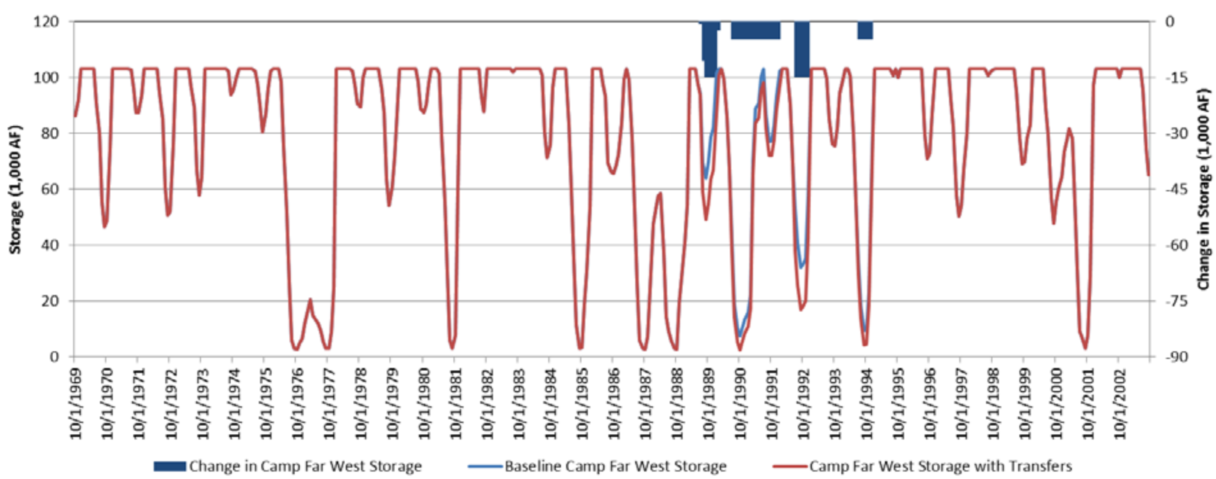

Figure B-~~15~~16. Camp Far West Operations with and without Alternative 2 Transfers

Browns Valley ID releases water from Merle Collins Reservoir to participate in reservoir release transfers. Figure B-~~16~~ 17 illustrates the only change in reservoir storage from baseline conditions as the quantity released for transfer, up to five TAF in any year. Merle Collins Reservoir storage returns to baseline levels when the reservoir refills.

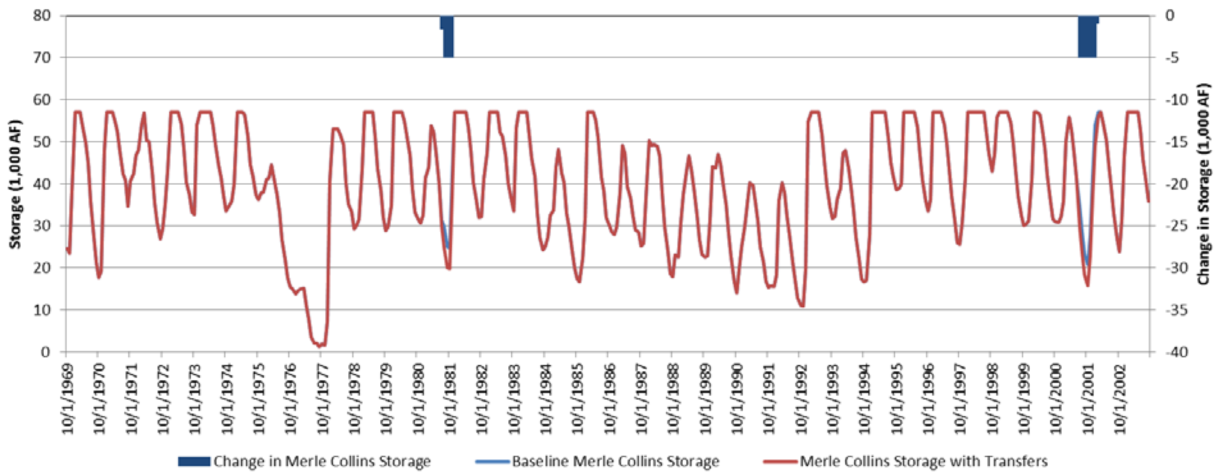

Figure B-~~16~~17. Merle Collins Reservoir Operations with and without Alternative 2 Transfers

Placer County Water Agency releases water from MFP reservoirs of French Meadows and Hell Hole to participate in reservoir release transfers. Figure B-~~17~~ 18 illustrates the combined storage in these two reservoirs under both baseline and with Project operations. MFP reservoir storage returns to baseline levels when the reservoirs refill.

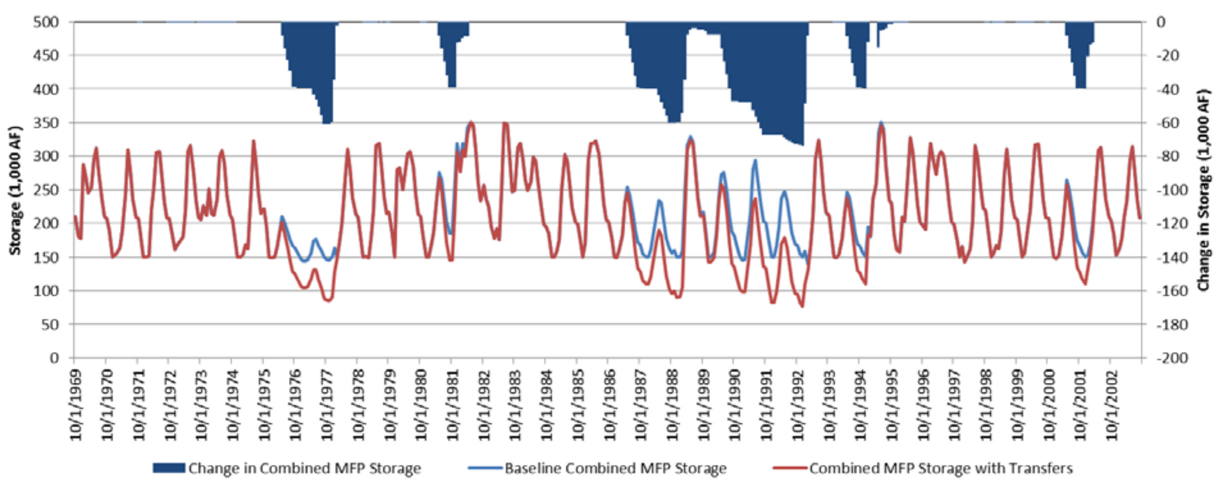

Figure B-~~17~~18. MFP Operations with and without Alternative 2 Transfers

Figure B-~~18~~ 19 illustrates Merced ID operations of Lake McClure with and without reservoir release transfers. Reservoir release transfers of up to 30 TAF reduce reservoir storage until the reservoir refills in subsequent wet years.

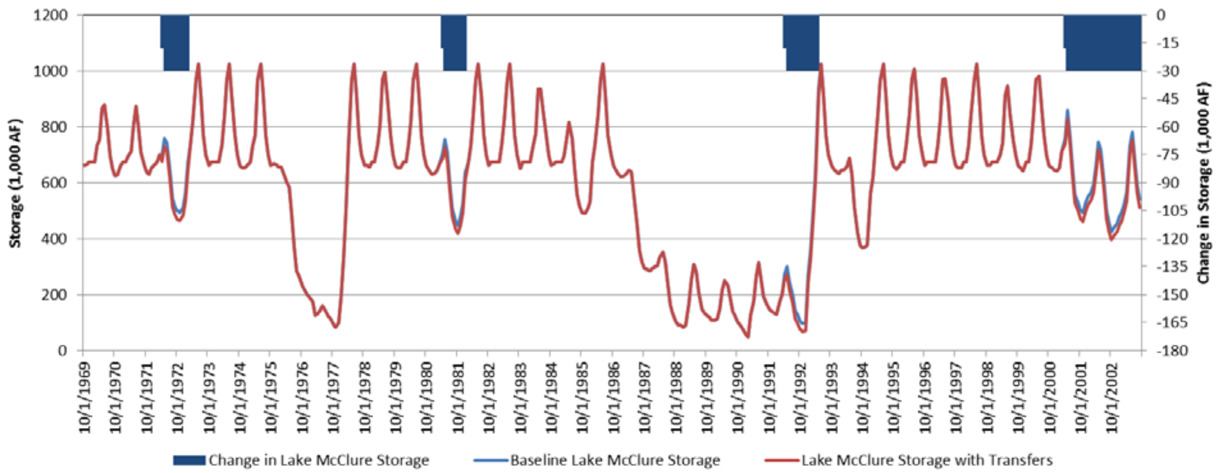

Figure B-~~18~~19. Lake McClure Operations with and without Alternative 2 Transfers

Conserved water is stored in Yuba County Water Agency's New Bullards Bar Reservoir and released for transfer in years with demand and capacity. The effect of these releases is illustrated below in Figure B-~~19~~20. New Bullards Bar Reservoir storage returns to baseline levels when the reservoir refills.

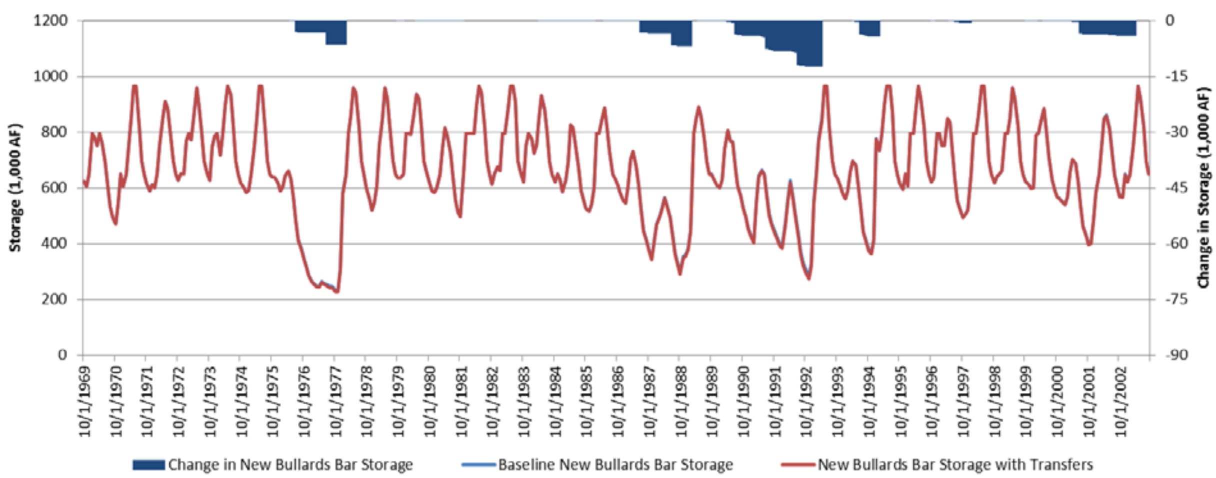

Figure B-~~19~~20. New Bullards Bar Operations with and without Alternative 2 Transfers

B.6.2.2 Stream Flow

Releases from Keswick Dam, as illustrated below in Figure B-~~20~~21, reflect the changes in Shasta storage seen in Figure B-~~12~~13. A reduction in release corresponds to an increase in Shasta storage. Reduced releases typically occur in the April through June period when it may be possible to store transfer water made available downstream in Shasta. Months of reduced releases are followed by increased releases as transfer water is released to be moved through the Delta during the July through September period.

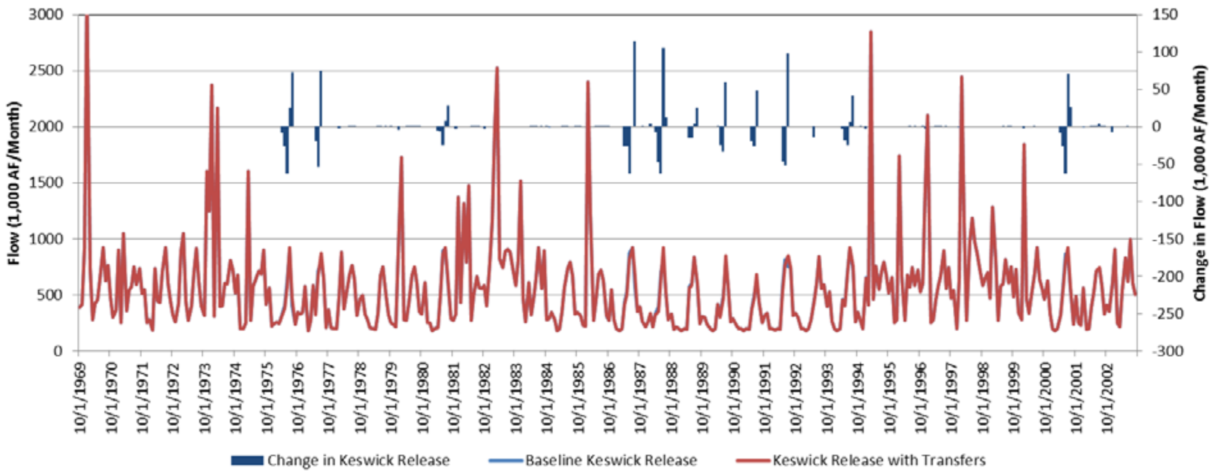

Figure B-~~20~~21. Keswick Dam Release with and without Alternative 2 Transfers

Figure B-~~21~~ 22 illustrates the effect of Alternative 2 transfers to the Sacramento River at Wilkins Slough. Increased flows result from changes in Keswick release, plus water made available by groundwater substitution and crop idling transfers upstream of Wilkins Slough. Decreases occur when transfer water is stored upstream in Shasta.

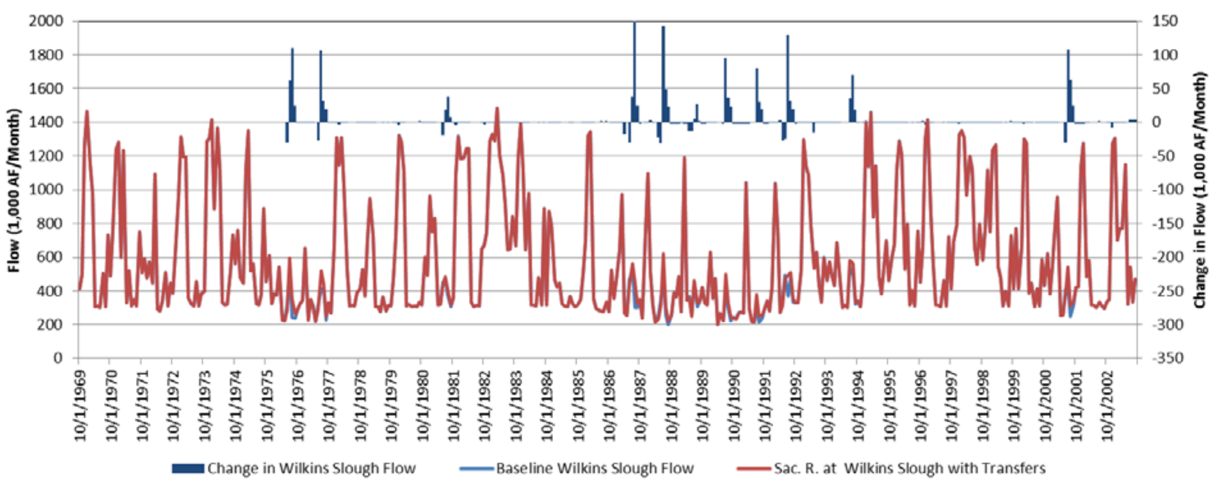

Figure B-~~21~~22. Sacramento River at Wilkins Slough with and without Alternative 2 Transfers

Figure B-~~22~~ 23 illustrates Nimbus Dam releases. Nimbus releases reflect CVP operations of Folsom Reservoir. Increases in release of approximately five TAF are water made available by Placer County Water Agency being released for re-diversion by East Bay MUD. Larger increases are typically preceded by decreases as transfer water made available downstream is stored in Folsom. Large releases occur when stored transfer water is release to be conveyed through the Delta. Decreases also occur when Placer County Water Agency's upstream reservoirs refill, typically during times when Folsom is also spilling water to maintain flood space requirements.

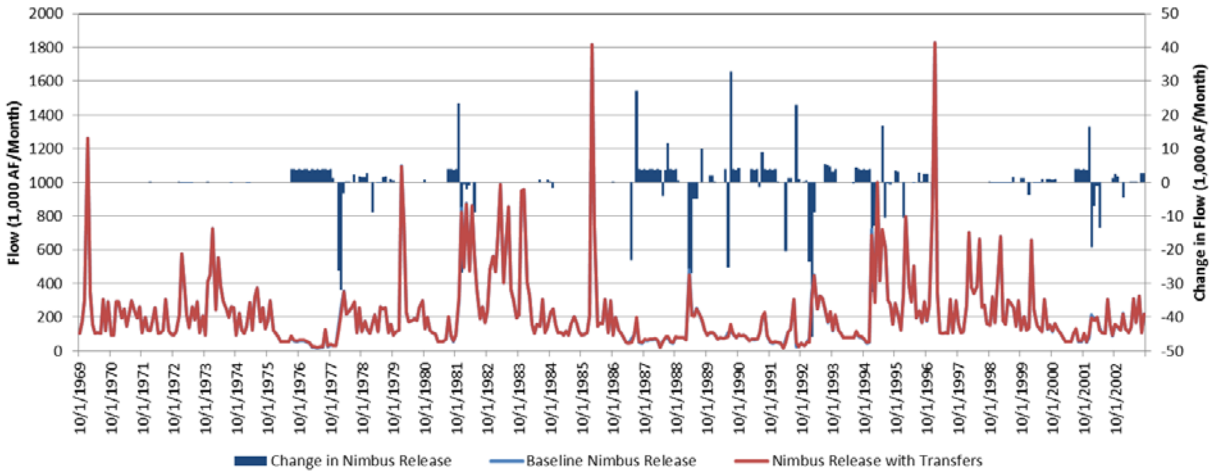

Figure B-~~22~~23. Nimbus Dam Release with and without Alternative 2 Transfers

Flows on the American River at H Street, illustrated in Figure B-~~23~~24, show similar changes as flows at Nimbus. Flow at H Street also increases from water made available by groundwater substitution transfers by Sacramento Suburban WD and the City of Sacramento.

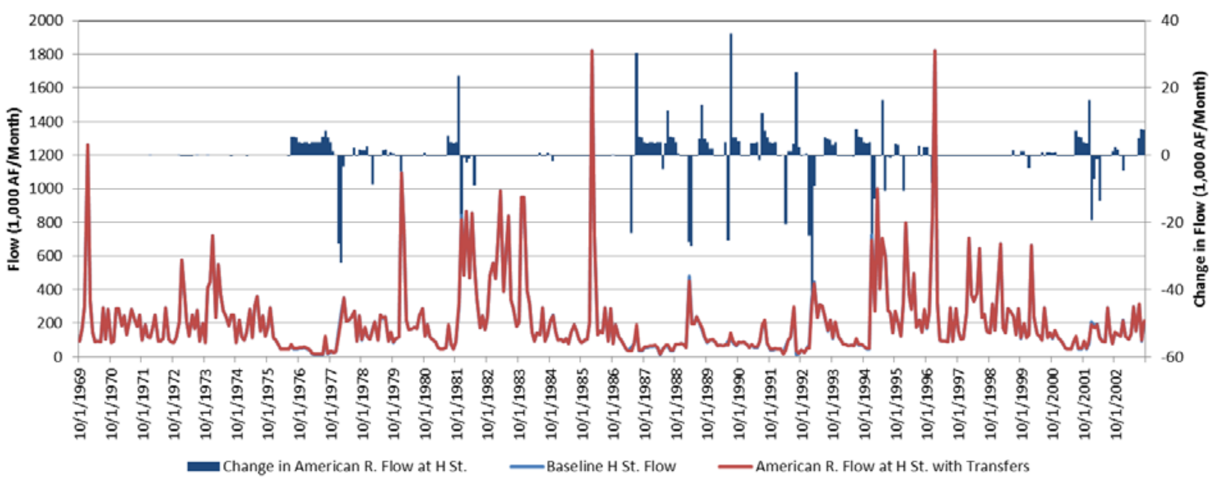

Figure B-~~23~~24. American River at H Street with and without Alternative 2 Transfers

Figure B-~~24~~ 25 illustrates change in Feather River flow below Thermalito. Flow in the Feather River below Thermalito changes due to changes in the operation of Oroville. Transfer water made available on the Feather River downstream from Thermalito can be temporarily stored in Oroville for release and transfer during the July through September period. Water stored prior to

July reduces Feather River flow. Increases and decreases in flow on the Feather River below Thermalito also occur from shifts in timing of SWP water to accommodate transfers. The magnitude of some of these differences is affected by model nuances within CalSim II that can create variations from month-to-month in release of SWP water from Oroville for movement through the Delta.

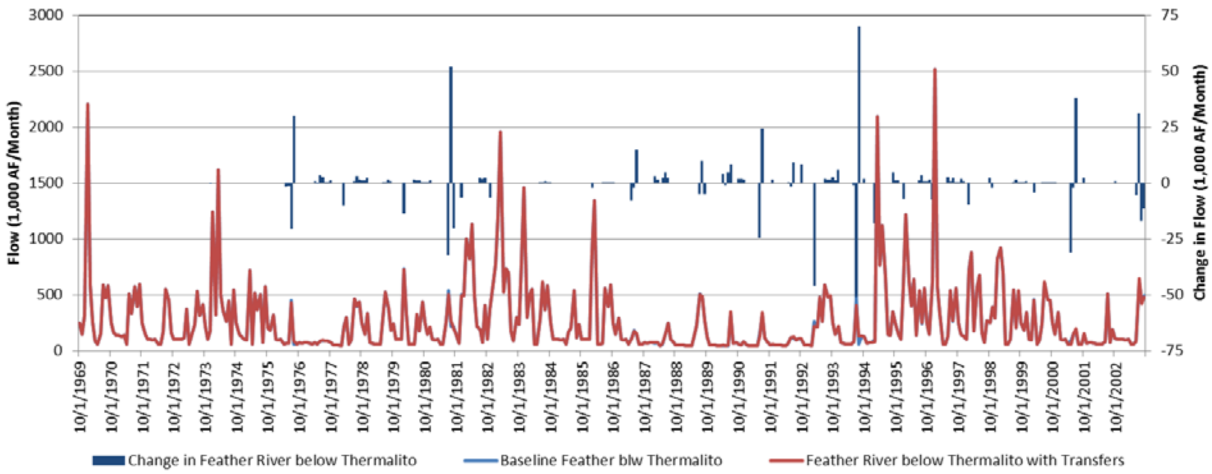

Figure B-~~24~~25. Feather River below Thermalito with and without Alternative 2 Transfers

Figure B-~~25~~ 26 illustrates changes in flow on the Yuba River at Marysville as a result of Browns Valley ID's transfers of conserved water from New Bullards Bar Reservoir and reservoir release from Merle Collins Reservoir. Increases indicate transfer water moving downstream for re-diversion and decreases indicate upstream reservoir refill.

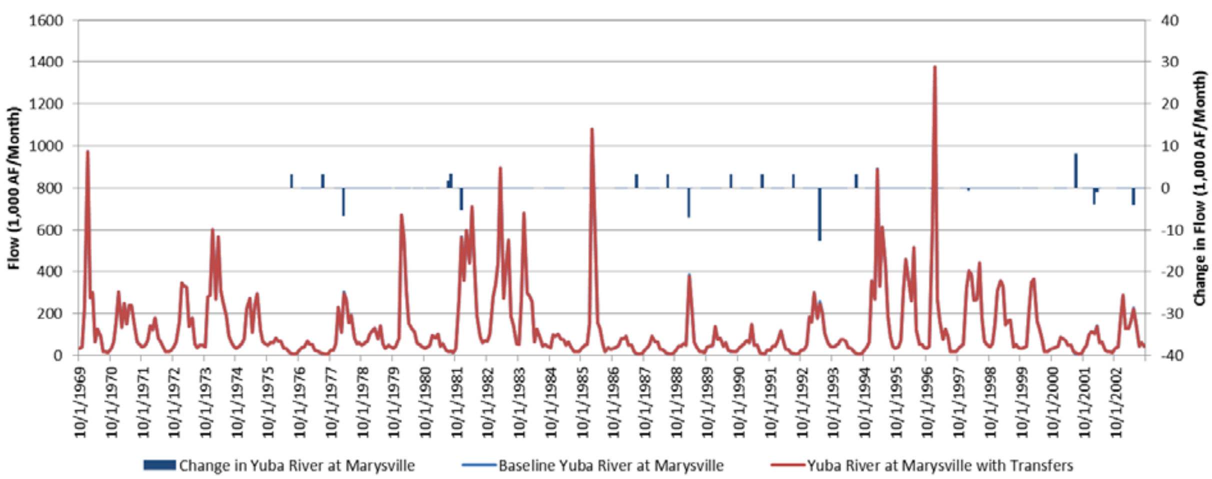

Figure B-~~25~~26. Yuba River at Marysville with and without Alternative 2 Transfers

Figure B-~~26~~ 27 illustrates the response of Bear River flows into the Feather River as a result of South Sutter WD reservoir release transfers from Camp Far

West Reservoir. Flows increase when water is released for transfer and decrease when Camp Far West refills.

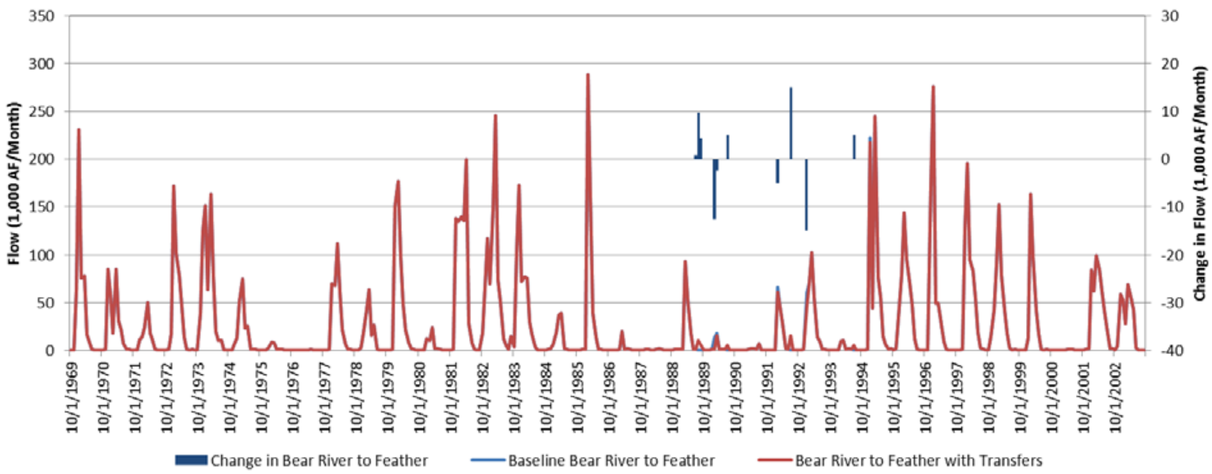

Figure B-~~26~~<u>27</u>. Bear River to the Feather River with and without Alternative 2 Transfers

The flow on the Lower Feather River represents an aggregation of flows on the Yuba River, Bear River, and upper portions of the Feather River. There are also increases due to water made available by groundwater substitution transfers along the Feather River between Thermalito and the confluence with the Sacramento. Figure B-~~27~~ <u>28</u> illustrates the effect to the Feather River.

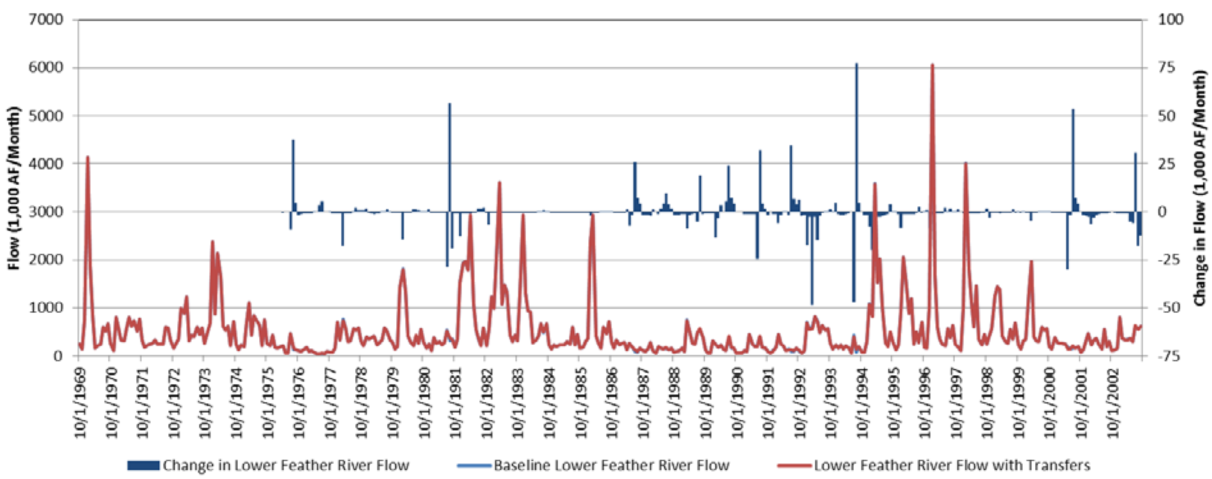

Figure B-~~27~~<u>28</u>. Lower Feather River with and without Alternative 2 Transfers

Figure B-~~28~~ <u>29</u> illustrates the flow of the Sacramento River at Freeport. This location is an aggregation of all changes on the Sacramento River at Wilkins Slough, the Lower Feather River, the American River at H Street, and changes between those locations and Freeport. Changes between those locations and Freeport include increases in flow due to water made available through groundwater substitution and crop idling transfers and decreases due to stream-aquifer interaction. Reductions in flow of approximately 50 TAF or more are a result of changes in stream and flood bypass flows during surplus conditions after one or more years of groundwater substation transfers. These changes are also illustrated above in Figure B-~~6~~7.

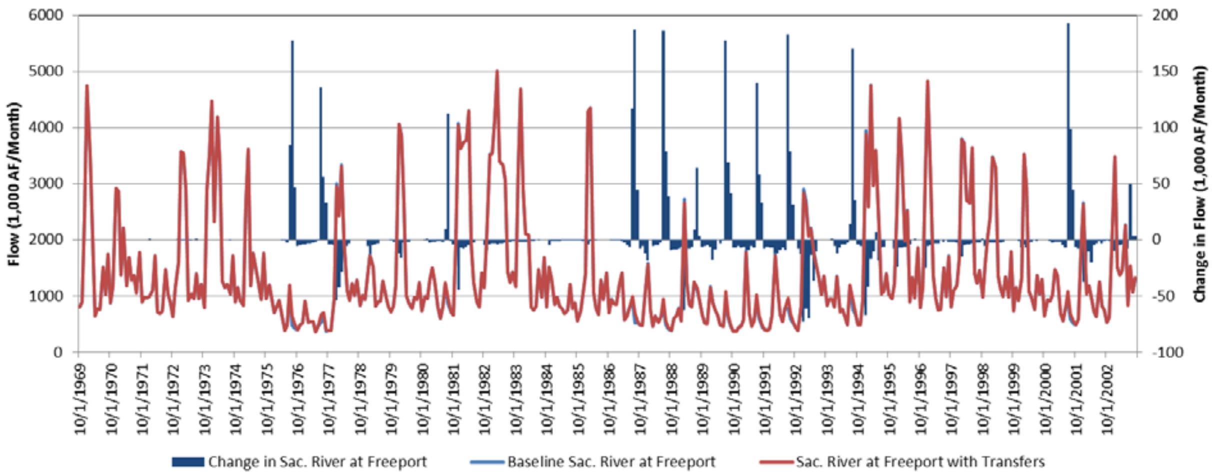

Figure B-~~28~~29. Sacramento River at Freeport with and without Alternative 2 Transfers

Figure B-~~29~~ 30 illustrates the changes on the Merced River at the confluence with the San Joaquin River. Increases in Merced River flow represent transfer water made available by reservoir releases at Lake McClure; decreases occur when Lake McClure refills.

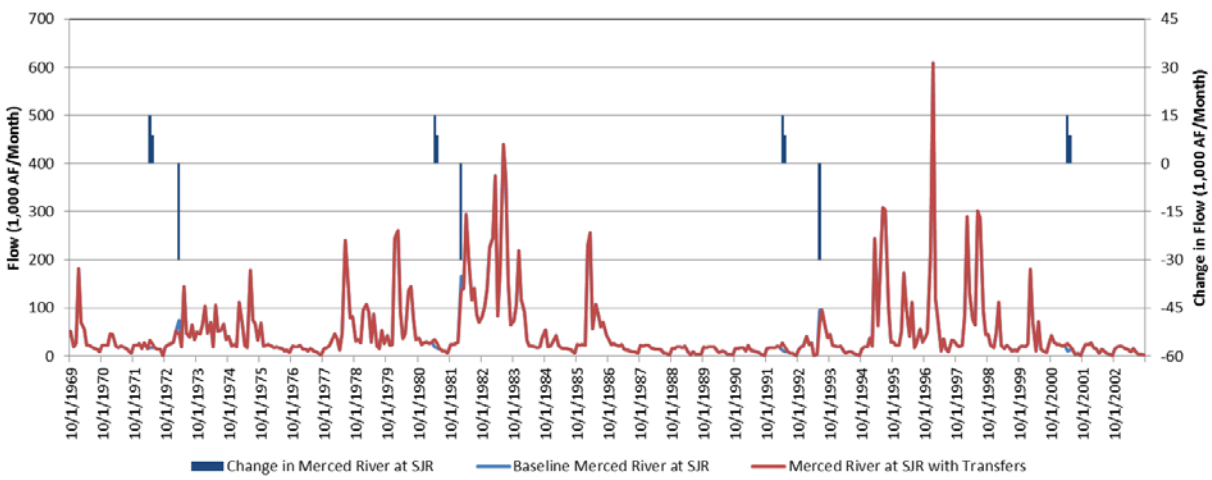

Figure B-~~29~~30. Merced River at the San Joaquin River with and without Alternative 2 Transfers

Figure B-~~30~~ 31 illustrates San Joaquin River flows at Vernalis. Increases in flow are Merced ID transfer water to be diverted at Banta Carbona ID and conveyed to the DMC. Decreases in flow occur when Lake McClure refills space vacated during reservoir release transfers.

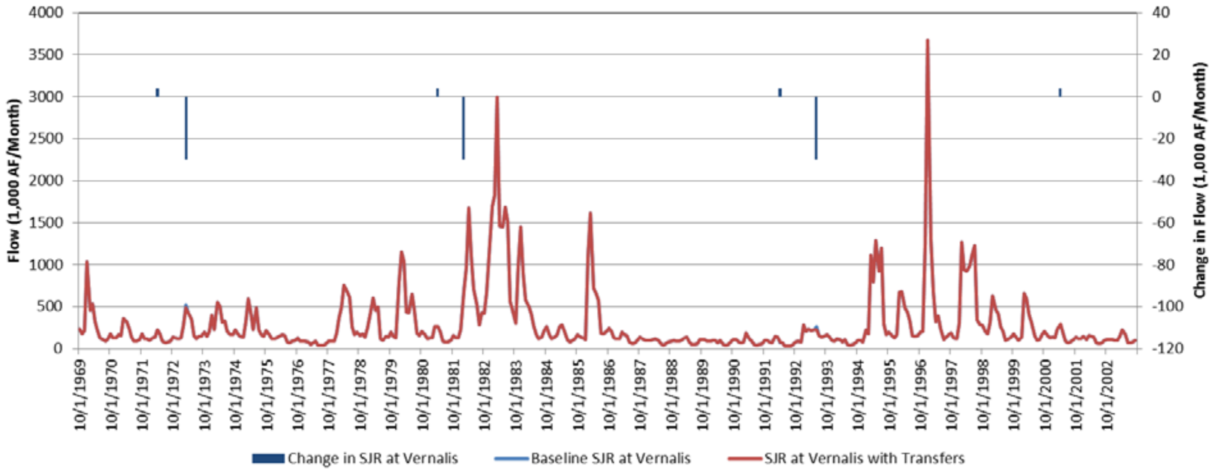

Figure B-~~30~~31. San Joaquin River at Vernalis with and without Alternative 2 Transfers

Changes to Delta outflow are illustrated below in Figure B-~~31~~32. Increases in Delta outflow are primarily due to carriage water to facilitate transfers through the Delta. Decreases in Delta outflow are attributed to reservoir refill upstream and changes in stream-aquifer interaction.

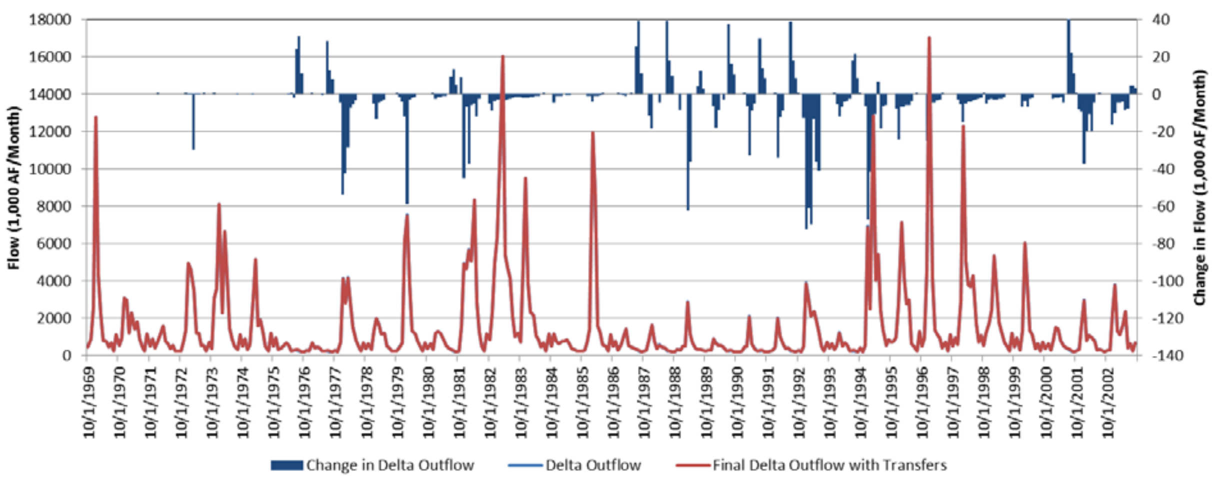

Figure B-~~31~~32. Delta Outflow with and without Alternative 2 Transfers

Table B-1 summarizes changes in Delta outflow on an average monthly basis. Average annual Delta outflow is decreased by approximately 31 TAF with decreases November through June and increases June through September.

Table B-1. Average Monthly Delta Outflow (TAF) for Alternative 2

Delta Outflow	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	393	867	1,490	3,260	3,312	3,278	1,753	1,381	816	546	297	638	18,031
With Transfers	393	867	1,485	3,250	3,300	3,268	1,748	1,378	813	554	303	641	18,000
Change	0	-1	-5	-10	-12	-10	-5	-3	-3	8	6	3	-31

B.6.2.3 Exports and Diversions

Figure B-~~32~~ 33 illustrates the change in exports at Jones Pumping Plant. Increases are generally due to export of transfer water for SLDMWA. Decreases in Jones exports are due to changes in Sacramento Valley stream-aquifer interaction that reduce Delta inflows.

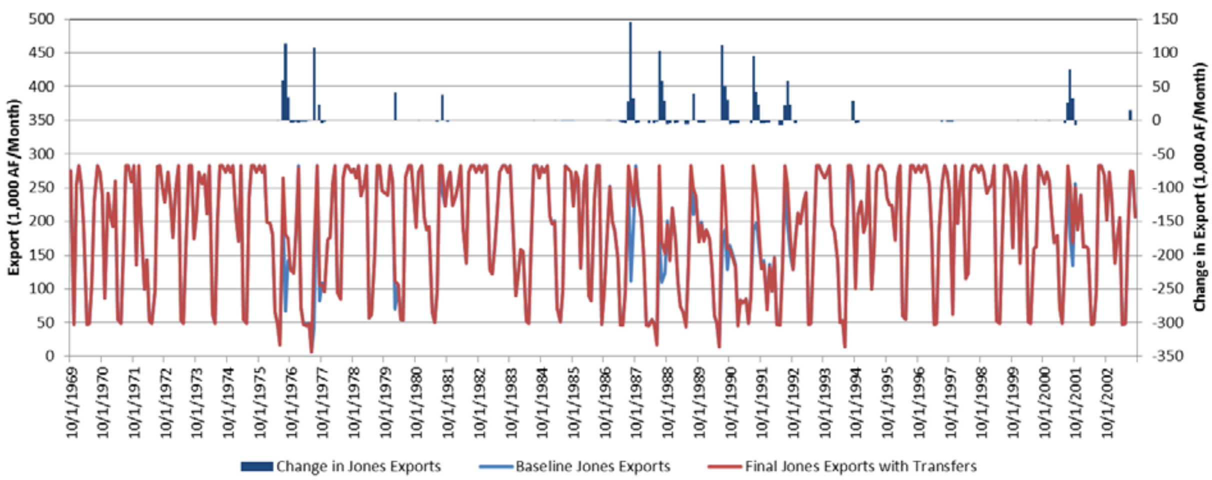

Figure B-~~32~~33. Exports at Jones Pumping Plant with and without Alternative 2 Transfers

Table B-2 summarizes the average monthly exports at Jones Pumping Plant for the baseline and with Project alternatives and the change. Increases occur during the transfer months of July, August, and September, with an average annual increase of 39 TAF.

Table B-2. Average Monthly Exports at Jones Pumping Plant (TAF) for Alternative 2

Jones Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	222	212	235	197	186	198	69	65	153	256	252	223	2,268
With Transfers	221	211	235	197	187	198	69	65	152	272	270	231	2,306
Change	-1	-1	0	0	1	0	0	-1	-1	17	18	8	39

Transfer water can also be exported at Banks Pumping Plant. Banks exports also can be reduced when changes in stream-aquifer interaction affect the SWP. This is illustrated below in Figure B-~~33~~34.

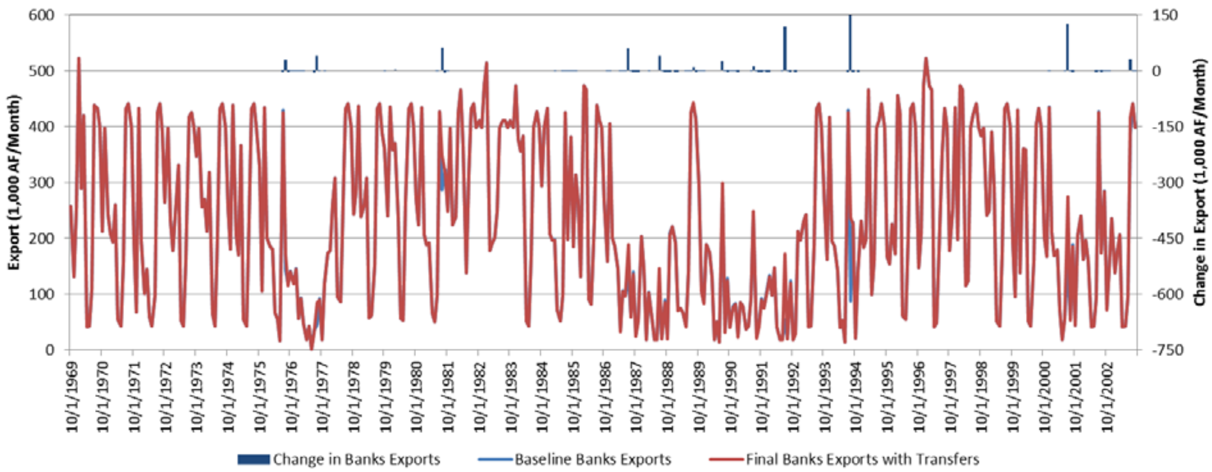

Figure B-~~33~~34. Exports at Banks Pumping Plant with and without Alternative 2 Transfers

Table B-3 summarizes the average monthly exports at Banks Pumping Plant for the baseline and with Project alternatives and the change. The average annual change is an increase of approximately 15 TAF.

Table B-3. Average Monthly Exports at Banks Pumping Plant (TAF) for Alternative 2

Banks Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	202	212	307	222	239	261	70	62	156	363	316	320	2,731
With Transfers	201	211	307	221	239	261	70	62	156	375	324	319	2,746
Change	-1	-1	0	0	0	0	0	0	0	11	8	-1	15

Total CVP/SWP exports, the sum of exports at Jones and Banks Pumping Plants, are illustrated in Figure B-~~34~~35.

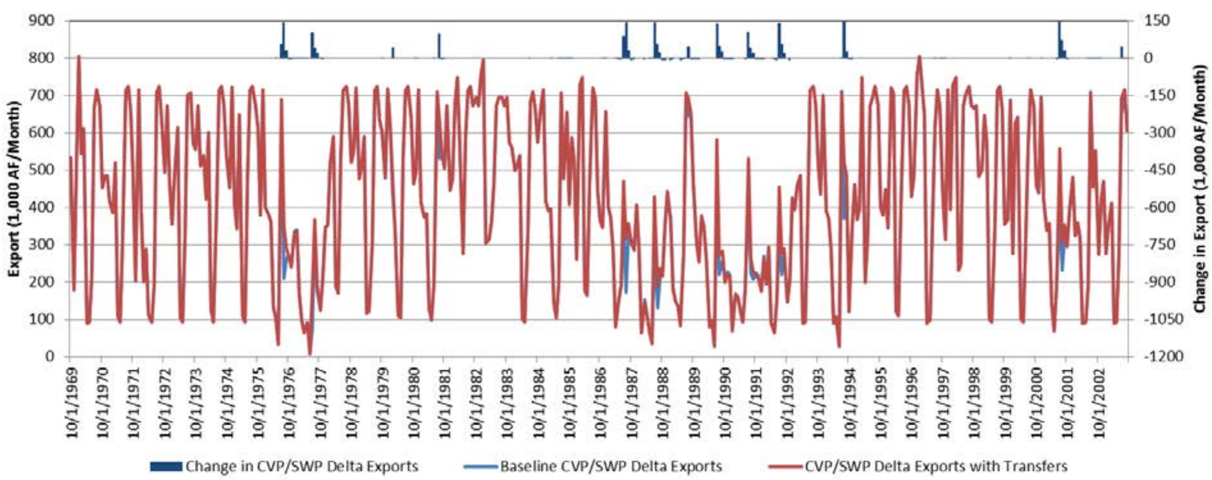

Figure B-~~34~~36. Total CVP/SWP Exports from the Delta with and without Alternative 2 Transfers

Table B-4 summarizes the average monthly combined CVP/SWP exports. The average annual change under Alternative 2 is approximately 54 TAF.

Table B-4. Average Monthly Combined CVP/SWP Exports (TAF) for Alternative 2

CVP/SWP Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	424	424	543	419	425	459	138	128	309	619	568	543	4,998
With Transfers	422	422	542	418	426	459	138	127	308	647	594	549	5,052
Change	-2	-2	-1	-1	1	0	0	-1	-1	28	26	6	54

Transfer water is also diverted by East Bay MUD at the Freeport Regional Water Project (Freeport) and by Contra Costa WD at their diversion facilities on Rock Slough, Old River, and Victoria Canal. Figure B-35 36 illustrates changes in diversions by East Bay MUD at Freeport. Baseline East Bay MUD diversions represent diversion of CVP project water under East Bay MUD's existing contract. Diversion of transfer water occurs during months when East Bay MUD is also diverting CVP project water and increases the total East Bay MUD Freeport diversion up to the available capacity.

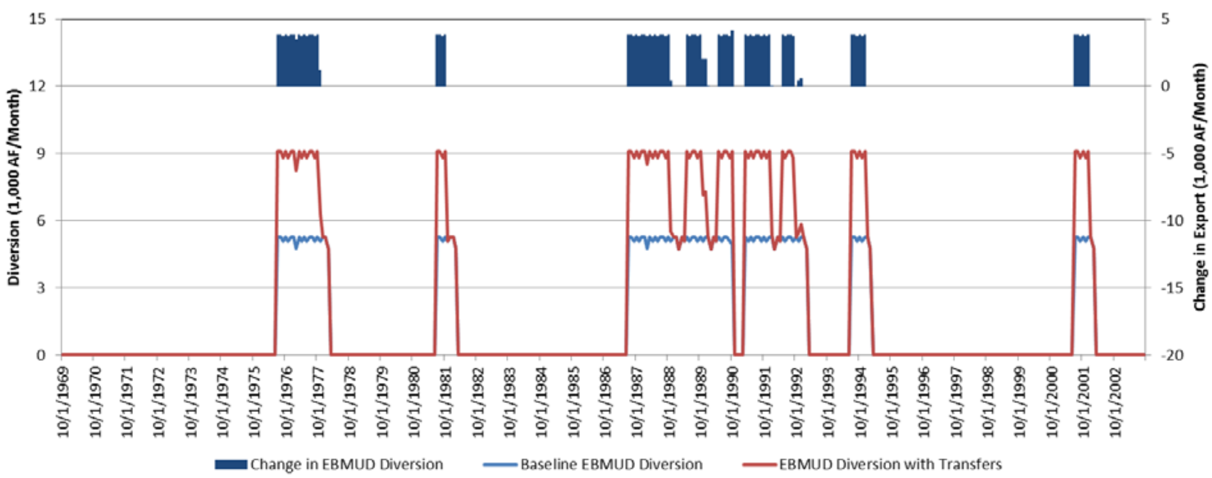

Figure B-3536. East Bay MUD Diversions with and without Alternative 2 Transfers

Contra Costa WD diversions increase to take delivery of transfer water as illustrated below in Figure B-3637. Contra Costa WD identified an annual transfer demand of up to 15 TAF and this volume of water diverted at a rate of five TAF per month during the July through September period. Contra Costa WD diversions of transfer water are assumed to occur at the point of diversion with the best water quality and available capacity.

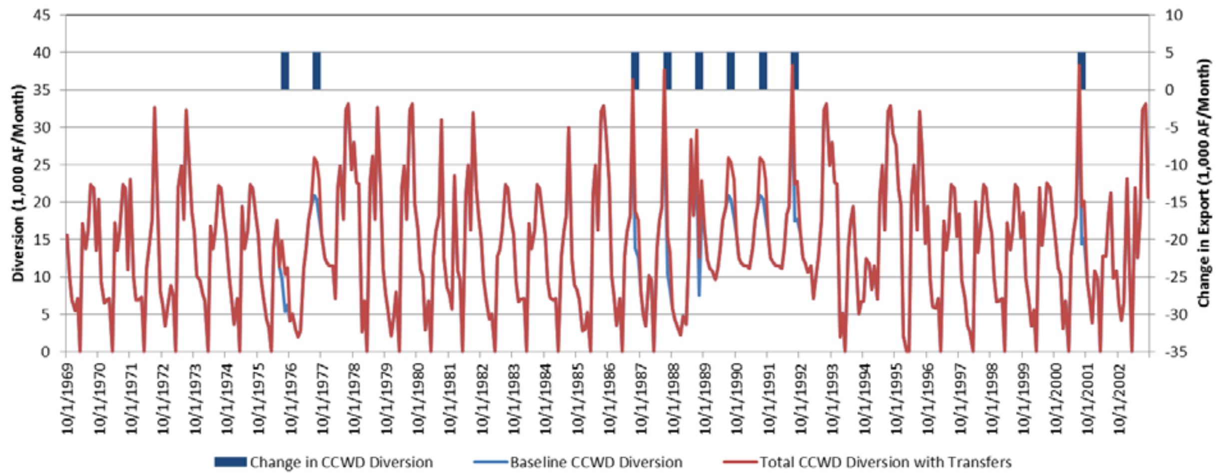

Figure B-~~36~~37. Contra Costa WD Diversions with and without Alternative 2 Transfers

B.6.3 Alternative 3: No Cropland Modifications

Alternative 3 would include transfers through groundwater substitution, stored reservoir release, and conservation. It would not include any cropland idling transfers.

Figure B-~~37~~ 38 summarizes the quantity of transfer water made available (Transfer Supply) under Alternative 3 on an annual basis, and illustrates where the water is diverted (Transfer Use). As in Alternative 2, a percentage of water to be transferred through the Delta becomes carriage water to maintain Delta water quality. Alternative 3 does not include crop idling transfer so there are no transfer supplies from that measure. Unused transfer water under this alternative is from the spill of Placer County Water Agency reservoir release water from Folsom before it can be released and re-diverted by East Bay MUD.

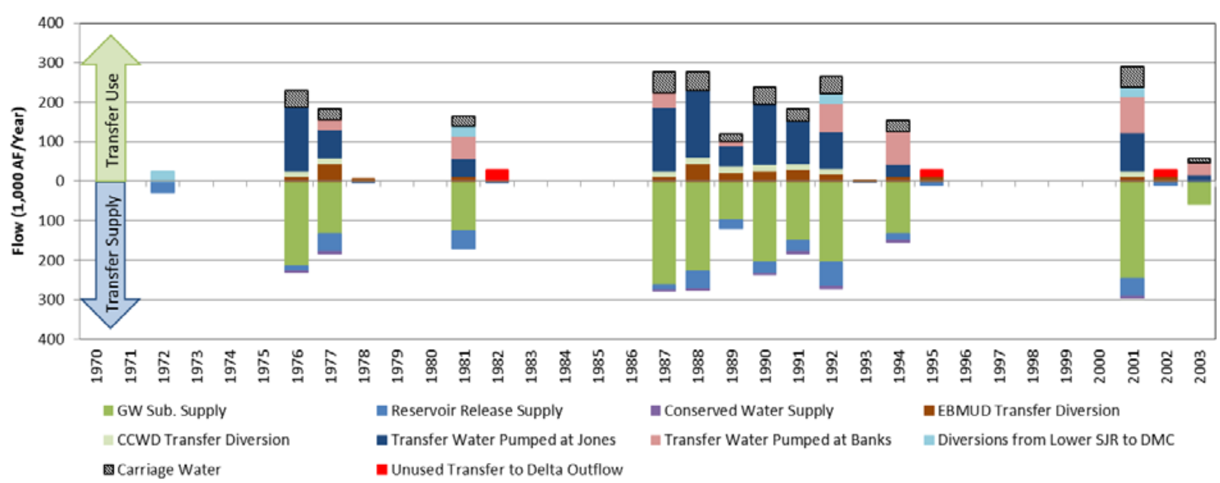

Figure B-~~37~~38. Annual Transfer Summary for Alternative 3

B.6.3.1 Storage

Changes in the operation of Shasta under Alternative 3 are similar to changes under Alternative 2 (see Figure B-~~38~~39). Increases in storage under Alternative 3 occur when groundwater substitution transfers start prior to July and transfer water is stored upstream. There are also small reductions in storage when additional releases are made to account for changes in Sacramento River flow as a result of groundwater substitution transfers.

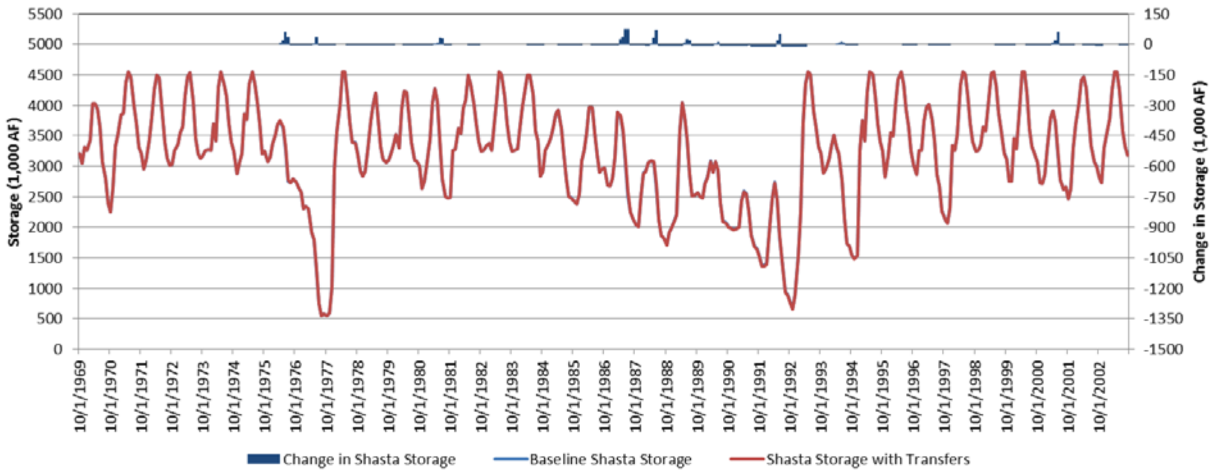

Figure B-~~38~~39. Shasta Operations with and without Alternative 3 Transfers

Folsom is used to regulate reservoir release transfers from Placer County Water Agency's upstream reservoirs before delivery to East Bay MUD. This operation can result in temporary changes in storage, as illustrated in Figure B-~~39~~40. Additional releases are also made out of Folsom to account for changes in river flows as a result of groundwater substitution transfers.

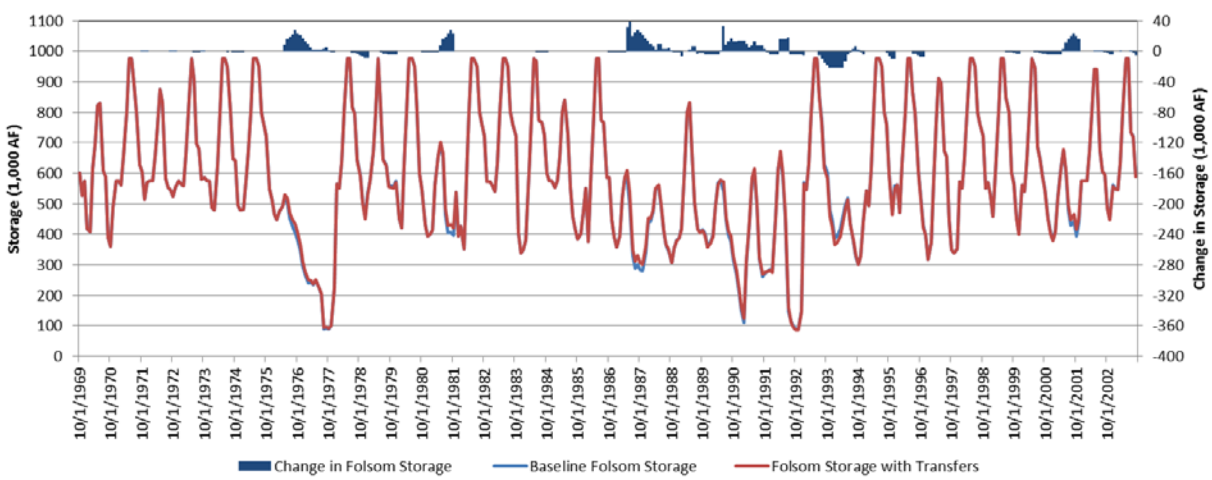

Figure B-~~39~~40. Folsom Operations with and without Alternative 3 Transfers

Figure B-~~40~~ 41 illustrates the change in operations at Oroville. Changes in Oroville operations result from shifting the timing of delivery of SWP water to accommodate transfers. There are also decreases in storage when additional water is released to maintain minimum flow requirements on the Lower Feather River. These additional releases from Oroville are made to account for reductions in Feather River flows due to groundwater substitution transfers.

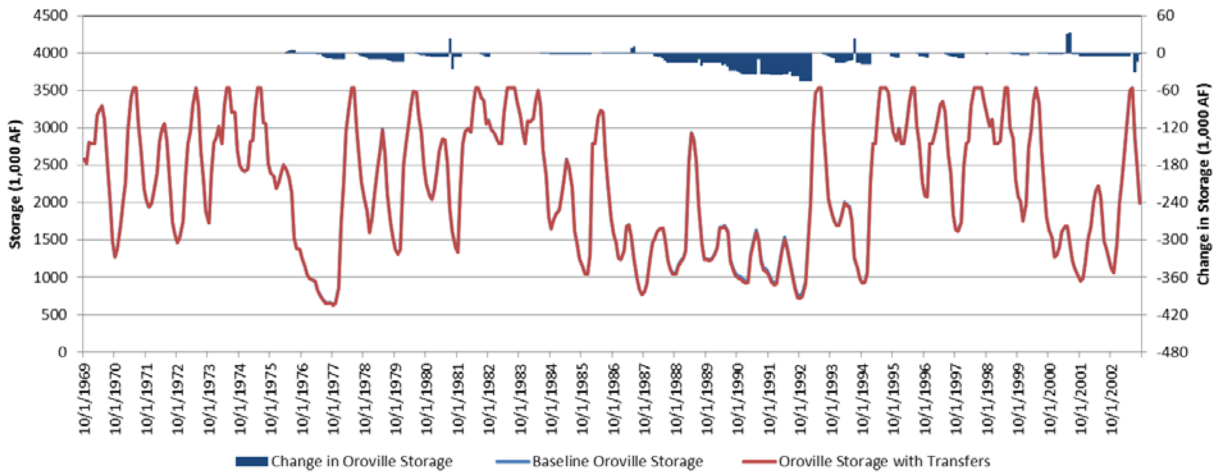

Figure B-~~40~~41. Oroville Operations with and without Alternative 3 Transfers

South Sutter WD releases water from Camp Far West Reservoir to participate in reservoir release transfers. Figure B-~~41~~ 42 illustrates the only change in reservoir storage from baseline conditions as the quantity released for transfer. Camp Far West Reservoir storage returns to baseline levels when the reservoir refills.

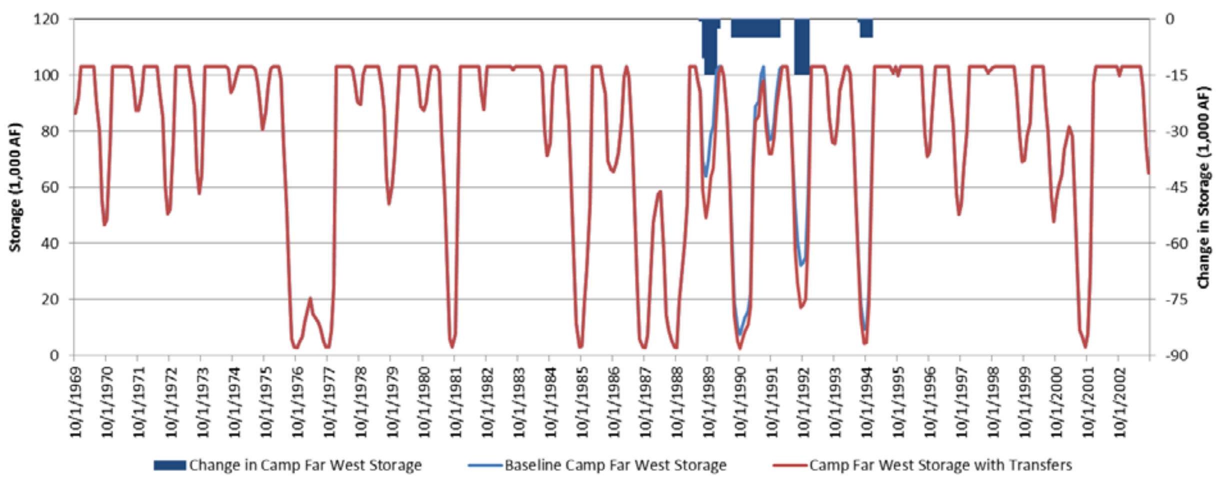

Figure B-~~41~~42. Camp Far West Operations with and without Alternative 3 Transfers

Browns Valley ID releases water from Merle Collins Reservoir to participate in reservoir release transfers. Figure B-~~42~~ 43 illustrates the only change in reservoir storage from baseline conditions as the quantity released for transfer, up to five TAF in any year. Merle Collins Reservoir storage returns to baseline levels when the reservoir refills.

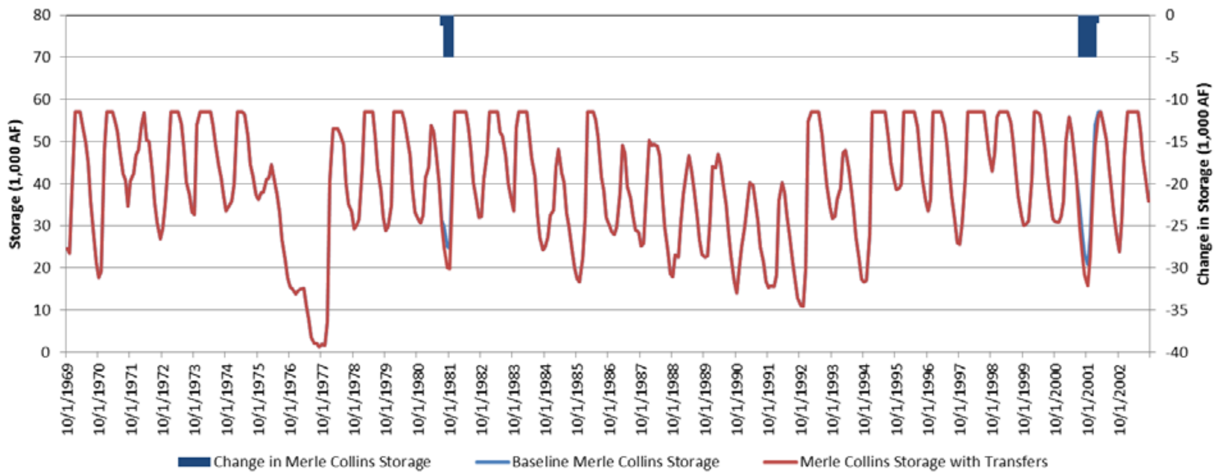

Figure B-~~42~~43. Merle Collins Operations with and without Alternative 3 Transfers

Placer County Water Agency releases water from MFP reservoirs of French Meadows and Hell Hole to participate in reservoir release transfers. Figure B-~~43~~ 44 illustrates the combined storage in these two reservoirs under both baseline and with Project operations. MFP reservoir storage returns to baseline levels when the reservoirs refill.

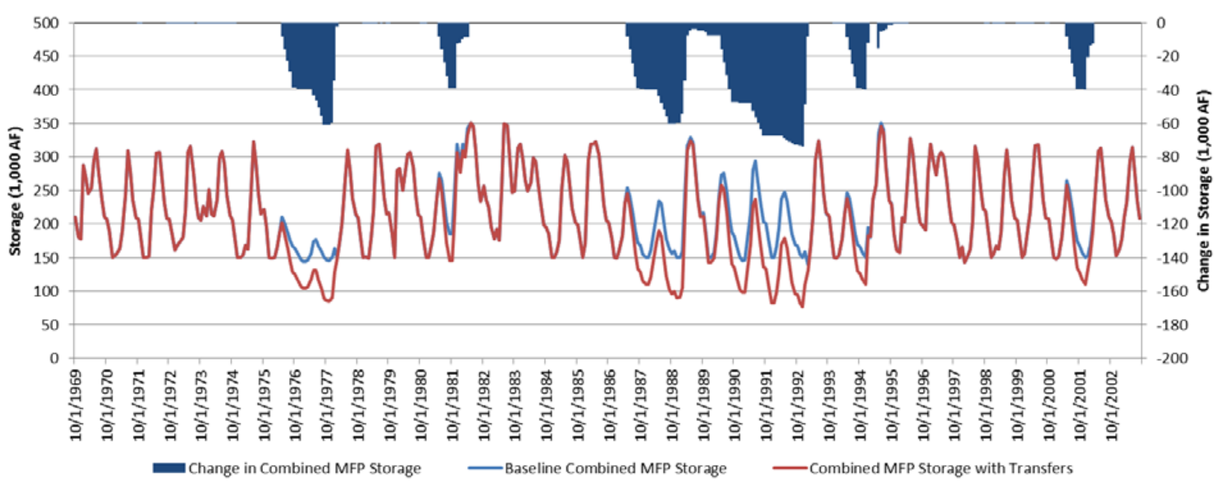

Figure B-~~43~~44. MFP Operations with and without Alternative 3 Transfers

Figure B-~~44~~ 45 illustrates change in storage of Lake McClure due to reservoir release transfers. Storage in Lake McClure can be lower by up to 30 TAF, the volume of reservoir release transfer, and returns to baseline levels when the reservoir refills with water that would otherwise have been released to maintain flood space requirements.

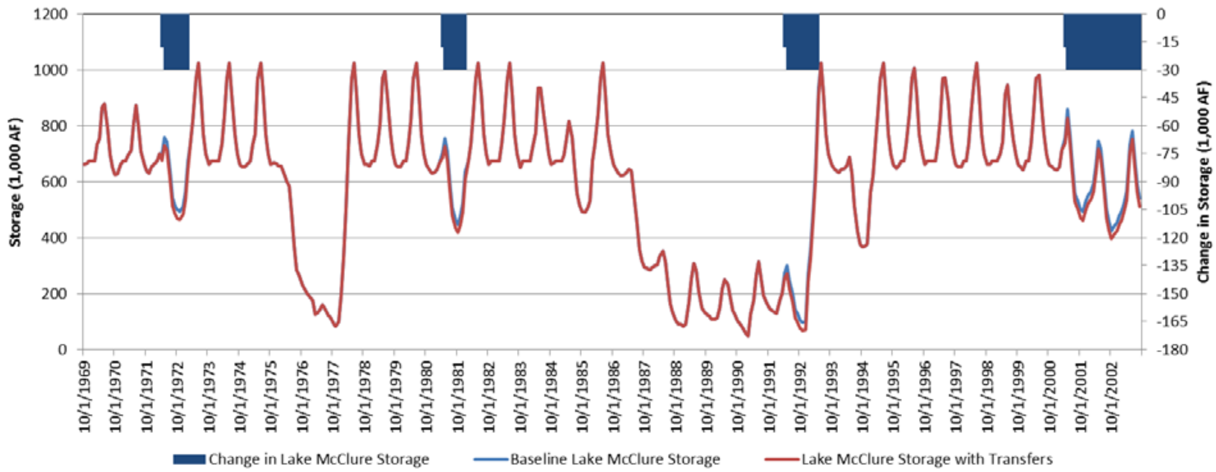

Figure B-~~44~~45. Lake McClure Operations with and without Alternative 3 Transfers

Conserved water from Browns Valley ID is stored in Yuba County Water Agency's New Bullards Bar Reservoir and released for transfer in years with demand and capacity. These releases of stored water are the primary effect to New Bullards Bar Reservoir as illustrated below in Figure B-~~45~~46.

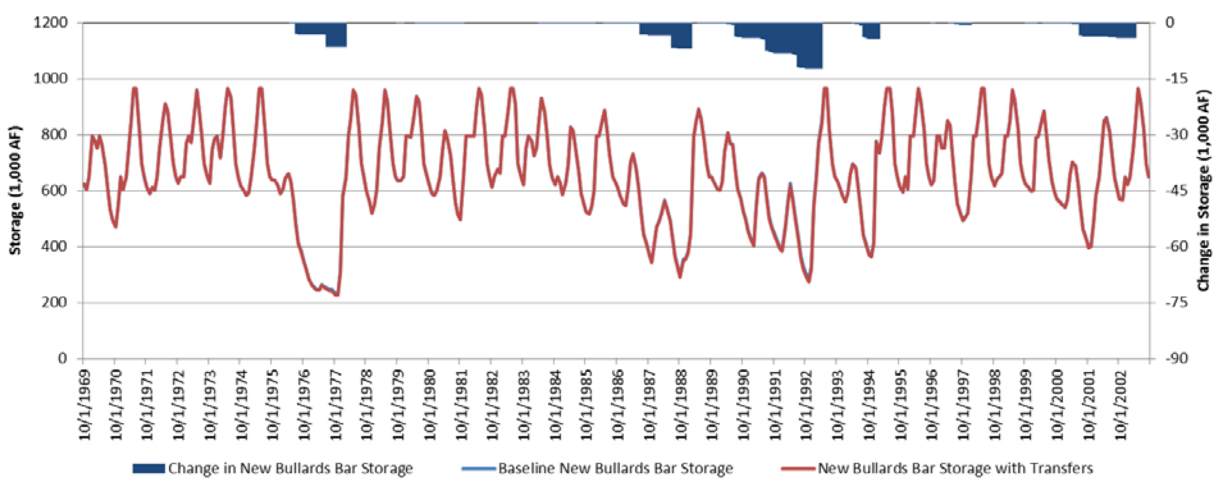

Figure B-~~45~~46. New Bullards Bar Operations with and without Alternative 3 Transfers

B.6.3.2 Stream Flow

Releases from Keswick Dam, as illustrated below in Figure B-~~46~~47, reflect changes in Shasta storage seen in Figure B-~~38~~39. A reduction in release corresponds to an increase in Shasta storage. Reduced releases typically occur in the April through June period when it may be possible to store transfer water made available downstream. Months of reduced releases are followed by increased releases as transfer water is released to be moved through the Delta during the July through September period.

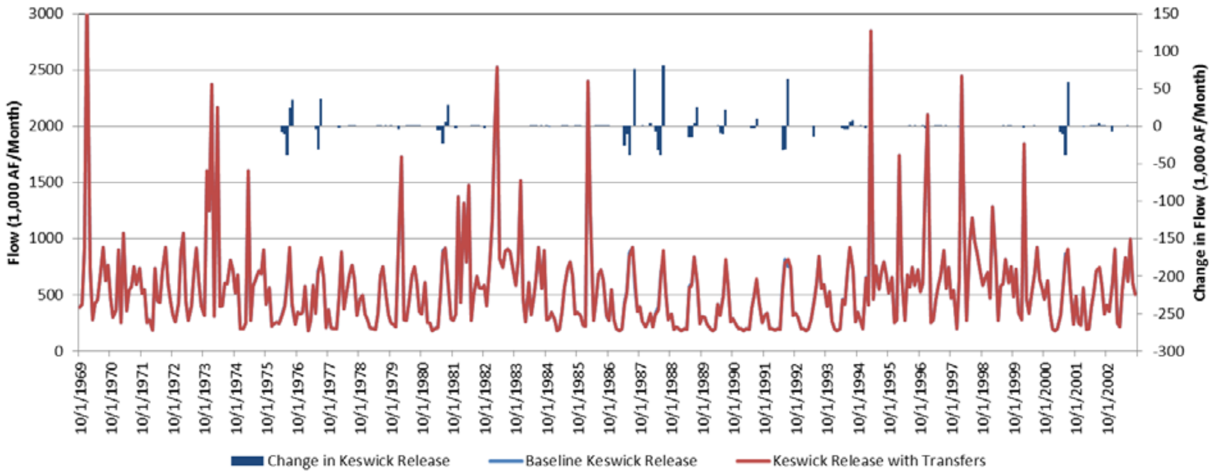

Figure B-~~46~~47. Keswick Dam Release with and without Alternative 3 Transfers

Figure B-~~47~~ 48 illustrates the effect to flows on the Sacramento River at Wilkins Slough. Flows are reduced when groundwater substitution transfers commence prior to July and are simulated as stored upstream in Shasta. Flows are increased in the July through September period when previously stored transfer water is released for delivery through the Delta, and additional groundwater substitution transfers occur upstream of Wilkins Slough.

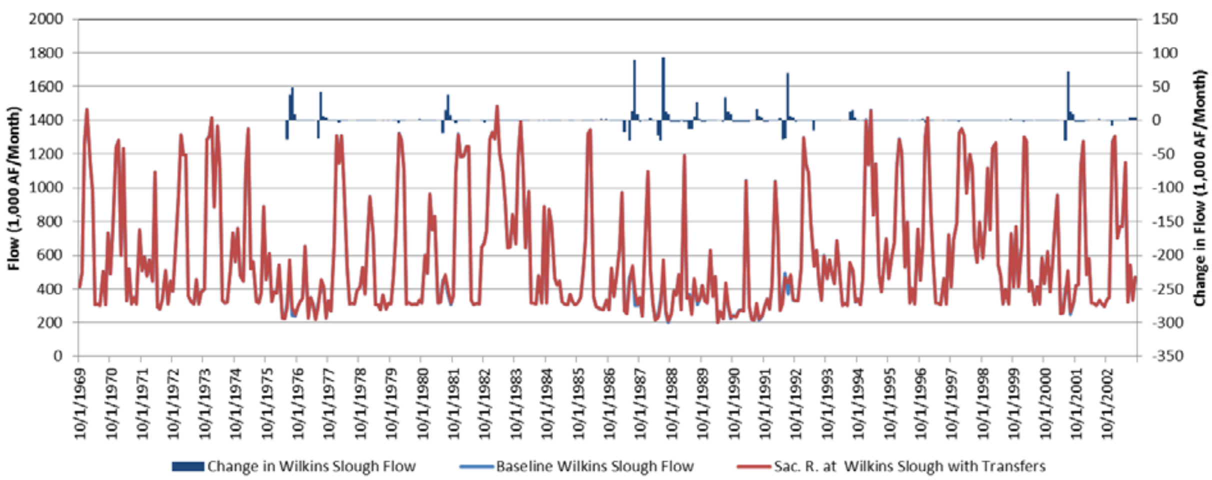

Figure B-~~47~~48. Sacramento River at Wilkins Slough with and without Alternative 3 Transfers

Figure B-~~48~~ 49 illustrates Nimbus Dam releases under baseline and with Alternate 3 transfers. Nimbus releases reflect CVP operations of Folsom

Reservoir. Increases in release of approximately five TAF are water made available by Placer County Water Agency and released from Folsom for re-diversion by East Bay MUD. Larger increases are typically preceded by decreases as transfer water made available downstream is stored in Folsom. Large releases occur when stored transfer water is release to be conveyed through the Delta. Decreases also occur when Placer County Water Agency's upstream reservoirs refill, typically during times when Folsom is also spilling water to maintain flood space requirements.

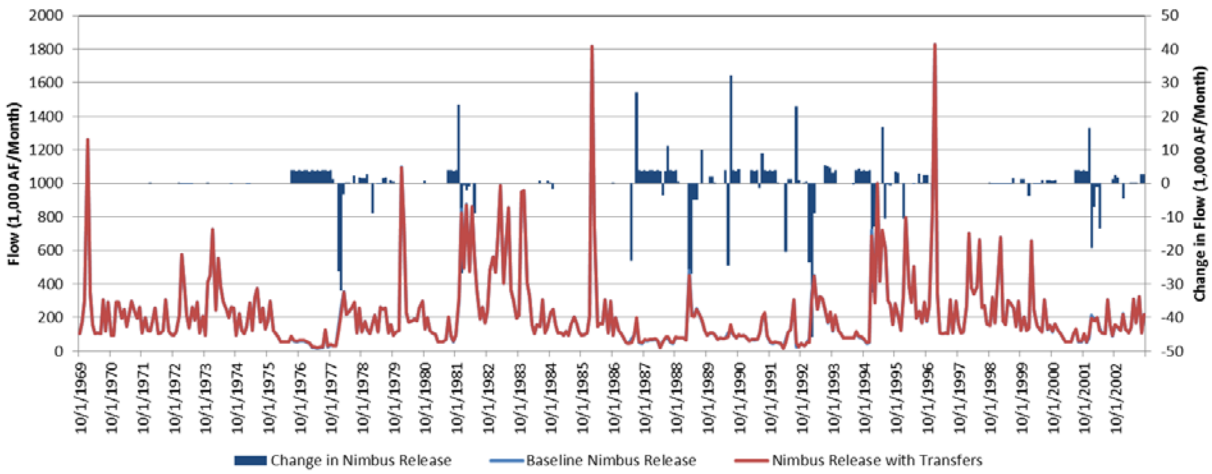

Figure B-4849. Nimbus Dam Release with and without Alternative 3 Transfers

The change in flow on the American River at H Street is similar as the change in release from Nimbus. Increases in flow are larger from July through September by the volume of groundwater substitution transfer made available by Sacramento Suburban WD and the City of Sacramento. Figure B-49 50 is a comparison of flows under baseline and Alternative 3.

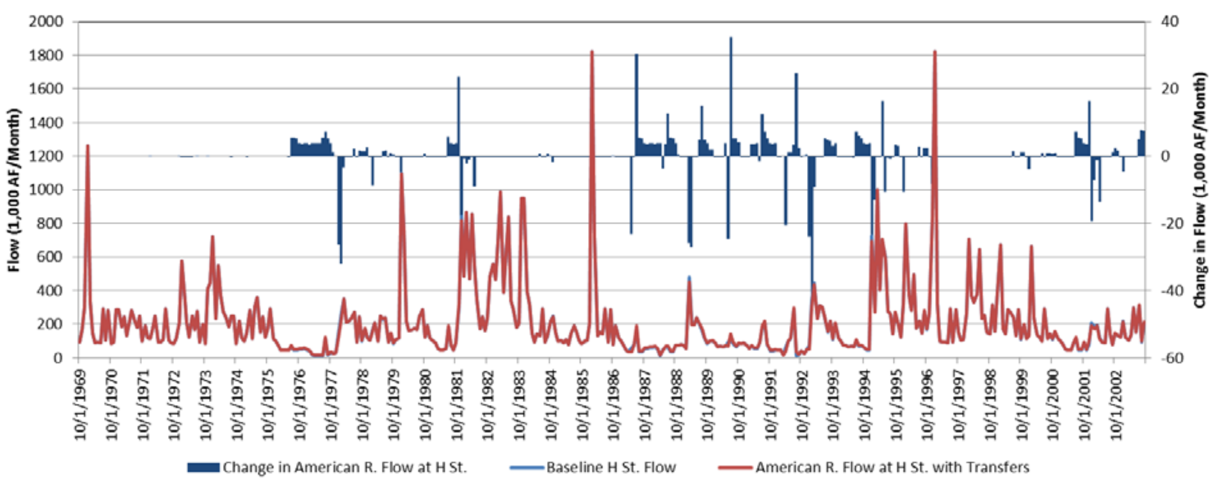

Figure B-4950. American River at H Street with and without Alternative 3 Transfers

Figure B-~~50~~ 51 illustrates changes in Feather River flow downstream from Thermalito. Flow in the Feather River below Thermalito changes due to changes in the operation of Oroville. Transfer water made available on the Feather River downstream from Thermalito can be temporarily stored in Oroville for release and transfer during the July through September period. Water stored prior to July reduces Feather River flow. Increases and decreases in flow on the Feather River below Thermalito also occur from shifts in timing of SWP water to accommodate transfers. The magnitude of some of these differences is affected by model nuances within CalSim II that can create variations from month-to-month in release of SWP water from Oroville for movement through the Delta.

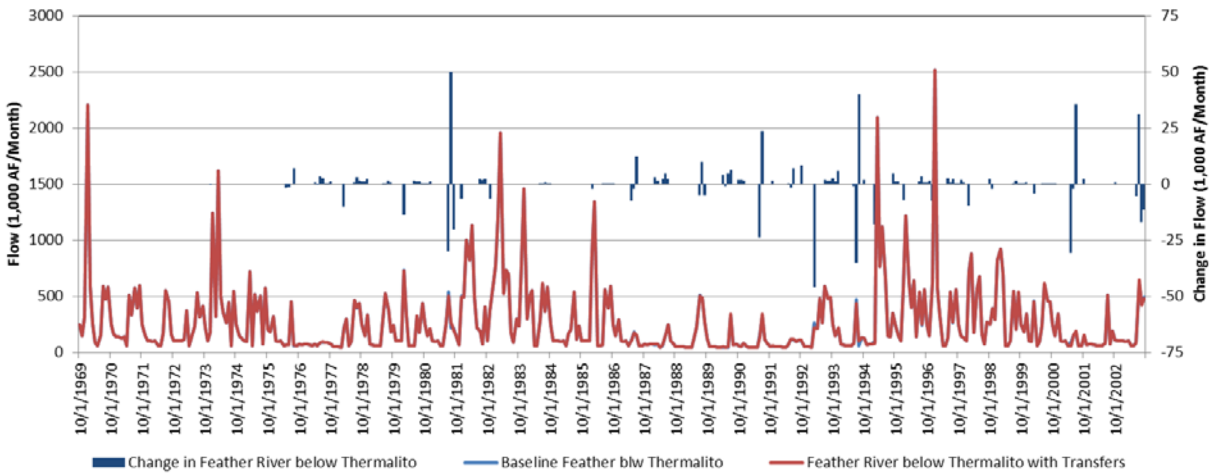

Figure B-~~50~~51. Feather River below Thermalito with and without Alternative 3 Transfers

Figure B-~~51~~ 52 illustrates changes in flow on the Yuba River as a result of New Bullards Bar Reservoir release of Browns Valley ID conserved water (increases) and reservoir refill (decreases).

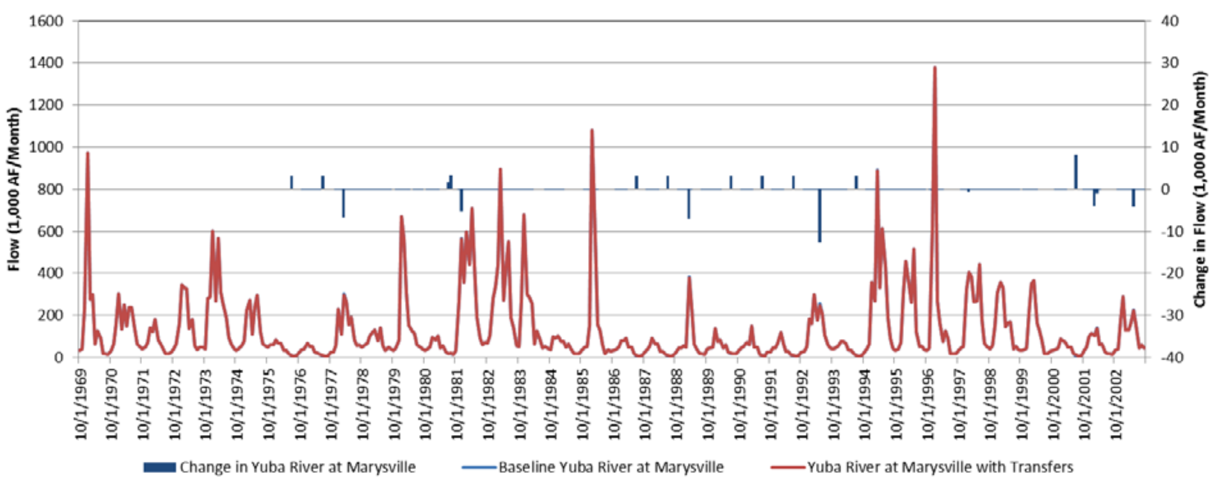

Figure B-~~51~~52. Yuba River at Marysville with and without Alternative 3 Transfers

Figure B-~~52~~ 53 illustrates the monthly flow of the Bear River at the confluence with the Feather River. Bear River flow changes as a result of South Sutter WD reservoir release transfers from Camp Far West Reservoir. Flows increase when water is released for transfer and decrease when Camp Far West refills.

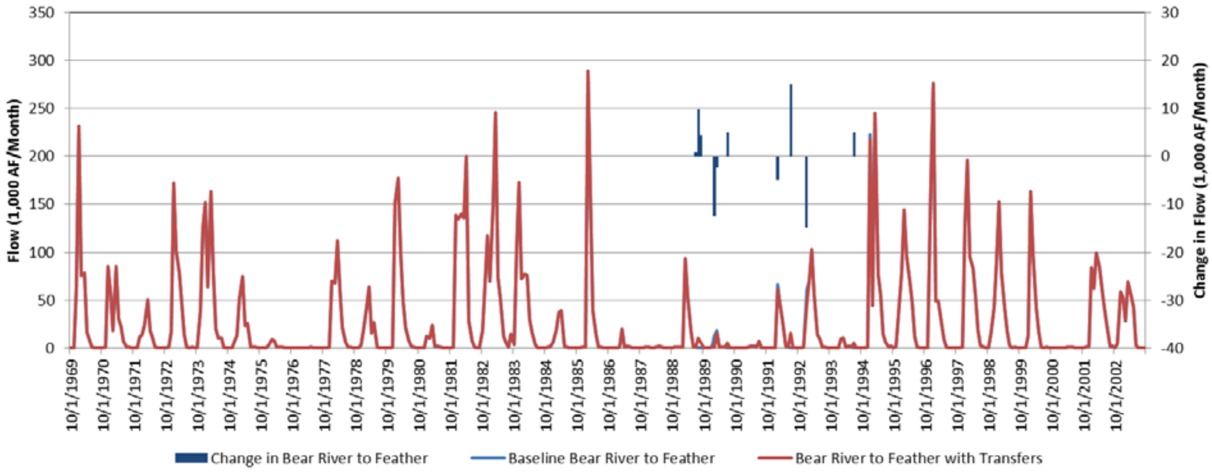

Figure B-~~52~~53. Bear River to the Feather River with and without Alternative 3 Transfers

The flow on the Lower Feather River represents an aggregation of flows on the Yuba River, Bear River, and upper portions of the Feather River. There are also increases due to water made available by groundwater substitution transfers along the Feather River between Thermalito and the confluence with the Sacramento. Figure B-~~53~~ 54 illustrates flows and changes in flows for the baseline and Alternative 3.

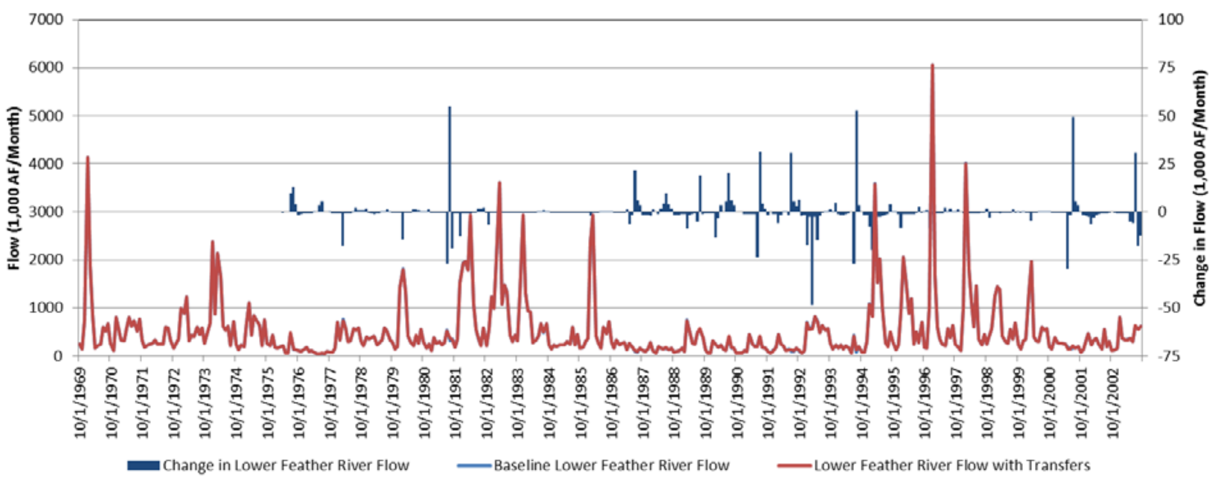

Figure B-~~53~~54. Lower Feather River with and without Alternative 3 Transfers

Figure B-~~54~~ 55 illustrates Sacramento River at Freeport under baseline and Alternative 3 transfers. This location is an aggregation of all changes on the

Sacramento River at Wilkins Slough, the Lower Feather River, and the American River at H Street, and changes between those locations and Freeport. Changes between those locations and Freeport include increases in flow due to water made available through groundwater substitution transfers and decreases due to stream-aquifer interaction. Reductions in flow of approximately 50 TAF or more are a result of changes in stream and flood bypass flows during surplus conditions after one or more years of groundwater substation transfers. These changes are also illustrated above in Figure B-~~6~~7.

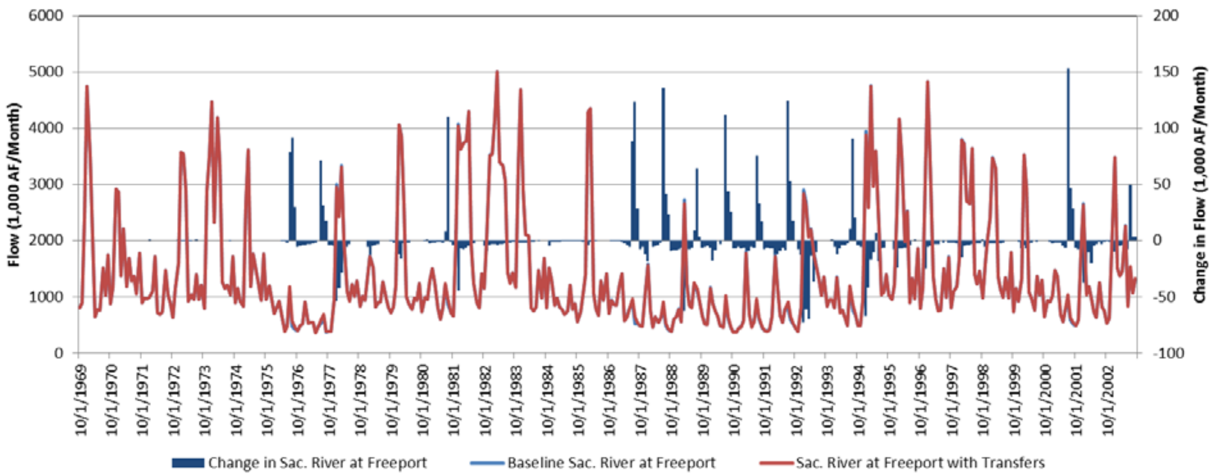

Figure B-~~54~~55. Sacramento River at Freeport with and without Alternative 3 Transfers

Figure B-~~55~~ 56 illustrates changes on the Merced River at the confluence with the San Joaquin River. Change in flow corresponds to storage change at Lake McClure; increases represent transfer water made available by reservoir releases at Lake McClure while decreases result from reservoir refill.

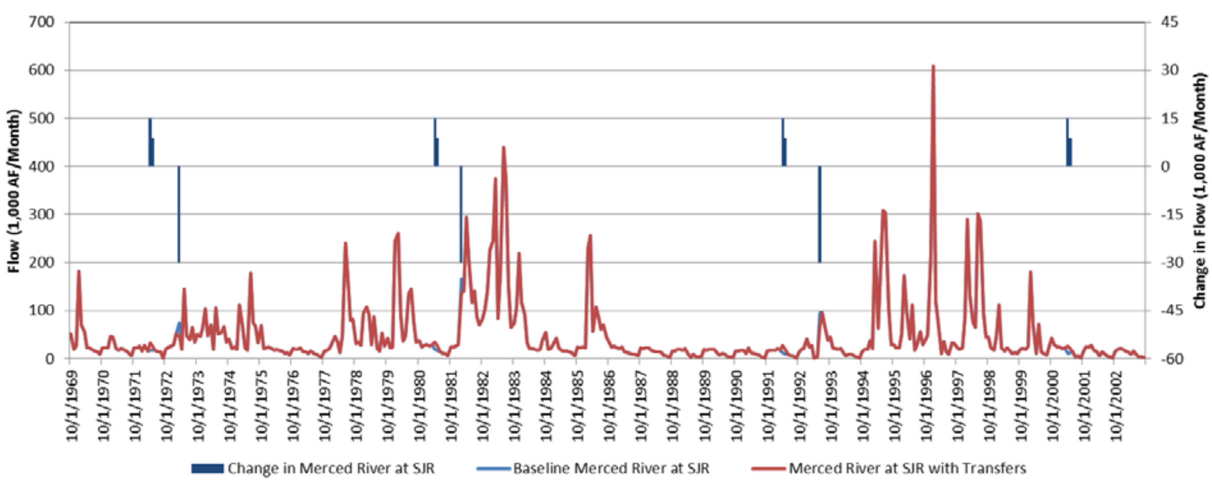

Figure B-~~55~~56. Merced River at the San Joaquin River with and without Alternative 3 Transfers

Figure B-~~56~~ 57 illustrates San Joaquin River flows at Vernalis. Increases in flow are Merced ID transfer water to be diverted at Banta Carbona ID and conveyed to the DMC prior to reaching the head of Old River. Decreases in flow occur when Lake McClure refills space vacated by reservoir release transfers and also reduce Delta outflow.

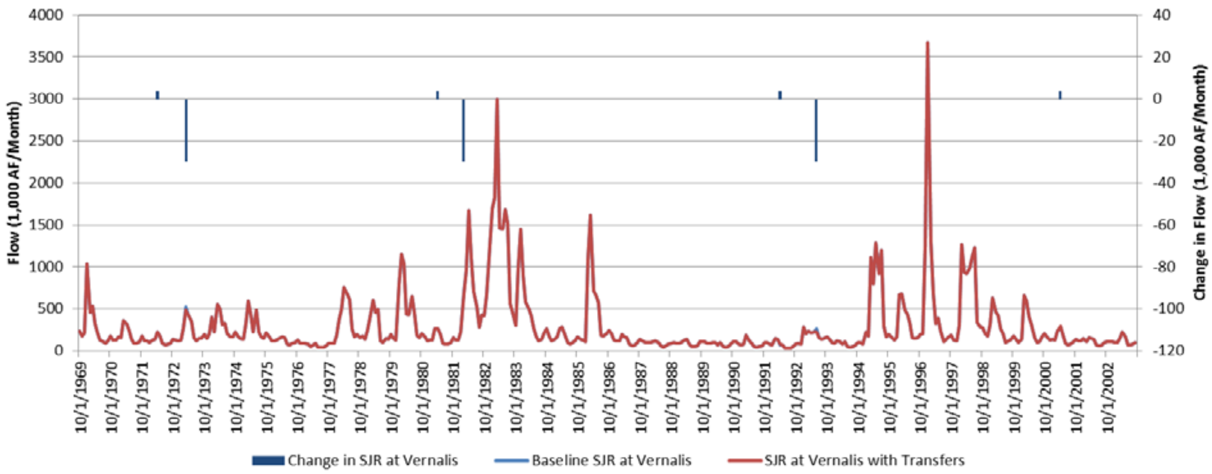

Figure B-~~56~~57. San Joaquin River at Vernalis with and without Alternative 3 Transfers

Changes to Delta outflow are illustrated below in Figure B-~~57~~58. Increases in Delta outflow are primarily due to carriage water to facilitate transfers. Decreases in Delta outflow are attributed to reservoir refill upstream and changes in stream-aquifer interaction during surplus conditions.

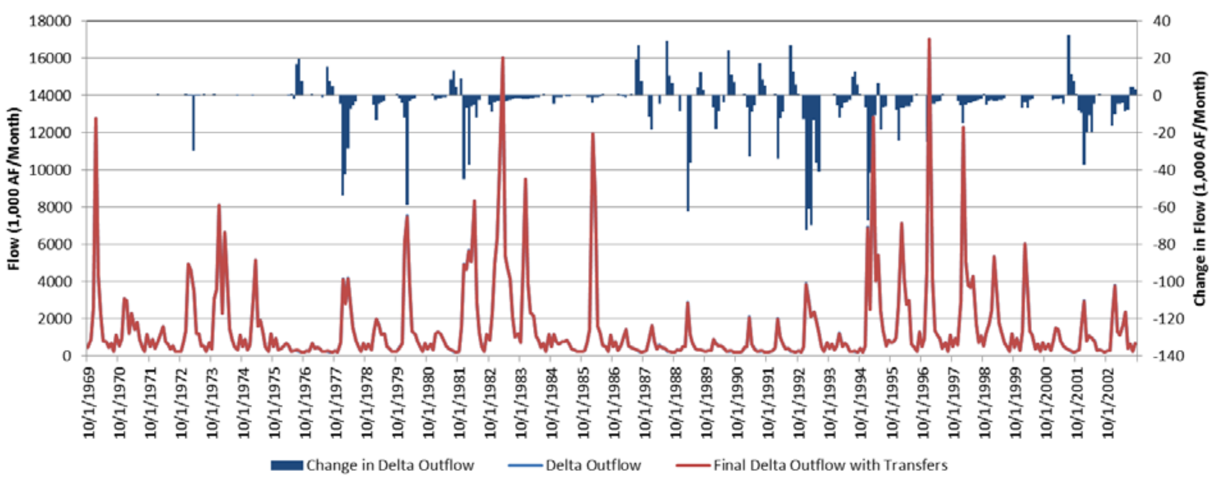

Figure B-~~57~~58. Delta Outflow with and without Alternative 3 Transfers

Table B-5 summarizes changes in Delta outflow on a monthly average basis. Average annual Delta outflow is reduced by approximately 31 TAF. Delta outflow increases from July through September due to carriage water for transfers through the Delta. Delta outflow is reduced from November through June when reservoirs refill and from changes in stream-groundwater interaction during surplus conditions.

Table B-5. Average Monthly Delta Outflow in (TAF) for Alternative 3

Delta Outflow	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	393	867	1,490	3,260	3,312	3,278	1,753	1,381	816	546	297	638	18,031
With Transfers	393	867	1,485	3,250	3,300	3,268	1,748	1,378	813	552	301	640	17,995
Change	0	-1	-5	-10	-12	-10	-5	-3	-3	6	4	2	-37

B.6.3.3 Exports and Diversions

Figure B-~~58~~ 59 illustrates the change in exports at Jones Pumping Plant. Increases are primarily transfer water exported to SLDMWA. Decreases in exports at Jones occur as a result of changes in stream-groundwater interaction that reduce Delta inflow during balanced conditions.

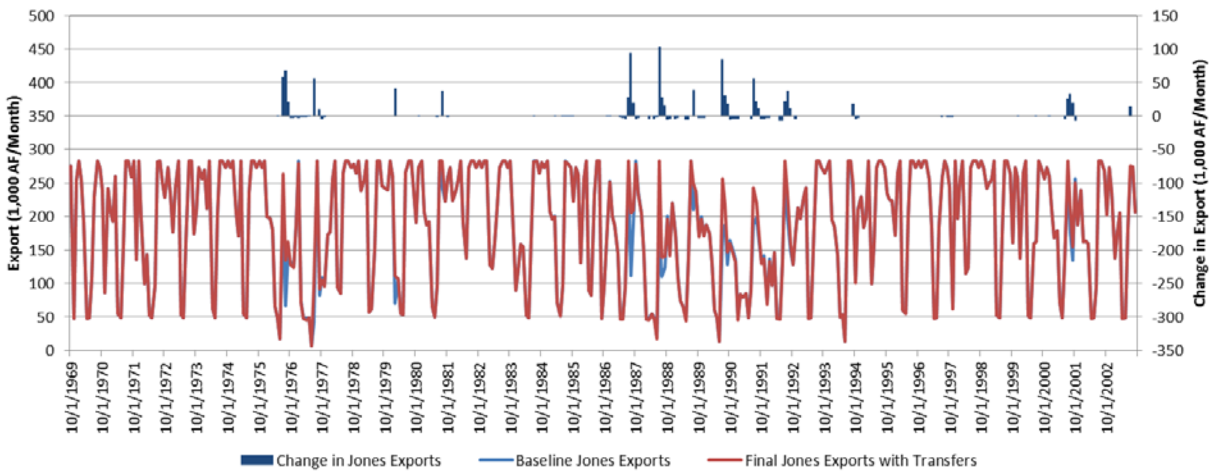

Figure B-~~58~~59. Exports at Jones Pumping Plant with and without Alternative 3 Transfers

Table B-6 summarizes the average monthly exports at Jones Pumping Plant. Increases occur during the transfer months of July, August, and September, with an average annual increase of 25 TAF. There are small decreases in most other months.

Table B-6. Average Monthly Exports at Jones Pumping Plant (TAF) for Alternative 3

Jones Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	222	212	235	197	186	198	69	65	153	256	252	223	2,268
With Transfers	221	211	235	197	187	198	69	65	152	269	263	227	2,292
Change	-1	-1	0	0	1	0	0	-1	-1	13	11	4	25

Increases in exports at Banks Pumping Plant occur when Banks is used to export transfer water. This is illustrated below in Figure B-~~59~~60.

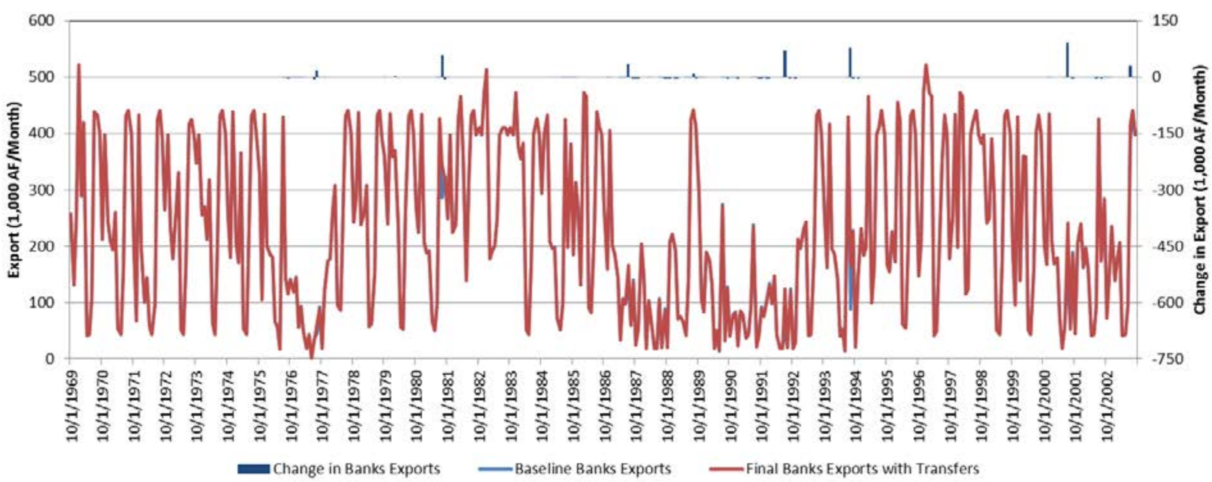

Figure B-~~59~~60. Exports at Banks Pumping Plant with and without Alternative 3 Transfers

Table B-7 summarizes the average monthly exports at Banks Pumping Plant. Pumping increases in the months of July, August, and September with an average annual increase of 8.3 TAF.

Table B-7. Average Monthly Exports at Banks Pumping Plant (TAF) for Alternative 3

Banks Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	202	212	307	222	239	261	70	62	156	363	316	320	2,731
With Transfers	201	211	307	221	239	261	70	62	156	370	320	319	2,737
Change	-1	-1	0	0	0	0	0	0	0	6	4	-1	6

Total CVP/SWP exports, the sum of exports at Jones and Banks Pumping Plants, are illustrated in Figure B-~~60~~61.

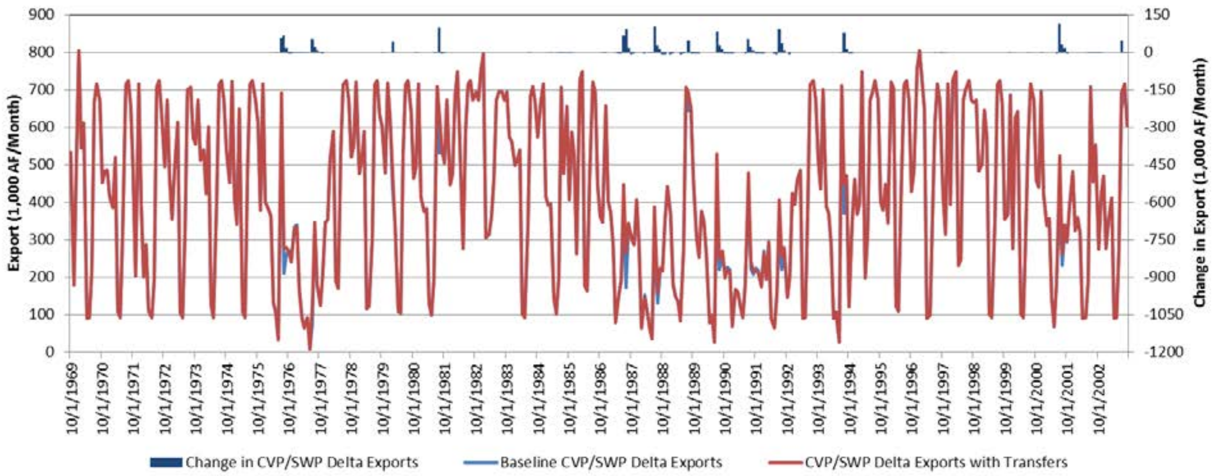

Figure B-~~60~~61. Total CVP/SWP Exports from the Delta with and without Alternative 3 Transfers

Table B-8 summarizes the average monthly combined CVP/SWP exports. The average annual change under Alternative 3 is approximately 31 TAF. Exports increase in the July through September period and decrease in most other months.

Table B-8. Average Monthly Combined CVP/SWP Exports (TAF) for Alternative 3

CVP/SWP Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	424	424	543	419	425	459	138	128	309	619	568	543	4,998
With Transfers	422	422	542	418	426	459	138	127	308	638	583	546	5,030
Change	-2	-2	-1	-1	1	0	0	-1	-1	19	16	3	31

Figure B-~~61~~ 62 illustrates baseline, Alternative 3, and the change in East Bay MUD diversions at Freeport. The changes are an increase in diversions during months when East Bay MUD would be taking CVP Project water.

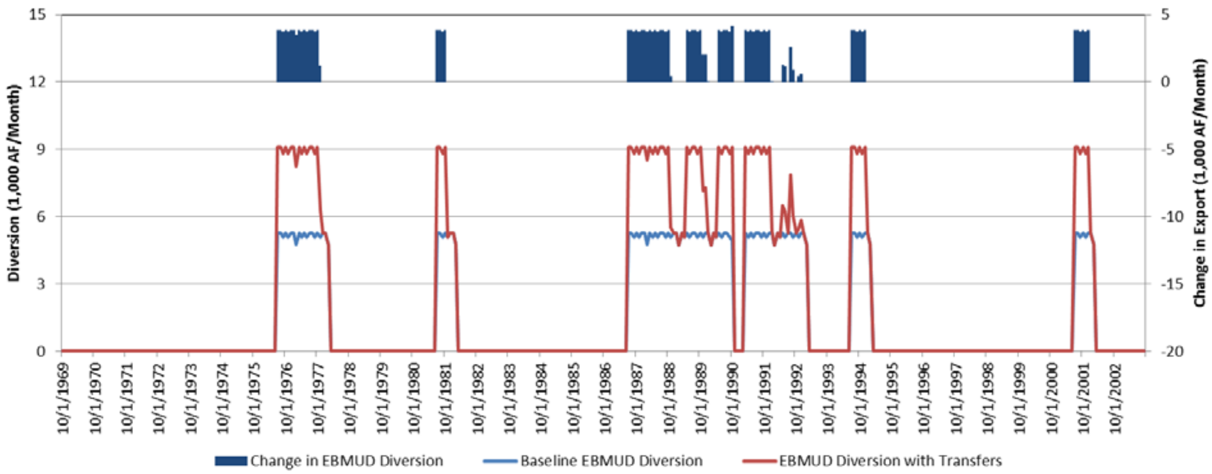

Figure B-~~61~~62. East Bay MUD Diversions with and without Alternative 3 Transfers

Contra Costa WD diversions increase to take delivery of transfer water as illustrated below in Figure B-~~62~~63. Contra Costa WD identified an annual transfer demand of up to 15 TAF and this volume of water diverted at a rate of five TAF per month during the July through September period. Contra Costa WD diversions of transfer water are assumed to occur at the point of diversion with the best water quality and available capacity.

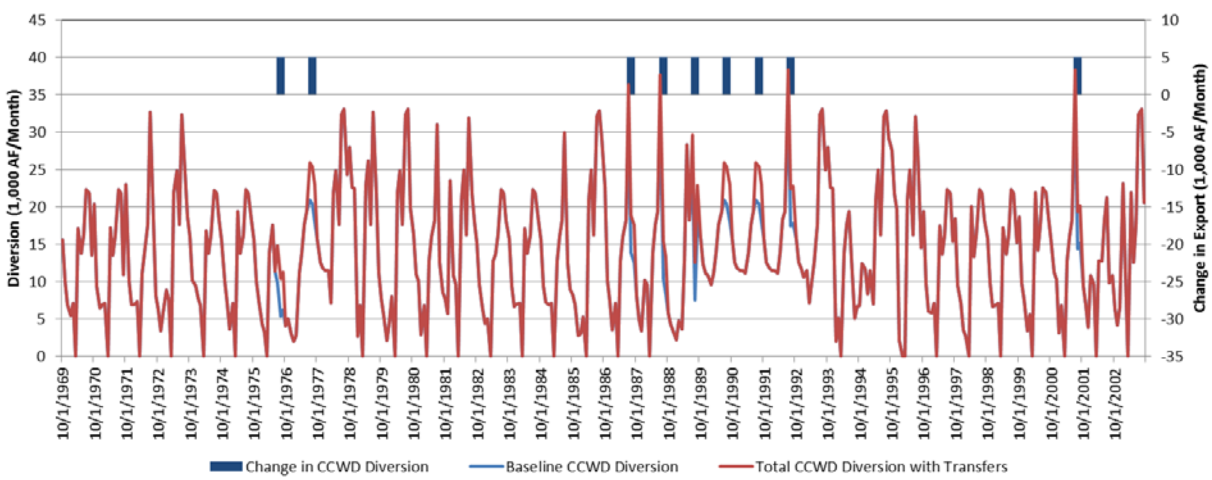

Figure B-~~62~~63. Contra Costa WD Diversions with and without Alternative 3 Transfers

B.6.4 Alternative 4: No Groundwater Substitution

Alternative 4 would include transfers through cropland idling, crop shifting, stored reservoir release, and conservation. It would not include any groundwater substitution transfers.

Figure B-~~63~~ 64 summarizes the quantity of transfer water made available under Alternative 4 on an annual basis and illustrates where the water is diverted or used. As in the other alternatives, a percentage of water to be transferred through the Delta goes to carriage water to maintain Delta water quality with increased exports under the transfer alternative. The volume of crop idling water available under Alternative 4 is greater than under Alternative 2 because some sellers may choose to expand crop idling transfers if groundwater substitution transfers are not used.

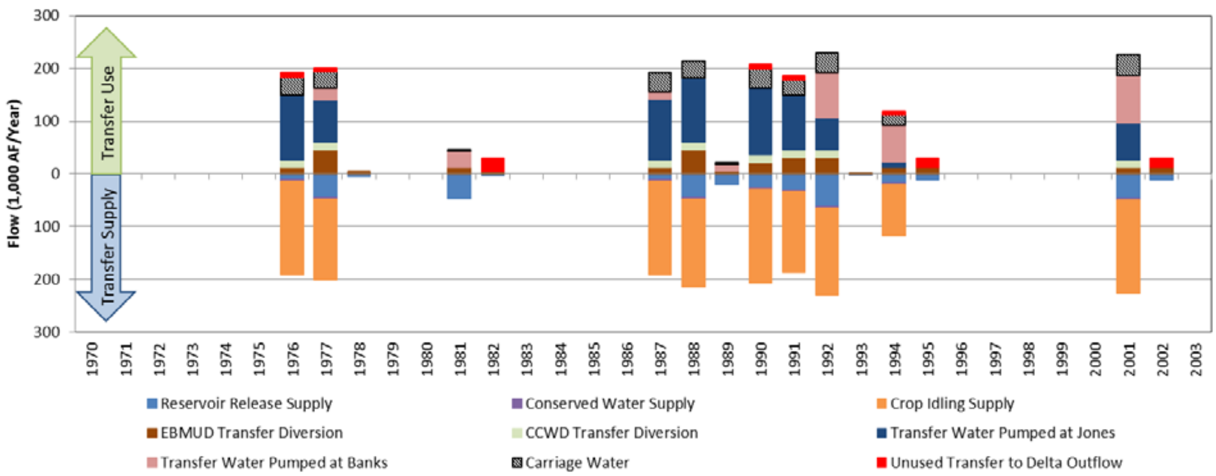

Figure B-~~63~~64. Annual Transfers Summary for Alternative 4

B.6.4.1 Storage

Figure B-~~64~~ 65 illustrates the change in operations at Shasta with the Project. Under Alternative 4 Shasta storage increases in some month when transfer water made available in May and June from crop idling can be stored for transfer in July, August, and September. There are no reductions in Shasta storage under this alternative because there are no releases in excess of baseline releases to account for changes in stream-aquifer interaction.

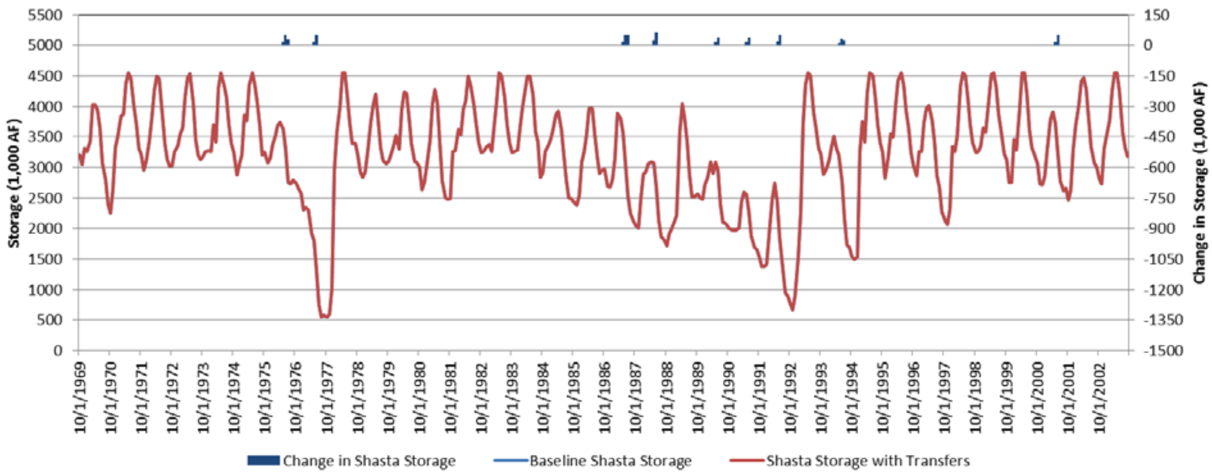

Figure B-~~64~~65. Shasta Operations with and without Alternative 4 Transfers

Operations at Folsom under Alternative 4 are illustrated below in Figure B-~~65~~66. Transfer water can be temporarily stored in Folsom for release and delivery in subsequent months. This includes transfers from crop idling in the Sacramento Valley, and reservoir release from upstream Placer County Water Agency reservoirs.

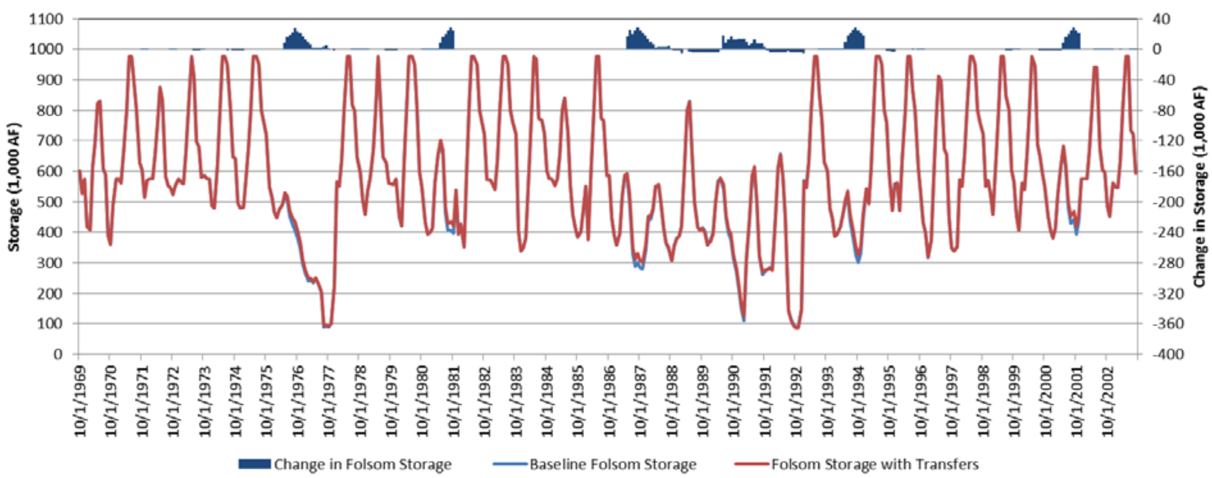

Figure B-~~65~~66. Folsom Operations with and without Alternative 4 Transfers

Figure B-~~66~~ 67 illustrates the change in SWP operations at Oroville. Changes in Oroville storage occur from shifts in the timing of delivery of SWP water to accommodate transfers and temporary storage of crop idling water.

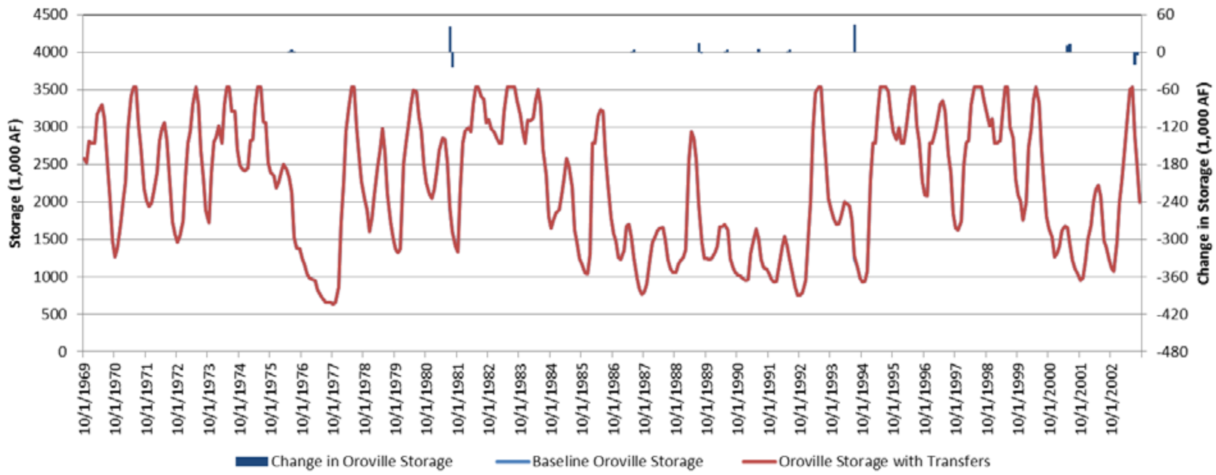

Figure B-~~66~~67. Oroville Operations with and without Alternative 4 Transfers

South Sutter WD releases water from Camp Far West Reservoir to participate in reservoir release transfers. Figure B-~~67~~ 68 illustrates the only change in reservoir storage from baseline conditions as the quantity released for transfer. Camp Far West Reservoir storage returns to baseline levels when the reservoir refills.

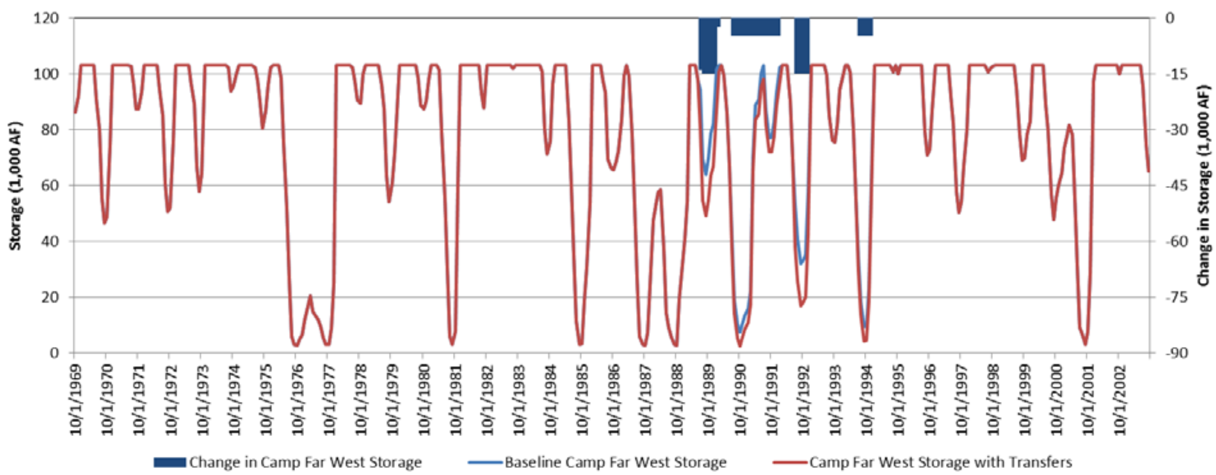

Figure B-~~67~~68. Camp Far West Operations with and without Alternative 4 Transfers

Browns Valley ID releases up to five TAF of water from Merle Collins Reservoir for transfer. Changes in Merle Collins storage are the same for Alternatives 2, 3, and 4 because all alternatives include reservoir release transfer measures. Figure B-~~68~~ 69 illustrates Browns Valley ID operations of Merle Collins when making reservoir release transfers of up to five TAF.

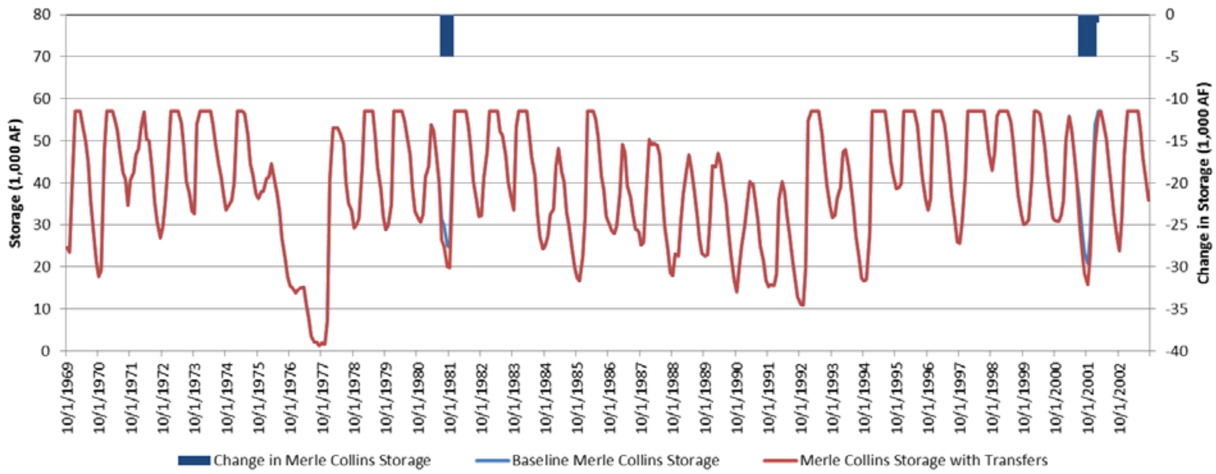

Figure B-~~68~~69. Merle Collins Operations with and without Alternative 4 Transfers

Placer County Water Agency releases water from MFP reservoirs for transfer to East Bay MUD. Changes in MFP storage are the same for Alternatives 2, 3, and 4 because all alternatives include reservoir release transfer measures (see Figure B-~~69~~70).

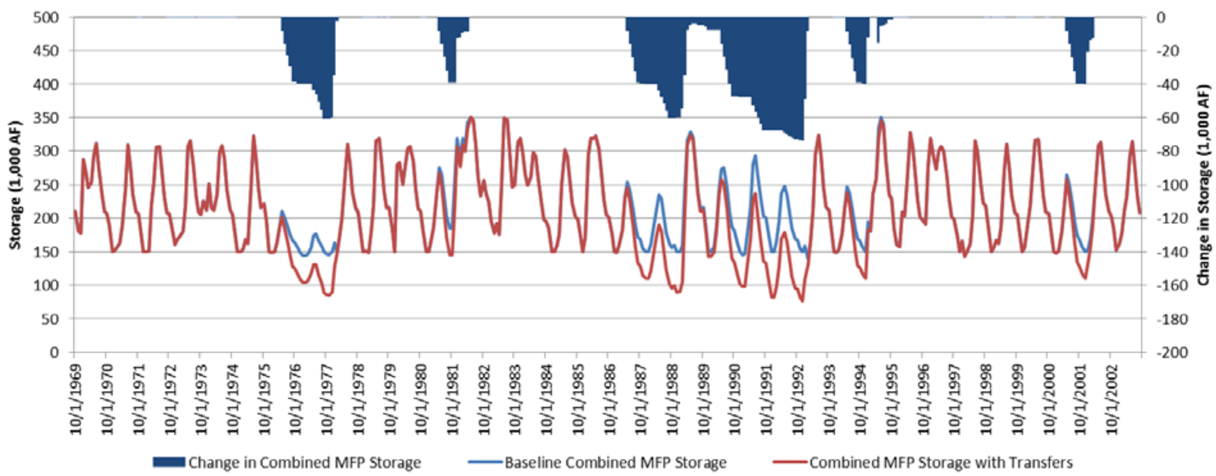

Figure B-~~69~~70. MFP Operations with and without Alternative 4 Transfers

Figure B-~~70~~ 71 illustrates Merced ID operations of Lake McClure when making reservoir release transfers of up to 30 TAF.

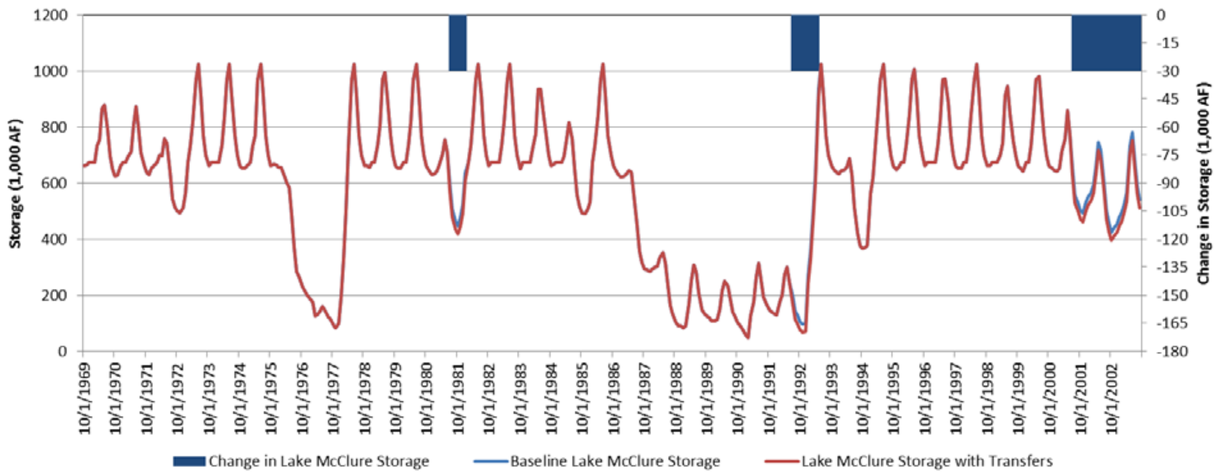

Figure B-~~70~~71. Lake McClure Operations with and without Alternative 4 Transfers

Browns Valley ID's conserved water is stored in Yuba County Water Agency's New Bullards Bar Reservoir and released for transfer in years with demand and available export capacity. These releases of conserved water are the only effect to New Bullards Bar Reservoir as illustrated below in Figure B-~~71~~72. New Bullards Bar Reservoir storage returns to baseline levels when the reservoir refills.

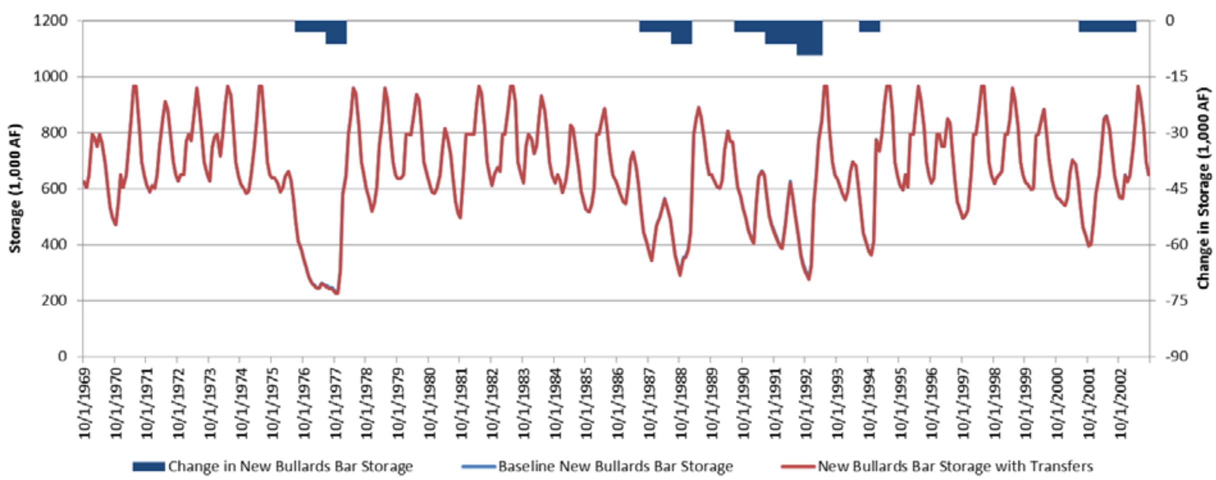

Figure B-~~71~~72. New Bullards Bar Operations with and without Alternative 4 Transfers

B.6.4.2 Stream Flow

Releases from Keswick Dam correspond with Shasta operations as illustrated below in Figure B-~~72~~73. Decreases in release occur when crop idling transfers are stored in Shasta and precede increases as stored transfer water is released for transfer through the Delta. There are no releases in response to changes in stream-groundwater interaction because there are no groundwater substitution transfers in Alternative 4.

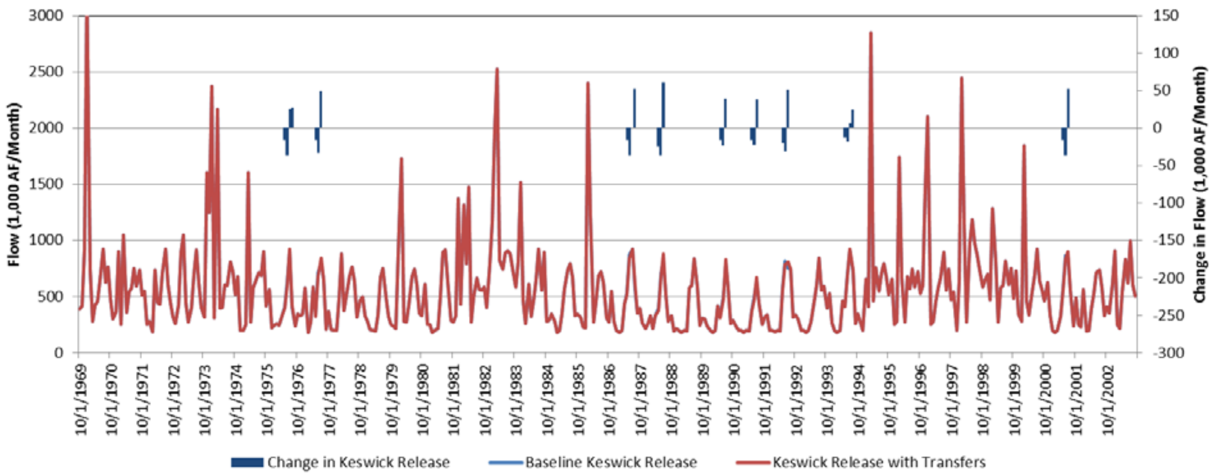

Figure B-~~72~~73. Keswick Dam Release with and without Alternative 4 Transfers

Figure B-~~73~~ 74 illustrates the effect of Alternative 4 transfers to the Sacramento River at Wilkins Slough. Increased flows result from changes in Keswick release, plus water made available by crop idling transfers upstream of Wilkins Slough. Decreases occur when transfer water is stored upstream in Shasta.

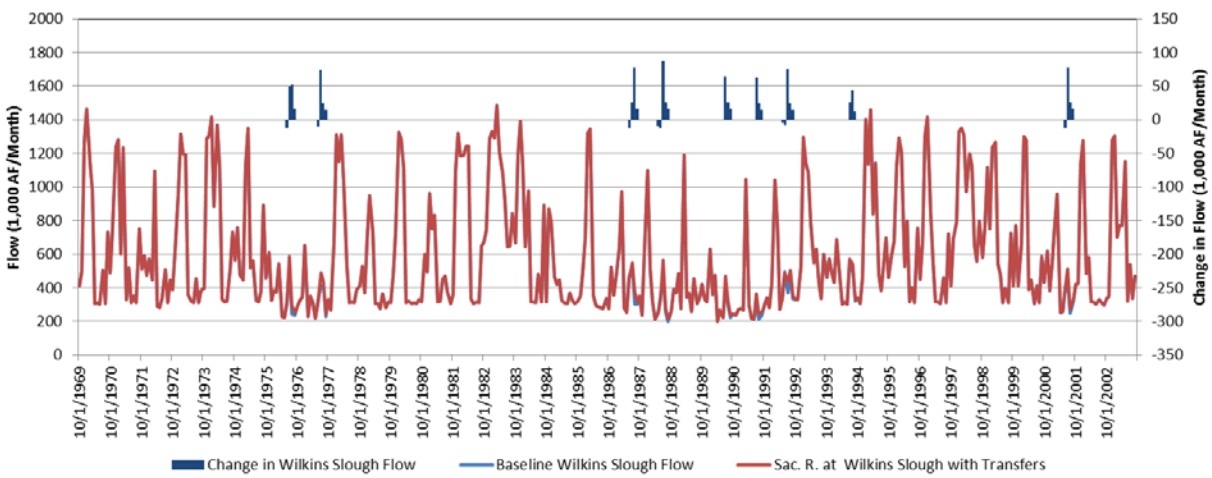

Figure B-~~73~~74. Sacramento River at Wilkins Slough with and without Alternative 4 Transfers

Figure B-~~74~~ 75 illustrates Nimbus Dam releases. Nimbus releases reflect CVP operations of Folsom Reservoir. Increases in release occur when Placer County Water Agency transfer water is released from Folsom for diversion at Freeport by East Bay MUD. Decreases can occur if transfer water made available downstream from Folsom is stored in Folsom and when Placer County Water Agency's upstream reservoirs refill.

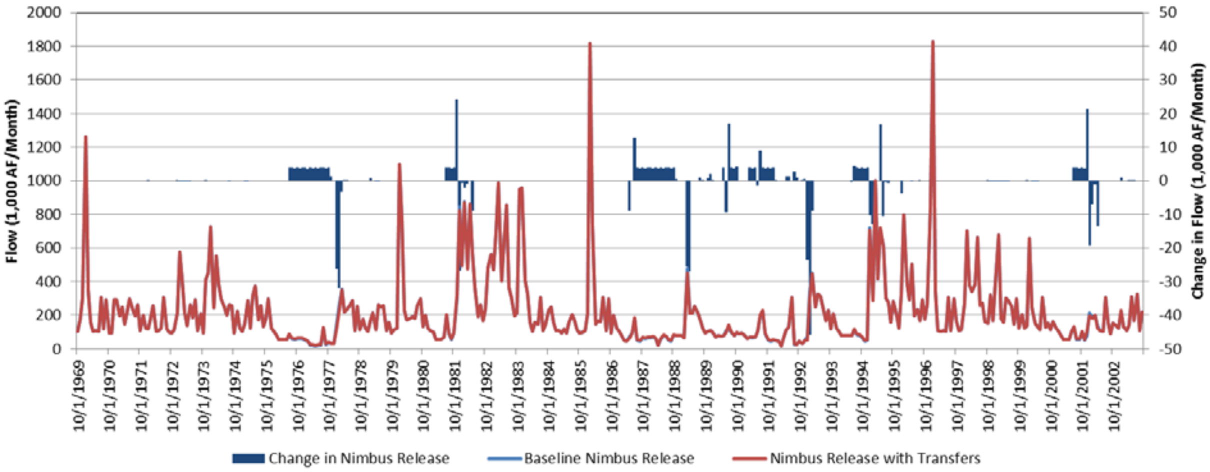

Figure B-~~74~~75. Nimbus Dam Release with and without Alternative 4 Transfers

Flows on the American River at H Street, illustrated below in Figure B-~~75~~76, reflect the same changes in flow under Alternative 4 as illustrated above at Nimbus.

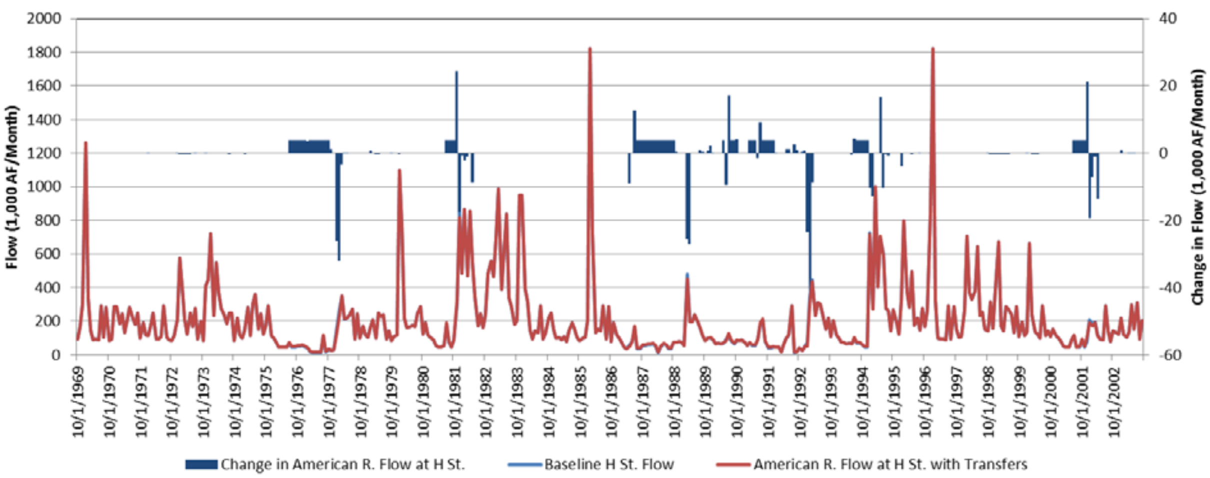

Figure B-~~75~~76. American River at H Street with and without Alternative 4 Transfers

Figure B-~~76~~-77 illustrates change in Feather River flow below Thermalito. Feather River flows change due to changes in operations at Oroville. Increases and decreases in flow on the Feather River below Thermalito are primarily a result of shifting the timing of delivery of SWP water to accommodate transfers. Changes also occur when crop idling water, stored in previous months, is released down the Feather River for delivery through the Delta.

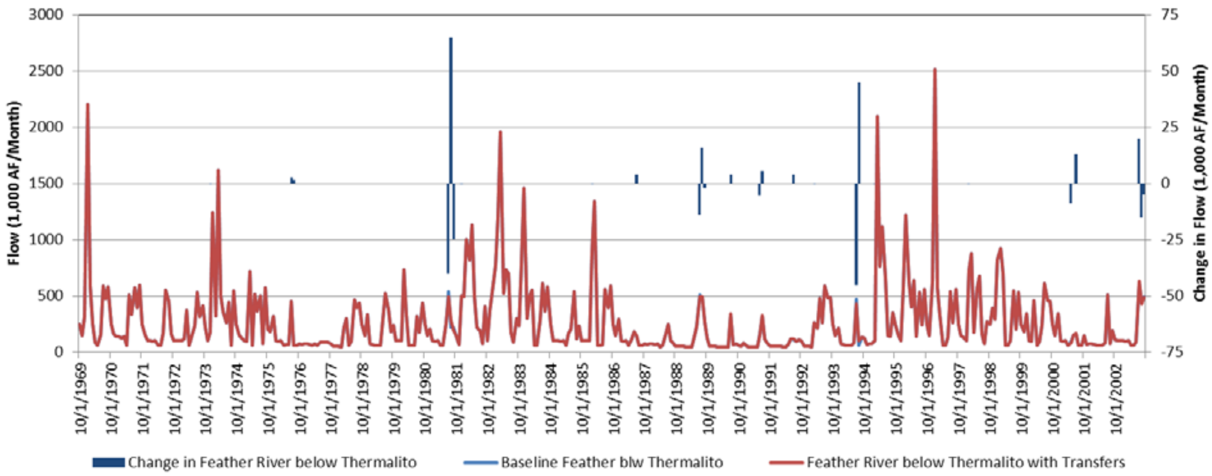

Figure B-~~76~~77. Feather River below Thermalito with and without Alternative 4 Transfers

Figure B-~~77~~ 78 illustrates changes in flow on the Yuba River as a result of Browns Valley ID's reservoir release transfers from Merle Collins Reservoir and release of Browns Valley ID's conserved water from New Bullards Bar Reservoir. Decreases occur when these reservoirs refill.

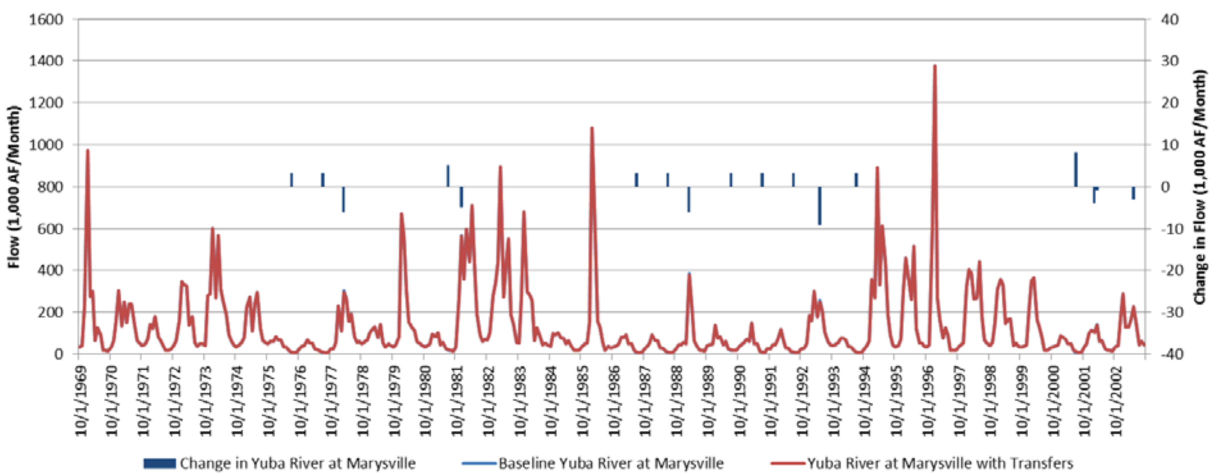

Figure B-~~77~~78. Yuba River at Marysville with and without Alternative 4 Transfers

Figure B-~~78~~ 79 illustrates the response of Bear River flows into the Feather River as a result of South Sutter WD reservoir release transfers from Camp Far West Reservoir. Flows increase when water is released for transfer and decrease when Camp Far West refills.

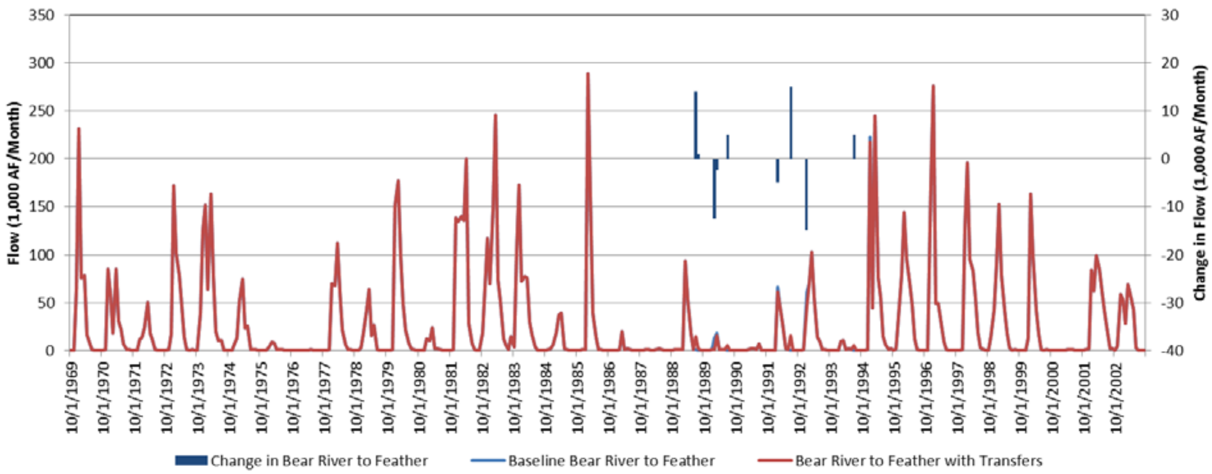

Figure B-~~78~~79. Bear River to the Feather River with and without Alternative 4 Transfers

The flow on the Lower Feather River represents an aggregation of flows on the Yuba River, Bear River, and upper portions of the Feather River. There are also increases due to water made available by crop idling transfers. Figure B-~~79~~ 80 represents the effect to the Feather River system.

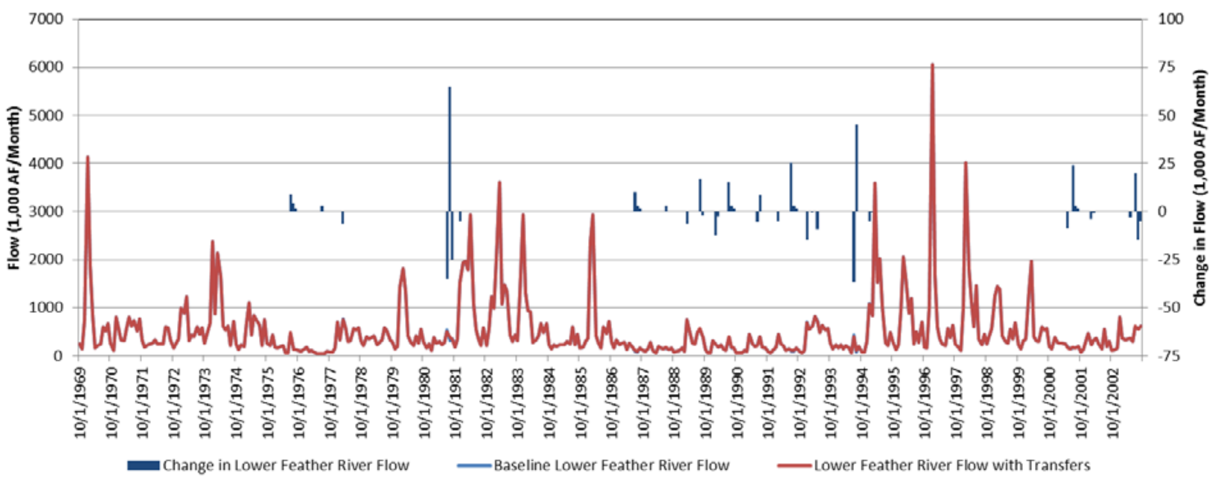

Figure B-~~79~~80. Lower Feather River with and without Alternative 4 Transfers

Figure B-~~80~~ 81 illustrates the flow of the Sacramento River at Freeport. This location is an aggregation of all changes on the Sacramento River at Wilkins Slough, the Lower Feather River, and the American River at H Street, and changes between those locations and Freeport. Changes between those locations and Freeport include increases in flow due to water made available through crop idling transfers.

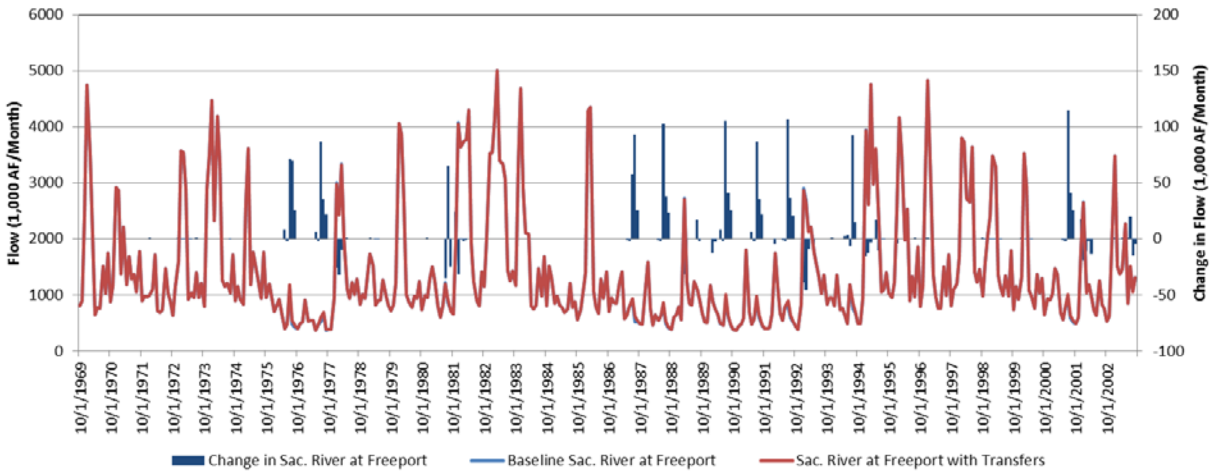

Figure B-~~80~~81. Sacramento River at Freeport with and without Alternative 4 Transfers

Figure B-~~81~~ 82 illustrates changes on the Merced River at the confluence with the San Joaquin River. Increases in Merced River flow are transfer water made available by reservoir releases at Lake McClure; decreases are a result of reservoir refill.

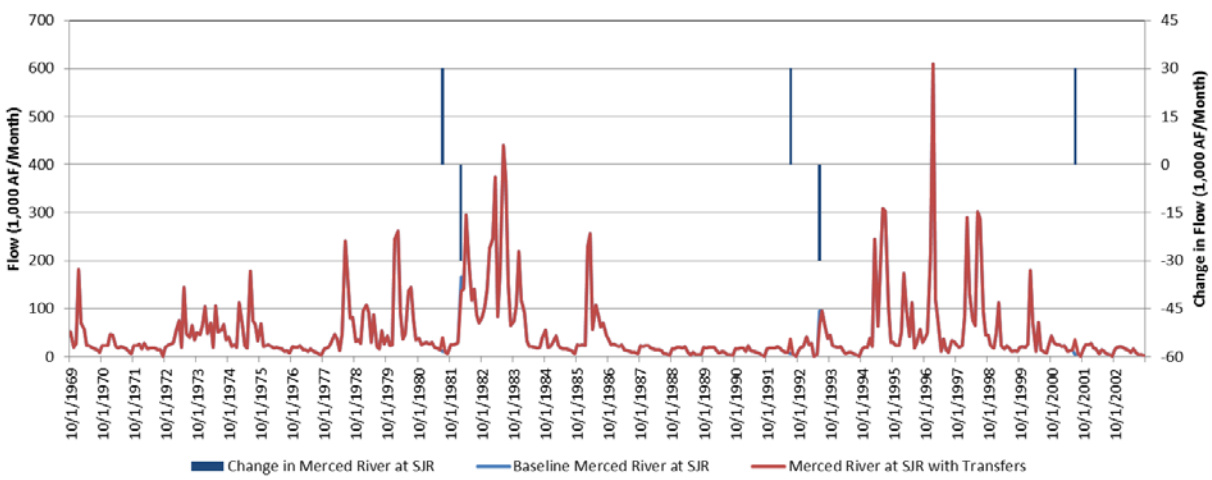

Figure B-~~81~~82. Merced River at the San Joaquin River with and without Alternative 4 Transfers

Figure B-~~82~~ 83 illustrates San Joaquin River flows at Vernalis. Increases in flow result from Merced ID transfers. Under Alternative 4, transfer water made available by Merced ID is diverted at CVP/SWP export facilities in the south Delta. Therefore, changes at Vernalis equal changes in Merced River flows at the confluence with the San Joaquin River.

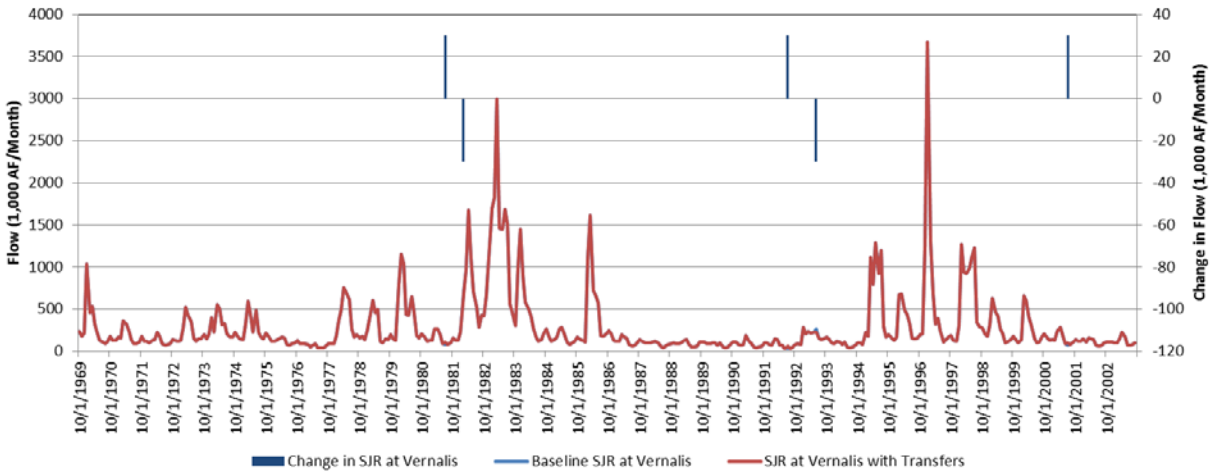

Figure B-~~82~~83. San Joaquin River at Vernalis with and without Alternative 4 Transfers

Changes to Delta outflow are illustrated below in Figure B-~~83~~84. Increases in Delta outflow are primarily due to carriage water to facilitate transfers through the Delta. Decreases in Delta outflow are attributed to reservoir refill upstream.

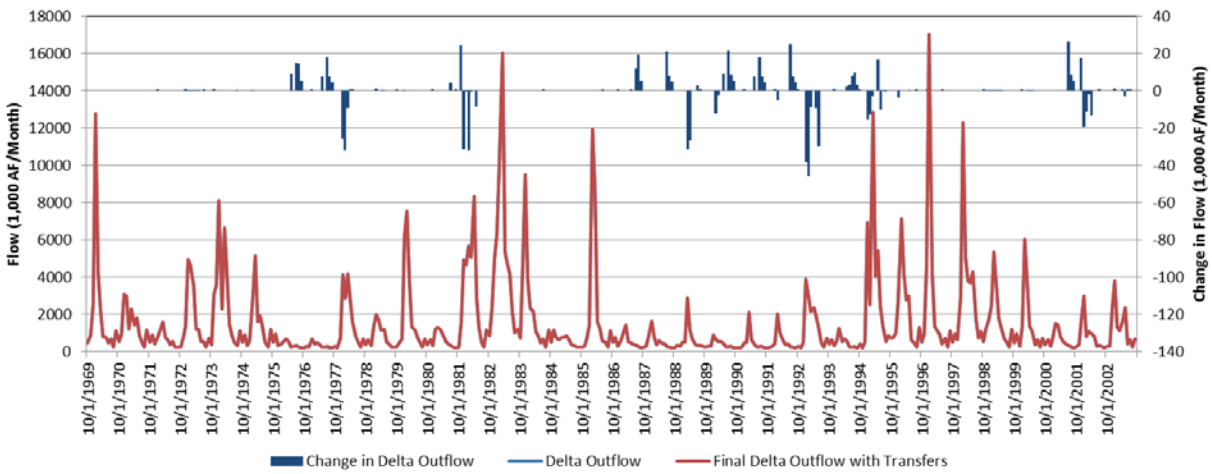

Figure B-~~83~~84. Delta Outflow with and without Alternative 4 Transfers

Table B-9 summarizes these changes on an average monthly and annual basis. Average annual Delta outflow is reduced by one TAF with increases primarily from July through September for carriage water and decreases primarily from January through March as reservoirs that made transfer releases refill.

Table B-9. Average Monthly Delta Outflow (TAF) for Alternative 4

Delta Outflow	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	393	867	1,490	3,260	3,312	3,278	1,753	1,381	816	546	297	638	18,031
With Transfers	393	868	1,489	3,257	3,307	3,277	1,751	1,382	815	551	300	640	18,030
Change	0	1	0	-3	-4	-2	-1	1	-1	5	3	1	-1

B.6.4.3 Exports and Diversions

Figure B-~~84~~ 85 illustrates the change in exports at Jones Pumping Plant. Under Alternative 4 there are only increases in exports.

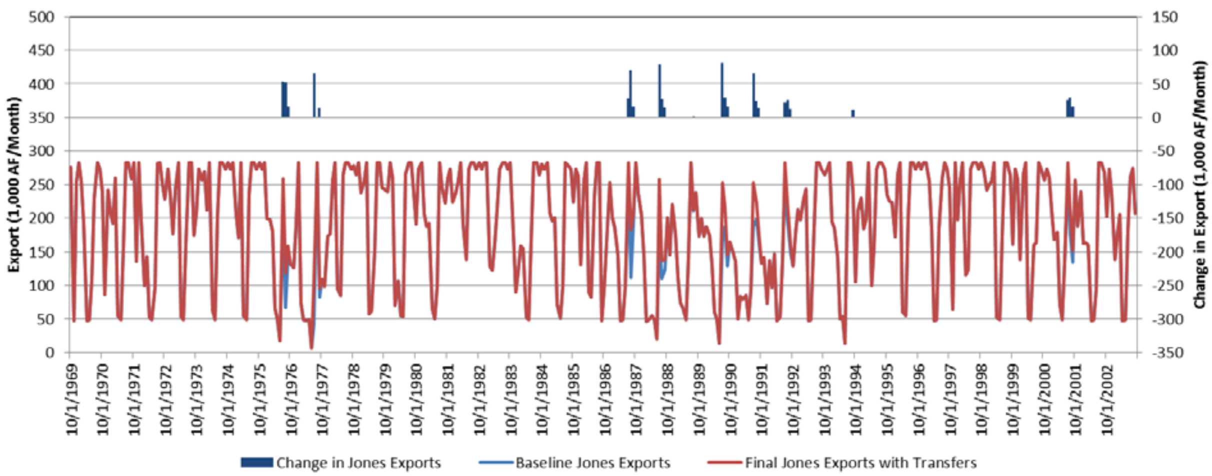

Figure B-~~84~~85. Exports at Jones Pumping Plant with and without Alternative 4 Transfers

Table B-10 summarizes the average monthly exports at Jones Pumping Plant. Increases occur during the transfer months of July, August, and September, with an average annual increase of 24 TAF.

Table B-10. Average Monthly Exports at Jones Pumping Plant (TAF) for Alternative 4

Jones Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	222	212	235	197	186	198	69	65	153	256	252	223	2,268
With Transfers	222	212	235	197	186	198	69	65	153	268	259	227	2,291
Change	0	0	0	0	0	0	0	0	0	12	8	4	24

Increases in Banks Pumping Plant exports occur when Banks is used to export transfer water. Decreases occur when the timing of SWP water as simulated in the CalSim II baseline is shifted to help facilitate transfers. These changes are illustrated below in Figure B-~~85~~86.

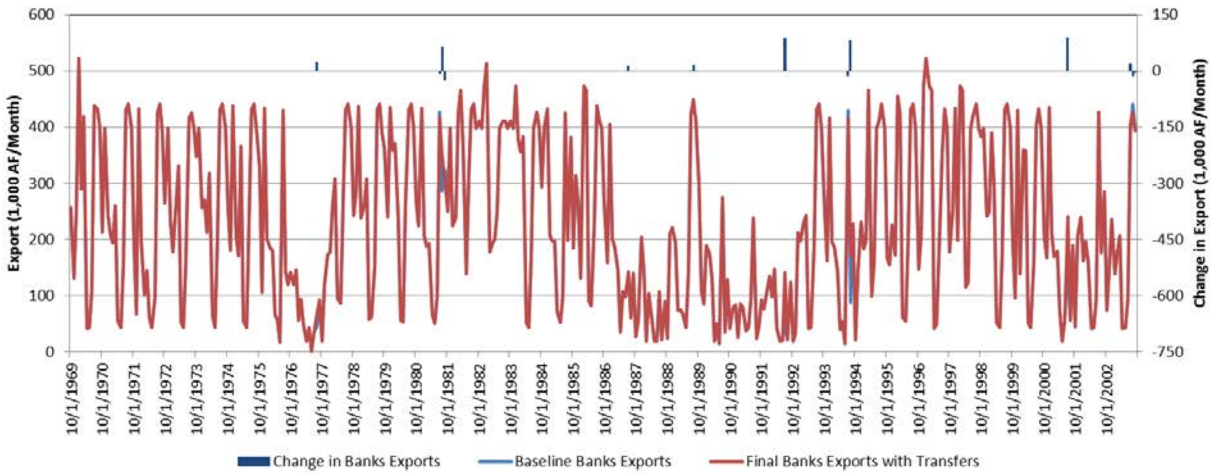

Figure B-~~85~~86. Exports at Banks Pumping Plant with and without Alternative 4 Transfers

Table B-11 summarizes average monthly exports at Banks Pumping Plant. Average annual Banks exports increase by ten TAF.

Table B-11. Average Monthly Exports at Banks Pumping Plant (TAF) for Alternative 4

Banks Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	202	212	307	222	239	261	70	62	156	363	316	320	2,731
With Transfers	202	212	307	222	239	261	70	62	156	369	321	319	2,740
Change	0	0	0	0	0	0	0	0	0	5	5	-1	10

Total CVP/SWP exports, the sum of exports at Jones and Banks Pumping Plants, are illustrated in Figure B-~~86~~87.

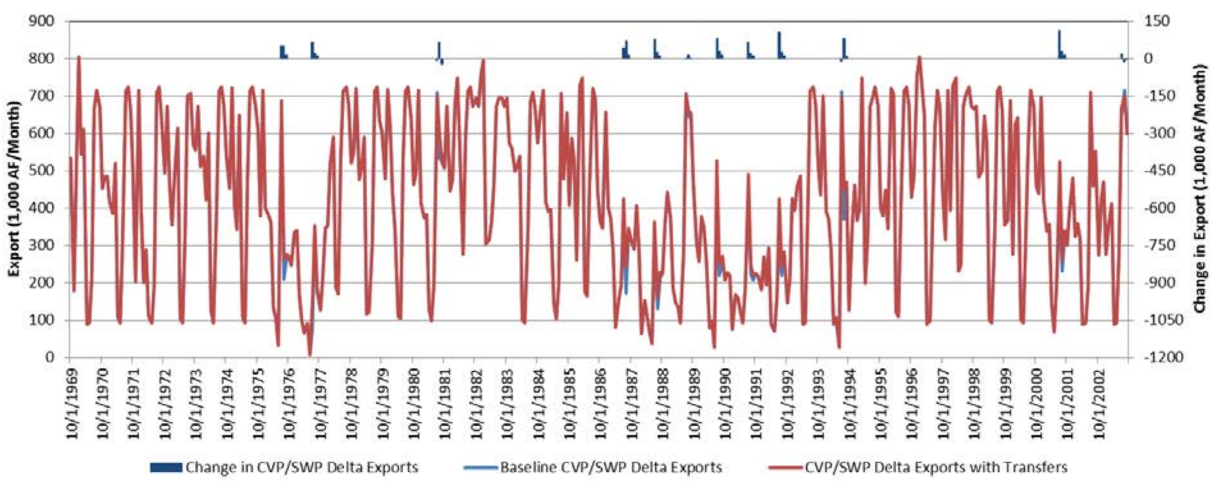

Figure B-~~86~~87. Total CVP/SWP Exports from the Delta with and without Alternative 4 Transfers

Table B-12 summarizes average monthly combined CVP/SWP exports. Average annual combined exports increase by 33 TAF with changes in the July through September period only.

Table B-12. Average Monthly Combined CVP/SWP Exports (TAF) for Alternative 4

CVP/SWP Exports	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Baseline	424	424	543	419	425	459	138	128	309	619	568	543	4,998
With Transfers	424	424	543	419	425	459	138	128	309	637	580	546	5,032
Change	0	0	0	0	0	0	0	0	0	18	13	3	33

Figure B-~~87~~ 88 illustrates diversions made by East Bay MUD at Freeport under both the baseline and with Project scenarios. Baseline diversions represent East Bay MUD taking delivery of CVP Project water under their existing water service contract.

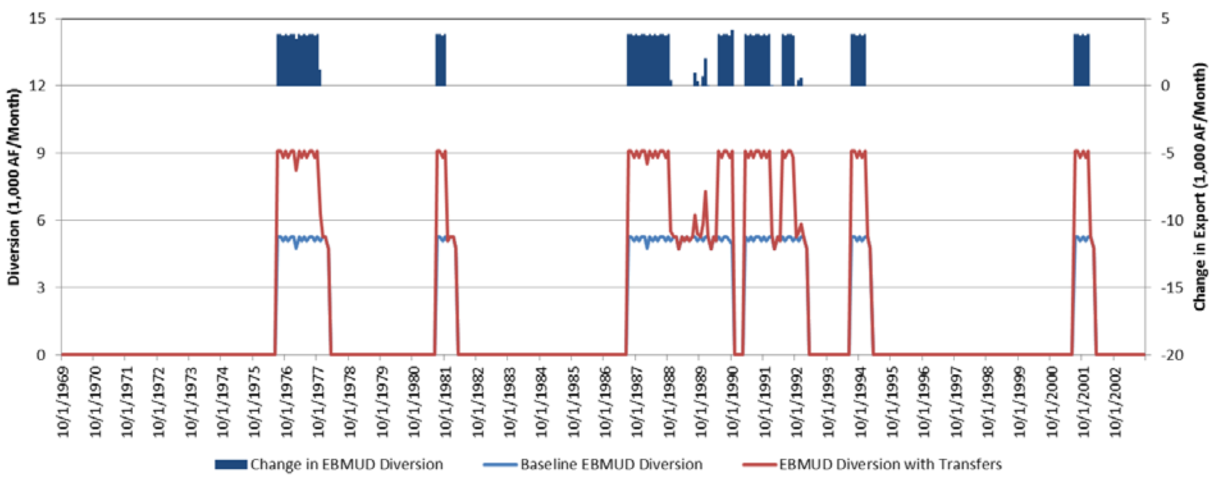

Figure B-~~87~~88. East Bay MUD Diversions with and without Alternative 4 Transfers

Contra Costa WD diversions increase to take delivery of transfer water as is illustrated below in Figure B-~~88~~89.

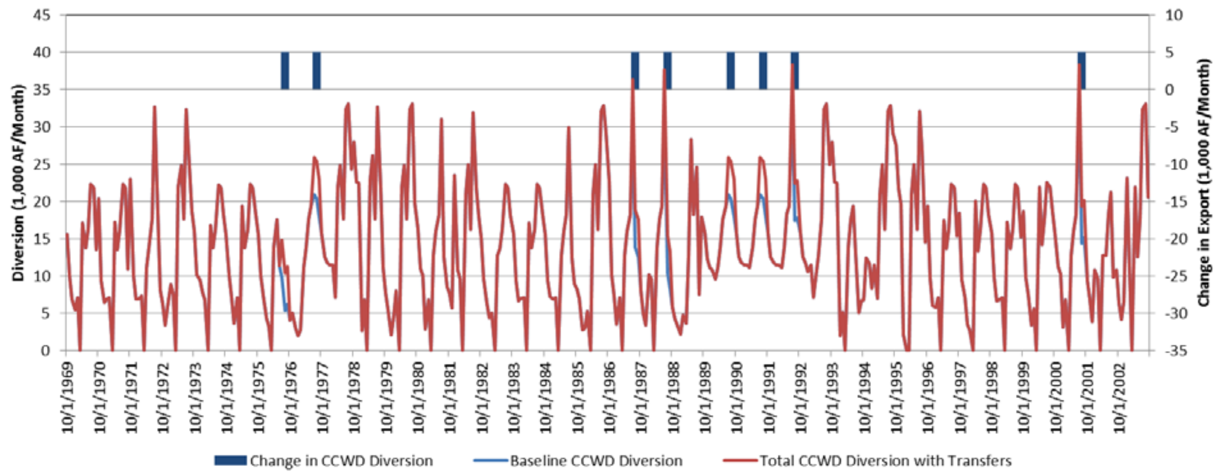

Figure B-~~88~~89. Contra Costa WD Diversions with and without Alternative 4 Transfers

B.7 References

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Reclamation. 2009. Cropland Idling, Issue No. 1 – DRAFT Rice Water Transfer Pattern. Available online at http://www.water.ca.gov/watertransfers/docs/Issue1-Rice.pdf [Accessed March 6, 2015].

U.S. Fish and Wildlife Service. 2008. Biological Opinion on the Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Final. December 15, 2008.

Attachment 1: CalSim II Assumptions for Baseline Operations

	Existing Condition[1]
Planning Horizon	2014
Period of Simulation	82 years (1922-2003)
HYDROLOGY	
Level of Development (land use)	2005 Level[3]
DEMANDS	
North of Delta (excluding the American River)	
CVP	Land-use based, limited by contract amounts[4]
SWP (FRSA)	Land-use based, limited by contract amounts[5]
Non-project	Land-use based, limited by water rights and SWRCB Decisions for Existing Facilities
Antioch Water Works	Pre-1914 water right
Federal refuges	Recent historical Level 2 water needs[6]
American River Basin	
Water rights	Year 2005, full water rights[7]
CVP	Year 2005 plus Freeport Regional Water Project[7]
San Joaquin River Basin[9]	
Friant Unit	Limited by contract amounts, based on current allocation policy
Lower basin	Land-use based, based on district level operations and constraints
Stanislaus River basin[10 19]	Land-use based, based on New Melones Interim Operations Plan, up to full CVP Contractor deliveries (155 TAF per year) depending on New Melones Index
South of Delta	
CVP	Demand based on contract amounts[4]
Federal refuges	Firm Level 2 water needs[6]
Contra Costa WD	195 TAF per year CVP contract supply and water rights[11]
SWP[5 12]	Demand based on full Table A amounts (4.13 MAF per year)
Article 56	Based on 2001-2008 contractor requests
Article 21	MWD demand up to 200 TAF per month (December-March) subject to conveyance capacity, KCWA demand up to 180 TAF per month, and other contractor demands up to 34 TAF per month, subject to conveyance capacity
North Bay Aqueduct	77 TAF per year demand under SWP contracts, up to 43.7 cfs of excess flow under Fairfield, Vacaville and Benicia Settlement Agreement
FACILITIES	
System-wide	Existing facilities
Sacramento Valley	
Shasta Reservoir	Existing, 4,552 TAF capacity
Red Bluff Diversion Dam	Diversion dam operated with gates out all year, NOAA Fisheries BO (Jun 2009) Action I.3.1[19]; assume permanent facilities in place

	Existing Condition[1]
Colusa Basin	Existing conveyance and storage facilities
Upper American River	Placer County Water Agency American River pump station
Lower Sacramento River	Freeport Regional Water Project
Fremont Weir	Existing (un-notched) Weir
Delta Export Conveyance	
SWP Banks Pumping Plant (South Delta)	Physical capacity is 10,300 cfs, permitted capacity is 6,680 cfs in all months and up to 8,500 cfs during Dec 15th - Mar 15th depending on Vernalis flow conditions[20];additional capacity of 500 cfs (up to 7,180 cfs) allowed Jul–Sep for reducing impact of NOAA Fisheries BO (Jun 2009) Action IV.2.1[19] on SWP[21]
CVP C.W. “Bill” Jones Pumping Plant (formerly Tracy PP)	Permit capacity is 4,600 cfs in all months (allowed for by the DMC-California Aqueduct Intertie)
Upper DMC Capacity	Exports limited to 4,200 cfs plus diversion upstream from DMC constriction plus 400 cfs DMC-California Aqueduct Intertie
Los Vaqueros Reservoir	Enlarged storage capacity (160 TAF), existing pump location, Alternate Intake project included[14]
San Joaquin River	
Millerton Lake (Friant Dam)	Existing, 520 TAF capacity
South of Delta (CVP/SWP project facilities)	
South Bay Aqueduct	SBA rehabilitation, 430 cfs capacity from junction with California Aqueduct to Alameda County FC&WSD Zone 7 point
California Aqueduct East Branch	Existing capacity
REGULATORY STANDARDS	
Trinity River	
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF per year)
Trinity Reservoir end-of-September minimum storage	Trinity EIS Preferred Alternative (600 TAF as able)
Clear Creek	
Minimum flow below Whiskeytown Dam	Downstream water rights, 1963 Reclamation proposal to USFWS and NPS, predetermined Central Valley Protection Improvement Act 3406(b)(2) flows[22], and NOAA Fisheries BO (Jun 2009) Action I.1.1[19]
Upper Sacramento River	
Shasta Reservoir end-of-September minimum storage	NOAA Fisheries 2004 Winter-run Biological Opinion (1,900 TAF in non-critical dry years), and NOAA Fisheries BO (Jun 2009) Action I.2.1[19]
Minimum flow below Keswick Dam	Flows for the SWRCB Water Rights Order 90-5, predetermined Central Valley Protection Improvement Act 3406(b)(2) flows, and NOAA Fisheries BO (Jun 2009) Action I.2.2[19]
Feather River	
Minimum flow below Thermalito Diversion Dam	2006 Settlement Agreement (700 / 800 cfs).
Minimum flow below Thermalito Afterbay outlet	1983 DWR, CDFW agreement (750 – 1,700 cfs)
Yuba River	
Minimum flow below Daguerre Point Dam	D-1644 Operations (Lower Yuba River Accord)[15]

	Existing Condition[1]
American River	
Minimum flow below Nimbus Dam	American River Flow Management as required by NOAA Fisheries BO (Jun 2009) Action II.1[19]
Minimum flow at H Street Bridge	SWRCB D-893
Lower Sacramento River	
Minimum flow near Rio Vista	SWRCB D-1641
Mokelumne River	
Minimum flow below Camanche Dam	Federal Energy Regulatory Commission 2916-029[13], 1996 (Joint Settlement Agreement)
Minimum flow below Woodbridge Diversion Dam	Federal Energy Regulatory Commission 2916-029[13], 1996 (Joint Settlement Agreement)
Stanislaus River	
Minimum flow below Goodwin Dam	1987 Reclamation, CDFW agreement, and flows required for NOAA Fisheries BO (Jun 2009) Action III.1.2 and III.1.3[19]
Minimum dissolved oxygen	SWRCB D-1422
Merced River	
Minimum flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180 – 220 cfs, Nov – Mar) and Cowell Agreement
Minimum flow at Shaffer Bridge	Federal Energy Regulatory Commission 2179 (25 – 100 cfs)
Tuolumne River	
Minimum flow at Lagrange Bridge	Federal Energy Regulatory Commission 2299-024, 1995 (Settlement Agreement) (94 – 301 TAF per year)
San Joaquin River	
San Joaquin River below Friant Dam/Mendota Pool	Interim San Joaquin River Restoration flows limited by existing channel capacities
Maximum salinity near Vernalis	SWRCB D-1641
Minimum flow near Vernalis	SWRCB D-1641 and NOAA Fisheries BO (Jun 2009) Action IV.2.1 Phase II flows not provided due to lack of agreement for purchasing water.
Sacramento-San Joaquin Delta	
Delta Outflow Index (flow and salinity)	SWRCB D-1641 and USFWS BO (Dec 2008) Action 4[19]
Delta Cross Channel gate operation	SWRCB D-1641 with additional days closed from Oct 1-Jan 31 based on NOAA Fisheries BO (Jun 2009) Action IV.1.2[19] (closed during flushing flows from Oct 1-Dec 14 unless adverse water quality conditions)
South Delta exports (Jones PP and Banks PP)	SWRCB D-1641 export limits and Vernalis flow-based export limits in Apr -May as required by NOAA Fisheries BO (June 2009) Action IV.2.1 Phase II[19] (additional 500 cfs allowed for Jul-Sep for reducing impact on SWP)[21]
Combined Flow in Old and Middle River	USFWS BO (Dec 2008) Actions 1-3 and NOAA Fisheries BO (Jun 2009) Action IV.2.3[19]
OPERATIONS CRITERIA: RIVER-SPECIFIC	
Upper Sacramento River	
Flow objective for navigation at Wilkins Slough	NOAA Fisheries BO (Jun 2009) Action I.4[19]; 3,250 – 5,000 cfs based on CVP water supply condition

	Existing Condition[1]
American River	
Folsom Dam flood control	Variable 400/670 flood control diagram (without outlet modifications)
Feather River	
Flow at mouth of Feather River (above Verona)	Maintain the CDFW/DWR flow target of 2,800 cfs for Apr - Sep dependent on Oroville inflow and FRSA allocation
Stanislaus River	
Flow below Goodwin Dam	Revised Operations Plan and NOAA Fisheries BO (Jun 2009) Action III.1.2 and III.1.3[19]
San Joaquin River	
Salinity at Vernalis	Grasslands Bypass Project (partial implementation)
OPERATIONS CRITERIA: SYSTEMWIDE	
CVP Water Allocation	
CVP settlement and exchange	100% (75% in Shasta critical years)
CVP refuges	100% (75% in Shasta critical years)
CVP agriculture	100% - 0% based on supply. South-of-Delta allocations are additionally limited due to D-1641, USFWS BO (Dec 2008), and NOAA Fisheries BO (Jun 2009) export restrictions[19]
CVP municipal & industrial	100% - 50% based on supply. South-of-Delta allocations are additionally limited due to D-1641, USFWS BO (Dec 2008), and NOAA Fisheries BO (Jun 2009) export restrictions[19]
SWP Water Allocation	
North of Delta (FRSA)	Contract-specific
South of Delta (including North Bay Aqueduct)	Based on supply; equal prioritization between Ag and M&I based on Monterey Agreement; allocations are limited due to D-1641, USFWS BO (Dec 2008), and NOAA Fisheries BO (Jun 2009) export restrictions[19]
CVP/SWP Coordinated Operations	
Sharing of responsibility for in-basin use	1986 Coordinated Operations Agreement (East Bay MUD FRWP and 2/3 of the North Bay Aqueduct diversions are considered as Delta export, 1/3 of the North Bay Aqueduct diversion is considered as in-basin use)
Sharing of surplus flows	1986 Coordinated Operations Agreement
Sharing of restricted export capacity for project-specific priority pumping	Equal sharing of export capacity under SWRCB D-1641, USFWS BO (Dec 2008), and NOAA Fisheries BO (Jun 2009) export restrictions[19]
Water transfers	Acquisitions by SWP contractors are wheeled at priority in Banks Pumping Plant over non- SWP users; LYRA included for SWP contractors[21]
Sharing of export capacity for lesser priority and wheeling-related pumping	Cross Valley Canal wheeling (max of 128 TAF per year), CALFED ROD defined Joint Point of Diversion
San Luis Reservoir	San Luis Reservoir is allowed to operate to a minimum storage of 100 TAF
CVPIA 3406(b)(2)	
Policy decision	Per May 2003 Department of Interior decision
Allocation	800 TAF per year, 700 TAF per year in 40-30-30 dry years, and 600 TAF per year in 40-30-30 critical years

	Existing Condition[1]
Actions	Pre-determined non-discretionary USFWS BO (Dec 2008) upstream fish flow objectives (Oct- Jan) for Clear Creek and Keswick Dam, non-discretionary NOAA Fisheries BO (Jun 2009) actions for the American and Stanislaus Rivers, and NOAA Fisheries BO (Jun 2009) actions leading to export restrictions[19]
Accounting adjustments	No discretion assumed under USFWS BO (Dec 2008) and NOAA Fisheries BO (Jun 2009)[19], no accounting
WATER MANAGEMENT ACTIONS	
Water Transfer Supplies	
Lower Yuba River Accord[21]	Yuba River acquisitions for reducing impact of NOAA Fisheries BO export restrictions[19] on SWP

Notes:

1 These assumptions were developed under the direction of the DWR and Reclamation management team for the Bay Delta Conservation Plan (BDCP) Habitat Conservation Plan and EIR/EIS. Additional modifications were made by Reclamation and the Long-Term Water Transfer Project team and coordinated with Reclamation.

2 Footnote removed.

3 The Sacramento Valley hydrology used in the Existing Condition CalSim II model reflects nominal 2005 land use assumptions. The nominal 2005 land use was determined by interpolation between the 1995 and projected 2020 land use assumptions associated with Bulletin 160-98. The San Joaquin Valley hydrology reflects 2005 land use assumptions developed by Reclamation to support Reclamation studies.

4 CVP contract amounts have been reviewed and updated according to existing and amended contracts, as appropriate. Assumptions regarding CVP agricultural and municipal and industrial (M&I) service contracts and Settlement Contract amounts are documented in the Delivery Specifications attachments to the BDCP CalSim II assumptions document.

5 SWP contract amounts have been updated as appropriate based on recent Table A transfers/agreements. Assumptions regarding SWP agricultural and M&I contract amounts are documented in the Delivery Specifications attachments to the BDCP CalSim II assumptions document.

6 Water needs for Federal refuges have been reviewed and updated and are documented in the Delivery Specifications attachments to the BDCP CalSim II assumptions document.

7 Assumptions regarding American River water rights and CVP contracts are documented in the Delivery Specifications attachments to the BDCP CalSim II assumptions document. The Sacramento Area Water Forum agreement, its dry year diversion reductions, MFP operations and “mitigation” water is not included.

8 Footnote removed.

9 The new CalSim II representation of the San Joaquin River has been included in this model package (CalSim II San Joaquin River Model, Reclamation, 2005). Updates to the San Joaquin River have been included since the preliminary model release in August 2005.

10 The CalSim II model representation for the Stanislaus River does not necessarily represent Reclamation’s current or future operational policies. A suitable plan for supporting flows has not been developed for NOAA Fisheries BO (Jun 2009) Action III.1.3.

11 The actual amount diverted is reduced because of supplies from the Los Vaqueros project. The existing Los Vaqueros storage capacity is 160 TAF. Associated water rights for Delta excess flows are included.

12 Under Existing Conditions it is assumed that SWP Contractors can take delivery of all Table A allocations and Article 21 supplies. Article 56 provisions are assumed and allow for SWP Contractors to manage storage and delivery conditions such that full Table A allocations can be delivered. Article 21 deliveries are limited in wet years under the assumption that demand is decreased in these conditions. Article 21 deliveries for the NBA are dependent on excess conditions only, all other Article 21 deliveries also require that San Luis Reservoir be at capacity and that Banks PP and the California Aqueduct have available capacity to divert from the Delta for direct delivery.

13 Mokelumne River flows reflect East Bay MUD operations in consideration of supplies associated with the Freeport Regional Water Project.

14 The Contra Costa WD Alternate Intake Project, an intake at Victoria Canal, that operates as an alternate Delta diversion for Los Vaqueros Reservoir.

15 D-1644 and the Lower Yuba River Accord are assumed to be implemented for the Existing Conditions baselines. The Yuba River is not dynamically modeled in CalSim II. Yuba River hydrology and availability of water acquisitions under the Lower Yuba River Accord are based on modeling performed and provided by the Lower Yuba River Accord EIS/EIR study team.

16 Footnote removed.

17 Footnote removed.

18 Footnote removed.

19 In cooperation with Reclamation, NOAA Fisheries, USFWS, and California Department of Fish and Wildlife, DWR has developed assumptions for implementation of the USFWS BO (Dec 15th 2008) and NOAA Fisheries BO (June 4th 2009) in CalSim II.

[20] Current U.S. Army Corps of Engineering permit for Banks PP allows for an average diversion rate of 6,680 cfs in all months. Diversion rate can increase up to 1/3 of the rate of San Joaquin River flow at Vernalis during Dec 15th – Mar 15th up to a maximum diversion of 8,500 cfs, if Vernalis flow exceeds 1,000 cfs.

[21] Acquisitions of Component 1 water under the Lower Yuba River Accord, and use of 500 cfs dedicated capacity at Banks PP during Jul– Sep, are assumed to be used to reduce as much of the impact of the Apr-May Delta export actions on SWP contractors as possible.

[22] Delta actions, under USFWS discretionary use of CVPIA 3406(b)(2) allocations, are no longer dynamically operated and accounted for in the CalSim II model. The Combined Old and Middle River Flow and Delta Export restrictions under the USFWS BO (Dec 15th 2008) and the NOAA Fisheries BO (June 4th 2009) severely limit any discretion that would have been otherwise assumed in selecting Delta actions under the CVPIA 3406(b)(2) accounting criteria. Therefore, it is anticipated that CVPIA 3406(b)(2) account availability for upstream river flows below Whiskeytown, Keswick and Nimbus Dams would be very limited. It appears the integration of BO Reasonable and Prudent Alternative actions will likely exceed the 3406(b)(2) allocation in all water year types. Upstream flows on Clear Creek and the Sacramento River are pre-determined based on CVPIA 3406(b)(2) based operations from the Aug 2008 BA Study 7.0 and Study 8.0 for Existing Conditions baselines. The procedures for dynamic operation and accounting of CVPIA 3406(b)(2) are not included in CalSim II.

[23] Only acquisitions of Lower Yuba River Accord Component 1 water are included.

Key:

CVP = Central Valley Project
FRSA = Feather River Service Area
TAF = thousand acre-feet
MAF = million acre-feet
KCWA = Kern County Water Agency
BO = biological opinion
DMC = Delta-Mendota Cana
NBA = North Bay Aqueduct
EIS = Environmental Impact Statement
NPS = National Park Service
CDFW = California Department of Fish and Wildlife
LYRA = Lower Yuba River Accord
SWP = State Water Project
SWRCB = State Water Resources Control Board
WD = Water District
MWD = Metropolitan Water District of Southern California
cfs = cubic feet per second
PP = Pumping Plant
SBA = South Bay Aqueduct
FC&WSD = Flood Control and Water Service District
USFWS = U.S. Fish and Wildlife Service
DWR = Department of Water Resources
FRWP = Freeport Regional Water Project
ROD = Record of Decision
CALFED = State (CAL) and Federal (FED) agencies participating in the Bay-Delta Accord
CVPIA = Central Valley Project Improvement Act
NOAA Fisheries = National Oceanic and Atmospheric Administration Fisheries Service

Attachment 2: Monthly Simulated Transfers by Seller for each Alternative

The following tables show the volume of water simulated as transferred by each seller for each alternative. A separate table is included for each type of transfer: groundwater substitution, reservoir release, conserved water, and crop idling.

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Conaway Preservation Group							
1976	0.0	0.0	8.6	5.4	5.4	2.7	22.1
1977	0.0	0.0	10.0	4.0	4.0	2.0	20.1
1981	0.0	0.0	8.6	5.4	5.4	2.7	22.1
1987	4.3	8.6	8.6	5.4	5.4	2.7	35.0
1988	0.0	8.6	8.6	5.4	5.4	2.7	30.7
1989	0.0	8.6	8.6	5.4	5.4	2.7	30.7
1990	0.0	0.0	8.6	5.4	5.4	2.7	22.1
1991	0.0	0.0	10.0	4.0	4.0	2.0	20.1
1992	5.0	10.0	10.0	4.0	4.0	2.0	35.0
1994	0.0	0.0	0.5	4.0	4.0	2.0	10.6
2001	0.0	8.6	8.6	5.4	5.4	2.7	30.7
2003	0.0	0.0	0.0	5.4	5.4	2.7	13.5
Natomas Central Mutual Water Company							
1976	0.0	0.0	6.0	6.0	6.0	3.0	21.0
1977	0.0	0.0	6.0	6.0	6.0	3.0	21.0
1981	0.0	0.0	6.0	6.0	6.0	3.0	21.0
1987	3.0	6.0	6.0	6.0	6.0	3.0	30.0
1988	0.0	6.0	6.0	6.0	6.0	3.0	27.0
1989	0.0	6.0	6.0	6.0	6.0	3.0	27.0
1990	0.0	0.0	6.0	6.0	6.0	3.0	21.0
1991	0.0	0.0	6.0	6.0	6.0	3.0	21.0
1992	3.0	6.0	6.0	6.0	6.0	3.0	30.0
1994	0.0	0.0	0.0	6.0	6.0	3.0	15.0
2001	0.0	6.0	6.0	6.0	6.0	3.0	27.0
2003	0.0	0.0	0.0	6.0	6.0	3.0	15.0
Sacramento Suburban Water District*							
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	1.8	0.0	1.8
1981	0.0	0.0	0.0	1.8	0.0	0.0	1.8
1987	0.0	0.0	0.0	1.8	0.0	0.0	1.8
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	5.0	5.0	5.0	5.0	5.0	25.0
1990	0.0	0.0	0.0	1.8	0.0	0.0	1.8
1991	0.0	0.0	0.0	1.8	1.8	0.0	3.7
1992	0.0	0.0	0.0	1.8	0.0	0.0	1.8
1994	0.0	0.0	0.0	1.8	0.0	0.0	1.8
2001	0.0	0.0	0.0	1.8	0.0	0.0	1.8
2003	0.0	0.0	0.0	5.0	5.0	5.0	15.0

*Sacramento Suburban WD simulated to pump 3,800 acre-feet in October 1989 for transfer to EBMUD

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Glenn-Colusa Irrigation District							
1976	4.2	4.2	4.2	4.2	4.2	4.2	25.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	4.2	4.2	4.2	4.2	4.2	4.2	25.0
1987	4.2	4.2	4.2	4.2	4.2	4.2	25.0
1988	4.2	4.2	4.2	4.2	4.2	4.2	25.0
1989	0.0	3.8	3.7	3.0	3.0	2.9	16.4
1990	0.0	4.2	4.2	4.2	4.2	4.2	20.8
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	4.2	4.2	4.2	4.2	4.2	4.2	25.0
2003	0.0	0.0	0.0	4.2	4.2	4.2	12.5
Pleasant Grove-Verona Mutual Water Company							
1976	0.0	0.0	3.2	4.0	4.0	2.0	13.2
1977	0.0	0.0	3.2	2.8	2.8	1.4	10.2
1981	0.0	0.0	3.2	4.0	4.0	2.0	13.2
1987	1.6	3.2	3.2	4.0	4.0	2.0	18.0
1988	0.0	3.2	3.2	4.0	4.0	2.0	16.4
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	3.2	4.0	4.0	2.0	13.2
1991	0.0	0.0	3.2	2.8	2.8	1.4	10.2
1992	1.6	3.2	3.2	2.8	2.8	1.4	15.0
1994	0.0	0.0	0.0	2.8	2.8	1.4	7.0
2001	0.0	3.2	3.2	4.0	4.0	2.0	16.4
2003	0.0	0.0	0.0	0.8	0.8	0.4	2.1
Reclamation District 108							
1976	2.5	2.5	2.5	2.5	2.5	2.5	15.0
1977	0.0	2.5	2.5	2.5	2.5	2.5	12.5
1981	1.5	1.5	1.5	2.5	2.5	2.5	12.1
1987	2.5	2.5	2.5	2.5	2.5	2.5	15.0
1988	2.5	2.5	2.5	2.5	2.5	2.5	15.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	2.5	2.5	2.5	2.5	2.5	12.5
1991	0.0	2.5	2.5	2.5	2.5	2.5	12.5
1992	2.5	2.5	2.5	2.5	2.5	2.5	15.0
1994	2.5	2.5	2.5	2.5	2.5	2.5	15.0
2001	2.5	2.5	2.5	2.5	2.5	2.5	15.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Sycamore Mutual Water Company							
1976	1.5	3.0	3.0	3.0	3.0	1.5	15.0
1977	0.0	1.2	1.2	1.6	1.6	0.8	6.4
1981	0.0	0.0	0.0	3.0	3.0	1.5	7.5
1987	1.5	3.0	3.0	3.0	3.0	1.5	15.0
1988	1.5	3.0	3.0	3.0	3.0	1.5	15.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	3.0	3.0	3.0	3.0	1.5	13.5
1991	0.0	1.2	1.2	1.6	1.6	0.8	6.4
1992	0.6	1.2	1.2	1.6	1.6	0.8	7.0
1994	0.6	1.2	1.2	1.6	1.6	0.8	7.0
2001	1.5	3.0	3.0	3.0	3.0	1.5	15.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sacramento County Water Agency							
1976	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1977	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1981	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1987	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1988	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1991	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1992	0.0	0.0	0.0	5.0	5.0	5.0	15.0
1994	0.0	0.0	0.0	5.0	5.0	5.0	15.0
2001	0.0	0.0	0.0	5.0	5.0	5.0	15.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Garden Highway Mutual Water Company							
1976	0.0	2.2	2.2	2.5	2.5	2.5	11.8
1977	0.0	1.2	1.2	1.3	1.3	1.3	6.3
1981	0.0	0.0	0.0	2.3	2.3	2.3	6.9
1987	2.2	2.2	2.2	2.5	2.5	2.5	14.0
1988	0.0	1.2	1.2	1.3	1.3	1.3	6.3
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	2.2	2.2	2.5	2.5	2.5	11.8
1991	0.0	0.0	1.2	1.3	1.3	1.3	5.2
1992	2.2	2.2	2.2	2.5	2.5	2.5	14.0
1994	0.0	0.0	2.2	2.5	2.5	2.5	9.7
2001	0.0	2.2	2.2	2.5	2.5	2.5	11.8
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Cordua Irrigation District							
1976	0.0	0.0	0.0	4.8	4.8	2.4	12.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	4.8	4.8	2.4	12.0
1988	0.0	0.0	0.0	4.8	4.8	2.4	12.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	4.8	4.8	2.4	12.0
1991	0.0	0.0	0.0	4.8	4.8	2.4	12.0
1992	0.0	0.0	0.0	4.8	4.8	2.4	12.0
1994	0.0	0.0	0.0	4.8	4.8	2.4	12.0
2001	0.0	0.0	0.0	4.8	4.8	2.4	12.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Goose Club Farms/Teichert							
1976	0.0	0.0	1.6	2.4	2.4	1.2	7.6
1977	0.0	0.0	1.6	2.4	2.4	1.2	7.6
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.8	1.6	1.6	2.4	2.4	1.2	10.0
1988	0.0	1.6	1.6	2.4	2.4	1.2	9.2
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	1.6	2.4	2.4	1.2	7.6
1991	0.0	0.0	1.6	2.4	2.4	1.2	7.6
1992	0.8	1.6	1.6	2.4	2.4	1.2	10.0
1994	0.0	0.0	0.0	2.4	2.4	1.2	6.0
2001	0.0	1.6	1.6	2.4	2.4	1.2	9.2
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
River Garden Farms							
1976	0.0	0.0	1.6	2.0	2.0	1.0	6.6
1977	0.0	0.0	1.2	1.2	1.2	0.6	4.2
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.8	1.6	1.6	2.0	2.0	1.0	9.0
1988	0.0	1.6	1.6	2.0	2.0	1.0	8.2
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	1.6	2.0	2.0	1.0	6.6
1991	0.0	0.0	1.2	1.2	1.2	0.6	4.2
1992	0.6	1.2	1.2	1.2	1.2	0.6	6.0
1994	0.0	0.0	0.0	1.2	1.2	0.6	3.0
2001	0.0	1.6	1.6	2.0	2.0	1.0	8.2
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Cranmore Farms							
1976	0.0	0.0	2.1	1.1	1.1	0.6	4.9
1977	0.0	0.0	1.5	0.9	0.9	0.4	3.7
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	1.0	2.1	2.1	1.1	1.1	0.6	8.0
1988	0.0	2.1	2.1	1.1	1.1	0.6	7.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	2.1	1.1	1.1	0.6	4.9
1991	0.0	0.0	1.5	0.9	0.9	0.4	3.7
1992	0.8	1.5	1.5	0.9	0.9	0.4	6.0
1994	0.0	0.0	0.0	0.9	0.9	0.4	2.1
2001	0.0	2.1	2.1	1.1	1.1	0.6	7.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tule Basin Farms							
1976	0.0	0.0	1.5	1.4	1.4	0.7	5.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.8	1.5	1.5	1.4	1.4	0.7	7.3
1988	0.0	1.5	1.5	0.0	0.0	0.0	3.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	1.5	0.0	0.0	0.0	1.5
1991	0.0	0.0	1.5	0.0	0.0	0.0	1.5
1992	0.8	1.5	0.0	0.0	0.0	0.0	2.3
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.5	1.5	1.4	1.4	0.7	6.6
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation District 1004							
1976	0.0	0.0	0.0	2.9	2.9	1.4	7.2
1977	0.0	0.0	0.0	2.2	2.2	1.1	5.4
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	2.9	2.9	1.4	7.2
1988	0.0	0.0	0.0	2.9	2.9	1.4	7.2
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	2.9	2.9	1.4	7.2
1991	0.0	0.0	0.0	2.2	2.2	1.1	5.4
1992	0.0	0.0	0.0	2.2	2.2	1.1	5.4
1994	0.0	0.0	0.0	2.2	2.2	1.1	5.4
2001	0.0	0.0	0.0	2.9	2.9	1.4	7.2
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Te Velde Trust							
1976	0.0	0.0	1.1	1.8	1.8	0.9	5.5
1977	0.0	0.0	0.8	0.4	0.4	0.2	1.8
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.5	1.1	1.1	1.8	1.8	0.9	7.1
1988	0.0	1.1	1.1	1.8	1.8	0.9	6.6
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	1.1	1.8	1.8	0.9	5.5
1991	0.0	0.0	0.8	0.4	0.4	0.2	1.8
1992	0.4	0.8	0.8	0.4	0.4	0.2	2.9
1994	0.0	0.0	0.0	0.4	0.4	0.2	1.0
2001	0.0	1.1	1.1	1.8	1.8	0.9	6.6
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Butte Water District							
1976	0.9	0.9	0.9	0.9	0.9	0.9	5.5
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.9	0.9	0.9	0.9	0.9	0.9	5.5
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.9	0.9	0.9	0.9	0.9	4.6
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.9	0.9	0.9	0.9	0.9	0.9	5.5
1994	0.9	0.9	0.9	0.9	0.9	0.9	5.5
2001	0.9	0.9	0.9	0.9	0.9	0.9	5.5
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anderson-Cottonwood Irrigation District							
1976	0.5	1.0	1.0	1.4	1.4	0.7	5.9
1977	0.0	1.0	1.0	1.4	1.4	0.7	5.5
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.5	1.0	1.0	1.4	1.4	0.7	5.9
1988	0.5	1.0	1.0	1.4	1.4	0.7	5.9
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.0	1.0	1.4	1.4	0.7	5.5
1991	0.0	1.0	1.0	1.4	1.4	0.7	5.5
1992	0.5	1.0	1.0	1.4	1.4	0.7	5.9
1994	0.5	1.0	1.0	1.4	1.4	0.7	5.9
2001	0.5	1.0	1.0	1.4	1.4	0.7	5.9
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
City of Sacramento							
1976	0.0	0.0	0.0	1.7	1.7	1.7	5.0
1977	0.0	0.0	0.0	1.7	1.7	1.7	5.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	1.7	1.7	1.7	5.0
1988	0.0	0.0	0.0	1.7	1.7	1.7	5.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	1.7	1.7	1.7	5.0
1991	0.0	0.0	0.0	1.7	1.7	1.7	5.0
1992	0.0	0.0	0.0	1.7	1.7	1.7	5.0
1994	0.0	0.0	0.0	1.7	1.7	1.7	5.0
2001	0.0	0.0	0.0	1.7	1.7	1.7	5.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation District 2068							
1976	0.0	0.0	0.8	0.8	0.8	0.8	3.0
1977	0.0	0.0	0.8	0.8	0.8	0.8	3.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.8	0.8	0.8	0.8	0.8	0.8	4.5
1988	0.0	0.8	0.8	0.8	0.8	0.8	3.8
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.8	0.8	0.8	0.8	3.0
1991	0.0	0.0	0.8	0.8	0.8	0.8	3.0
1992	0.8	0.8	0.8	0.8	0.8	0.8	4.5
1994	0.0	0.0	0.0	0.8	0.8	0.8	2.3
2001	0.0	0.8	0.8	0.8	0.8	0.8	3.8
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gilsizer Slough Ranch							
1976	0.0	0.0	0.5	0.8	0.8	0.8	2.9
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.5	0.5	0.5	0.8	0.8	0.8	3.9
1988	0.0	0.5	0.5	0.0	0.0	0.0	1.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.5	0.0	0.0	0.0	0.5
1991	0.0	0.0	0.5	0.0	0.0	0.0	0.5
1992	0.5	0.5	0.0	0.0	0.0	0.0	1.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.5	0.5	0.8	0.8	0.8	3.4
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B1. Simulated Groundwater Substitution Transfers for Alternatives 2 & 3 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Pelger Mutual Water Company							
1976	0.0	0.0	0.9	0.6	0.6	0.3	2.5
1977	0.0	0.0	0.1	0.5	0.5	0.2	1.3
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.4	0.9	0.9	0.6	0.6	0.3	3.8
1988	0.0	0.9	0.9	0.6	0.6	0.3	3.3
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.9	0.6	0.6	0.3	2.5
1991	0.0	0.0	0.1	0.5	0.5	0.2	1.3
1992	0.1	0.1	0.1	0.5	0.5	0.2	1.5
1994	0.0	0.0	0.0	0.5	0.5	0.2	1.2
2001	0.0	0.9	0.9	0.6	0.6	0.3	3.3
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pope Ranch							
1976	0.0	0.0	0.6	0.6	0.6	0.3	2.0
1977	0.0	0.0	0.6	0.6	0.6	0.3	2.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.3	0.6	0.6	0.6	0.6	0.3	2.8
1988	0.0	0.6	0.6	0.6	0.6	0.3	2.5
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.6	0.6	0.6	0.3	2.0
1991	0.0	0.0	0.6	0.6	0.6	0.3	2.0
1992	0.3	0.6	0.6	0.6	0.6	0.3	2.8
1994	0.0	0.0	0.0	0.6	0.6	0.3	1.4
2001	0.0	0.6	0.6	0.6	0.6	0.3	2.5
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eastside Mutual Water Company							
1976	0.2	0.4	0.4	0.5	0.5	0.2	2.2
1977	0.0	0.4	0.4	0.4	0.4	0.2	1.8
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.2	0.4	0.4	0.5	0.5	0.2	2.2
1988	0.2	0.4	0.4	0.5	0.5	0.2	2.2
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.4	0.4	0.5	0.5	0.2	2.0
1991	0.0	0.4	0.4	0.4	0.4	0.2	1.8
1992	0.2	0.4	0.4	0.4	0.4	0.2	2.0
1994	0.2	0.4	0.4	0.4	0.4	0.2	2.0
2001	0.2	0.4	0.4	0.5	0.5	0.2	2.2
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B2. Simulated Crop Idling Transfers for Alternative 2 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Glenn-Colusa Irrigation District							
1976	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1977	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1981	0.0	0.6	0.8	0.9	0.9	0.6	3.7
1987	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1988	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1991	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1992	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1994	0.0	9.9	14.5	15.8	15.8	9.9	66.0
2001	0.0	9.9	14.5	15.8	15.8	9.9	66.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation District 108							
1976	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1977	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1988	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1991	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1992	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1994	0.0	3.0	4.4	4.8	4.8	3.0	20.0
2001	0.0	3.0	4.4	4.8	4.8	3.0	20.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Butte Water District							
1976	0.0	0.9	1.3	1.4	1.4	0.9	6.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.9	1.3	1.4	1.4	0.9	6.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.9	1.3	1.4	1.4	0.9	6.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.9	1.3	1.4	1.4	0.9	6.0
1994	0.0	0.9	1.3	1.4	1.4	0.9	6.0
2001	0.0	0.9	1.3	1.4	1.4	0.9	6.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B2. Simulated Crop Idling Transfers for Alternative 2 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Reclamation District 1004							
1976	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1977	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1988	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1991	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1992	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1994	0.0	0.7	1.1	1.2	1.2	0.7	5.0
2001	0.0	1.5	2.2	2.4	2.4	1.5	10.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sycamore Mutual Water Company							
1976	0.0	0.8	1.1	1.2	1.2	0.8	5.0
1977	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.8	1.1	1.2	1.2	0.8	5.0
1988	0.0	0.8	1.1	1.2	1.2	0.8	5.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.8	1.1	1.2	1.2	0.8	5.0
1991	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1992	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1994	0.0	0.1	0.2	0.2	0.2	0.1	1.0
2001	0.0	0.8	1.1	1.2	1.2	0.8	5.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation District 2068							
1976	0.0	0.5	0.7	0.7	0.7	0.5	3.0
1977	0.0	0.5	0.7	0.7	0.7	0.5	3.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.5	0.7	0.7	0.7	0.5	3.0
1988	0.0	0.5	0.7	0.7	0.7	0.5	3.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.5	0.7	0.7	0.7	0.5	3.0
1991	0.0	0.5	0.7	0.7	0.7	0.5	3.0
1992	0.0	0.5	0.7	0.7	0.7	0.5	3.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.2
2001	0.0	0.5	0.7	0.7	0.7	0.5	3.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B2. Simulated Crop Idling Transfers for Alternative 2 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Pelger Mutual Water Company							
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.1	0.1	0.1	0.1	0.1	0.4
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.1	0.1	0.1	0.1	0.1	0.4
1992	0.0	0.1	0.1	0.1	0.1	0.1	0.4
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B3. Simulated Crop Idling Transfers for Alternative 4 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Glenn-Colusa Irrigation District							
1976	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1977	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1988	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1991	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1992	0.0	9.9	14.5	15.8	15.8	9.9	66.0
1994	0.0	9.9	14.5	15.8	15.8	9.9	66.0
2001	0.0	9.9	14.5	15.8	15.8	9.9	66.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conaway Preservation Group							
1976	0.0	3.2	4.7	5.1	5.1	3.2	21.3
1977	0.0	2.4	3.5	3.8	3.8	2.4	16.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	3.2	4.7	5.1	5.1	3.2	21.3
1988	0.0	3.2	4.7	5.1	5.1	3.2	21.3
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	3.2	4.7	5.1	5.1	3.2	21.3
1991	0.0	2.4	3.5	3.8	3.8	2.4	16.0
1992	0.0	2.4	3.5	3.8	3.8	2.4	16.0
1994	0.0	2.4	3.5	3.8	3.8	2.4	16.0
2001	0.0	3.2	4.7	5.1	5.1	3.2	21.3
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation District 108							
1976	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1977	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1988	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1991	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1992	0.0	3.0	4.4	4.8	4.8	3.0	20.0
1994	0.0	2.4	3.6	3.9	3.9	2.4	16.2
2001	0.0	3.0	4.4	4.8	4.8	3.0	20.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B3. Simulated Crop Idling Transfers for Alternative 4 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Butte Water District							
1976	0.0	1.7	2.5	2.8	2.8	1.7	11.5
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.7	2.5	2.8	2.8	1.7	11.5
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.7	2.5	2.8	2.8	1.7	11.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	1.7	2.5	2.8	2.8	1.7	11.5
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.7	2.5	2.8	2.8	1.7	11.5
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation District 1004							
1976	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1977	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1988	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1991	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1992	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.5	2.2	2.4	2.4	1.5	10.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sycamore Mutual Water Company							
1976	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1977	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1988	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1991	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1992	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.5	2.2	2.4	2.4	1.5	10.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B3. Simulated Crop Idling Transfers for Alternative 4 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Goose Club Farms/ Teichert							
1976	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1977	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1988	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1991	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1992	0.0	1.5	2.2	2.4	2.4	1.5	10.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.5	2.2	2.4	2.4	1.5	10.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pleasant Grove-Verona Mutual Water Company							
1976	0.0	1.4	2.0	2.2	2.2	1.4	9.0
1977	0.0	1.4	2.0	2.2	2.2	1.4	9.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.4	2.0	2.2	2.2	1.4	9.0
1988	0.0	1.4	2.0	2.2	2.2	1.4	9.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.4	2.0	2.2	2.2	1.4	9.0
1991	0.0	1.4	2.0	2.2	2.2	1.4	9.0
1992	0.0	1.4	2.0	2.2	2.2	1.4	9.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.4	2.0	2.2	2.2	1.4	9.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation District 2068							
1976	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1977	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1988	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1991	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1992	0.0	1.1	1.7	1.8	1.8	1.1	7.5
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.1	1.7	1.8	1.8	1.1	7.5
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B3. Simulated Crop Idling Transfers for Alternative 4 (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Te Velde Trust							
1976	0.0	1.0	1.5	1.7	1.7	1.0	7.0
1977	0.0	0.2	0.3	0.4	0.4	0.2	1.5
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	1.0	1.5	1.7	1.7	1.0	7.0
1988	0.0	1.0	1.5	1.7	1.7	1.0	7.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	1.0	1.5	1.7	1.7	1.0	7.0
1991	0.0	0.2	0.3	0.4	0.4	0.2	1.5
1992	0.0	0.2	0.3	0.4	0.4	0.2	1.5
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	1.0	1.5	1.7	1.7	1.0	7.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pelger Mutual Water Company							
1976	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1977	0.0	0.3	0.4	0.5	0.5	0.3	1.9
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1988	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1991	0.0	0.3	0.4	0.5	0.5	0.3	1.9
1992	0.0	0.3	0.4	0.5	0.5	0.3	1.9
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.4	0.6	0.6	0.6	0.4	2.5
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cranmore Farms							
1976	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1977	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1988	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1991	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1992	0.0	0.4	0.6	0.6	0.6	0.4	2.5
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.4	0.6	0.6	0.6	0.4	2.5
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table B4: Simulated Reservoir Release Transfers for Specified Alternatives (1,000 acre-feet)

WY	Apr	May	Jun	Jul	Aug	Sep	Total
South Sutter Water District: Alts. 2, 3, & 4							
1989	0	0	0	14	1	0	15
1990	0	0	0	5	0	0	5
1992	0	0	0	15	0	0	15
1994	0	0	0	5	0	0	5
Browns Valley Irrigation District: Alts. 2, 3, & 4							
1981	0	0	0	5	0	0	5
2001	0	0	0	5	0	0	5

Additionally, Browns Valley ID is simulated to make a conserved water transfer of 3,100 acre-feet in July of the following years: 1976, 1977, 1987, 1988, 1990, 1991, 1992, 1994, and 2001. This conserved water transfer operates similar to a reservoir release transfer from New Bullards Bar Reservoir.

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Placer County Water Agency: Alts. 2, 3, & 4							
1976 1977	0	8.2	7.5	6.8	7.2	9.0	38.7
1977	0	4.1	3.2	4.3	4.9	5.5	22.0
1981	0	8.2	7.8	7.9	8.1	7.4	39.4
1987	0	8.2	7.6	8.2	8.3	7.2	39.5
1988	0	4.1	3.8	4.0	4.5	4.6	21.0
1990	0	8.2	8.0	7.7	8.2	7.7	39.8
1991	0	5.2	3.9	3.5	4.1	3.8	20.5
1992	0	1.2	1.2	1.3	1.3	0.9	5.9
1994	0	8.4	7.9	8.2	7.9	6.7	39.0
2001	0	8.2	7.6	8.2	8.3	7.3	39.5

Values shown are releases from PCWA reservoirs into Folsom Reservoir. Water is released from Folsom for rediversion at Freeport by EBMUD at approximately 3,800 acre-feet per month from July through February.

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Merced Irrigation District: Alts. 2 & 3							
1972	18	12	0	0	0	0	30
1981	18	12	0	0	0	0	30
1992	18	12	0	0	0	0	30
2001	18	12	0	0	0	0	30

In Alts. 2 & 3 transfers from Merced ID are diverted from facilities on the lower San Joaquin River.

WY	Apr	May	Jun	Jul	Aug	Sep	Total
Merced Irrigation District: Alt. 4							
1981	0	0	0	30	0	0	30
1992	0	0	0	30	0	0	30
2001	0	0	0	30	0	0	30

In Alt. 4 transfers from Merced ID are diverted from CVP/SWP facilities in the south Delta.

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Appendix C

Delta Conditions Assessment

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Appendix C
Delta Conditions Assessment

C.1 Background

Hydrologic conditions, climatic variability, and regulatory requirements for operation of water projects commonly affect water supply availability in California. This variability strains water supplies, making advance planning for water shortages necessary and routine. In the past decades, water transfers have become a common tool in water resource planning to supplement available water supplies to serve existing demands.

The United States Department of the Interior, Bureau of Reclamation (Reclamation) manages the Central Valley Project (CVP), which includes storage in reservoirs (such as Shasta, Folsom, and Trinity reservoirs) and diversion pumps in the Sacramento-San Joaquin Delta (Delta) to deliver water to users in the San Joaquin Valley and San Francisco Bay area. When these users experience water shortages, they may look to water transfers to help reduce potential impacts of those shortages.

A water transfer involves an agreement between a willing seller and a willing buyer. To make water available for transfer and conveyance to the Buyer Service Area for beneficial use, the willing seller must take an action to reduce the consumptive use of water or reduce reservoir storage. Water transfers would only be used to help meet existing demands and would not serve any new demands in the Buyer Service Area.

Reclamation and the San Luis & Delta-Mendota Water Authority (SLDMWA) are completing a joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR), in compliance with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), for water transfers from 2015 through 2024. Reclamation is serving as the Lead Agency under NEPA and SLDWMA is the Lead Agency under CEQA. Reclamation would facilitate transfers proposed by buyers and sellers. The SLDMWA, consisting of federal and exchange water service contractors in western San Joaquin Valley, San Benito, and Santa Clara counties, helps negotiate transfers in years when the member agencies could experience shortages.

This EIS/EIR evaluates water transfers that originate from entities located upstream of the Delta. Purchasing agencies are in areas south of the Delta or in the San Francisco Bay Area. Water transfers are subject to federal and state law.

This EIS/EIR analyzes transfers to CVP contractors, using CVP or SWP facilities to deliver these transfers.

C.2 Purpose of Delta Conditions Analysis

An analysis of Delta conditions is necessary to assist in evaluation of potential environmental impacts associated with Long-Term Water Transfers within the Delta. Water transfers have the potential to affect both the natural system and operation of the CVP and State Water Project (SWP). The purpose of this analysis is to simulate the hydrodynamics and water quality within the Delta when transfer water is made available by various sellers to determine how and where within the Delta the effects are likely to occur under the alternatives. Output from the Delta conditions analysis for parameters such as water level (stage), water quality, and environmental flows under D-1641 and the biological opinions (BOs) provides a basis for environmental assessment.

C.3 Analytical Approach

The Delta Conditions analysis is performed with the Delta Simulation Model 2 (DSM2). DSM2 setup relies on the output of three additional tools for this Project: CalSim II, the Transfer Operations Model (TOM), and the Delta Island Consumptive Use model (DICU model). CalSim II outputs simulating California’s water delivery system to the Delta are used to supply inflow and export boundary conditions to DSM2. Within DSM2, agricultural influences and the effect of meteorological conditions are modeled by boundary conditions supplied by the DICU, model. DSM2 boundary conditions affected by the assumptions under the alternatives are supplied by TOM.

DSM2 model results of a baseline (Base) alternative, the No Action/No Project Alternative without proposed water transfers, as developed in CALSIM II, are compared to model results with proposed water transfers under each alternative supplied by TOM to determine the extent and significance of any differences resulting from the transfers.

A distinction needs to be made between the uses of models for *absolute* versus *comparative* analyses. In an *absolute analysis,* the model is run once to predict an outcome – for example, the outcome could be the concentration of EC at one of the Delta water intakes. In a *comparative analysis*, the model is run twice, once with conditions representing a baseline and another run with an alternative representing some specific changes to Delta operations and/or bathymetry in order to assess the change in modeled outcome due to the given change in model configuration. The assumption is that while the model might not produce results reflecting these changes with absolute certainty, it does produce a reasonably reliable estimate of the relative change in outcome.

For the long-term water transfers analysis, as is customary in most projects using CalSim II planning models combined with DSM2, the analysis is a comparative analysis approach[1]. The Base alternative represents a condition that approximates an operational and regulatory framework that is assumed to determine the hydrodynamics and water quality in the Delta at an Existing Condition time frame. DSM2 was used to determine changes from due to the Alternatives in: EC patterns in the Delta; water level changes in the south Delta; changes in X2, the location of the 2 ppt salinity isohaline; and, changes in the magnitude of the combined flow in Old and Middle Rivers (OMR flow).

C.4 Model Descriptions

Models used in the Delta conditions analysis are described briefly in the following sections – DSM2, CALSIM II, the TOM and the DICU model. Appendix B supplies detail on the assumptions and logic used in CalSim II and TOM. For these studies, the modeled time frame is restricted to water years 1970 – 2003.

C.4.1 DSM2

DSM2 is a one-dimensional (1-D) hydrodynamic and water quality simulation model used to represent conditions in the Sacramento-San Joaquin Delta. The model was developed by the Delta Modeling Section (DMS) of the Department of Water Resources (DWR) and is used to model impacts associated with projects in the Delta. DSM2 has been used extensively to model hydrodynamics and salinity in the Delta, as well as Dissolved Organic Carbon (DOC). Salinity is modeled as electrical conductivity (EC), which is assumed to behave as a conservative constituent. DOC was not modeled in the current study.

DSM2 contains three separate modules, a hydrodynamic module (HYDRO), a water quality module (QUAL), and a particle tracking module (PTM). QUAL uses the hydrodynamics simulated in HYDRO as the basis for its transport calculations. PTM was not used in the current study. Detailed descriptions of the mathematical formulation implemented in the hydrodynamic module, DSM2-HYDRO and for EC in the water quality module, DSM2-QUAL, the data required for simulation, and the calibration of HYDRO and QUAL are documented in a series of reports available at: http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm .

The calibration of DSM2 has primarily focused on hydrodynamics and the conservative transport of salinity (EC). The DSM2 network used for the HYDRO hydrodynamic and QUAL water quality simulations in this study was updated in 2009 (Chilmakuri, 2009), The version of the model (V 8.1.2) used in

[1] 2003, http://sacramentoriverportal.org/modeling/CALSIM-Review.pdf

this study implements the NAVD88 datum in the formulation of the grid and the development of boundary conditions, a change from previous versions of the model.

C.4.2 DICU

The Delta Island Consumptive Use Model, or DICU[2] model, was developed by the Planning Division of DWR to estimate agricultural diversions and return flows to Delta channels. The DICU model is used in DSM2 to estimate historical agricultural flows and to estimate project planning model agricultural volumes and the salinity of return flows. These volumes and the associated concentration of water quality parameters are assigned to numerous DSM2 nodes. In this report, the term "DICU" is used to refer both to the conceptual model and to the associated computer program.

The values calculated for consumptive use in the conceptual model include the following parameters:

- Evapotranspiration – includes climatic conditions, soil type and plant type and associated acreage
- Precipitation – spatially distributed using Delta weather station values
- Surface runoff
- Soil moisture
- Irrigation – water diverted from channels, estimated by season
- Seepage – water used by plants flows from channels to Delta islands
- Drainage – return flows from irrigation and leaching to channels from Delta islands
- Leach water – heavy applications of water in winter months used to leach salts from soils.

The DICU model as a whole is most sensitive to changes in irrigation efficiency (a constant factor applied to irrigation withdrawals) and to leaching water estimates. Calculations for water diversions and returns are most sensitive to changes in efficiency of irrigation and in evapotranspiration. Changes in seepage values can cause changes in irrigation demands and in return flows, although they only have a small impact on return flows. Studies have indicated that DICU seepage estimates are probably low.

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[2] http://modeling.water.ca.gov/delta/reports/misc/EstDICU.pdf

The DICU model provides time series of values that are applied as boundary conditions on a monthly average basis[3],[4] (DWR, 1995a; DWR 2002) in DSM2 at 257[5] locations throughout the Delta – these locations are subdivided into 142 regions. There are three components to DICU flows – diversion, drainage and seepage. The total monthly diversions incorporate agricultural use, evaporation and precipitation, drains incorporate agricultural returns, and seeps incorporate channel depletions. These flows are distributed as boundary conditions that vary by region and by Water Year Type. Acreages for land use categories and crop type are varied by two categories of water year type, critical and non-critical. The critical years in the DICU model include the D-1485 (same as D-1641) water year classification types of Critical and Dry; non-critical years include the remaining Water Year classification types.

The concentration of EC in agricultural return flows, the Drain flows in DSM2, are also applied on a monthly average basis using the same monthly averages in every year regardless of water year type. The estimation of water quality concentrations in return flows in the DICU model is documented in DWR publications available online[6].

C.4.3 CALSIM II

CalSim is a model that was developed by the California Department of Water Resources to simulate California State Water Project (SWP) and Central Valley Project (CVP) operations in planning studies. CalSim II is the latest version of CalSim available for general use. It represents the Central Valley with a node and link structure to simulate natural and managed flows in rivers and canals. It generates monthly flows showing the effect of land use, potential climate change, and water operations on flows throughout the Central Valley.

CalSim II is a simulation by optimization model which simulates operations by solving a mixed-integer linear program to maximize an objective function for each month of the simulation. CalSim II simulates the operation of the CVP and SWP systems for defined physical conditions and a set of regulatory requirements. The model simulates these conditions using up to 82 years of historical hydrology from Water Year (WY) 1922 through WY 2003.

The system objectives and constraints are specified as input to the model, and CalSim II then utilizes optimization techniques to route water through a network representing the California water system given user-defined priority weights. A linear programming (LP)/mixed integer linear programming (MILP) solver determines an optimal set of decisions for each time period given this set

[3] http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dicu/dicu.cfm

[4] http://www.iep.ca.gov/dsm2pwt/reports/DSM2FinalReport_v07-19-02.pdf, http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dicu/DICU_Dec2000.pdf

[5] note that Byron-Bethany irrigation district is included as a DICU flow in Clifton Court Forebay, so there are actually 258 DICU nodes

[6] http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dicu/DICU_Dec2000.pdf

of weights and system constraints. The CalSim II model has been designed to separate the physical and operational criteria from the actual process of determining the allocations of water to competing interests. Thus, CalSim II provides quantitative hydrologic-based information to those responsible for planning, managing and operating the SWP and CVP. As the official model of those projects, CalSim II is the default system model for the analysis of water in the Central Valley of California.[7]

C.4.4 Transfer Operations Model (TOM)

TOM was developed to analyze effects of Long-Term Water Transfers on the CVP, SWP, major rivers, and the Delta by tracking: the water made available from various sellers as it moves through the system; the effects on CVP and SWP operations; and, the diversion of transfer water by buyers. TOM simulates operations on a monthly time-step for the same 34-year period as CalSim II, and its output is used is supply a subset of the boundary conditions used in DSM2 to model the Alternatives. (See Appendix B for more details.)

In real-time operations, tracking transfer water requires an increased level of coordination between CVP and SWP operators as it affects accounting under the Coordinated Operation Agreement (COA) between the CVP and SWP, and can require COA accounting adjustments. Transfer water can change the timing of when CVP and SWP Project water is moved. A portion of transfer water is typically used as carriage water to maintain Delta water quality when transfer water is moved through the Delta. This requires initial estimates for carriage water that must later be verified and adjusted. TOM was developed in consultation with Reclamation and with an understanding of both actual operations and CalSim II model assumptions. Rules used in TOM to simulate operational responses to water transfers and changes in stream-aquifer interaction were reviewed with CVP operations staff.

C.4.5 Level of Development

The Long-Term Water Transfers EIS/EIR is intended to provide environmental assessment for water transfers occurring over a ten-year period. Because of the relatively short horizon, it is anticipated that the existing Level of Development (LOD) would not substantially change, although reasonably foreseeable projects that may be constructed over the next ten years have been incorporated into the model. CalSim II existing LOD simulations depict how the modeled water system might operate with an assumed physical and institutional configuration imposed on a long-term hydrologic sequence, assuming that current land use, facilities, and operational objectives are in place for each year of simulation (water years 1970 through 2003). The results are a depiction of the current environment which provides a basis for comparison of alternatives effects for the impact analysis under CEQA. The ten-year period allows simulation of a

[7] http://sacramentoriverportal.org/modeling/CALSIM-Review.pdf, Section 6.1

single level of development under the assumptions that conditions are not likely to change significantly over such a short time horizon.

C.5 Modeling Methodology and Analysis Limitations

C.5.1 DSM2 Scenario Development

DWR-DMS has developed a series of computer applications, called preprocessors, to automate the generation of DSM2 model inputs and boundary conditions. These applications produce input time series for DSM2 flows from CalSim II output, as well as time series for the timing of operations for certain gates and barriers, for example, the gates at the entry of Clifton Court Forebay (CCFB) and the gates in the Delta Cross Channel (DCC). The time series, as well as the time series for DICU flows and EC concentrations, are copied into a single input file in the DSS data format that is read directly into DSM2. Boundary conditions for the Base case come solely from CalSim II output, while boundary conditions defining the alternatives come from TOM. As mentioned previously, these alternatives depict an Existing, or Current Conditions, LOD.

C.5.2 Inflow, Export and EC Boundary Conditions

Boundaries that define the movement of water into and out of the Delta, and thus also the transport of water quality constituents, consist of inflow boundaries, outflow boundaries and a stage boundary set at Martinez. In Figure C-1 (left), the main inflow boundary locations are denoted by blue dots as is the stage boundary at Martinez. The inflow boundaries are found at the each of the major rivers (Sacramento, San Joaquin, Calaveras, Mokelumne and Cosumnes), and at the Yolo Bypass. The stage boundary at Martinez is also an outflow boundary. In Figure C-1 (right), the approximate positions of Delta export/ diversion locations (water intakes) are shown.

CalSim II and EXCEL files were converted to DSM2 input. CalSim II output was developed as boundary conditions by running the preprocessors for DSM2. Time series in EXCEL files representing TOM model output were transferred to DSS format using the CalSim II file as a template, and then run through the DSM2 preprocessors. Similarly, the stage boundary at Martinez was obtained from a standardized time series under direction of the preprocessor logic. The EC boundary condition at Martinez is calculated in a DSM2 preprocessor using the NDO (Net Delta Outflow) value from CalSim II DSS file output and an equation defining an NDO-EC relationship at Martinez. The EC time series at the San Joaquin River location at Vernalis was supplied by MBK staff, either in the original CalSim II DSS file or in the EXCEL file with TOM model output. EC values at the other major inflow boundaries are set as standard constants for use in QUAL.

C.5.3 Limitations of the Analysis

There are limitations in the ability of models to accurately address all of the intricacies of complex water management operations. Professional judgment is required to interpret results and determine benefits and impacts. Analysis of Delta Conditions for the Long-Term Water Transfers is based on several models each with their own simplifications, idiosyncrasies and limitations. The overall analysis is therefore subject to the individual and combined limitations of these models. While it is important to recognize and acknowledge the limitations of models as they are applied for this analysis, these three models represent the best available tools for performing the analysis to serve as the basis for determining environmental impacts. The regular and continued use of DSM2, in particular, for planning studies and environmental assessment by Reclamation, DWR, and others indicates DSM2 is adequate for the purposes of this EIS/EIR.

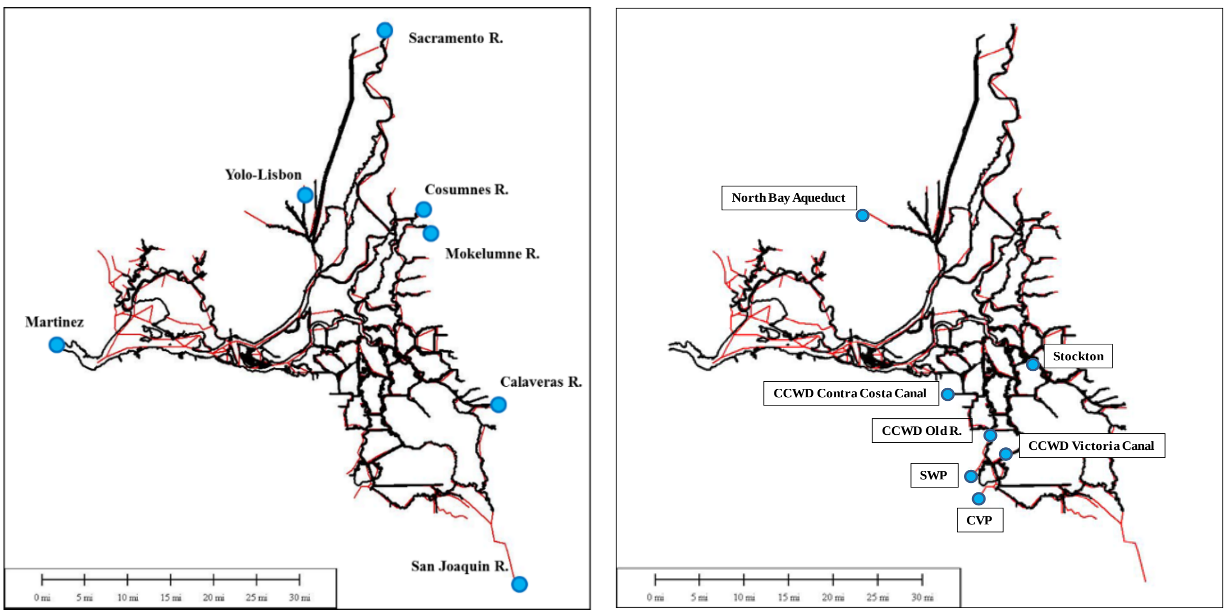

Figure C-1. Approximate Location (Blue Circles) Of: (Left) the Main Model Inflow Boundaries and the Stage Boundary At Martinez; and, (Right) the Water Intakes (Export Locations).

C.6 Description of Project Alternatives

C.6.1 Alternative 1: No Action/No Project Alternative

CEQA requires an EIR to include a No Action/No Project Alternative which allows for a comparison between the impacts of the action alternatives with Base case conditions. The No Action/No Project Alternative may include some reasonably foreseeable changes in existing conditions and changes that would be reasonably expected to occur in the foreseeable future if transfers were not approved.

Under the No Action/No Project Alternative, CVP related water transfers through the Delta would not occur from 2015-2024. However, other transfers that do not involve the CVP could occur under the No Action/No Project Alternative. Additionally, CVP transfers within basins could continue and would still require Reclamation's approval. Some CVP entities may decide that they are interested in selling water to buyers in export areas under the No Action/No Project Alternative; however, they would need to complete individual NEPA and Endangered Species Act (ESA) compliance for each transfer to allow Reclamation to complete the evaluation of the transfers for approval.

C.6.2 Alternative 2/Proposed Action: Full Range of Transfers

Alternative 2 would involve transfers from potential sellers upstream from the Delta to buyers in the Central Valley and Bay Area. Alternative 2 includes transfers under all potential transfer measures: groundwater substitution, reservoir release, conserved water, and cropland idling and crop shifting.

C.6.3 Alternative 3: No Cropland Modifications

Alternative 3 would include transfers through groundwater substitution, stored reservoir release, and conservation. It would not include any cropland idling or shifting transfers.

C.6.4 Alternative 4: No Groundwater Substitution

Alternative 4 would include transfers through cropland idling, crop shifting, stored reservoir release, and conservation. It would not include any groundwater substitution transfers.

C.6.5 Nomenclature Used in the DSM2 Analysis of Delta Conditions

The following descriptive nomenclature was used in headings and/or captions for Tables and Plots depicting model results for the Alternatives, and in the text of this document:

- Alternative 1 = (Existing Condition) Base
- Alternative 2 = All Transfers
- Alternative 3 = No Crop Idle
- Alternative 4 = No Groundwater Substitution

C.7 Comparison of Boundary Conditions for the Alternatives

Alternative 1, the Base condition, was simulated in DSM2 with the conditions defined by the baseline CalSim II output. These results represent reasonably foreseeable conditions for the 2015-2024 period and are used for comparison with results from each of the project alternatives. Selected boundary conditions for Alternatives 2 – 4 differed from CalSim II baseline conditions – the Base conditions and the monthly average differences are depicted in Figure C-2 through Figure C-10. Tables show computations of monthly average differences, average monthly differences and average monthly percent differences – the Attachment to this Appendix contain the full set of tabular results. In general, the Proposed Action has the greatest change from Base among the Alternatives.

Conditions for all other boundary conditions (not shown), including DICU flows and EC concentrations, were used by all four Alternatives. For the All Transfers and No Crop Idle alternatives, diversions of water for Banta Carbona Water District were specified downstream of Vernalis. These diversions were incorporated in the San Joaquin River inflow boundary instead of at their geographic location as they were small in volume, totaling 54 cfs in increments of 4 cfs over the simulation period (water years 1970 through 2003), and the diversion location would not affect any of parameters tracked for the Delta conditions analysis.

Table C-1 document the change from Base for Sacramento River inflow as shown in Figure C-2, while Table C-2 through Table C-4 show computation of the average monthly percent difference results. These tables show that the period July to September in Dry and Critical water years account for the increases in Sacramento River inflow for each of the water transfer alternatives, and that most other months and years have variable levels of decrease in inflow. The timing of the increases in inflow are in line with the release of transfer water from storage in upstream dams discussed in Appendix B. Percent decreases in inflow are less than 2% in all other months and year types.

Table C-1~~1~~. Monthly Average Difference in Sacramento River Inflow (c~~C~~fs) between the All Transfers and Base Alternatives, (All Transfers – Base). The Lower Table Computes Average Monthly Differences.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.5	-0.2	0.0	-0.2	0.3	0.0	0.2	-0.5	-0.4	-0.4	0.2	0.1
1971	0.5	-0.5	0.2	-0.4	-0.1	-0.3	0.2	0.0	0.3	-0.3	0.0	0.4
1972	-0.1	0.4	0.3	0.4	0.4	-0.1	-0.4	0.3	-0.4	-0.4	0.0	0.4
1973	0.5	0.3	-0.3	0.2	-0.4	0.1	0.3	0.0	0.0	-0.1	0.3	0.2
1974	-0.5	-0.3	0.4	-0.5	0.3	0.4	0.1	0.3	0.4	-0.4	-0.3	0.3
1975	0.2	-0.1	0.0	-0.1	0.1	-0.3	-0.5	0.2	-0.4	-0.2	0.1	-0.1
1976	0.3	-0.5	-0.1	-0.5	-0.3	0.2	-2.9	-4.6	-45.0	1279.9	2802.7	693.4
1977	-180.2	-167.5	-155.3	-155.8	-148.7	-146.2	-127.1	-120.2	-97.1	2118.5	826.0	471.0
1978	-146.4	-160.4	-162.1	-961.7	-849.3	-464.5	-123.7	-92.9	-58.4	0.3	-0.4	-0.3
1979	-0.1	-0.2	0.0	-84.7	-239.3	-76.8	-65.9	-49.4	-0.1	-0.1	-0.5	0.0
1980	-12.6	-30.7	-69.9	-196.4	-291.8	-48.9	-34.5	-27.9	-0.2	-0.3	0.2	0.1
1981	0.3	-13.8	0.5	-43.6	-29.2	-28.5	-22.5	-19.9	-37.8	66.8	1740.4	-102.3
1982	-153.3	62.5	-817.2	-198.8	-218.7	-100.8	-84.4	-199.9	-40.5	0.5	-0.1	-0.1
1983	-84.4	-150.4	-64.7	-50.0	-56.6	-63.2	-56.8	-49.4	-40.9	-30.8	-27.6	-25.6
1984	-23.7	-37.0	-37.2	-35.0	-31.4	-29.6	-20.3	-17.7	0.0	-13.7	0.0	0.3
1985	-0.1	-76.3	-20.9	-16.3	-20.8	-16.5	-13.1	-12.1	-10.6	-12.3	-11.7	-9.7
1986	-9.0	-9.1	-22.2	-16.1	-77.5	-19.9	-18.1	-11.2	-0.2	-0.2	0.4	-0.3
1987	0.3	-9.4	-8.9	-8.9	-12.0	-17.4	-46.0	-77.8	-106.5	1818.7	2956.2	659.8
1988	-216.7	-182.1	-276.8	-384.3	-82.3	-173.0	-165.1	-158.5	-126.5	2939.3	1189.0	567.7
1989	-237.4	-229.1	-222.9	-213.6	-204.0	-1104.4	-698.7	-210.6	-196.1	59.1	959.5	-30.2
1990	-186.6	-179.8	-168.8	-189.9	-409.6	-227.7	-85.6	-144.3	-96.6	2801.2	1042.1	616.0
1991	-197.1	-113.6	-91.9	-111.1	-114.4	-620.4	-240.6	-177.9	-198.1	2186.9	856.5	463.1
1992	-209.3	-186.1	-200.7	-193.7	-674.1	-286.3	-234.3	-198.9	-235.7	2889.0	1185.5	443.6
1993	-85.7	-218.3	-298.0	-1265.1	-1190.4	-1136.9	-226.0	-595.1	-184.2	-0.4	-0.5	0.1
1994	0.3	0.0	0.3	-90.1	-216.4	-110.4	-73.6	-64.5	-43.6	142.6	2682.3	503.4
1995	-157.6	-176.8	-189.7	-1176.5	-837.8	-282.3	-183.1	109.2	-311.7	-108.4	-100.0	-0.4
1996	-0.4	0.5	-129.0	-397.0	-117.1	-109.6	-102.4	-97.9	-66.3	0.3	0.5	0.2
1997	-0.3	0.3	-406.3	-92.0	-83.7	-75.8	-54.0	-49.2	0.3	-33.7	0.0	-30.4
1998	-29.6	-37.9	-48.2	-90.0	-272.1	-81.4	-74.2	-67.1	-59.2	-46.1	-41.5	-38.6
1999	0.5	-89.5	-46.6	-39.1	-53.5	-47.8	-46.0	-38.5	-30.0	-0.1	-0.1	-0.1
2000	0.1	0.4	-14.2	-110.9	-69.3	-109.4	-39.8	-31.3	-0.1	-18.3	-0.5	0.1
2001	-0.2	0.3	-22.5	-38.5	-33.9	-31.9	-28.8	-82.3	-112.7	3053.6	1524.6	657.0
2002	-185.6	-220.9	-236.8	-692.3	-440.7	-176.1	-335.0	-76.7	-61.3	-15.9	-49.0	-25.5
2003	-2.7	-24.0	-264.7	-165.5	-81.9	-77.7	-75.4	-137.2	-133.2	800.8	55.0	46.6
Average	-62.3	-66.2	-116.9	-206.4	-201.7	-166.6	-96.4	-79.5	-67.4	584.6	517.3	142.9
Critical	-141.3	-118.5	-127.6	-160.8	-235.1	-223.4	-132.8	-124.1	-120.4	2051.0	1512.0	536.9
Dry	-70.4	-91.6	-85.3	-168.9	-123.4	-229.1	-190.7	-79.9	-87.5	828.3	1186.7	191.5
BN	-0.1	0.1	0.2	-42.1	-119.4	-38.5	-33.1	-24.5	-0.2	-0.3	-0.3	0.2
AN	-41.1	-72.1	-134.8	-449.9	-413.8	-306.2	-83.2	-147.4	-62.7	130.3	9.0	7.8
Wet	-35.2	-33.7	-135.4	-161.2	-134.4	-62.4	-49.2	-32.4	-42.2	-18.0	-12.9	-7.3

Table C-2~~2~~. Average Monthly Percent Difference in Sacramento River Inflow Between the All Transfers and Base Alternatives.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.8	-0.7	-0.6	-0.6	-0.7	-0.6	-0.5	-0.6	-0.5	4.3	5.2	1.8
Critical	-1.9	-1.5	-1.4	-1.1	-1.3	-1.5	-1.2	-1.5	-1.2	15.7	15.8	7.0
Dry	-1.0	-0.8	-0.5	-0.6	-0.8	-0.6	-1.1	-0.7	-0.7	5.6	11.1	2.3
BN	0.0	0.0	0.0	-0.2	-0.4	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0
AN	-0.6	-1.0	-0.7	-1.0	-0.9	-0.8	-0.3	-0.6	-0.3	0.5	0.1	0.0
Wet	-0.3	-0.2	-0.4	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0

Table C-3~~3~~. Average Monthly Percent Difference in Sacramento River Inflow between the No Groundwater Substitution and Base Alternatives.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.4	-0.3	-0.2	-0.2	-0.3	-0.2	-0.2	0.0	-0.2	2.4	2.4	0.8
Critical	-0.8	-0.6	-0.5	-0.3	-0.6	-0.5	-0.6	0.1	-0.8	9.2	7.3	3.7
Dry	-0.4	-0.3	0.0	-0.3	-0.4	-0.3	-0.7	-0.2	-0.2	2.4	5.0	0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.4	-0.4	-0.2	-0.4	-0.6	-0.1	0.0	-0.1	0.0	0.2	-0.2	-0.1
Wet	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-4~~4~~. Average Monthly Percent Difference in Sacramento River Inflow between the No Crop Idle and Base Alternatives.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.8	-0.7	-0.6	-0.6	-0.7	-0.6	-0.5	-0.6	-0.4	2.9	3.1	1.0
Critical	-1.9	-1.5	-1.4	-1.1	-1.3	-1.5	-1.2	-1.5	-1.1	9.9	8.4	3.6
Dry	-1.0	-0.8	-0.5	-0.6	-0.8	-0.6	-1.1	-0.7	-0.6	4.4	7.7	1.3
BN	0.0	0.0	0.0	-0.2	-0.4	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0
AN	-0.6	-1.0	-0.7	-1.0	-0.9	-0.8	-0.3	-0.6	-0.3	0.5	0.1	0.0
Wet	-0.3	-0.2	-0.4	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0

The East Bay Municipal Utility District (EBMUD) transfer water occur as exports on the upper Sacramento River near Freeport. Table C-5, Table C-6 and Figure C-3 illustrate these results. The flow volumes are small in comparison with Sacramento River flows. The exports of transfer water occur mainly in Critical and Dry water years, although some transfer also occurs in a few Above Normal or Wet water years.

Table C-55. Monthly Average Difference in EBMUD Export (cfs) for the All Transfers Alternative, (All Transfers – Base). The Lower Table Computes Average Monthly Differences.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1977	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1978	62.5	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1982	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1988	62.5	62.5	62.5	62.5	65.3	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1989	62.5	7.5	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1990	62.5	34.5	33.0	0.9	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1991	67.9	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1992	62.5	62.5	62.5	1.2	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1993	0.0	6.8	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1995	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
2002	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	18.5	11.2	10.5	3.7	3.8	5.5	5.5	11.0	11.0	20.2	20.2	20.2
Critical	45.4	31.7	31.5	18.2	18.3	26.8	26.8	44.6	44.6	62.5	62.5	62.5
Dry	20.8	11.7	10.4	0.0	0.0	0.0	0.0	10.4	10.4	41.7	41.7	41.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	10.4	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	9.6	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-6~~6~~. Average Monthly Difference in EBMUD Exports (cfs) for Alternatives 3 and 4.

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	18.5	11.2	10.5	3.7	3.8	5.5	5.5	9.8	9.8	18.4	19.6	18.8
Critical	45.4	31.7	31.5	18.2	18.3	26.8	26.8	38.6	38.5	53.6	59.6	55.8
Dry	20.8	11.7	10.4	0.0	0.0	0.0	0.0	10.4	10.4	41.7	41.7	41.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	10.4	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	9.6	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	16.7	10.6	10.5	3.7	3.8	5.5	5.5	9.2	9.2	18.4	18.8	18.5
Critical	36.5	28.6	31.5	18.2	18.3	26.8	26.8	44.6	44.6	62.5	62.5	62.5
Dry	20.8	11.7	10.4	0.0	0.0	0.0	0.0	0.0	0.0	31.3	33.9	32.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	10.4	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	9.6	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

On the San Joaquin River (Figure C-4), Table C-7 shows that the average monthly percent change from Base inflow is less than +/- 2% for all months, water year types and alternatives except for July in Dry and Critical water years in the No Groundwater Substitution alternative, Alternative 3, whose results for average monthly percent difference results are shown in Table C-7. As can be seen in Figure C-3, the increased flow of approximately 500 cfs in this alternative occurred in exactly three water years (1981, 1992 and 2001). Figure C-5, San Joaquin River inflow EC for Base and change from Base for the Alternatives, illustrates that the upstream changes on the San Joaquin make little difference to inflow EC, as increases and decreases were infrequent and small in magnitude. Thus, the changes in San Joaquin River inflow and EC in Alternatives 2 through 4 have very little influence on the model results in the Delta.

Table C-7~~7~~. Average Monthly Percent Difference in San Joaquin River Inflow between the No Groundwater Substitution and Base Alternatives

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.3	5.5	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.9	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

South Delta exports at the SWP-Banks and CVP-Jones locations, Figure C-6 and Figure C-7 respectively, show a similar pattern to Sacramento R. inflow in monthly average percent difference increases and decreases, shown in Table C-8 and Table C-9 for Alternative 2. Increases in export flow occur July and August in Dry and Critical years at SWP, and July – September in Dry and Critical years at CVP. The patterns of percent increases and decreases of exports at these locations are similar for Alternatives 3 and 4, but the percentages are smaller (see the Attachment Section on Export Boundary Conditions for monthly average table details).

Table C-88. Average Monthly Percent Difference in SWP Export Flow between the All Transfers and Base Alternatives.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.3	-1.0	-0.3	-0.5	-0.2	-0.2	-0.1	-0.2	-0.6	11.2	7.3	-1.1
Critical	-3.6	-2.1	-1.4	-2.4	-0.2	-0.7	0.0	0.0	-1.6	35.3	33.7	-3.9
Dry	-2.9	-0.4	0.0	-0.3	-0.7	0.0	-0.6	-0.9	-1.7	21.2	2.3	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	-2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
Wet	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-99. Average Monthly Percent Difference in CVP Export Flow between the All Transfers and Base Alternatives.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.8	-0.7	-0.3	-0.4	1.6	-0.4	-0.2	-1.2	-0.9	14.6	15.0	5.4
Critical	-1.7	-1.6	-1.5	-1.6	-0.4	-1.7	-0.8	-3.3	-2.6	67.4	43.3	20.4
Dry	-0.8	-0.5	-0.1	-0.4	-0.5	0.0	-0.5	-3.0	-2.2	3.5	34.5	7.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.8	-0.1	0.0	9.8	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Wet	-0.5	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1

The export volumes are much smaller at each of the three Contra Costa Water District (CCWD) export locations, shown in Figure C-10 through Figure C-8. For each of these transfer water buyers, all changes in exports are increases for each of the alternatives, unlike the SWP and CVP which also experience decreases in export flow in the Alternatives. The three locations have different patterns of increases in the export of transfer water – although all exports occur in Critical and Dry water years, the Old River location (Table C-10) only exports transfer water in August and September, while the other two locations also export water in July (Table C-11 and Table C-12).

Table C-10~~10~~. Average Monthly Change from Base for CCWD Old River Exports (cfs) for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	11.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4	21.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	11.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4	21.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	5.5
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	11.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4	18.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-11~~11~~. Average Monthly Change from Base for CCWD Rock Slough Exports (cfs) for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.1	8.5	10.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.1	41.2	36.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.7	0.0	13.9
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.1	8.5	10.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.1	41.2	36.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.7	0.0	13.9
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	8.5	8.2
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.1	41.2	36.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.1	0.0	3.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-12~~12~~. Average Monthly Change from Base for CCWD Victoria Canal Exports (cfs) for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	8.3	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	23.1	24.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	6.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	8.3	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	23.1	24.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	6.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	6.0	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	23.1	24.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	6.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-13 illustrates the percent change from Base Net Delta Outflow (NDO) for the alternatives – NDO is the sum of all inflow and outflows set as boundary conditions in DSM2 as calculated in CalSim II. NDO percent changes in the table reflect the changes in Sacramento inflow with the largest increases occurring July through September in Critical and Dry water years for all alternatives in comparison with Base With a few exceptions, the rest of the differences from Base are relatively small percent decreases. Figure C-11 illustrates the plot of Base NDO and the change from Base NDO for the alternatives. The Martinez EC boundary condition, illustrated in Figure C-12 as a monthly average, is calculated in a preprocessor from NDO for each of the Alternatives.

Table C-13~~13~~. Average Monthly Percent Change from Base Net Delta Outflow (cfs) for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	-0.1	-0.4	-0.4	-0.5	-0.5	-0.4	-0.3	-0.3	3.3	2.6	1.5
Critical	0.0	0.0	-0.2	-0.4	-1.0	-0.8	-0.6	-0.4	-0.3	12.3	7.7	5.1
Dry	0.0	-0.5	-0.6	-0.3	-0.5	-0.6	-0.9	-0.3	0.0	4.3	5.5	2.6
BN	0.0	0.0	0.0	-0.2	-0.3	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0
AN	0.0	-0.1	-0.8	-0.7	-0.8	-0.9	-0.2	-0.5	-1.0	0.1	0.3	0.1
Wet	-0.1	0.0	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	-0.1	-0.4	-0.4	-0.5	-0.5	-0.4	-0.3	-0.3	2.2	1.7	1.1
Critical	0.0	0.0	-0.2	-0.4	-1.0	-0.8	-0.6	-0.5	-0.3	7.9	4.9	3.4
Dry	0.0	-0.5	-0.6	-0.3	-0.5	-0.6	-0.9	-0.3	0.0	3.5	4.0	2.0
BN	0.0	0.0	0.0	-0.2	-0.3	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0
AN	0.0	-0.1	-0.8	-0.7	-0.8	-0.9	-0.2	-0.5	-1.0	0.1	0.3	0.1
Wet	-0.1	0.0	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	-0.1	-0.2	-0.1	-0.1	0.3	0.0	1.9	1.1	0.7
Critical	0.0	0.0	0.0	0.0	-0.3	-0.1	0.0	1.6	0.2	7.1	3.7	2.6
Dry	0.0	0.0	0.2	-0.1	-0.2	-0.2	-0.6	0.0	0.0	2.4	1.8	1.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.3	-0.4	-0.1	0.0	-0.1	-0.4	0.0	0.0	0.0
Wet	0.0	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

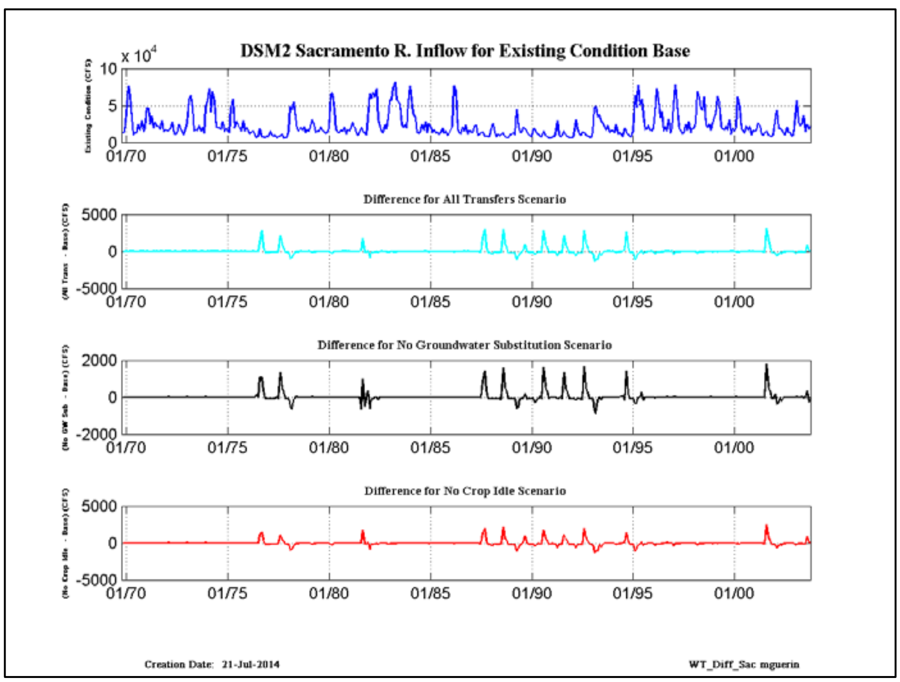

Figure C-2. Sacramento River Inflow for the Base Condition and Change from Base for the Alternatives.

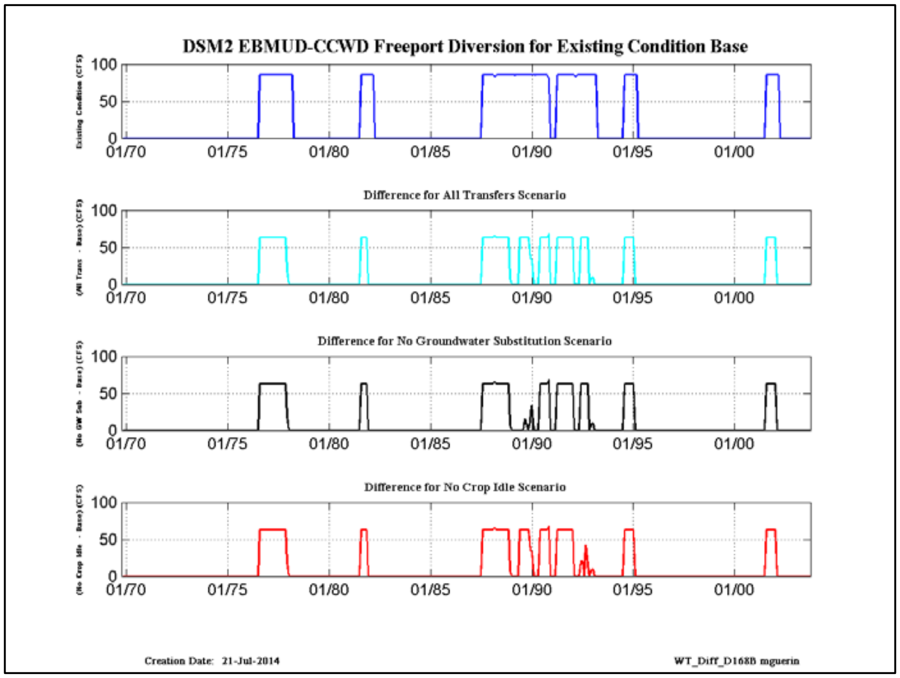

Figure C-3. EBMUD Freeport Diversion for the Base Condition and Change from Base for the Alternatives.

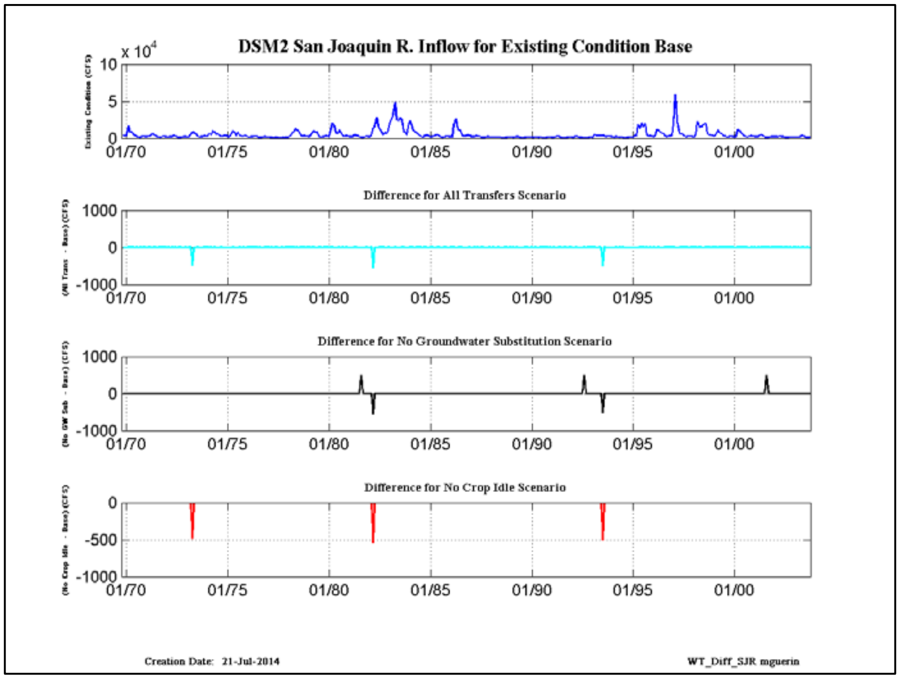

Figure C-4. San Joaquin R. inflow for Existing Base Condition and Change from Base for the Alternatives.

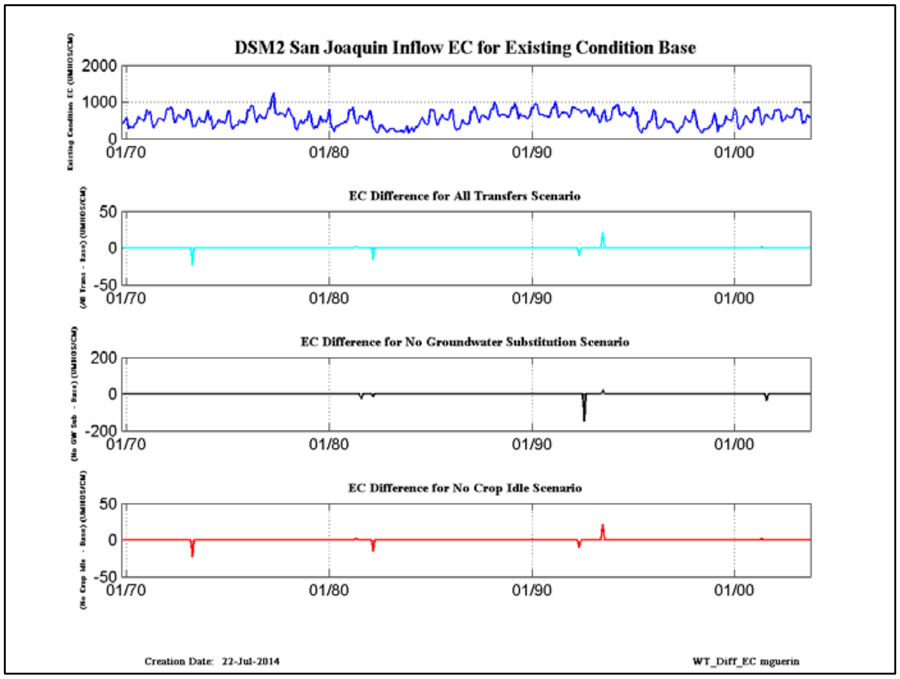

Figure C-5. San Joaquin inflow EC for Existing Base Condition and Change from Base for the Alternatives.

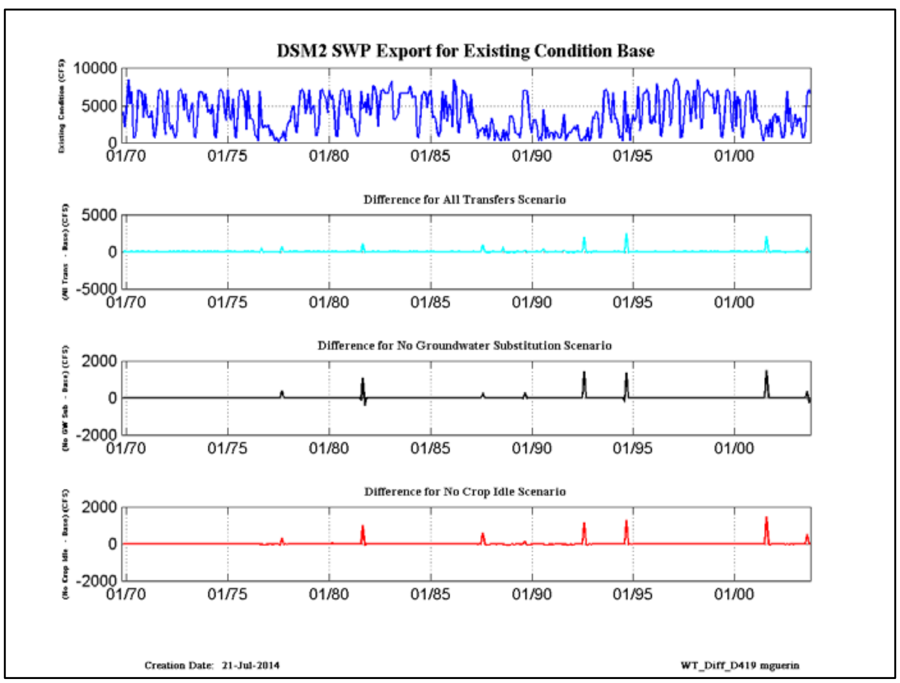

Figure C-6. SWP Export for the Base Condition and Change from Base for the Alternatives.

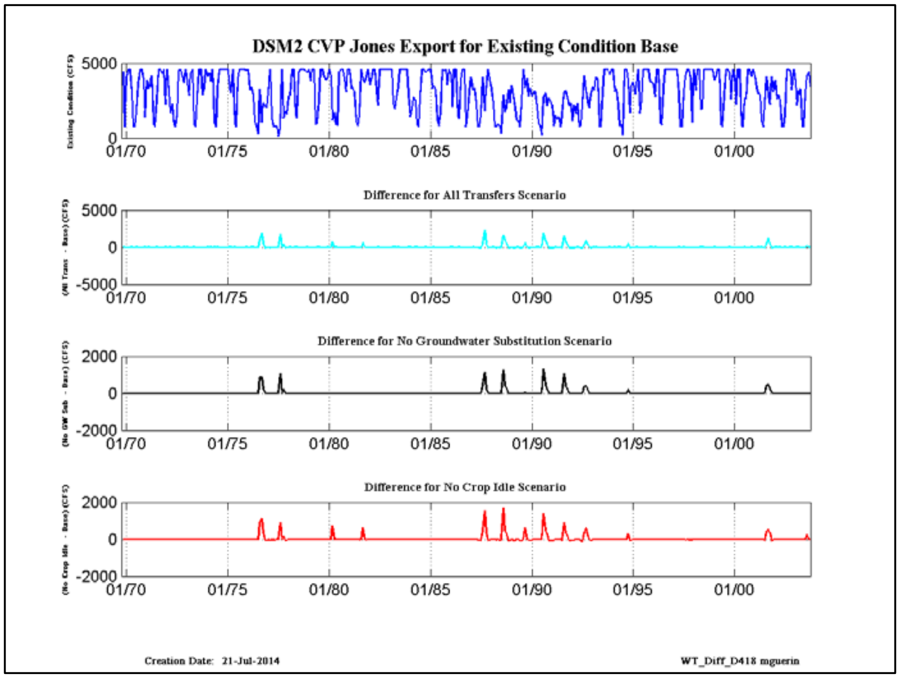

Figure C-7. CVP Export for the Base Condition and Change from Base for the Alternatives.

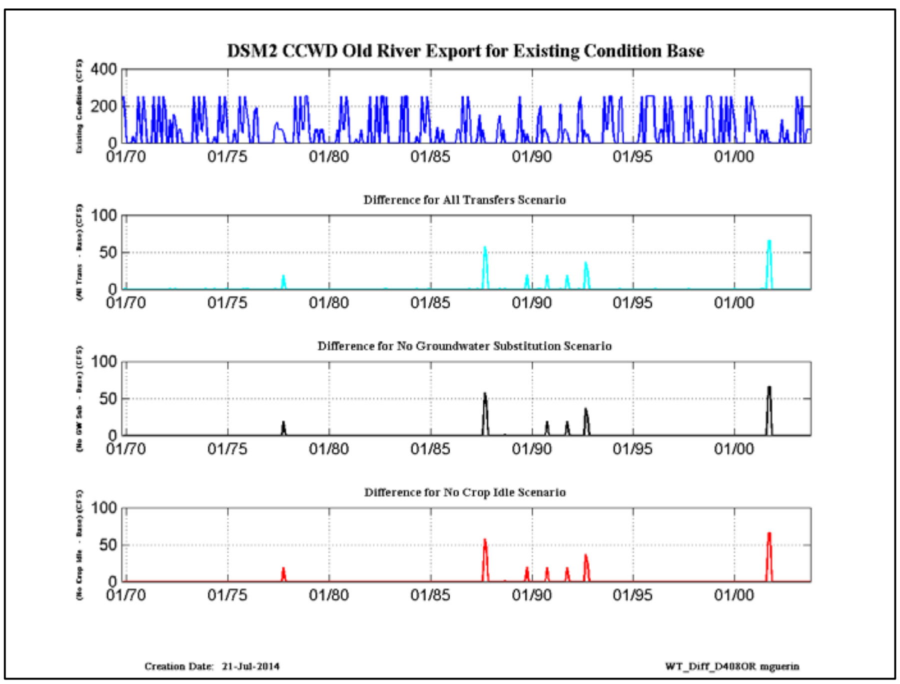

Figure C-8. CCWD Old River Export for the Base Condition and Change from Base for the Alternatives.

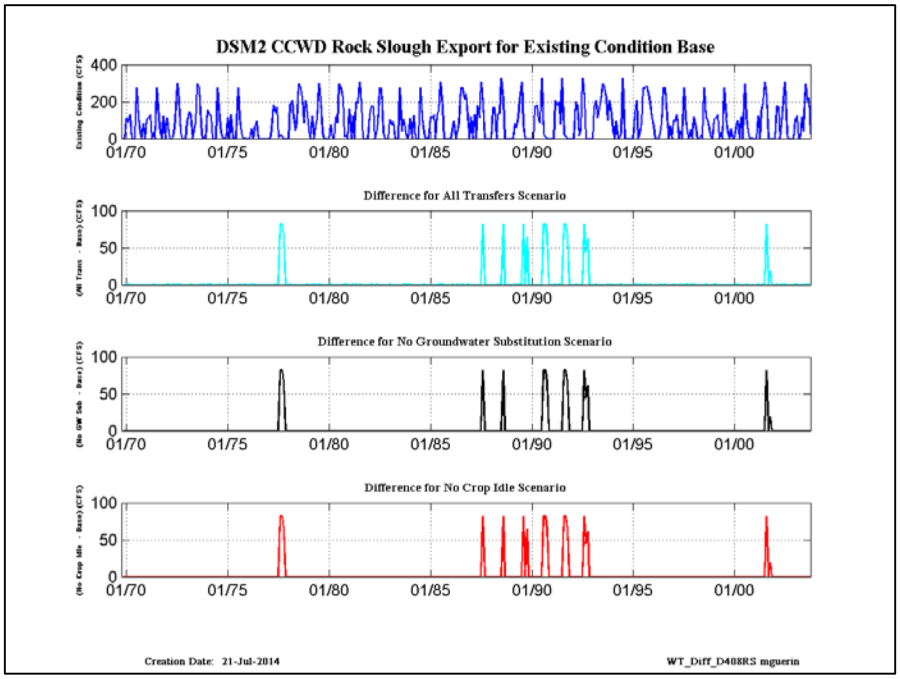

Figure C-9. CCWD Rock Slough Export for the Base Condition and Change from Base for the Alternatives.

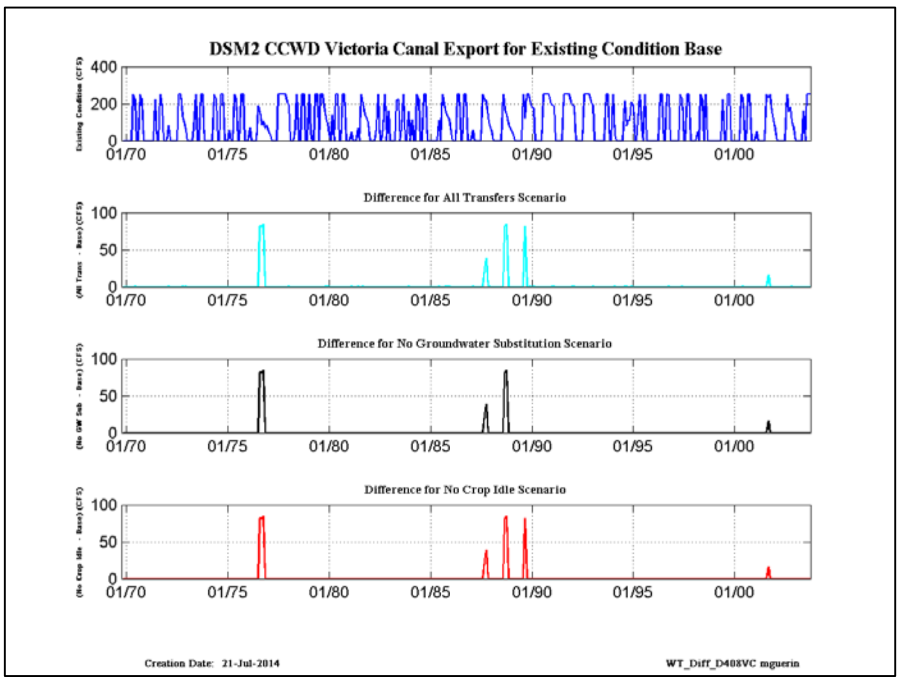

Figure C-10. CCWD Victoria Canal Export for the Base Condition and Change from Base for the Alternatives.

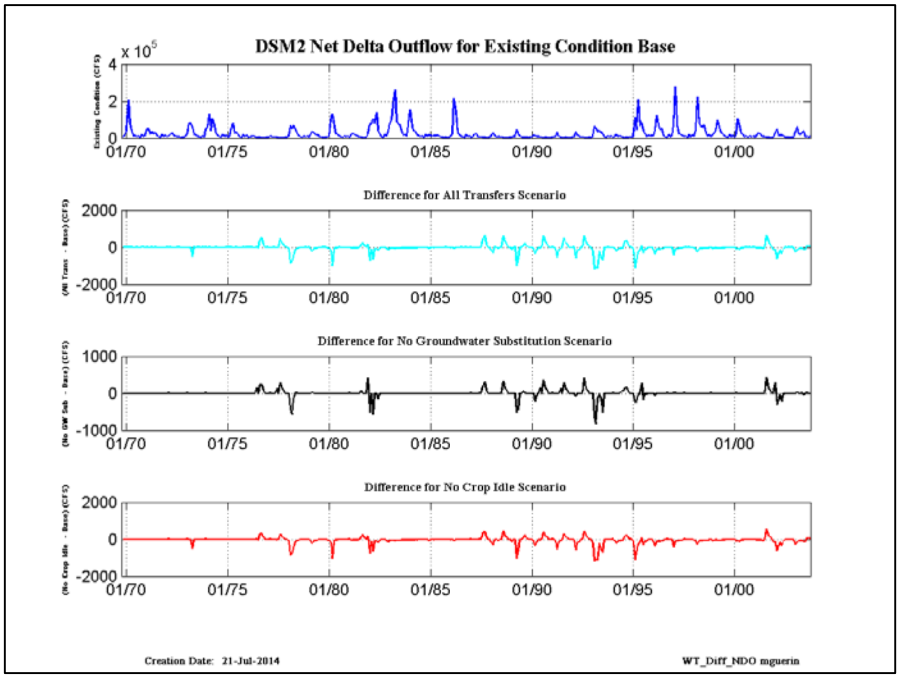

Figure C-11. Net Delta Outflow for the Base Condition and Change from Base for the Alternatives.

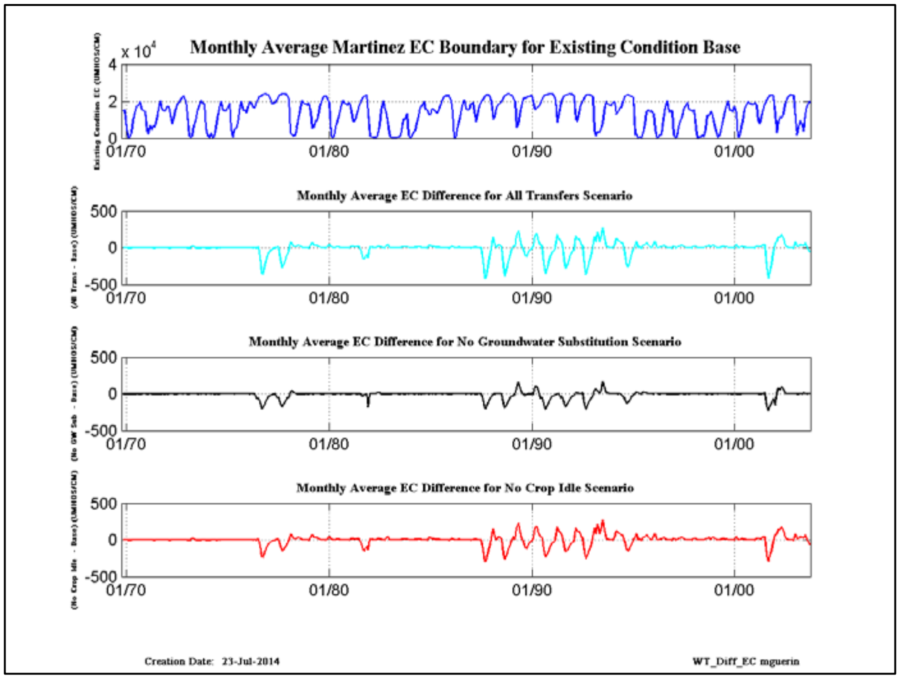

Figure C-12. Monthly Average Martinez EC for the Base Condition and Change from Base for the Alternatives.

C.8 Comparison of Salinity (EC) Results

The change in EC for Alternatives 2 – 4 in large part reflects the changes in flow for the Sacramento River and the SWP and CVP exports as these volumes were by far the largest in magnitude in comparison with the Base, Alternative 1. The largest changes in EC should reflect the balance between these two flows for the alternatives, as Sacramento inflow increases tend to reduce EC in the Delta while SWP+CVP export increases tend to increase EC. If export increases dominate locally, EC increases due to increased intrusion of Martinez EC, and if Sacramento inflow increases dominate locally, EC will decrease. In addition, when the Delta Cross Channel is open, low EC Sacramento River water reaches the central Delta, mainly through Middle River – increases in this flow are facilitated by increases in SWP and CVP export pumping. Table C-14 illustrates that on average, flow through the DCC was greater than Base flow July - September in Critical and Dry water years for all alternatives while in almost all other months and water year types, Base flow through the DCC was greater.

In this section, modeled EC results are presented at selected D-1641 locations that showed a change from Base EC (illustrated in figures) and/or average monthly percent change from Base EC (illustrated in tables) values that differed notably from Base monthly average or average monthly values. At most locations, the change or percent change from base EC was negligible. Plots and tables for locations not covered in this section are found in the Attachment.

Sacramento River (inflow) and SWP and CVP (export) increases in volume occurred mainly July – September in Critical and Dry water years, with the largest increases in the All Transfers alternative, with decreases in volume occurring in most other months with few exceptions. Of the three alternatives, the All Transfers alternative had the greatest changes and percent changes in comparison with the Base alternative.

Figure C-13 and Table C-15 illustrate that the largest changes in modeled EC at the intake to Clifton Court Forebay (for SWP exports) occur in the All Transfers alternative. For all alternatives, the largest EC percent increases occur in July and August of Critical and Dry water years, and the largest decreases occur in September and October of Critical water years. The No Groundwater Substitution alternative has a different pattern for EC percent decreases in Dry water years than the other two alternatives, as the percent differences are smaller in magnitude in September and October for this alternative.

Figure C-14 and Table C-16 illustrate the changes in modeled EC for CVP exports for the three alternatives. The pattern of EC increases and decreases is the same as those for the SWP exports, but the magnitudes are smaller at the CVP location.

Table C-14~~14~~. Delta Cross Channel Average Monthly Percent Change from Base flow (cfs).

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.5	-0.5	-0.3	0.0	0.0	0.0	0.0	0.0	-0.4	3.8	5.6	2.5
Critical	-1.2	-1.1	-0.8	0.0	0.0	0.0	0.0	-0.2	-1.0	14.3	17.5	9.3
Dry	-0.7	-0.5	-0.2	0.0	0.0	0.0	0.0	0.4	-0.6	4.7	11.7	3.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
AN	-0.2	-0.7	-0.2	0.0	0.0	0.0	0.0	-0.2	-0.2	0.4	0.0	0.0
Wet	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	-0.1	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	2.2	2.8	1.4
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	8.9	8.7	5.6
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	2.2	5.7	1.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-0.2	-0.1
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.5	-0.5	-0.3	0.0	0.0	0.0	0.0	0.0	-0.4	2.6	3.4	1.5
Critical	-1.2	-1.1	-0.8	0.0	0.0	0.0	0.0	-0.1	-0.8	9.3	9.9	5.5
Dry	-0.7	-0.5	-0.2	0.0	0.0	0.0	0.0	0.3	-0.6	3.7	8.1	2.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
AN	-0.2	-0.7	-0.2	0.0	0.0	0.0	0.0	-0.2	-0.2	0.4	0.0	0.0
Wet	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	-0.1	0.0

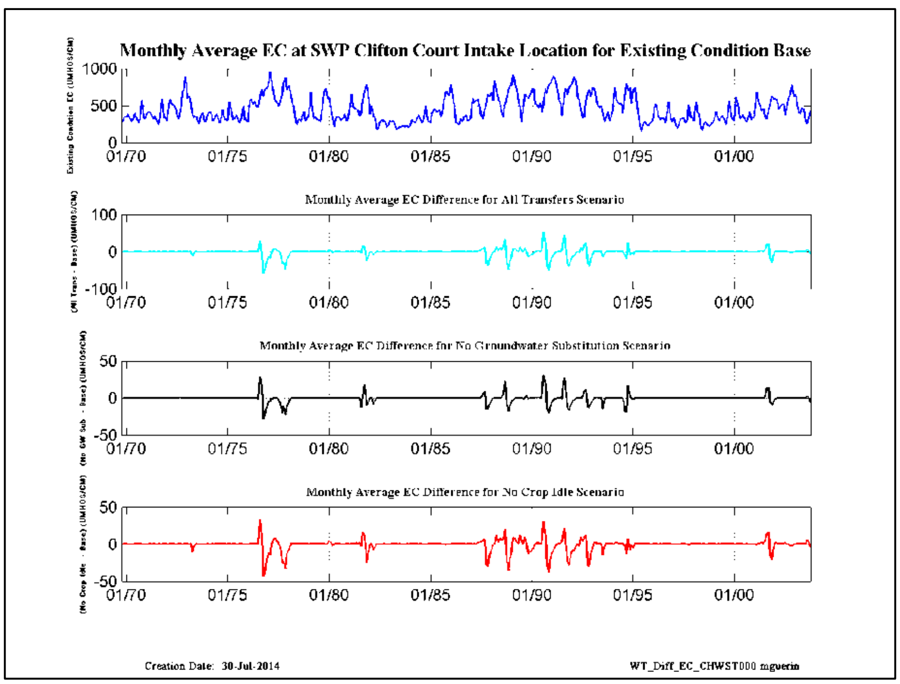

Figure C-13. Monthly Average EC at the SWP-Banks intake to Clifton Court Forebay for the Base Condition and Change from Base for the Alternatives.

Table C-15~~15~~. SWP Intake to Clifton Court Forebay Average Monthly Percent Change from Base EC for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.6	-0.9	-0.4	-0.1	0.0	0.0	0.1	0.2	0.1	1.1	0.6	-1.2
Critical	-3.8	-2.2	-1.1	-0.7	-0.1	0.4	0.3	0.6	0.6	4.2	1.0	-4.3
Dry	-1.9	-0.9	-0.2	0.1	0.2	0.1	0.2	0.6	0.6	1.2	1.9	-1.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.8	-1.0	-0.3	0.1	0.0	-0.5	0.0	0.0	-0.6	0.0	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.2	-0.7	-0.3	-0.1	0.0	0.0	0.1	0.2	0.1	0.7	0.4	-1.0
Critical	-3.0	-1.7	-0.9	-0.6	-0.1	0.4	0.3	0.6	0.5	2.7	0.6	-3.6
Dry	-1.4	-0.7	-0.1	0.2	0.2	0.1	0.2	0.6	0.6	0.8	1.5	-1.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.4	-0.7	-0.2	0.1	0.0	-0.5	0.0	0.0	-0.6	0.0	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.6	-0.4	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.5	0.4	-0.4
Critical	-1.5	-0.8	-0.4	-0.2	-0.1	0.0	0.0	0.0	-0.2	2.2	1.1	-1.6
Dry	-0.7	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.3	1.0	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.7	-0.4	-0.2	0.0	0.0	0.0	0.1	0.0	-0.6	-0.2	0.0	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

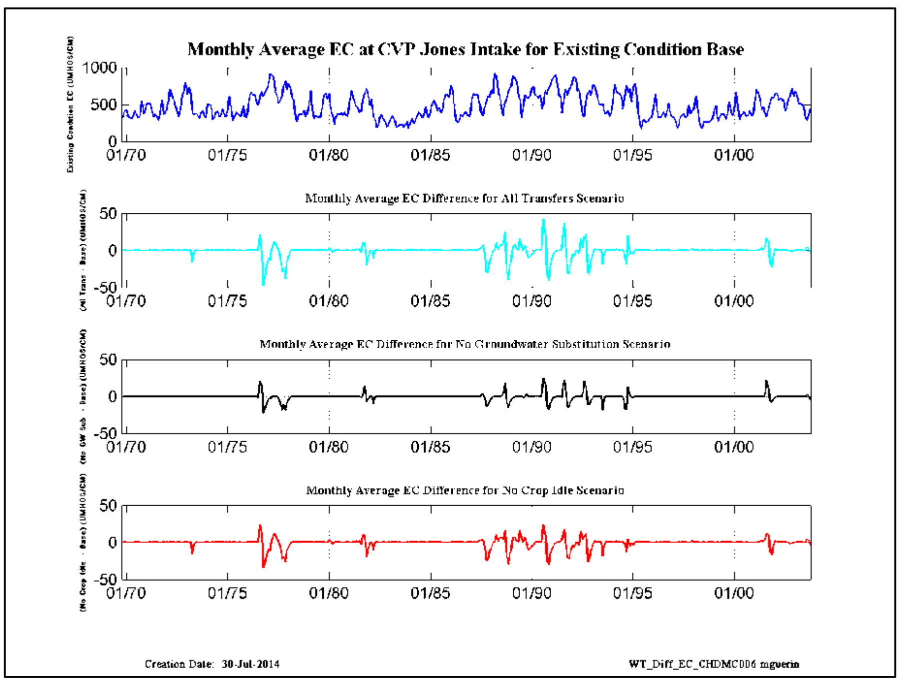

Figure C-14. Monthly Average CVP-Jones Intake EC for the Base Condition and Change from Base for the Alternatives.

Table C-16~~16~~. CVP Intake at Delta Mendota Canal Average Monthly Percent Change from Base EC for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.3	-0.7	-0.3	-0.1	-0.1	0.0	0.1	0.2	0.1	0.9	0.3	-1.1
Critical	-3.2	-1.8	-0.8	-0.5	0.0	0.4	0.2	0.7	0.6	3.3	0.8	-3.9
Dry	-1.6	-0.8	-0.2	0.1	0.2	0.0	0.2	0.6	0.5	1.0	0.7	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.6	-0.8	-0.2	0.0	-0.1	-0.7	-0.1	0.0	-0.6	0.1	0.1	-0.1
Wet	-0.3	-0.2	-0.1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.1	-0.5	-0.2	-0.1	-0.1	0.0	0.1	0.2	0.1	0.5	0.2	-0.9
Critical	-2.5	-1.4	-0.6	-0.4	0.0	0.4	0.2	0.7	0.6	2.1	0.5	-3.2
Dry	-1.2	-0.5	-0.1	0.1	0.2	0.0	0.2	0.6	0.5	0.6	0.6	-1.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.2	-0.6	-0.1	0.0	-0.1	-0.7	-0.1	0.0	-0.6	0.1	0.1	-0.1
Wet	-0.3	-0.1	-0.1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.5	-0.3	-0.1	0.0	-0.1	0.0	0.0	0.0	-0.1	0.6	0.2	-0.4
Critical	-1.3	-0.7	-0.3	-0.1	0.0	0.0	0.0	0.0	-0.1	2.0	0.9	-1.5
Dry	-0.6	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.3	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.4	-0.2	0.0	0.0	0.0	0.1	0.0	-0.6	-0.1	0.0	-0.1
Wet	-0.1	-0.1	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure C-15. SWP and CVP Monthly Average Chloride for the Alternatives.

D-1641 standards require that all export locations maintain chloride concentration less than 250 mg/L. Figure C-15 shows chloride concentration at SWP and CVP, and Figure C-16 shows chloride at CCWD’s Old River and Victoria Canal locations. Each location used the following conversion (DWR, 2001) calculated from monthly average EC:

$$\textit{Chloride (mg/L)} = (EC - 160.6)/3.66$$

Figure C-16. CCWD's Old River (OR) and Victoria Canal (VC) monthly Average Chloride for the Alternatives.

At CCWD's intake in the Contra Costa Canal, denoted in this document as the Rock Slough Intake, a different conversion is used to calculate chloride from EC:

$$\text{Chloride (mg/L)} = (EC - 89.6)/3.73$$

The D-1641 criteria at this location specifies the minimum number of days that mean daily chloride should be less than 150 mg/L. For Critical water years this is 155 days, and for Dry water years this is 165 days. Results in Table C-17 indicate that several Critical and one Dry water year have greater percent differences (bold font).

Table C-17~~17~~. Monthly Average Percent Change from Base EC at CCWD Rock Slough Location for the All Transfers Alternative.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.7	-2.2	-0.4	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	4.2	-0.8	-8.5
1977	-7.8	-5.1	-2.9	-2.1	-1.2	0.0	0.4	0.3	0.4	1.7	-0.3	-1.0
1978	-4.8	-4.1	-2.0	-0.3	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.4	0.6	1.0	2.2	0.2	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.1	0.2	-0.9	1.1	4.0
1982	-3.6	-2.6	-0.8	0.0	-1.7	-1.4	-0.2	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1
1986	-0.1	-0.1	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	-0.1	0.0	0.0	0.6	0.9	0.5	**4.3**	**6.8**	-4.3
1988	-6.6	-4.6	-2.7	-0.3	0.0	0.6	0.7	1.0	0.8	**7.8**	**9.0**	-4.9
1989	-7.2	-4.9	-2.9	0.7	0.7	0.7	0.3	1.2	0.5	2.7	1.3	-1.5
1990	-3.0	-2.2	-1.6	-1.2	0.0	0.7	0.7	0.4	0.6	**17.2**	**2.0**	-5.7
1991	-6.2	-4.7	-2.8	-2.1	-0.7	-0.1	0.1	0.2	1.4	**13.1**	**1.3**	-5.0
1992	-5.5	-4.0	-2.5	-2.0	-1.2	0.0	0.1	0.8	0.6	**8.2**	**7.3**	-3.0
1993	-5.5	-3.9	-1.7	0.6	0.3	0.3	0.2	0.2	-1.6	-1.1	0.3	0.2
1994	0.1	0.0	0.0	0.0	0.6	0.4	0.3	0.2	0.3	-0.9	-2.2	5.1
1995	-1.2	-1.1	-1.5	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.2
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1
1997	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1998	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1999	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0
2000	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.2	0.6	**9.5**	**8.2**	-1.1
2002	-4.7	-3.6	-0.1	0.3	0.2	0.1	0.1	0.0	0.3	0.0	-0.1	-0.3
2003	-0.3	-0.1	-0.1	0.2	0.0	0.0	0.0	0.0	0.1	2.7	0.8	-1.4
Average	-1.7	-1.2	-0.6	-0.2	0.0	0.1	0.1	0.2	0.2	2.0	1.0	-0.8
Critical	-4.1	-2.9	-1.8	-1.1	-0.4	0.2	0.3	0.4	0.6	**7.3**	**2.3**	-3.3
Dry	-2.0	-1.4	-0.5	0.1	0.2	0.2	0.2	0.4	0.4	**2.6**	**2.9**	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.8	-1.4	-0.6	0.2	0.3	0.3	-0.3	0.0	-0.3	0.3	0.2	-0.2
Wet	-0.4	-0.3	-0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

For these years, mean daily chloride was calculated from EC model output for the four Alternatives, and the number of days that chloride was greater than 150.5 mg/L was tabulated – results are shown in Table C-18. Although D-1641 specifies 14-day durations for mean daily chloride concentration, since most DSM2 boundary conditions are specified as monthly values, it is not sensible to account for this constraint herein.

Table C-18~~18~~. Check on D-1641 Chloride Standard at the CCWD Rock Slough Intake Location – Number Days Mean Daily Chloride < 150 mg/L.

Water Year	Base	All Transfers	No Crop Idle	No GW Sub
1988 (Crit)	272	264	278	275
1990 (Crit)	201	193	195	195
1991 (Crit)	180	176	177	177
1992 (Crit)	194	183	185	186
2001 (Crit)	338	338	338	338

The model results for the three CCWD intake locations are also presented by comparing the monthly average percent difference tables by alternative. Table C-19 through Table C-21 illustrates the results for all three locations for the All Transfers, No Groundwater Substitution and No Crop Idle alternatives, respectively. For each alternative, the CCWD-Victoria Canal intake location has a different pattern of monthly average percent increases and decreases than the other two alternatives (not shown), as the path for much of the water exported is through Middle River which is more heavily influenced by the operations of the DCC than the other two locations. In August of Critical water years, Victoria Canal sees a decrease in EC while the other locations saw an increase – this is likely due to the increased flow through the DCC (Table C-14) combined with the increased exports (Table C-8 and Table C-9) in comparison with the Base alternative.

The pattern of EC changes at CCWD's Rock Slough and Old River intake locations is similar to the pattern at the SWP location, with the largest EC increases occurring in July and August of Critical and Dry water years, with Rock Slough showing greater increases than Old River as it receives a greater proportion of higher EC water from the Martinez boundary than the Old River location.

Table C-19~~19~~. CCWD Intakes –Average Monthly Percent Change from Base EC for the All Transfers Alternative.

CCWD Victoria Canal location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.3	-0.5	-0.3	-0.1	0.1	0.0	0.1	0.2	0.1	0.0	-0.4	-1.5
Critical	-3.1	-1.3	-0.9	-0.6	-0.2	0.2	0.3	0.4	0.4	0.5	-1.9	-5.9
Dry	-1.5	-0.6	-0.2	0.1	0.2	0.1	0.2	0.3	0.5	-0.3	0.0	-1.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.8	-0.7	-0.3	0.0	1.1	-0.3	-0.1	0.1	-0.6	-0.3	0.1	-0.1
Wet	-0.2	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

CCWD Old River location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.6	-0.9	-0.5	-0.1	0.0	0.0	0.1	0.2	0.1	1.3	0.5	-1.2
Critical	-4.0	-2.3	-1.5	-0.9	-0.3	0.3	0.3	0.6	0.6	4.9	0.5	-4.4
Dry	-2.0	-1.0	-0.2	0.2	0.2	0.2	0.2	0.5	0.5	1.7	2.4	-1.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.9	-1.1	-0.4	0.1	0.5	-0.4	-0.1	0.0	-0.4	0.2	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

CCWD Rock Slough location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.7	-1.2	-0.6	-0.2	0.0	0.1	0.1	0.2	0.2	2.0	1.0	-0.8
Critical	-4.1	-2.9	-1.8	-1.1	-0.4	0.2	0.3	0.4	0.6	7.3	2.3	-3.3
Dry	-2.0	-1.4	-0.5	0.1	0.2	0.2	0.2	0.4	0.4	2.6	2.9	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.8	-1.4	-0.6	0.2	0.3	0.3	-0.3	0.0	-0.3	0.3	0.2	-0.2
Wet	-0.4	-0.3	-0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table C-20~~20~~. CCWD Intakes –Average Monthly Percent Change from Base EC for the No Groundwater Substitution Alternative.

CCWD Victoria Canal location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.6	-0.3	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.7
Critical	-1.4	-0.6	-0.4	-0.2	-0.1	0.0	0.0	0.0	-0.2	-0.1	-0.7	-2.8
Dry	-0.6	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.8	-0.4	-0.2	0.0	0.0	0.0	0.0	0.1	-0.6	-0.3	0.0	-0.1
Wet	-0.1	-0.1	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

CCWD Old River location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.6	-0.4	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.6	0.4	-0.4
Critical	-1.5	-0.9	-0.5	-0.3	-0.1	0.0	0.0	0.0	-0.3	2.7	0.8	-1.7
Dry	-0.7	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.4	1.2	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.8	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.1	-0.4	-0.1	-0.1	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

CCWD Rock Slough location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.5	-0.5	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	1.0	0.6	-0.1
Critical	-1.5	-1.1	-0.6	-0.3	-0.1	0.0	0.0	0.0	-0.4	4.7	2.1	-0.7
Dry	-0.6	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.6	-0.3	-0.1	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table C-21~~21~~. CCWD Intakes –Average Monthly Percent Change from Base EC for the No Crop Idle Alternative.

CCWD Victoria Canal location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.0	-0.4	-0.2	0.0	0.2	0.0	0.1	0.2	0.1	0.0	-0.2	-1.1
Critical	-2.3	-0.9	-0.7	-0.4	-0.1	0.2	0.3	0.4	0.4	0.3	-1.1	-4.3
Dry	-1.1	-0.4	-0.1	0.2	0.2	0.1	0.2	0.3	0.5	-0.3	0.1	-1.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.3	-0.5	-0.1	0.1	1.1	-0.3	-0.1	0.1	-0.6	-0.3	0.1	-0.1
Wet	-0.2	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

CCWD Old River location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.3	-0.7	-0.3	-0.1	0.0	0.0	0.1	0.2	0.1	0.9	0.4	-1.0
Critical	-3.1	-1.8	-1.2	-0.8	-0.2	0.3	0.3	0.6	0.5	3.2	0.1	-3.8
Dry	-1.5	-0.7	-0.1	0.2	0.3	0.2	0.2	0.5	0.5	1.1	1.8	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.4	-0.8	-0.2	0.2	0.5	-0.4	-0.1	0.0	-0.4	0.2	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

CCWD Rock Slough location

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.3	-0.9	-0.5	-0.1	0.0	0.1	0.1	0.2	0.1	1.5	0.7	-0.7
Critical	-3.3	-2.3	-1.4	-0.9	-0.3	0.3	0.3	0.4	0.5	5.2	1.6	-2.8
Dry	-1.5	-1.1	-0.4	0.2	0.2	0.2	0.2	0.4	0.4	1.9	2.1	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.3	-1.0	-0.4	0.2	0.3	0.3	-0.3	0.0	-0.3	0.3	0.2	-0.2
Wet	-0.4	-0.2	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table C-22~~22~~. RSAC081 location (Collinsville) Average Monthly Percent Change from Base EC for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.8	-0.3	0.2	0.4	0.5	0.6	0.6	0.5	0.6	-1.9	-2.8	-1.9
Critical	-1.9	-0.8	-0.2	0.5	1.4	1.7	1.5	1.0	1.1	-6.9	-9.2	-6.1
Dry	-1.0	-0.1	0.5	0.5	0.9	0.9	1.5	1.1	0.6	-3.1	-5.6	-3.7
BN	0.0	0.0	0.0	0.3	0.2	0.1	0.3	0.3	0.1	0.0	0.0	0.0
AN	-0.9	-0.3	0.5	0.9	0.1	0.2	0.0	0.2	1.3	0.3	-0.1	-0.2
Wet	-0.1	-0.1	0.2	0.2	0.0	0.0	0.1	0.1	0.2	0.1	0.2	0.2

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.5	-0.2	0.3	0.5	0.5	0.6	0.6	0.5	0.5	-1.3	-1.9	-1.3
Critical	-1.3	-0.5	0.0	0.6	1.5	1.8	1.5	1.0	0.8	-4.6	-5.9	-3.9
Dry	-0.7	0.1	0.6	0.5	1.0	0.9	1.5	1.1	0.5	-2.5	-4.4	-2.8
BN	0.0	0.0	0.0	0.3	0.2	0.1	0.3	0.3	0.1	0.0	0.0	0.0
AN	-0.6	-0.2	0.6	0.9	0.1	0.2	0.0	0.2	1.3	0.3	-0.1	-0.2
Wet	-0.1	-0.1	0.3	0.2	0.0	0.0	0.1	0.1	0.2	0.1	0.2	0.2

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.4	-0.2	-0.1	0.0	0.1	0.1	0.2	-0.1	0.1	-1.1	-1.4	-0.8
Critical	-0.9	-0.4	-0.2	-0.2	0.4	0.3	0.1	-0.9	-0.2	-4.2	-4.9	-3.0
Dry	-0.5	-0.2	-0.3	-0.1	0.3	0.3	0.9	0.5	0.3	-1.5	-2.4	-1.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.5	-0.2	-0.2	0.1	0.1	0.0	0.0	0.0	0.5	0.2	0.1	0.1
Wet	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-22 illustrates results for average monthly percent change from Base EC at Collinsville, RSAC081, on the Sacramento River. The increases and decreases in percent change from Base EC at RSAC081 reflect the boundary conditions changes in NDO (Figure C-11). EC results at locations in Suisun Marsh show a similar pattern.

Table C-23 and Table C-24 illustrate EC results as percent change from Base at RSAN007, near Antioch, and RSAN018, Jersey Point, respectively, on the San Joaquin River. The model results for EC at RSAN007 are similar to those at RSAC081, as they are both strongly influenced by the increases in Sacramento River outflow, as reflected in the changes in NDO flow in comparison with Base. The results at RSAN018 (Table C-24), Jersey Point, are somewhat different than those at RSAN007 (Table C-23). The Jersey Point location has a more complicated set of influences on EC, as local antecedent conditions, such as the EC in Franks Tract, of higher or lower EC waters can serve as reservoirs that mix locally near RSAN018. However, the largest increases (June – July) and decreases (August – November) in EC occur in Critical water years for all alternatives.

Both RSAN018 and RSAC092 on the Sacramento River at Emmaton have D-1641 have constraints for EC specified by water year type. Examining the average monthly percent change from Base at RSAN018 in Table C-24, large changes in EC are seen in Critical (Cr) June and July periods and in Above Normal (AN) July's (i.e., the values indicate individual years may be influencing results). Monthly average Tables (not shown, see the Attachment) indicate that for RSAN018 the AN water year 2003 and the Cr water years 1990 and 1991 can serve as indicators for adherence to D-1641 criteria for RSAN018, and that water years 2003 (AN) and 1976, 1977 and 1991 (Cr) can serve as indicators for RSAC092.

Using the maximum EC constraints at RSAC092 for AN and Cr water years (the plotted constants), Figure C-17 shows that there are only minor differences between the Base Alternative 1 and the other Alternatives (2-4) . Similarly, for RSAN018 (Figure C-18) the difference in Base alternative in increase in EC amounts to a shift in EC increases of a few days. These differences could be accounted for in real operations by delaying exports and/or reservoir releases by a few days to adhere more closely to D-1641 standards.

Table C-23~~23~~. RSAN007 Location (Near Antioch) Average Monthly Percent Change from Base EC for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.1	-0.4	0.1	0.3	0.3	0.4	0.4	0.4	0.5	-1.5	-2.6	-2.1
Critical	-2.5	-1.1	-0.5	0.1	0.9	1.4	1.4	1.1	1.3	-5.8	-8.8	-6.5
Dry	-1.3	-0.3	0.5	0.5	0.5	0.5	0.6	0.9	0.5	-2.6	-5.0	-4.2
BN	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
AN	-1.2	-0.5	0.4	0.7	0.0	0.0	-0.2	0.0	0.7	0.5	-0.2	-0.2
Wet	-0.3	-0.2	0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.8	-0.3	0.2	0.3	0.3	0.4	0.4	0.4	0.4	-1.1	-1.9	-1.5
Critical	-1.9	-0.8	-0.3	0.2	1.0	1.4	1.4	1.1	1.0	-3.8	-5.8	-4.3
Dry	-1.0	-0.1	0.6	0.5	0.5	0.5	0.6	0.8	0.4	-2.1	-4.0	-3.3
BN	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
AN	-0.8	-0.3	0.5	0.7	0.0	0.0	-0.2	0.0	0.7	0.5	-0.2	-0.2
Wet	-0.2	-0.1	0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.5	-0.2	-0.2	-0.1	0.1	0.1	0.1	-0.2	0.0	-0.9	-1.3	-0.8
Critical	-1.1	-0.5	-0.3	-0.2	0.3	0.3	0.1	-1.1	-0.2	-3.5	-4.6	-3.0
Dry	-0.6	-0.2	-0.2	-0.1	0.1	0.2	0.3	0.4	0.4	-1.2	-2.0	-1.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.2	-0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.1	0.0
Wet	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-24~~24~~. RSAN018 Location (Jersey Point) Average Monthly Percent Change from Base EC for the Alternatives.

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.6	-0.9	-0.2	0.0	0.0	0.1	0.1	0.2	0.3	1.3	-0.3	-1.6
Critical	-3.8	-2.2	-1.3	-0.9	0.0	0.5	0.5	0.6	1.4	3.5	-2.4	-5.0
Dry	-1.9	-0.8	0.3	0.3	0.0	0.1	0.1	0.1	0.0	2.2	1.1	-3.2
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.7	-1.0	0.0	0.4	0.1	0.0	-0.2	0.0	0.1	1.0	-0.1	-0.2
Wet	-0.5	-0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-1.3	-0.7	-0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.9	-0.4	-1.3
Critical	-3.0	-1.8	-1.1	-0.7	0.0	0.5	0.5	0.6	1.0	2.3	-2.4	-4.0
Dry	-1.5	-0.6	0.4	0.3	0.0	0.1	0.1	0.1	-0.1	1.5	0.4	-2.9
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.3	-0.8	0.2	0.5	0.1	0.0	-0.2	0.0	0.1	1.0	-0.1	-0.2
Wet	-0.4	-0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.6	-0.3	-0.2	-0.1	0.0	0.0	0.0	-0.2	0.0	0.7	0.0	-0.5
Critical	-1.3	-0.7	-0.4	-0.2	0.0	0.2	0.1	-0.9	-0.3	2.3	-0.9	-1.6
Dry	-0.6	-0.3	-0.3	-0.1	0.0	0.0	0.0	0.1	0.3	0.9	1.1	-0.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.7	-0.3	-0.2	0.0	0.1	0.0	0.0	0.0	-0.1	0.4	-0.1	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure C-17. Comparison of 14-Day Running Average EC at RSAC092 for Selected Time Frames Pertinent to D-1641.

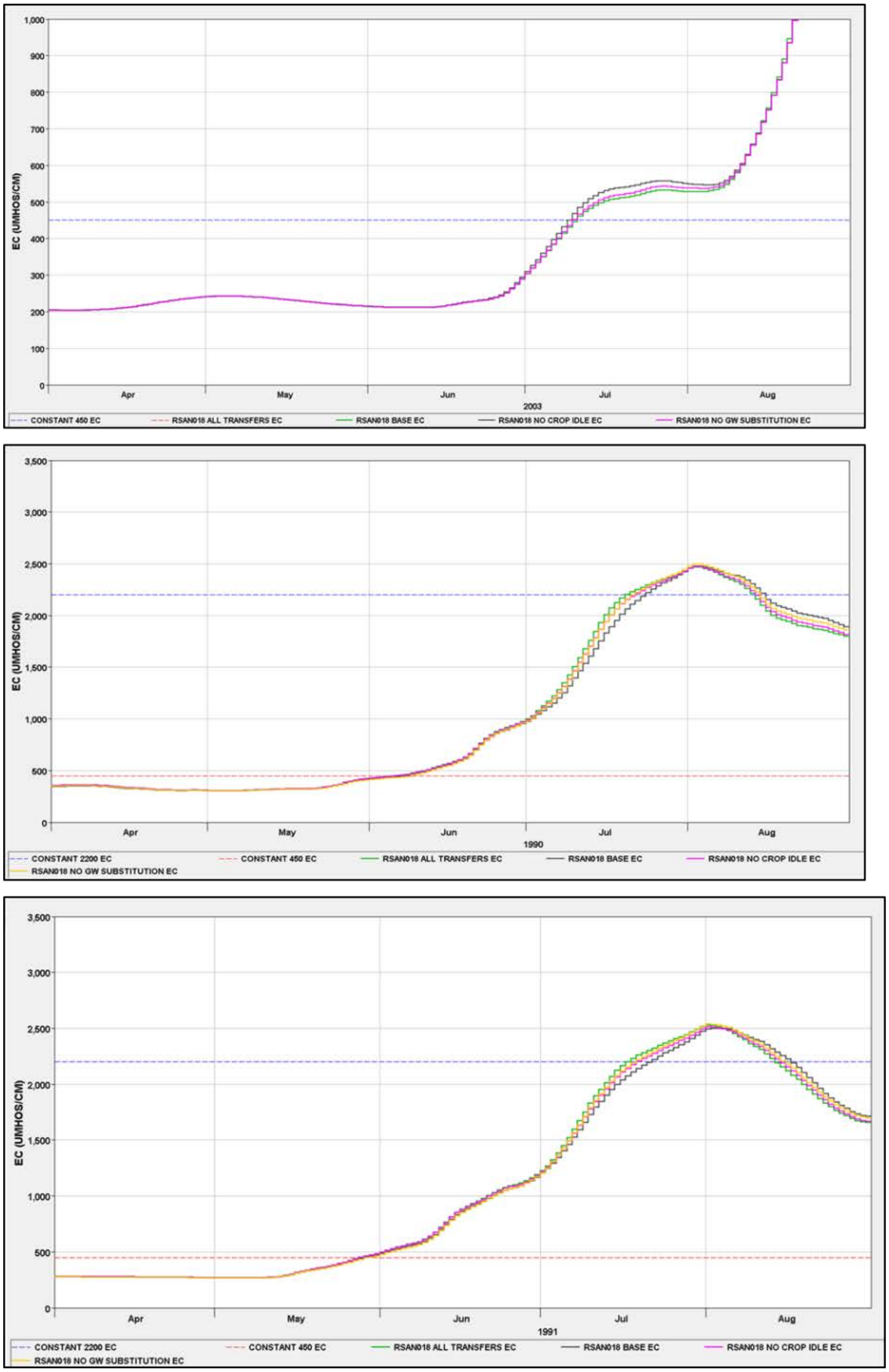

Figure C-18. Comparison of 14-Day Running Average EC at RSAN018 for Selected Time Frames Pertinent to D-1641.

C.9 Comparison of Stage Results

The potential exists for decreases in water level elevation due operational changes in the three Alternative that might affect agricultural withdrawals of water in the south Delta, a conservative estimate of stage changes was calculated as follows at each relevant D-1641 location in HEC DSSVue:

1. the daily minimum stage was calculated for all the Base and three Alternative from the 15-minute model output

2. daily change from Base stage was calculated (Daily Alternative Min Stage – Daily Base Min Stage)

3. monthly average stage was calculated from the results at step 2.

3.4. overall monthly averages and averages by Water Year type were calculated

Step 2, the difference in daily minimum stage is a conservative estimate of potential decreases in stage since changes in exports and/or inflows can shift the timing of stage potentially resulting in overly optimistic or pessimistic stage differences when calculated with 15-minute output data. As CalSim II model outputs are calculated on a monthly time step and input as boundary conditions for DSM2, the final calculation of stage changes as a monthly average is appropriate.

In addition, there is the potential for stage increases which would be considered a benefit during low flow conditions or during the summer particularly in dry or critical years. To this end, an additional calculation was made in which a conservative estimate of increase in stage was similarly made as:

1. the daily maximum stage was calculated for all the Base and three Alternative from the 15-minute model output

2. daily change from Base stage was calculated (Daily Alternative Max Stage – Daily Base Max Stage)

3. monthly average stage was calculated from the results at step 2.

4. overall monthly maximum and monthly maximum by Water Year type were calculated.

Stage changes were calculated upstream and downstream of agricultural barrier locations in Old and Middle Rivers, in Grant Line Canal, and in three additional locations: Old River near Middle River, Old River near Tracy, and RMID040 in Middle River. Results are shown as monthly average tables of difference in stage (Alternative – Base), with Average monthly results separated by water year type at the bottom of each Table.

A selection of results for ~~three~~ several of these locations ~~are~~ is shown in this section to illustrate the general results. T~~t~~he complete set of stage results is found in the Attachment. The largest differences for stage decrease from Base ~~stage~~ occurred for the All Transfers alternative, as this alternative had the greatest increases over Base exports for SWP and CVP in the south Delta. Figure C-19 shows the monthly averaged minimum daily Base stage calculation and change from minimum Base stage for each the alternatives downstream of the Old River agricultural barrier. This location was chosen for the All Transfers alternative as it had the largest decreases in monthly average of daily minimum stage difference, -0.2 ft., of any of the agricultural barrier locations, as shown in Table C-25. All seven of these occur in July or August of Dry or Critical water years. For the No Crop Idle Alternative, June 1993 had a difference of -0.2 ft. upstream of the barrier in Old River as did July 1987 downstream of this barrier. All other decreases in monthly average of daily minimum stage were -0.1 ft. or less at both the upstream and downstream locations of the Grant Line Canal and Middle River agricultural barrier locations for all of the alternative. The stage difference results in Grant Line Canal upstream of the agricultural barrier are plotted in Figure C-20 for all of the alternatives, and the monthly average results for the All Transfers alternative are shown in Table C-26. Each of Old River near Middle River, Old River near Tracy, and RMID040 in Middle River had exactly one stage decrease of -0.2 ft., occurring in June 1993, an Above Normal water year, for all three of the alternative. These results are shown for the Old River near Middle River location in Figure C-21, and monthly average calculation for the All Transfers alternative in Table C-27.

The results for stage increases highlighted the “No Groundwater Substitution” alternative in both the minimum and maximum stage difference calculations. This Alternative was the only one in which either maximum or minimum stage increased. Table C-28 shows increases maximum stage difference for the location in Middle River (RMID040) in July for several Dry (1981, 2001) and Critical (1992) Water Years. Table C-29 shows an increase in the minimum stage difference for the location at Old River near Middle River (RMID040) in July of 1981, 2001. Note that stage increases for the No Groundwater substitution Alternative are among the smallest of the all the Alternatives, so it is not surprising that stage increases also occur at several locations.

Table C-25~~25~~. Difference in Minimum Stage (ft) at Old River Downstream of Barrier for All Transfers minus Base Alternatives.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

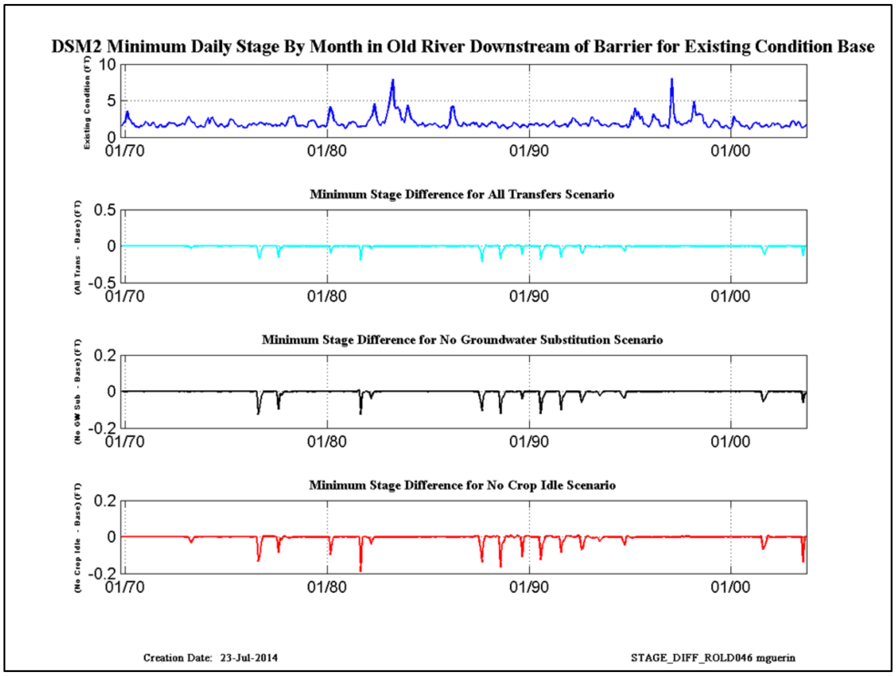

Figure C-19. Minimum stage at Old River Downstream Barrier and Minimum Stage Differences Alternative – Base.

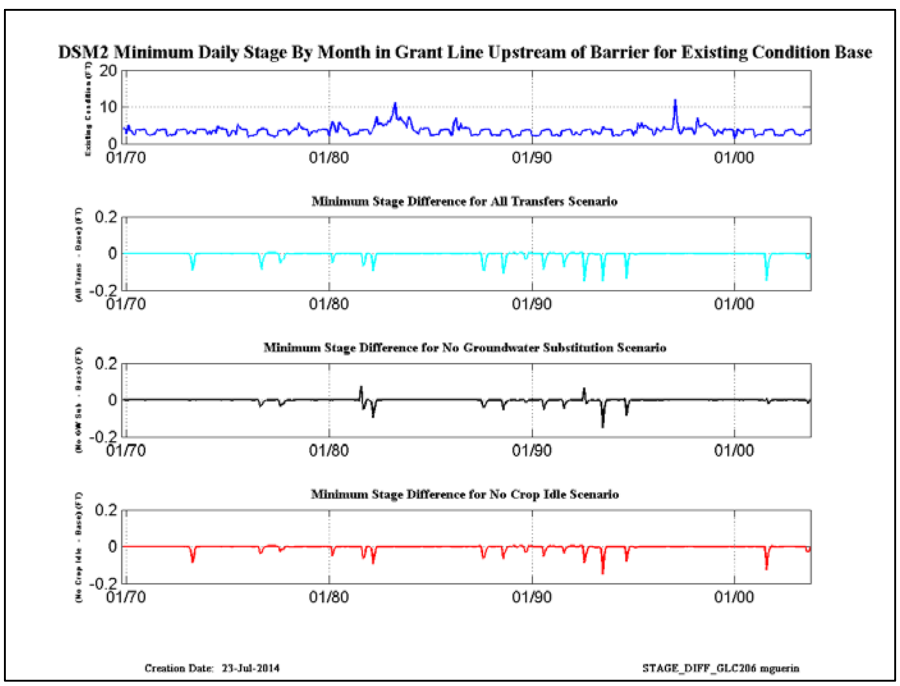

Figure C-20. Minimum Stage At Grant Line Upstream Barrier and Minimum Stage Differences Alternative – Base.

Table C-26~~26~~. Difference in Minimum Stage (ft) at Grant Line Canal Upstream of Barrier for All Transfers minus Base Alternatives.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-27~~27~~. Difference in Minimum Stage (ft) at Old River near Middle River Location for All Transfers Minus Base Alternative~~s~~.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

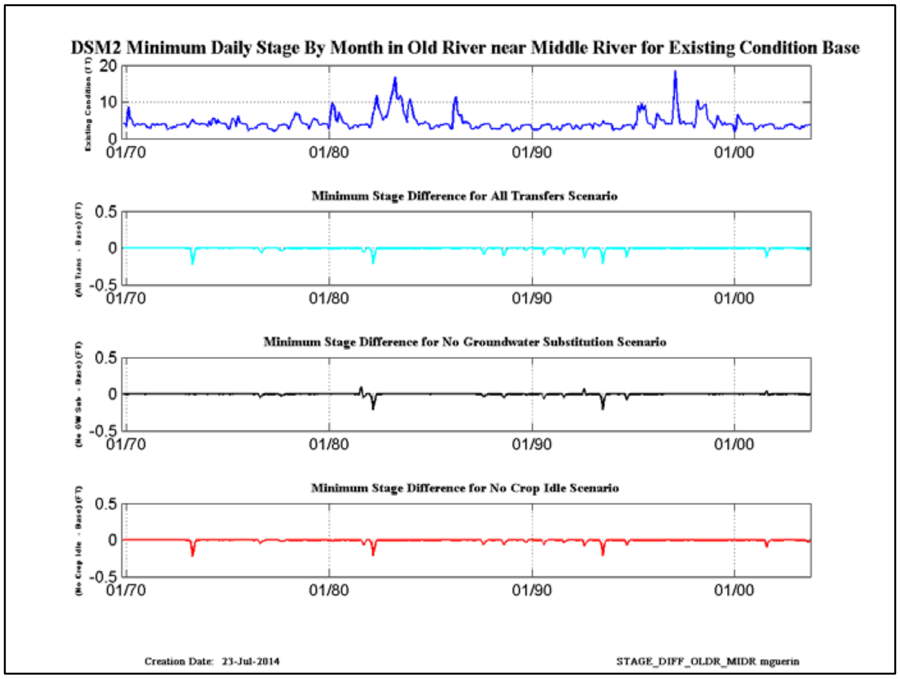

Figure C-21. Minimum Stage at Old River Near Middle River Location and Minimum Stage Differences Alternative – Base.

Table C-28. Difference in Maximum Stage (ft) at the Middle River Location (RMID040) for the No Groundwater Substitution Alternative.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table C-29. Difference in Minimum Stage (ft) at the Middle River Location (RMID040) for the No Groundwater Substitution Alternative.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C.10 Comparison OF X2 Results

Figure C-22 and Table C-30 illustrate the monthly average and average monthly, respectively, model results for the alternatives for the location of X2 in kilometers (km) from the Golden Gate. Westward changes, negative values, are considered beneficial as higher outflow is thought to expand the volume of habitat region available to fish species. Specification of X2 is part of the D-1641 compliance standards February – June. Changes in inflow and export operations will result in a change in X2 location. According to criteria specified in (SWRCB, 1999), eastward changes in monthly average X2 position (positive values in our analysis) of 1.1 km are not significant in general, and in Critically

Dry years an eastward movement of 3.0 km is not significant. It can be seen in Figure C-22 that changes in X2 are insignificant for each of the alternative, as all monthly average differences are less than 1.1 km. Alternative 3, No Groundwater Substitution, has the smallest differences in comparison with the Base X2 location.

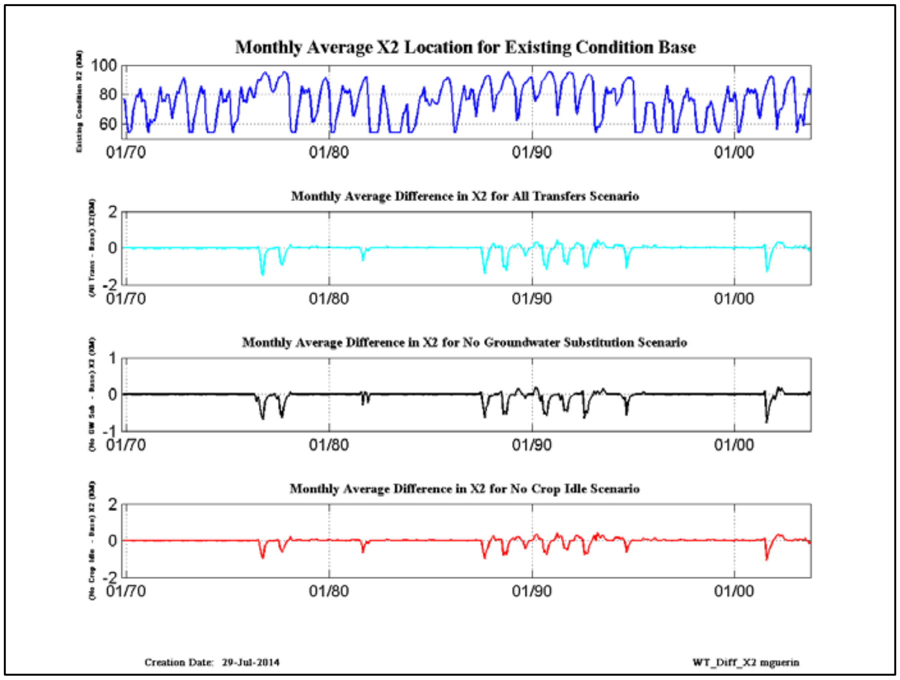

Figure C-22. Monthly Average X2 Location for Existing Condition Base and the Differences Alternative – Base.

Table C-30~~28~~. X2 Monthly Average Change from Base Location (km).

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.2	-0.3	-0.3
Critical	-0.2	-0.1	0.0	0.1	0.2	0.2	0.1	0.1	0.1	-0.8	-1.1	-1.1
Dry	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.4	-0.7	-0.4
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.2	-0.2	-0.2
Critical	-0.2	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.1	-0.5	-0.7	-0.7
Dry	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.3	-0.5	-0.3
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1
Critical	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.5	-0.6	-0.5
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.2	-0.3	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C.11 Comparison of OMR results

Under National Marine Fisheries Service and California Fish and Wildlife Service Biological Opinions (BOs), CVP and SWP operations are mandated to maintain exports at levels to minimize entrainment of delta smelt, steelhead, and winter-run salmon between December and June. Entrainment protection is currently met via prescriptions for OMR flow using measurements supplied by the US Geological Survey (USGS). This prescription is called into play when delta smelt are found in locations believed to put them at risk for entrainment. Restrictions to OMR flow, and therefore to export levels, are considered to be an “adaptive management” process in which decisions on changes in Delta operations are made after assessing current conditions and data. The period December – March is used to protect pre-spawning delta smelt adults along with turbidity or export salvage triggers, and the period through June is used to protect larval smelt along with water temperature triggers.

The 15-minute DSM2 flow results at ROLD024 and at RMID015 were daily averaged, added together then smoothed with a 14-day running average – the final step was to monthly average the running average results and then calculate change from Base and percent change between each alternative and the Base alternative. Percent change from Base of the monthly averaged OMR flow for the alternatives was then used to gauge the effect of alternative Delta operations found in the alternatives. Note that negative percent difference numbers indicate that a negative OMR flow in the alternative was smaller in magnitude than the Base.

The change from Base results (Figure C-23) show that all alternative tend to increase the magnitude of negative OMR flow. The December – June percent change from Base values (Table C-31) of OMR flow are similar for the All Transfers and No Crop Idle alternatives, with positive percent changes in April and June of Above Normal water years, while the No Groundwater Substitution alternative has a positive percent change in June of Above Normal water years.

The Biological Opinions (FWS, 2008; NOAA, 2009) prescribing OMR flow values for the protection of delta smelt are complicated by additional triggers used to specify the “adaptive” actions to restrict negative OMR flows, such as turbidity, water temperature, and the presence of delta smelt at certain locations or times.

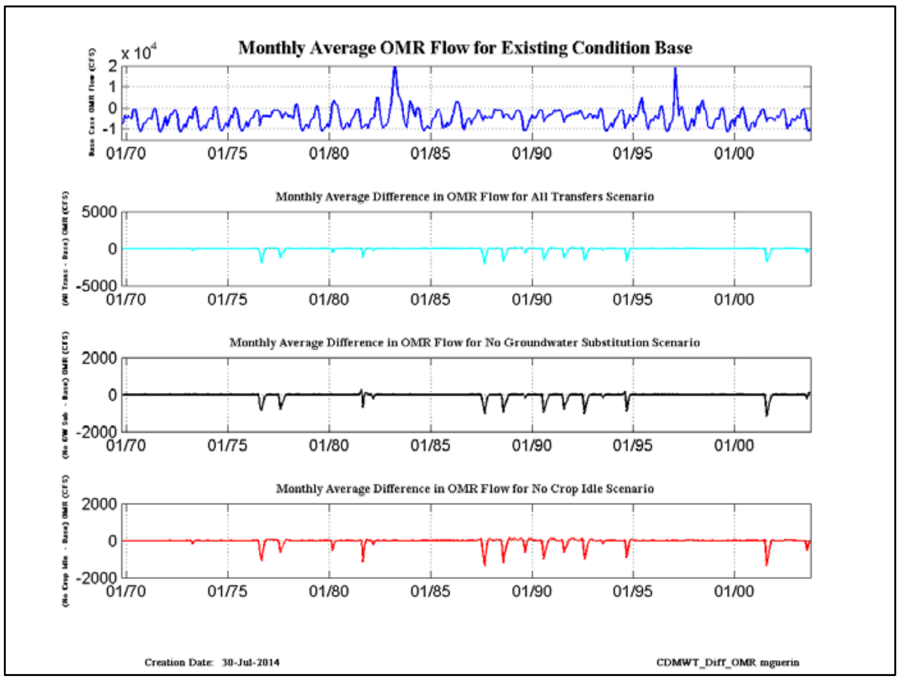

Figure C-23. Monthly Average OMR Flow (Cfs) and Flow Differences Alternative – Base.

Table C-3129. OMR Monthly Average Percent Change from Base Flow (cfs)

Alternative 2 - All Transfers

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.1	-0.7	-0.4	-0.5	-0.9	-0.3	0.2	-0.8	-0.4	6.5	8.3	4.0
Critical	0.0	-1.7	-1.6	-1.9	-0.7	-1.3	-0.7	-1.8	-1.3	24.6	25.4	14.0
Dry	0.1	-0.6	-0.1	-0.3	-0.7	-0.3	-0.5	-1.5	-1.7	7.2	17.0	6.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.5	-0.9	-0.2	0.0	-4.0	-0.1	2.5	-1.2	0.7	1.0	0.2	0.0
Wet	0.0	-0.2	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 3 – No Crop Idle

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	-0.2	-0.7	-0.4	-0.5	-0.9	-0.3	0.2	-0.8	-0.4	4.2	5.1	2.2
Critical	-0.6	-1.7	-1.6	-1.9	-0.7	-1.3	-0.7	-1.8	-1.3	15.1	14.3	7.3
Dry	-0.3	-0.6	-0.1	-0.3	-0.7	-0.3	-0.5	-1.5	-1.7	5.4	11.8	4.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	-0.9	-0.2	0.0	-4.0	-0.1	2.5	-1.2	0.7	1.0	0.2	0.0
Wet	-0.1	-0.2	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Alternative 4 – No Groundwater Substitution

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Average	0.4	0.0	0.0	0.0	0.1	0.0	0.0	-0.2	0.1	4.0	4.3	2.2
Critical	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.4	13.6	8.1
Dry	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	8.7	3.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.6	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	0.7	0.5	-0.2	-0.2
Wet	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0

C.12 Summary of Results

The Delta Conditions analysis of DSM2 alternatives examined regulated parameters to determine the magnitude of changes to these parameters that could occur if the system operations defined by any of the Alternatives were implemented instead of Base operations. The pertinent parameters are:

- salinity (EC) changes at D-1641 locations
- changes in south Delta stage heights identified in D-1641, as decreases in stage might affect agricultural diversion operations
- changes in the location of X2, the 2 ppt salinity isohaline, as regulated by D-1641
- changes in the magnitude in the combined Old River plus Middle River flow (OMR) December – June as regulated by the NMFS and FWS BOs

Alternative 1 is the Base condition, and all analyses of the regulated parameters for the Alternatives are defined *via* a change from the Base conditions using the “comparative analysis” approach discussed above. The model time span is 09/1969 – 10/2003, i.e., water years 1970 through 2003. As DSM2 boundary conditions are specified as monthly values, defined either by CalSim II or TOM model output, all comparisons are made using either monthly average (one value per month modeled) or average monthly (one value per month, averaged over the modeled years) calculations.

The Proposed Project, Alternative 2 or the “All Transfers” alternative, has boundary conditions with the greatest changes to Base conditions among the alternatives. Although both the Sacramento and San Joaquin Rivers change under the alternatives, increases in Sacramento River inflow in the months July – September of Critical and Dry water years dominate the changes and are greatest in the All Transfers alternative and smallest in the No Groundwater Substitution alternative, Alternative 3. Export changes are the greatest at the SWP and CVP export locations, as expected, and the increases generally mirror the increases in Sacramento River inflow, although increases in SWP exports end in August while increases in CVP exports end in September. In the other months, exports generally decrease as average monthly values. These results reflect the changes discussed in Appendix B (Water Operations Assessment).

Changes in the EC regime were calculated for each Alternative in comparison with Base at all D-1641 locations, and the entire set of results are compiled in the Attachment to this Appendix. It was found that results at many locations were either small (had average monthly percent differences around +/- 1% or less) or were characteristic of a region (e.g., Suisun Marsh), so they are not discussed in this document. Instead, only those results that reflect general trends or occur at export locations were included herein.

As expected, the All Transfers alternative, the Proposed Project, exhibits the largest increases in EC in July – August of Critical and Dry water years at SWP and CVP export locations, with the No Groundwater Substitution alternative showing the smallest average monthly EC increases over all water years. At these locations, EC decreases in Critical and Dry water years September - December even though exports have increased over Base in September. Note that the EBMUD exports were not covered herein for EC, as only low EC Sacramento River water is exported at this location.

The model results for the three CCWD intake locations are differ by location. The CCWD-Victoria Canal intake location has a different pattern of increases and decreases than the other two locations. In August of Critical water years, Victoria Canal sees a decrease in EC while the other locations saw an increase – this is likely due to the increased flow of low EC Sacramento River water through the DCC and then through Middle River as Victoria Canal is more heavily influenced by DCC operations than the other two locations. The pattern of EC changes at CCWD’s Rock Slough and Old River intake locations is similar to the pattern at the SWP location, with the largest EC increases occurring in July and August of Critical and Dry water years, with Rock Slough showing greater increases than Old River as it receives a greater proportion of water from the Martinez boundary than the Old River location.

In general, the All Transfers alternative sees the largest increases in EC when exports are the greatest, with Critical water years in July seeing the largest percent difference of 4.2% at the SWP location and 3.3 % at the CVP location. In terms of D-1641 criteria for chloride concentration, all export locations regulated by the 250 mg/L standard were in compliance on a monthly average basis – spot checks at SWP showed the compliance was also maintained with daily average chloride. At the Contra Costa Canal location (CCWD's intake modeled at Rock Slough), the chloride standard was in compliance for the requisite number of days for all alternatives.

At locations RSAN007 and RSAC081, near the confluence of the Sacramento and San Joaquin Rivers, the influence of Sacramento River increases result in EC decreases during the increased export periods. The increases in EC during other periods are less than 2% on an average monthly. RSAN018, Jersey Point, and RSAC092, Emmaton were checked for D-1641 EC compliance and it was found that only in June/July of one Above Normal (2003) and a selection of Critical water years had the potential to violate standards. In comparison with the Base, the potential exists for the Critical water year standards to be exceeded in the Alternatives by EC increases occurring a few days sooner than in the Base, which could be changed with a minor variation in export timing.

Changes in the south Delta stage were calculated for each Alternative in comparison with Base at all D-1641 locations, and discussed only at representative locations - the entire set of results are compiled in the Attachment to this Appendix. Stage changes were assessed via a conservative calculation that compared the monthly average of differences in daily minimum stage. The analyses consider a stage difference of -0.2 ft. to indicate a potentially significant result. Stage decreases were greatest for the Proposed Project/All Transfers alternative at the Old River downstream of agricultural barrier location, but changes of this magnitude only occurred in seven of the 408 months simulated. These decreases occurred in July and August of Dry or Critical water years, when south Delta exports increased in comparison with Base. Monthly average decreases in stage were sparse in all other locations and alternatives, with few instances when stage changes reached -0.2 ft. (e.g., in June 1993 in several locations for each of the alternatives).

Changes in X2 were evaluated as the change from monthly average Base values. The No Groundwater Substitution alternative, Alternative 3, had the smallest changes in X2. According to the criteria specified in (SWRCB, 1999), none of the changes in X2 are considered significant.

The Biological Opinions (FWS, 2008; NOAA, 2009) prescribing December – June OMR flow values for the protection of delta smelt are complicated by additional triggers used to specify the "adaptive" actions to restrict the magnitude of negative OMR flows, such as turbidity, water temperature, and the presence of delta smelt at certain locations or times. These adaptive constraints make it difficult to assess the significance of a change in OMR flow due to the alternatives. However, all of the Alternatives tend to increase the magnitude of negative OMR flow (positive percent values indicate a result to be avoided). The December – June average monthly percent change from Base values of OMR flow are similar for the All Transfers and No Crop Idle alternatives, with positive percent changes in April and June of Above Normal water years, while the No Groundwater Substitution alternative has a positive percent change in June of Above Normal water years.

C.13 References

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Attachment C.1: DSM2 Detailed Model Output and Boundary Conditions

C.1.1 Salinity (EC) Model Output

Model output for EC at each location was calculated for water years 1970 – 200. It is presented here in two basic forms – as Tables and as Figures showing monthly average EC for the Base scenario and change from Base EC, (Scenario – Base). The Tables have several subtypes: monthly average results for water years 1970 – 2003, average monthly results for the average over all water year types and results split by water year type. For each location, the Tables show Base salinity as EC, change from Base EC and percent change from Base EC for each of the three alternative scenarios (i.e., seven tables per location).

Table 1-1. Martinez Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	15017.8	15341.5	5550.8	210.8	583.9	3326.3	10070.2	13841.5	17131.7	17836.8	19848.6	15539.9
1971	15069.8	14704.2	3807.2	2159.7	6928.3	4818.1	6810.6	6151.1	10434.5	16094.3	20489.2	15603.0
1972	15102.5	14743.8	17116.6	17362.1	13256.4	7918.8	11193.0	15234.0	18325.4	19152.2	20962.2	22417.0
1973	22847.2	20227.0	12717.5	1381.0	522.8	1246.7	6882.3	9675.1	14196.2	17722.4	20416.4	19007.8
1974	18806.4	5278.9	1551.7	248.1	2730.4	428.5	731.2	5969.6	11291.9	16170.3	19854.3	15211.2
1975	15125.4	14819.1	17454.7	19102.2	4911.5	541.0	4864.9	5592.2	8088.1	14693.0	20165.6	15196.6
1976	14981.4	14013.3	17058.6	19756.7	18839.4	16861.5	16713.6	19526.5	21934.1	22659.3	23189.2	23809.4
1977	24140.9	23811.9	23838.1	21451.7	19105.8	19163.4	19326.5	20901.0	22679.3	23675.9	23963.0	24237.1
1978	23909.0	23756.1	21476.5	3366.6	1783.4	976.2	2011.4	6017.0	11669.6	16545.6	20472.8	19063.6
1979	18577.8	18092.4	19363.9	14219.7	5516.1	5871.7	9372.5	9613.8	14571.0	18830.2	21263.5	22680.3
1980	22974.2	21624.1	19511.6	1861.2	234.7	971.7	6166.1	9483.8	13079.2	16891.8	20485.3	19233.6
1981	18590.3	18033.2	19223.7	14941.7	9315.7	9220.2	11522.4	15187.2	18331.4	20742.9	22300.8	23218.5
1982	23580.8	14475.7	1097.8	728.6	366.6	521.0	219.2	2072.6	7623.2	15067.1	20296.5	15496.8
1983	12854.9	5679.2	869.5	373.6	208.4	200.6	374.7	630.9	874.9	4438.0	10294.5	10414.1
1984	13701.5	1954.7	209.8	1143.9	3104.7	4068.1	8348.6	12412.3	16593.4	17651.6	19971.4	15620.2
1985	15281.8	12792.9	13096.5	15981.3	15142.4	14464.0	13668.3	14960.1	18381.9	20993.7	22625.8	23098.1
1986	23068.0	23262.7	20690.2	13779.2	340.3	215.5	4978.8	9030.3	14006.2	17829.2	20873.9	16173.1
1987	15438.8	15792.6	18630.2	19417.6	14375.8	8988.6	13200.6	17771.3	19479.0	20938.2	22498.3	23444.0
1988	23624.3	23370.4	19891.4	10401.8	11454.4	16723.6	17949.7	18770.2	20019.9	21696.8	22940.5	23803.4
1989	24174.3	23611.7	23238.2	21839.5	20110.8	5778.1	7331.7	13073.5	18135.1	21242.1	21951.2	22223.8
1990	22607.7	23003.3	23116.4	18919.4	15668.9	16480.7	17154.1	18556.6	20825.0	23014.9	23464.8	23752.7
1991	23929.0	24096.0	24164.9	22924.1	20850.8	8703.8	11369.4	17874.5	21192.3	22900.9	23386.2	23817.1
1992	24040.7	24015.1	23998.2	22958.8	9946.2	9186.8	14095.9	18310.5	20149.7	21797.5	23324.1	23842.8
1993	23514.0	23348.6	22440.7	4447.7	1524.1	3789.6	3382.9	4966.3	8355.8	14892.9	20086.5	18513.4
1994	18123.2	17960.9	19209.7	19618.0	12933.8	14156.6	15975.7	16726.0	19989.5	22395.6	23262.3	23700.5
1995	22913.5	22758.0	22412.3	2017.3	2464.1	224.0	820.3	495.9	2997.4	7687.9	14505.4	15109.1
1996	14498.9	14617.3	13411.3	4600.9	315.0	750.3	2000.2	2099.8	10630.2	17072.7	20478.2	14671.2
1997	14696.0	14704.1	1930.4	202.2	631.9	6065.4	9389.3	11556.5	16297.0	17314.7	19569.8	15595.9
1998	15352.3	14605.0	15412.1	5385.5	219.2	479.8	932.3	1242.4	820.3	5251.7	12308.8	12446.8
1999	14649.4	12204.3	7108.5	4099.7	507.6	1136.9	4278.5	8007.5	13094.0	17038.4	20462.0	15206.4
2000	15239.6	14518.6	17291.1	14037.6	905.4	999.7	5982.3	9591.7	15872.5	17978.4	19966.8	18795.7
2001	18606.3	18210.5	19306.4	17834.6	9685.6	7693.9	11392.5	15672.5	18500.6	20800.0	22312.8	23190.2
2002	23405.6	22909.1	12919.1	2989.0	9051.3	11378.4	11180.0	13260.5	18186.2	21302.7	22494.8	23456.6
2003	23382.3	23133.3	10292.3	1695.7	6007.8	9590.8	7074.8	3908.6	12954.5	17619.0	20032.7	19014.8
Average	19171.3	17513.8	14982.6	10042.9	7045.4	6263.0	8434.2	10828.9	14609.1	17880.5	20603.5	19311.9
Critical	21635.3	21467.3	21611.1	19432.9	15542.7	14468.1	16083.6	18666.5	20970.0	22591.5	23361.4	23851.9
Dry	19249.5	18558.3	17735.7	15500.6	12946.9	9587.2	11382.6	14987.5	18502.4	21003.2	22364.0	23105.2
BN	16840.2	16418.1	18240.2	15790.9	9386.3	6895.2	10282.7	12423.9	16448.2	18991.2	21112.9	22548.6
AN	21977.7	21101.3	17288.3	4465.0	1829.7	2929.1	5250.0	7273.8	12688.0	16941.7	20243.4	18938.2
Wet	16871.9	13415.8	8577.4	4157.8	1793.2	1752.0	4139.9	6084.8	9991.0	14165.1	18393.7	14791.1

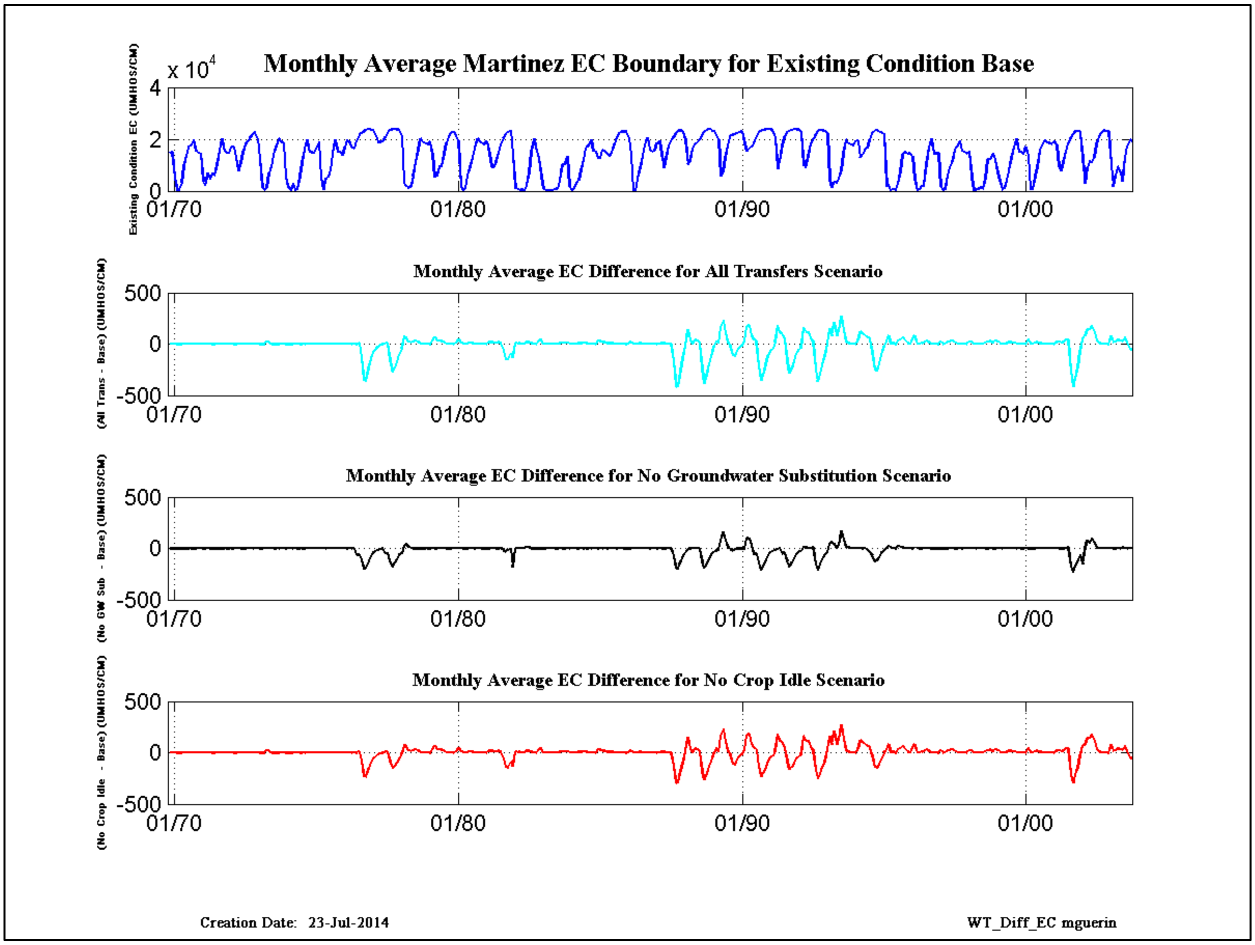


Figure 1-1. Monthly Average Martinez EC for the Base condition and change from Base for the scenarios.

Table 1-2. Martinez salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	-0.1	0.0	-0.1	26.7	12.5	-0.8	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	1.3	-3.4	12.2	-128.1	-349.8	-360.4
1977	-233.1	-138.6	-80.5	-53.2	-26.7	-9.5	-3.5	4.1	10.2	-151.3	-270.2	-234.8
1978	-174.5	-100.9	-42.2	68.2	65.1	23.1	14.2	27.5	35.7	17.1	3.3	1.3
1979	0.4	0.1	-0.6	35.1	62.0	31.6	30.6	29.0	10.7	1.8	0.5	0.2
1980	-0.1	11.8	43.5	13.6	1.3	2.0	9.6	14.8	6.0	0.7	0.2	0.1
1981	0.0	0.0	-0.3	19.7	19.2	14.4	14.6	15.4	10.0	-57.1	-147.2	-148.8
1982	-93.0	-128.2	13.2	3.6	5.1	2.0	0.1	18.9	20.2	6.9	1.0	-0.2
1983	35.5	44.8	3.8	0.4	0.0	0.0	0.5	1.1	1.5	6.1	12.4	14.6
1984	15.2	4.2	0.0	1.6	4.6	6.1	8.7	11.6	5.7	1.3	0.3	0.1
1985	-0.5	31.5	26.0	16.3	16.8	7.4	7.0	9.5	4.9	1.4	0.5	0.3
1986	0.1	0.0	9.5	16.0	0.4	0.0	3.9	6.0	2.3	0.3	0.1	0.0
1987	0.0	0.0	-0.1	3.9	8.8	8.8	3.2	0.7	5.0	-163.9	-416.0	-412.3
1988	-252.0	-141.0	-6.5	142.0	44.1	3.7	37.1	32.4	14.8	-244.9	-381.5	-299.7
1989	-196.2	-119.0	-21.9	28.1	5.5	171.2	228.8	111.1	14.7	-20.2	-107.4	-119.8
1990	-65.3	-31.5	-16.7	35.3	176.1	180.3	82.0	43.3	34.1	-213.0	-356.9	-300.2
1991	-204.9	-113.6	-66.0	-43.9	15.2	183.1	115.7	89.7	53.3	-157.5	-285.8	-239.3
1992	-163.0	-92.4	-54.8	-38.7	158.8	120.6	112.7	57.9	23.9	-240.0	-362.4	-290.3
1993	-199.1	-110.2	8.8	154.7	79.0	216.4	76.3	135.6	274.9	128.5	19.1	7.3
1994	2.4	0.7	-0.5	38.4	124.7	99.0	81.6	66.3	52.9	-75.9	-250.7	-260.3
1995	-188.6	-98.1	-18.8	27.5	84.8	1.5	6.0	-1.1	39.6	47.6	60.9	36.4
1996	5.8	0.1	53.8	83.3	2.3	3.2	10.0	10.4	31.1	19.0	4.0	1.5
1997	0.3	-3.1	21.4	0.0	1.9	20.3	29.8	31.5	14.6	3.4	0.7	0.3
1998	0.0	-0.3	21.0	24.8	0.1	1.2	2.9	3.8	2.0	11.0	22.5	27.9
1999	9.5	37.8	26.4	9.2	0.9	2.4	9.6	15.8	19.7	10.2	2.2	0.9
2000	0.1	0.0	-0.8	48.2	6.1	4.6	12.3	16.8	7.3	1.5	0.4	0.1
2001	0.0	0.0	-0.2	17.7	23.1	13.9	16.0	42.5	38.8	-262.7	-411.9	-334.5
2002	-217.8	-73.0	51.8	77.8	144.6	145.3	178.8	116.2	34.1	9.0	3.5	1.5
2003	0.8	-1.2	78.9	16.9	23.0	38.0	32.7	26.3	64.0	12.2	-43.4	-62.4
Average	-56.4	-30.0	1.4	22.0	30.8	38.7	33.4	27.4	24.8	-42.3	-95.6	-87.4
Critical	-130.8	-73.8	-32.1	11.4	70.3	82.5	61.0	41.5	28.8	-173.0	-322.5	-283.6
Dry	-69.1	-26.8	9.2	27.2	36.3	60.2	74.7	49.2	17.9	-82.3	-179.7	-168.9
BN	0.2	0.1	-0.3	17.5	31.0	15.8	15.3	14.5	5.4	0.9	0.3	0.1
AN	-62.1	-33.4	14.7	50.3	29.1	51.8	26.2	36.7	64.6	26.7	-3.4	-8.9
Wet	-16.5	-11.0	10.0	12.8	7.7	2.8	5.5	7.5	10.5	8.1	8.0	6.3

Table 1-3. Martinez salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	2.1	0.2	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.6	-1.5	-1.5
1977	-1.0	-0.6	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	-0.6	-1.1	-1.0
1978	-0.7	-0.4	-0.2	2.0	3.7	2.4	0.7	0.5	0.3	0.1	0.0	0.0
1979	0.0	0.0	0.0	0.2	1.1	0.5	0.3	0.3	0.1	0.0	0.0	0.0
1980	0.0	0.1	0.2	0.7	0.6	0.2	0.2	0.2	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.1	-0.3	-0.7	-0.6
1982	-0.4	-0.9	1.2	0.5	1.4	0.4	0.1	0.9	0.3	0.0	0.0	0.0
1983	0.3	0.8	0.4	0.1	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.1
1984	0.1	0.2	0.0	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0
1985	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.8	-1.8	-1.8
1988	-1.1	-0.6	0.0	1.4	0.4	0.0	0.2	0.2	0.1	-1.1	-1.7	-1.3
1989	-0.8	-0.5	-0.1	0.1	0.0	3.0	3.1	0.8	0.1	-0.1	-0.5	-0.5
1990	-0.3	-0.1	-0.1	0.2	1.1	1.1	0.5	0.2	0.2	-0.9	-1.5	-1.3
1991	-0.9	-0.5	-0.3	-0.2	0.1	2.1	1.0	0.5	0.3	-0.7	-1.2	-1.0
1992	-0.7	-0.4	-0.2	-0.2	1.6	1.3	0.8	0.3	0.1	-1.1	-1.6	-1.2
1993	-0.8	-0.5	0.0	3.5	5.2	5.7	2.3	2.7	3.3	0.9	0.1	0.0
1994	0.0	0.0	0.0	0.2	1.0	0.7	0.5	0.4	0.3	-0.3	-1.1	-1.1
1995	-0.8	-0.4	-0.1	1.4	3.4	0.7	0.7	-0.2	1.3	0.6	0.4	0.2
1996	0.0	0.0	0.4	1.8	0.7	0.4	0.5	0.5	0.3	0.1	0.0	0.0
1997	0.0	0.0	1.1	0.0	0.3	0.3	0.3	0.3	0.1	0.0	0.0	0.0
1998	0.0	0.0	0.1	0.5	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.2
1999	0.1	0.3	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0
2000	0.0	0.0	0.0	0.3	0.7	0.5	0.2	0.2	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.3	0.2	-1.3	-1.8	-1.4
2002	-0.9	-0.3	0.4	2.6	1.6	1.3	1.6	0.9	0.2	0.0	0.0	0.0
2003	0.0	0.0	0.8	1.0	0.4	0.4	0.5	0.7	0.5	0.1	-0.2	-0.3
Average	-0.2	-0.1	0.1	0.5	0.7	0.7	0.4	0.3	0.2	-0.2	-0.4	-0.4
Critical	-0.5	-0.3	-0.1	0.2	0.6	0.7	0.4	0.2	0.1	-0.8	-1.4	-1.2
Dry	-0.3	-0.1	0.1	0.5	0.4	0.8	0.8	0.4	0.1	-0.4	-0.8	-0.7
BN	0.0	0.0	0.0	0.1	0.6	0.3	0.2	0.2	0.0	0.0	0.0	0.0
AN	-0.3	-0.1	0.1	1.3	1.7	1.9	0.7	0.7	0.7	0.2	0.0	0.0
Wet	-0.1	0.0	0.3	0.4	0.5	0.2	0.2	0.2	0.2	0.1	0.1	0.0

Table 1-4. Martinez salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	1.2	-61.1	-60.9	-115.0	-200.9	-186.6
1977	-121.1	-72.8	-42.5	-28.5	-14.0	-5.1	-0.8	-47.7	-48.3	-118.2	-177.1	-146.5
1978	-107.8	-62.7	-45.8	23.0	47.7	10.5	0.7	-0.3	-0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	-2.8	-0.7	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	-23.3	-30.9	-12.2
1982	-2.5	-177.8	-2.8	0.8	4.2	0.5	0.0	13.5	5.7	-0.1	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	3.6	-75.2	-196.0	-196.9
1988	-123.1	-69.0	-45.1	-13.4	-0.7	0.0	0.0	0.7	4.2	-129.2	-192.4	-146.6
1989	-97.8	-59.4	-35.0	-20.5	-13.9	81.1	159.7	81.8	10.6	-14.6	-20.9	-9.4
1990	-4.2	-2.1	-1.1	-2.6	96.1	92.8	33.7	-55.6	-54.6	-146.0	-211.5	-168.7
1991	-113.7	-63.6	-37.4	-24.7	-14.7	-4.9	0.6	-51.1	-44.8	-121.3	-177.6	-140.3
1992	-94.7	-54.2	-32.4	-21.2	15.7	6.8	0.2	0.6	6.0	-155.9	-210.3	-153.4
1993	-105.7	-58.7	-39.3	52.4	57.1	38.1	4.7	30.6	175.0	92.9	13.7	5.2
1994	1.6	0.5	0.1	0.0	0.0	0.0	0.3	-17.3	-35.4	-69.9	-127.2	-117.9
1995	-80.8	-41.9	-24.1	1.9	25.8	0.4	0.1	-3.7	21.5	10.3	5.7	3.8
1996	0.6	0.1	-0.5	9.9	0.3	0.0	0.0	0.3	0.2	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	-0.3	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	6.0	-175.2	-233.3	-166.7
2002	-109.3	-59.8	-146.7	14.9	80.3	54.3	101.6	54.2	6.8	1.9	0.7	0.3
2003	0.2	0.1	0.1	-0.9	-0.3	0.0	-0.3	8.1	4.0	-1.4	0.7	0.5
Average	-28.2	-21.2	-13.3	-0.3	8.3	8.1	8.9	-1.3	0.0	-30.6	-51.7	-42.2
Critical	-65.0	-37.3	-22.6	-12.9	11.8	12.8	5.0	-33.1	-33.4	-122.2	-185.3	-151.4
Dry	-34.5	-19.9	-30.3	-0.9	11.1	22.6	43.5	22.9	4.6	-47.7	-80.1	-64.1
BN	0.0	0.0	0.0	0.1	-1.4	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
AN	-35.6	-20.2	-14.2	12.4	17.4	8.1	0.8	6.4	29.8	15.3	2.4	0.9
Wet	-6.4	-16.9	-2.1	1.0	2.3	0.1	0.0	0.8	2.1	0.8	0.4	0.3

Table 1-5. Martinez salinity (EC) difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3	-0.5	-0.9	-0.8
1977	-0.5	-0.3	-0.2	-0.1	-0.1	0.0	0.0	-0.2	-0.2	-0.5	-0.7	-0.6
1978	-0.5	-0.3	-0.2	0.7	2.7	1.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
1982	0.0	-1.2	-0.3	0.1	1.1	0.1	0.0	0.7	0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.9	-0.8
1988	-0.5	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.6	-0.8	-0.6
1989	-0.4	-0.3	-0.2	-0.1	-0.1	1.4	2.2	0.6	0.1	-0.1	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.6	0.6	0.2	-0.3	-0.3	-0.6	-0.9	-0.7
1991	-0.5	-0.3	-0.2	-0.1	-0.1	-0.1	0.0	-0.3	-0.2	-0.5	-0.8	-0.6
1992	-0.4	-0.2	-0.1	-0.1	0.2	0.1	0.0	0.0	0.0	-0.7	-0.9	-0.6
1993	-0.4	-0.3	-0.2	1.2	3.7	1.0	0.1	0.6	2.1	0.6	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.5	-0.5
1995	-0.4	-0.2	-0.1	0.1	1.0	0.2	0.0	-0.7	0.7	0.1	0.0	0.0
1996	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-1.0	-0.7
2002	-0.5	-0.3	-1.1	0.5	0.9	0.5	0.9	0.4	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Average	-0.1	-0.1	-0.1	0.1	0.3	0.1	0.1	0.0	0.1	-0.1	-0.2	-0.2
Critical	-0.3	-0.2	-0.1	-0.1	0.1	0.1	0.0	-0.2	-0.2	-0.5	-0.8	-0.6
Dry	-0.1	-0.1	-0.2	0.1	0.1	0.3	0.5	0.2	0.0	-0.2	-0.4	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	-0.1	-0.1	0.3	1.1	0.3	0.0	0.1	0.4	0.1	0.0	0.0
Wet	0.0	-0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Table 1-6. Martinez salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	-0.1	0.0	-0.1	26.7	12.5	-0.8	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	1.2	-0.6	14.1	-85.8	-229.1	-235.3
1977	-155.3	-92.7	-54.0	-35.7	-18.0	-6.4	-2.4	7.6	11.2	-78.9	-148.5	-133.5
1978	-100.6	-58.5	-13.7	73.9	65.1	23.1	14.2	27.5	35.7	17.1	3.4	1.3
1979	0.4	0.1	-0.6	35.1	62.0	31.6	30.6	29.0	10.7	1.8	0.5	0.2
1980	-0.1	11.8	43.5	13.6	1.3	2.0	9.6	14.8	6.0	0.7	0.2	0.1
1981	0.0	0.1	-0.3	19.7	19.2	14.4	14.6	15.4	9.8	-50.2	-140.2	-145.5
1982	-90.7	-126.7	13.2	3.6	5.1	2.0	0.1	18.9	20.2	6.9	1.0	-0.2
1983	35.5	44.8	3.8	0.4	0.0	0.0	0.5	1.1	1.5	6.1	12.4	14.6
1984	15.2	4.2	0.0	1.6	4.6	6.1	8.7	11.6	5.7	1.3	0.3	0.1
1985	-0.5	31.5	26.0	16.3	16.8	7.4	7.0	9.5	4.9	1.4	0.5	0.3
1986	0.1	0.0	9.5	16.0	0.4	0.0	3.9	6.0	2.3	0.3	0.1	0.0
1987	0.0	0.0	-0.1	3.9	8.8	8.8	3.2	0.5	3.6	-126.9	-296.0	-285.4
1988	-175.6	-99.2	20.3	150.1	44.5	3.8	37.1	32.1	12.7	-179.7	-264.6	-198.9
1989	-131.9	-80.5	0.5	41.2	12.2	172.7	228.8	111.1	14.7	-20.2	-107.3	-119.8
1990	-65.3	-31.5	-16.7	35.3	176.1	180.3	82.0	46.3	34.7	-130.6	-229.8	-197.9
1991	-136.8	-76.3	-44.1	-29.6	23.6	186.0	115.7	93.1	54.4	-79.6	-161.5	-140.7
1992	-97.5	-55.4	-32.9	-24.8	165.8	120.9	112.7	57.7	21.2	-163.1	-250.8	-201.5
1993	-137.5	-76.7	28.3	160.1	79.0	216.4	76.3	135.6	274.9	128.5	19.1	7.3
1994	2.4	0.7	-0.5	38.4	124.7	99.0	81.6	66.6	52.6	-30.3	-139.0	-151.3
1995	-114.0	-60.2	1.2	30.2	84.8	1.5	6.0	-1.1	39.6	47.6	60.9	36.4
1996	5.8	0.1	53.8	83.3	2.3	3.2	10.0	10.4	31.1	19.0	4.0	1.5
1997	0.3	-3.1	21.4	0.0	1.9	20.3	29.8	31.5	14.6	3.4	0.7	0.3
1998	0.0	-0.3	21.0	24.8	0.1	1.2	2.9	3.8	2.0	11.0	22.5	27.9
1999	9.5	37.8	26.4	9.2	0.9	2.4	9.6	15.8	19.7	10.2	2.2	0.9
2000	0.1	0.0	-0.8	48.2	6.1	4.6	12.3	16.8	7.3	1.5	0.4	0.1
2001	0.0	0.0	-0.2	17.7	23.1	13.9	16.0	42.1	36.1	-208.9	-289.4	-216.2
2002	-144.5	-32.7	74.4	78.6	144.6	145.3	178.8	116.2	34.1	9.0	3.5	1.5
2003	0.8	-1.2	78.9	16.9	23.0	38.0	32.7	26.3	64.0	12.2	-43.4	-62.4
Average	-37.6	-19.5	7.6	24.4	31.7	39.0	33.4	27.8	24.7	-25.8	-63.8	-58.7
Critical	-89.7	-50.6	-18.3	19.1	73.8	83.4	61.1	43.3	28.7	-106.9	-203.3	-179.9
Dry	-46.1	-13.6	16.7	29.5	37.5	60.4	74.7	49.1	17.2	-66.0	-138.2	-127.5
BN	0.2	0.1	-0.3	17.5	31.0	15.8	15.3	14.5	5.4	0.9	0.3	0.1
AN	-39.5	-20.8	22.7	52.1	29.1	51.8	26.2	36.7	64.6	26.7	-3.4	-8.9
Wet	-10.6	-8.0	11.6	13.0	7.7	2.8	5.5	7.5	10.5	8.1	8.0	6.3

Table 1-7. Martinez salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	2.1	0.2	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.4	-1.0	-1.0
1977	-0.6	-0.4	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	-0.3	-0.6	-0.6
1978	-0.4	-0.2	-0.1	2.2	3.7	2.4	0.7	0.5	0.3	0.1	0.0	0.0
1979	0.0	0.0	0.0	0.2	1.1	0.5	0.3	0.3	0.1	0.0	0.0	0.0
1980	0.0	0.1	0.2	0.7	0.6	0.2	0.2	0.2	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.1	-0.2	-0.6	-0.6
1982	-0.4	-0.9	1.2	0.5	1.4	0.4	0.1	0.9	0.3	0.0	0.0	0.0
1983	0.3	0.8	0.4	0.1	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.1
1984	0.1	0.2	0.0	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0
1985	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.6	-1.3	-1.2
1988	-0.7	-0.4	0.1	1.4	0.4	0.0	0.2	0.2	0.1	-0.8	-1.2	-0.8
1989	-0.5	-0.3	0.0	0.2	0.1	3.0	3.1	0.8	0.1	-0.1	-0.5	-0.5
1990	-0.3	-0.1	-0.1	0.2	1.1	1.1	0.5	0.2	0.2	-0.6	-1.0	-0.8
1991	-0.6	-0.3	-0.2	-0.1	0.1	2.1	1.0	0.5	0.3	-0.3	-0.7	-0.6
1992	-0.4	-0.2	-0.1	-0.1	1.7	1.3	0.8	0.3	0.1	-0.7	-1.1	-0.8
1993	-0.6	-0.3	0.1	3.6	5.2	5.7	2.3	2.7	3.3	0.9	0.1	0.0
1994	0.0	0.0	0.0	0.2	1.0	0.7	0.5	0.4	0.3	-0.1	-0.6	-0.6
1995	-0.5	-0.3	0.0	1.5	3.4	0.7	0.7	-0.2	1.3	0.6	0.4	0.2
1996	0.0	0.0	0.4	1.8	0.7	0.4	0.5	0.5	0.3	0.1	0.0	0.0
1997	0.0	0.0	1.1	0.0	0.3	0.3	0.3	0.3	0.1	0.0	0.0	0.0
1998	0.0	0.0	0.1	0.5	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.2
1999	0.1	0.3	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.0
2000	0.0	0.0	0.0	0.3	0.7	0.5	0.2	0.2	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.3	0.2	-1.0	-1.3	-0.9
2002	-0.6	-0.1	0.6	2.6	1.6	1.3	1.6	0.9	0.2	0.0	0.0	0.0
2003	0.0	0.0	0.8	1.0	0.4	0.4	0.5	0.7	0.5	0.1	-0.2	-0.3
Average	-0.2	-0.1	0.1	0.5	0.7	0.7	0.4	0.3	0.2	-0.1	-0.3	-0.2
Critical	-0.4	-0.2	-0.1	0.2	0.6	0.7	0.4	0.2	0.1	-0.5	-0.9	-0.8
Dry	-0.2	0.0	0.1	0.5	0.4	0.8	0.8	0.4	0.1	-0.3	-0.6	-0.6
BN	0.0	0.0	0.0	0.1	0.6	0.3	0.2	0.2	0.0	0.0	0.0	0.0
AN	-0.2	-0.1	0.2	1.3	1.7	1.9	0.7	0.7	0.7	0.2	0.0	0.0
Wet	0.0	0.0	0.3	0.4	0.5	0.2	0.2	0.2	0.2	0.1	0.1	0.0

Table 1-8. CCWD Contra Costa Canal Intake (CHCCC006) Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	321.1	268.7	261.2	464.0	308.8	285.4	338.1	391.8	290.1	279.8	345.0	670.4
1971	338.9	302.6	299.6	276.4	264.4	290.8	355.6	399.1	267.5	244.3	387.7	717.8
1972	330.6	283.8	274.4	473.6	408.1	354.5	364.0	399.2	304.7	350.4	479.3	802.8
1973	893.9	1027.6	638.3	545.6	483.4	385.0	384.3	425.9	287.3	264.8	385.8	534.5
1974	294.6	322.2	285.5	308.7	288.9	285.9	323.3	393.5	289.4	249.0	325.2	524.1
1975	356.4	294.7	284.5	564.2	437.8	393.4	356.4	400.1	280.9	248.5	322.9	587.9
1976	363.8	271.2	260.7	528.9	547.1	458.6	386.5	401.6	460.6	637.5	934.1	741.4
1977	863.1	904.0	859.3	1158.2	701.6	473.9	421.5	393.9	492.5	605.3	739.5	979.8
1978	1061.2	827.3	888.6	642.9	468.3	440.1	403.4	333.7	285.7	257.9	378.7	511.9
1979	292.0	324.6	378.9	884.2	440.6	357.4	367.1	402.6	284.2	321.1	545.8	808.5
1980	939.1	787.7	710.4	547.2	697.2	518.2	334.5	399.3	314.0	259.2	340.9	498.9
1981	299.0	283.3	439.6	789.3	368.2	305.7	395.7	406.7	306.7	442.6	705.7	812.8
1982	987.0	917.1	325.6	487.5	329.0	414.3	328.0	242.7	245.0	256.9	292.9	375.8
1983	234.9	321.3	359.8	672.4	575.8	583.4	391.2	276.5	260.9	292.4	244.7	212.6
1984	223.6	283.5	348.7	360.3	307.5	274.9	348.2	412.2	286.0	280.3	338.8	603.3
1985	376.3	322.5	254.2	283.3	296.2	320.2	400.3	396.0	302.0	446.2	689.7	784.3
1986	879.6	736.6	996.4	583.9	666.0	722.6	395.7	327.4	291.9	271.1	391.0	393.4
1987	242.6	257.9	281.5	631.7	443.5	397.2	432.4	394.7	314.1	357.0	493.7	566.1
1988	745.3	717.1	772.2	461.4	423.4	461.2	403.5	395.0	352.6	366.7	591.0	650.7
1989	803.3	937.6	866.0	1104.9	732.4	511.4	399.7	326.0	263.2	506.1	808.6	778.9
1990	738.4	758.8	788.0	833.6	414.7	320.9	344.0	333.0	355.6	579.7	884.3	785.1
1991	929.2	939.1	1009.0	1012.1	680.4	525.6	445.5	374.3	365.7	642.0	902.1	757.5
1992	883.8	906.2	922.1	1014.5	775.5	442.9	379.7	356.6	324.2	388.6	660.7	784.0
1993	856.7	692.8	839.7	774.0	552.5	408.3	427.5	439.3	294.9	238.4	366.2	508.7
1994	282.3	353.8	431.4	875.0	558.2	385.1	358.0	341.2	334.0	620.0	1013.0	851.4
1995	944.8	614.5	760.9	802.7	362.1	489.2	431.6	245.3	234.5	293.1	233.3	216.8
1996	222.2	236.4	277.8	527.9	895.5	628.3	389.9	386.6	286.0	259.3	418.9	697.9
1997	340.7	272.0	398.1	536.3	328.0	296.3	331.6	411.1	298.2	278.2	324.5	596.9
1998	354.2	297.3	261.5	527.2	1368.3	844.8	313.3	265.2	248.0	299.1	245.7	216.4
1999	222.0	265.0	230.1	327.7	332.0	291.4	346.7	405.1	275.4	255.1	390.5	706.9
2000	358.0	274.0	273.1	578.1	661.9	440.8	350.3	417.7	293.7	282.1	341.1	534.2
2001	330.5	318.7	363.0	764.4	450.6	361.8	397.0	421.9	313.3	339.1	484.5	548.7
2002	724.9	713.5	873.2	394.9	299.0	296.9	362.6	450.7	327.1	501.7	745.2	752.5
2003	983.1	741.1	759.5	337.5	318.0	284.0	332.6	400.8	262.2	280.3	388.6	554.5
Average	559.3	522.8	528.6	619.8	505.4	419.1	374.7	375.5	305.6	358.6	504.1	619.6
Critical	686.6	692.9	720.4	840.5	585.8	438.3	391.3	370.8	383.6	548.5	817.8	792.8
Dry	462.8	472.3	512.9	661.4	431.6	365.5	398.0	399.3	304.4	432.1	654.6	707.2
BN	311.3	304.2	326.6	678.9	424.4	355.9	365.6	400.9	294.4	335.8	512.6	805.6
AN	848.6	725.1	684.9	570.9	530.2	412.7	372.1	402.8	289.6	263.8	366.9	523.8
Wet	440.0	394.8	391.5	495.3	497.2	446.2	357.7	350.5	273.4	269.8	327.8	501.6

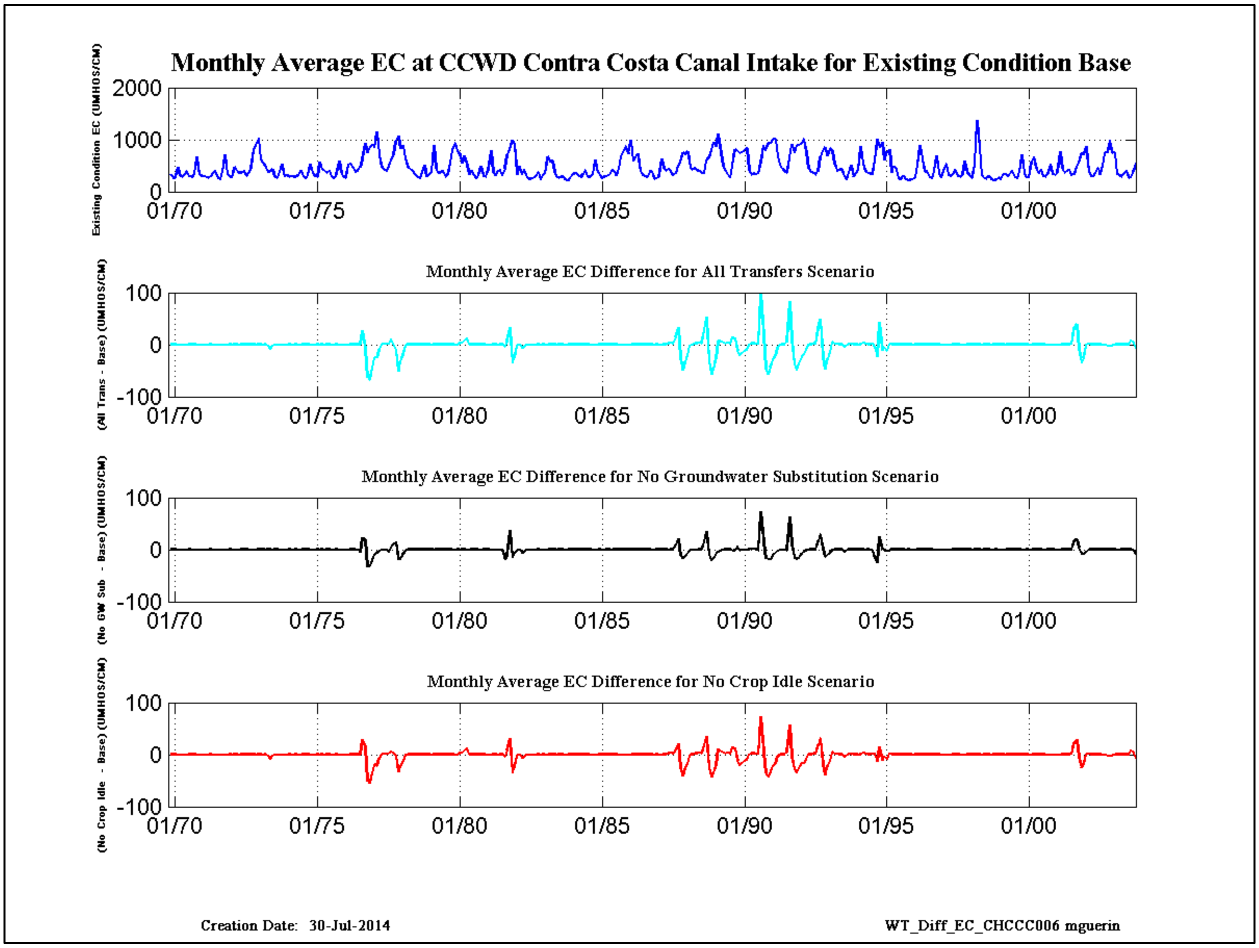


Figure 1-2. Monthly Average CCWD Contra Costa Canal Intake EC for the Base condition and change from Base for the scenarios.

Table 1-9. CVP-Jones Intake (CHDMC006) Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	320.3	411.9	423.6	321.7	326.1	300.3	337.2	414.2	361.0	311.3	344.8	540.7
1971	373.1	392.7	503.3	506.4	509.4	413.6	333.8	371.4	331.6	270.0	372.8	558.2
1972	367.8	380.4	432.4	561.7	702.4	602.9	550.7	476.8	387.5	340.0	432.2	628.8
1973	659.8	797.2	636.4	735.5	621.8	375.9	361.3	374.5	358.9	304.8	372.0	418.3
1974	337.3	324.8	504.3	488.8	482.9	301.4	306.8	391.0	404.3	335.7	340.6	437.5
1975	343.3	339.4	432.8	604.6	436.0	286.8	338.5	388.8	368.7	332.4	342.9	470.8
1976	335.1	328.5	414.8	615.0	663.2	620.7	634.3	504.6	496.5	583.9	671.6	606.2
1977	661.6	698.5	765.0	911.9	884.3	865.4	681.0	625.9	511.2	542.4	613.5	749.9
1978	816.7	696.6	771.5	717.8	600.6	557.5	301.7	261.2	367.2	355.9	366.0	410.7
1979	332.1	362.6	492.9	684.0	433.9	308.9	346.3	329.4	324.4	323.0	460.2	622.7
1980	645.9	561.3	641.3	396.4	355.2	220.0	327.5	369.9	358.5	379.4	347.8	394.8
1981	345.6	341.3	506.4	686.9	594.2	520.2	464.5	448.7	384.9	401.6	558.6	647.2
1982	707.9	625.2	487.3	569.1	324.7	313.8	186.3	187.9	321.8	360.4	305.7	264.3
1983	201.3	210.1	275.8	337.1	316.0	272.1	190.9	207.7	212.7	227.9	194.3	220.6
1984	264.2	176.6	249.2	302.7	232.1	296.6	341.0	387.0	365.8	316.8	353.4	462.8
1985	336.4	322.6	410.0	500.3	545.9	500.3	417.3	455.4	385.8	408.9	550.5	629.2
1986	629.3	596.6	758.3	681.4	456.6	283.1	255.7	266.8	361.4	334.2	366.9	397.5
1987	348.0	335.4	420.4	631.0	625.6	628.8	617.4	491.3	382.1	344.4	451.0	511.2
1988	605.0	596.4	693.1	641.9	915.5	877.3	675.9	594.2	459.4	349.9	493.5	569.2
1989	669.2	719.7	759.1	886.5	840.5	801.8	602.8	554.3	311.2	439.9	625.2	591.1
1990	579.7	625.8	720.0	737.8	619.3	609.5	576.5	621.1	438.8	515.0	683.0	639.8
1991	729.9	747.6	830.8	873.3	891.3	750.1	615.0	595.3	384.5	548.0	700.0	627.2
1992	703.6	722.9	800.4	871.5	849.4	680.1	692.7	528.8	345.8	338.2	531.4	640.5
1993	684.7	612.9	745.5	759.9	673.6	572.9	493.2	492.6	503.9	378.8	370.4	418.6
1994	334.9	384.0	525.0	762.1	668.9	645.2	638.5	600.8	432.3	585.4	755.7	667.7
1995	708.6	535.7	710.1	786.7	583.8	394.5	228.1	165.1	290.3	262.3	264.3	276.8
1996	309.3	328.5	452.9	633.3	438.5	319.9	320.1	341.7	395.1	325.9	388.6	517.3
1997	363.5	325.7	316.3	272.0	178.6	213.8	331.6	349.9	368.2	312.7	346.5	489.8
1998	375.1	410.1	430.9	603.9	483.5	278.5	194.8	178.1	260.0	260.7	258.3	257.4
1999	272.5	308.5	424.0	480.6	268.1	321.6	352.6	370.9	347.2	293.3	384.8	533.2
2000	394.2	341.6	429.8	661.9	459.3	290.1	345.2	382.3	382.0	338.2	352.6	418.9
2001	340.7	362.6	491.2	705.3	655.8	569.0	432.3	455.3	377.8	335.2	432.3	508.8
2002	590.8	579.3	638.3	647.8	554.8	577.1	554.9	550.5	401.8	455.0	573.4	619.8
2003	717.6	604.9	678.8	614.0	514.5	509.1	490.8	462.9	304.9	281.8	365.5	446.5
Average	482.5	473.8	552.1	623.3	550.2	472.9	427.6	417.5	373.2	367.4	440.3	505.7
Critical	564.3	586.2	678.4	773.3	784.6	721.2	644.9	581.5	438.4	494.7	635.5	642.9
Dry	438.5	443.5	537.5	676.3	636.1	599.5	514.9	492.6	373.9	397.5	531.9	584.5
BN	350.0	371.5	462.7	622.8	568.2	455.9	448.5	403.1	355.9	331.5	446.2	625.7
AN	653.2	602.4	650.6	647.6	537.5	420.9	386.6	390.6	379.2	339.8	362.4	418.0
Wet	400.4	383.5	459.1	506.8	387.4	307.4	286.0	309.3	337.5	303.4	328.0	417.5

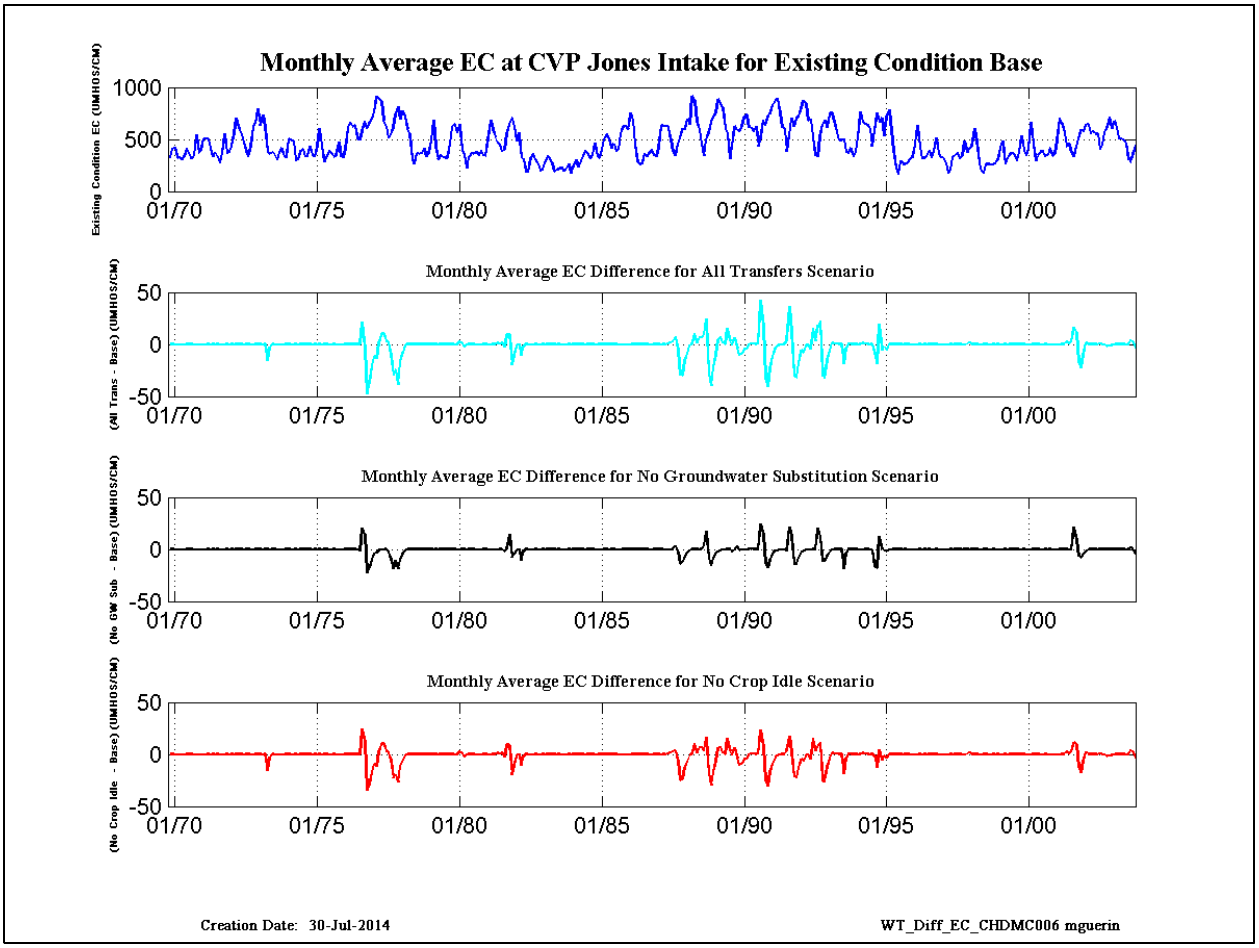


Figure 1-3. Monthly Average CVP-Jones Intake EC for the Base condition and change from Base for the scenarios.

Table 1-10. SWP-Clifton Court Intake (CHWST000) Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	287.5	354.1	346.1	376.3	320.9	286.0	315.5	398.5	333.9	262.7	320.3	560.1
1971	337.1	313.5	385.7	413.8	405.2	361.9	314.4	359.7	295.7	233.3	356.6	580.4
1972	335.3	330.6	299.6	490.2	585.8	508.4	504.5	460.9	353.2	314.8	424.6	667.3
1973	715.8	880.1	590.5	623.3	526.9	365.4	344.5	354.7	319.4	259.8	350.9	401.4
1974	289.5	277.5	372.1	412.0	400.5	304.2	301.0	376.3	342.2	263.3	309.4	440.5
1975	313.1	304.8	305.8	545.8	442.1	309.2	329.7	374.6	326.5	261.6	313.7	484.0
1976	304.5	288.2	277.6	559.8	575.4	515.9	560.0	478.8	477.3	601.2	712.8	629.5
1977	719.9	734.1	775.1	951.2	784.7	669.6	556.0	541.0	485.4	548.7	642.5	793.7
1978	870.0	711.4	767.9	677.8	544.8	499.5	287.8	242.7	318.0	282.4	345.8	416.7
1979	298.8	327.7	396.8	679.2	444.9	329.3	337.6	307.0	298.6	294.0	471.2	679.6
1980	729.5	590.1	609.3	453.0	320.5	211.8	316.2	352.4	343.7	298.7	323.9	384.2
1981	297.4	303.2	416.1	653.5	483.9	456.3	445.5	439.6	350.3	390.0	575.0	689.5
1982	780.9	658.8	389.5	490.9	350.0	342.8	181.7	172.7	275.2	295.4	292.1	287.8
1983	210.3	225.8	291.0	278.2	290.3	241.7	179.2	199.4	201.3	219.1	217.7	205.9
1984	227.9	204.2	228.2	314.7	277.0	274.5	321.4	370.7	323.4	266.3	321.1	490.2
1985	314.0	277.2	273.9	397.2	440.9	443.3	400.4	443.2	348.4	394.5	564.8	676.6
1986	679.0	632.1	784.2	623.4	501.7	268.6	247.7	249.2	323.2	278.5	350.3	368.1
1987	299.1	293.7	326.8	596.7	537.3	555.6	582.7	463.2	353.2	328.6	431.8	508.2
1988	640.2	616.6	678.7	569.8	830.0	717.7	588.7	542.7	427.7	348.8	496.0	572.2
1989	706.4	760.3	773.7	915.5	790.5	719.2	549.4	473.4	285.2	449.4	652.7	621.6
1990	599.1	648.6	711.6	712.6	517.0	505.4	467.6	534.7	402.5	529.6	717.2	662.1
1991	780.2	795.3	853.5	886.9	822.4	702.3	584.6	521.5	367.5	566.9	733.0	642.8
1992	744.5	760.3	807.5	881.5	823.6	619.7	574.0	445.0	339.4	346.7	558.2	656.1
1993	707.8	617.3	740.5	726.2	596.7	494.8	472.3	486.9	386.8	271.8	337.0	413.5
1994	296.9	353.7	444.2	743.0	585.4	538.9	521.4	525.9	395.4	612.2	793.5	698.9
1995	744.4	520.8	704.2	742.3	502.6	416.6	217.9	154.5	254.3	278.4	238.6	226.0
1996	259.6	277.7	342.0	525.4	456.7	341.6	313.2	329.9	329.1	268.7	375.1	545.7
1997	336.6	286.6	333.7	245.6	193.9	234.2	308.3	325.8	326.8	267.2	306.0	507.0
1998	343.3	337.6	291.9	544.1	404.9	376.5	189.7	171.2	251.1	274.2	237.9	222.9
1999	237.0	268.2	314.5	412.4	326.5	291.1	340.8	357.5	308.5	246.8	365.8	556.5
2000	354.0	300.2	298.3	604.5	525.8	330.0	331.6	366.9	327.0	274.2	321.6	410.7
2001	304.5	332.0	385.7	675.5	562.2	494.9	422.1	450.2	353.3	315.2	419.3	500.5
2002	622.1	593.5	586.4	567.3	449.8	482.5	514.1	522.0	378.4	461.6	590.5	652.5
2003	771.8	621.6	650.1	515.3	410.1	392.9	461.6	450.2	288.7	258.8	339.7	428.3
Average	484.1	464.6	492.7	582.5	500.9	429.5	393.6	389.5	338.0	340.1	435.5	517.1
Critical	583.6	599.5	649.7	757.8	705.5	609.9	550.3	512.8	413.6	507.7	664.7	665.1
Dry	423.9	426.6	460.4	634.3	544.1	525.3	485.7	465.3	344.8	389.9	539.0	608.2
BN	317.1	329.2	348.2	584.7	515.4	418.8	421.0	383.9	325.9	304.4	447.9	673.4
AN	691.5	620.1	609.4	600.0	487.5	382.4	369.0	375.6	330.6	274.3	336.5	409.1
Wet	388.2	358.6	391.4	455.8	374.8	311.5	273.9	295.4	299.3	262.7	308.0	421.2

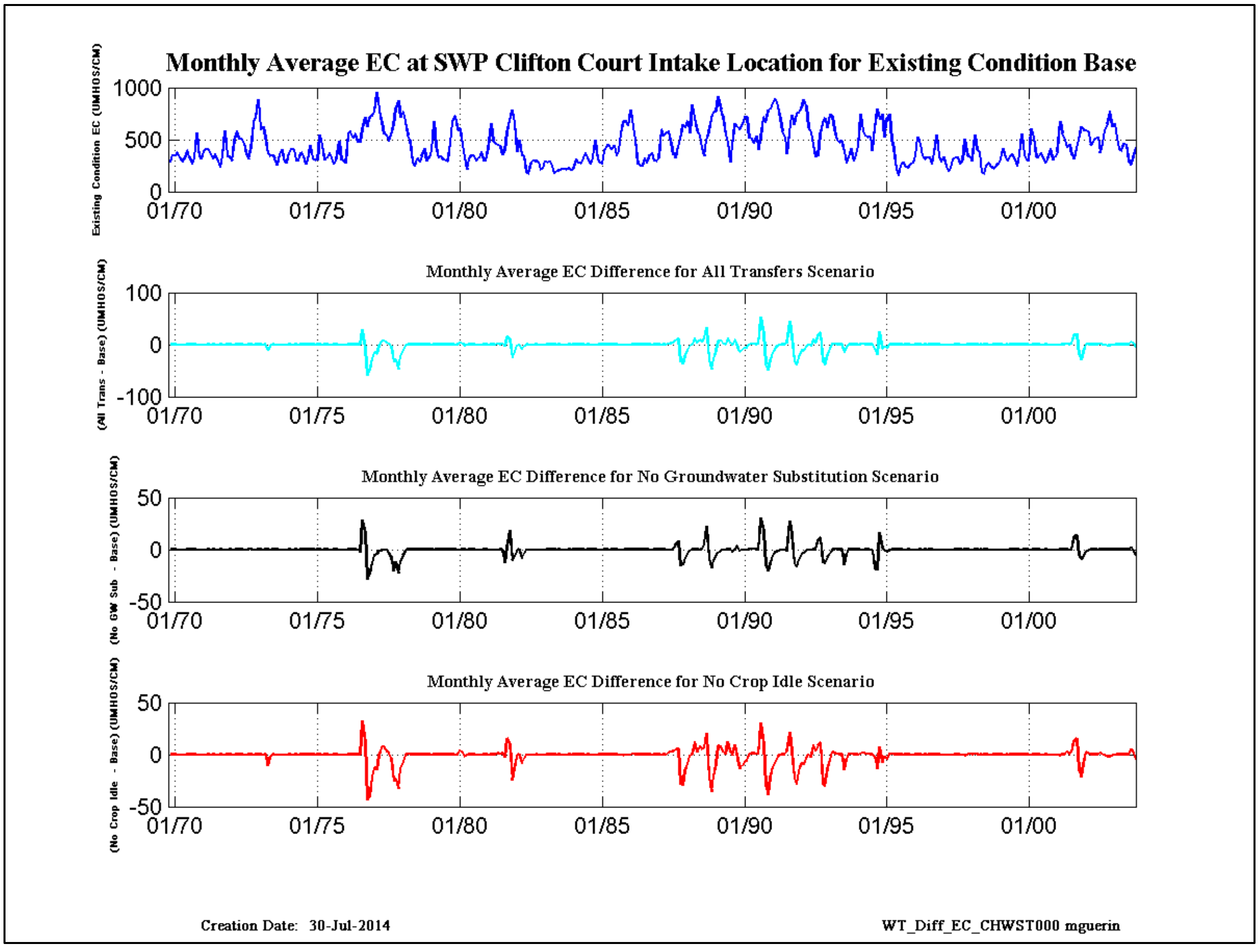


Figure 1-4. Monthly Average SWP-Banks Intake to Clifton Court Forebay EC for the Base condition and change from Base for the scenarios.

Table 1-11. Old River near Middle River location Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	415.0	479.9	583.6	286.4	320.5	296.9	309.4	401.2	432.3	592.9	558.8	528.9
1971	486.7	564.4	786.6	673.6	736.4	449.5	303.3	358.9	459.6	569.3	555.8	541.0
1972	489.5	583.5	796.4	804.2	852.2	827.3	503.3	453.9	589.5	643.6	590.6	584.6
1973	526.1	577.4	784.9	807.3	648.4	350.8	339.9	349.0	481.2	591.8	477.6	490.3
1974	448.2	523.5	770.0	522.1	608.9	278.1	300.0	376.4	457.1	528.8	450.5	463.4
1975	430.1	470.9	728.2	757.0	389.6	261.5	328.9	369.3	374.8	511.3	438.9	478.5
1976	424.6	505.1	774.3	779.0	896.8	873.5	624.8	471.8	595.1	659.2	585.7	578.9
1977	535.1	656.8	824.3	824.5	1045.6	1224.0	781.0	683.2	676.9	695.7	685.1	666.6
1978	613.9	684.8	838.3	724.7	619.4	569.0	279.2	239.9	375.9	508.3	443.5	425.5
1979	513.9	494.8	746.7	667.0	387.4	285.7	336.3	302.5	443.3	605.0	476.6	511.2
1980	462.3	528.3	778.7	350.4	305.0	207.1	316.4	350.2	350.5	429.1	416.4	460.9
1981	453.3	501.3	771.9	768.3	852.4	581.7	433.7	426.7	594.8	626.2	591.1	572.6
1982	507.4	578.9	774.9	623.4	298.0	281.2	178.4	170.5	329.5	384.4	312.3	244.7
1983	190.7	195.1	268.1	266.0	282.9	227.4	177.1	198.9	200.4	217.8	171.0	224.5
1984	343.7	164.3	223.3	294.8	202.5	302.9	316.3	365.9	472.2	591.4	496.5	416.3
1985	381.9	470.3	789.4	767.9	769.7	561.5	381.4	443.6	581.9	667.7	574.1	538.9
1986	502.8	551.7	769.0	797.2	400.4	259.8	245.0	246.9	366.2	517.6	434.4	412.4
1987	395.0	424.7	721.9	743.1	869.0	722.2	583.3	461.5	602.2	653.6	613.6	590.5
1988	530.7	605.0	810.0	816.3	985.2	920.1	669.6	616.7	666.7	665.7	650.2	619.9
1989	584.8	638.5	818.0	826.9	963.2	840.2	580.4	684.1	648.0	634.2	621.2	555.7
1990	573.8	628.2	823.0	835.6	953.7	928.4	756.7	655.4	681.4	656.7	636.5	620.3
1991	583.5	626.9	828.7	848.7	1005.9	738.8	606.0	673.3	717.9	720.6	702.9	679.3
1992	593.1	639.6	838.5	852.9	837.4	798.2	801.7	731.8	742.4	746.2	772.5	732.9
1993	616.1	669.8	844.2	678.7	671.5	636.3	456.7	486.1	689.8	780.9	506.5	486.4
1994	500.8	555.6	814.1	842.6	906.3	927.5	697.4	631.1	692.9	709.1	664.8	641.4
1995	610.1	646.2	835.2	715.4	713.1	355.4	212.0	152.4	289.8	250.4	300.3	461.0
1996	453.0	510.7	772.6	742.5	337.3	284.6	310.2	328.3	456.2	565.7	472.0	476.1
1997	453.5	442.9	297.3	235.3	169.4	197.2	306.0	321.2	437.1	601.7	512.1	469.8
1998	471.8	567.4	784.7	569.4	349.2	253.7	186.6	169.5	253.1	249.6	275.9	303.9
1999	353.2	443.5	680.1	526.5	222.0	341.5	337.6	352.9	421.4	618.6	539.7	511.1
2000	485.7	555.8	809.1	751.0	361.4	256.4	330.1	364.1	569.2	631.5	556.1	477.0
2001	439.0	516.0	770.2	769.1	854.6	668.8	401.5	443.0	601.2	659.9	612.7	573.7
2002	533.7	591.7	785.4	759.7	806.9	774.2	514.1	517.9	561.0	652.2	608.4	586.3
2003	579.0	622.5	802.4	818.8	792.1	799.6	447.3	453.3	473.5	633.9	602.0	587.2
Average	484.8	535.8	736.6	677.8	629.8	537.7	422.1	419.2	508.4	581.5	526.7	515.1
Critical	534.5	602.4	816.1	828.5	947.3	915.8	705.3	637.6	681.9	693.3	671.1	648.5
Dry	464.6	523.8	776.1	772.5	852.6	691.4	482.4	496.1	598.2	648.9	603.5	569.6
BN	501.7	539.1	771.6	735.6	619.8	556.5	419.8	378.2	516.4	624.3	533.6	547.9
AN	547.2	606.4	809.6	688.5	566.3	469.9	361.6	373.8	490.0	595.9	500.3	487.9
Wet	435.9	472.3	636.4	539.2	386.9	291.5	270.1	293.2	380.8	476.9	424.5	425.5

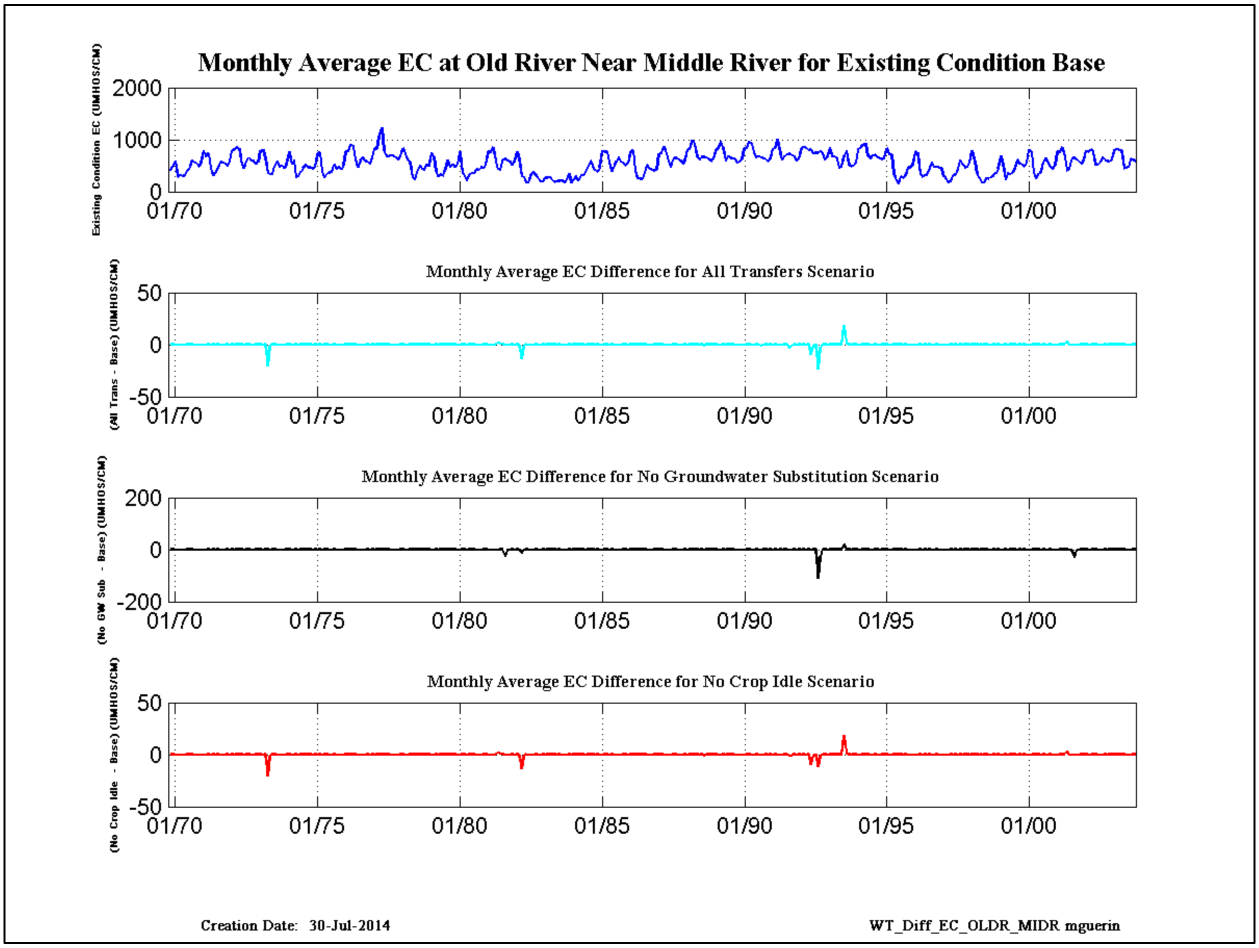


Figure 1-5. Monthly Average Old River near Middle River EC for the Base condition and change from Base for the scenarios.

Table 1-12. CCWD Old River Intake (ROLD034) Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	274.1	291.1	271.4	401.3	304.2	267.4	328.7	392.4	308.2	261.6	335.4	593.0
1971	320.2	282.0	285.2	304.3	292.0	303.7	341.3	380.6	274.8	231.4	378.1	616.6
1972	319.3	301.1	284.8	436.0	399.9	355.0	422.1	440.8	326.9	325.2	454.7	727.9
1973	783.3	950.7	552.9	485.9	434.6	340.6	353.8	387.4	299.2	258.9	367.2	413.8
1974	278.6	267.4	278.0	345.9	316.5	293.0	306.7	384.4	307.6	250.6	316.6	462.0
1975	299.8	292.3	298.9	510.2	447.0	308.3	335.5	387.5	298.5	249.3	321.5	511.9
1976	293.4	273.0	272.7	538.2	514.5	414.8	427.0	439.7	462.5	650.7	781.3	668.5
1977	787.1	783.0	830.7	1009.2	676.0	529.0	462.5	426.3	484.4	562.4	691.4	871.9
1978	919.3	738.1	793.1	612.5	470.9	434.4	299.0	252.5	295.6	269.0	358.4	436.1
1979	291.8	324.9	416.0	689.5	428.2	330.6	345.6	325.5	286.3	302.8	503.9	743.9
1980	798.6	629.7	644.1	495.9	353.1	223.9	318.5	364.9	327.7	278.2	331.0	398.8
1981	283.7	291.3	433.3	640.3	377.2	347.1	445.7	455.8	327.6	412.0	621.5	756.4
1982	857.5	703.7	306.0	419.1	340.3	347.3	188.4	177.9	249.7	273.6	292.2	290.9
1983	206.4	228.7	336.8	322.0	296.2	245.1	186.5	202.7	208.2	232.4	219.0	199.9
1984	218.5	257.6	239.9	349.2	304.2	254.0	329.4	398.0	298.0	265.2	334.6	517.7
1985	301.1	266.2	251.0	296.8	325.1	351.4	431.1	435.1	322.1	416.2	609.4	738.7
1986	730.0	686.3	846.9	535.0	574.0	312.1	257.2	258.5	298.2	271.9	364.9	363.6
1987	262.2	268.9	299.5	576.5	438.2	407.2	512.6	425.4	331.9	337.9	447.4	535.7
1988	675.9	645.8	688.5	464.2	566.6	488.7	457.4	448.3	400.1	353.6	524.5	604.9
1989	752.3	814.4	829.9	978.4	706.8	577.8	464.5	373.0	271.7	480.7	706.5	670.9
1990	641.7	690.4	730.7	702.8	421.3	353.5	369.6	377.1	381.9	573.9	763.2	708.1
1991	833.1	848.3	919.1	923.9	726.4	602.5	525.4	412.2	362.8	621.5	775.1	679.6
1992	802.5	805.0	848.1	920.3	783.5	499.2	432.4	372.5	330.6	362.0	595.1	708.5
1993	743.9	632.1	775.5	717.7	513.8	401.7	481.0	496.4	331.3	255.6	349.5	432.7
1994	288.9	352.5	464.8	756.0	509.7	383.4	387.7	383.4	371.3	662.2	858.6	766.3
1995	795.3	525.5	755.1	711.9	404.2	459.6	234.6	158.9	235.2	306.5	231.8	218.9
1996	242.4	259.6	260.4	386.4	441.2	334.4	326.0	340.0	299.9	262.0	395.3	579.1
1997	321.0	270.8	374.5	250.1	273.4	240.3	325.1	354.0	307.1	263.5	316.7	535.8
1998	327.9	282.7	268.4	472.4	573.3	426.7	199.1	177.3	246.4	299.2	230.3	213.4
1999	226.2	260.4	244.7	339.8	324.1	263.1	345.0	382.9	286.7	244.8	387.3	590.6
2000	336.3	282.1	296.5	527.9	547.8	329.8	338.3	390.8	303.7	268.7	335.8	427.0
2001	292.2	325.0	393.3	674.5	444.2	367.3	449.1	467.0	333.8	322.6	435.9	527.4
2002	654.8	630.0	556.3	431.5	335.4	321.5	429.7	502.0	353.9	493.6	635.7	716.9
2003	826.5	661.7	638.2	368.5	293.6	275.4	420.4	429.5	271.3	262.5	359.8	448.1
Average	499.6	474.2	490.7	546.9	445.8	364.4	367.0	370.6	317.5	349.5	459.7	549.3
Critical	617.5	628.3	679.2	759.2	599.7	467.3	437.4	408.5	399.1	540.9	712.7	715.4
Dry	424.4	432.6	460.5	599.7	437.8	395.4	455.5	443.0	323.5	410.5	576.1	657.7
BN	305.5	313.0	350.4	562.8	414.0	342.8	383.9	383.1	306.6	314.0	479.3	735.9
AN	734.6	649.1	616.7	534.7	435.6	334.3	368.5	386.9	304.8	265.5	350.3	426.1
Wet	392.2	354.5	366.6	411.4	376.2	311.9	284.9	307.3	278.3	262.5	317.2	438.0

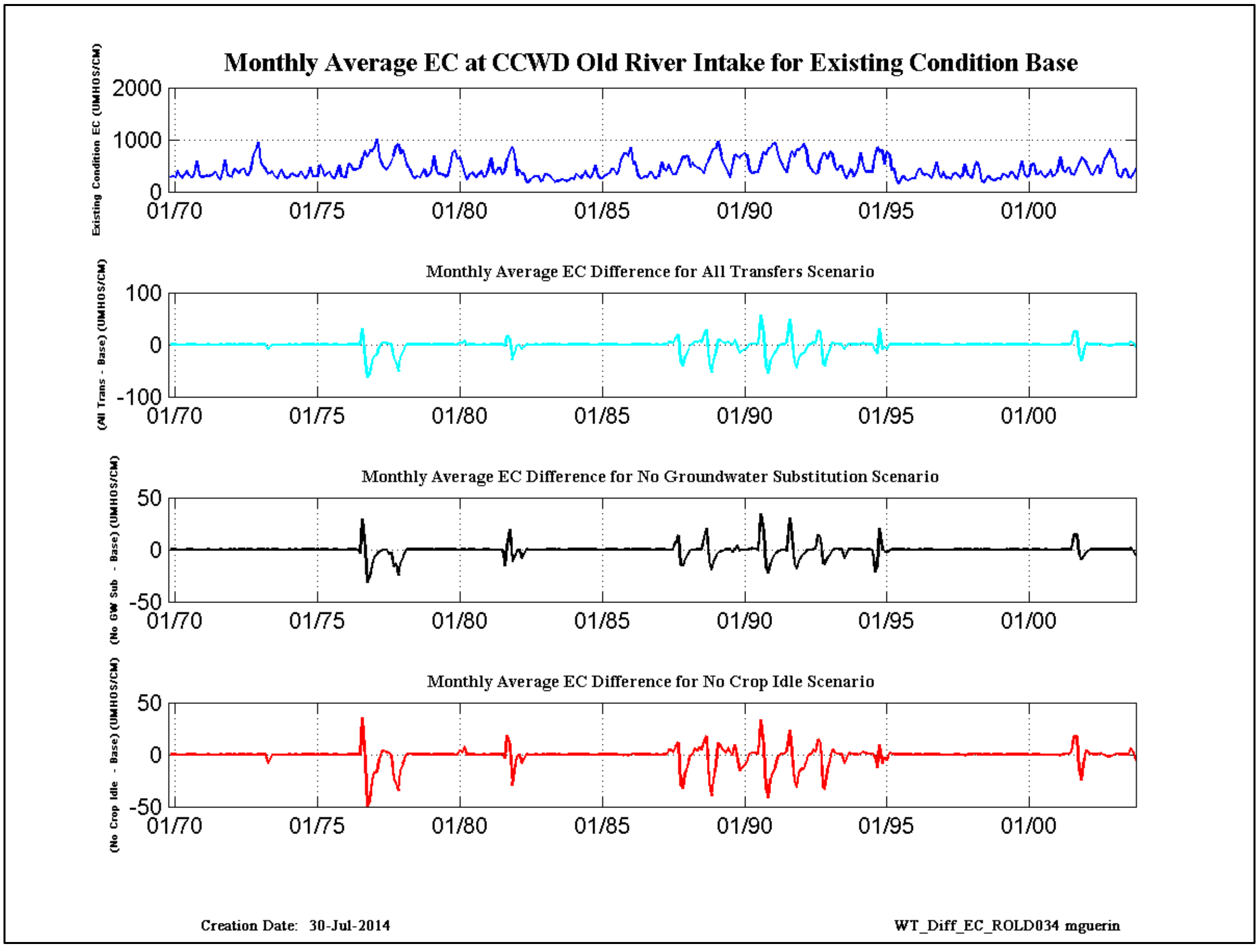


Figure 1-6. Monthly Average CCWD Old River Intake EC for the Base condition and change from Base for the scenarios.

Table 1-13. Old River location (ROLD059) Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	417.0	477.0	582.7	310.4	339.1	308.0	321.0	409.4	458.2	589.1	581.6	549.3
1971	498.7	573.4	832.8	713.3	748.7	469.6	317.9	364.4	472.2	573.5	580.1	559.6
1972	502.2	565.3	780.4	826.4	861.6	841.6	534.3	469.2	581.2	648.9	618.3	598.3
1973	540.5	601.7	785.3	973.8	770.4	383.3	349.0	358.5	488.3	594.2	509.2	500.9
1974	458.6	524.7	768.8	559.8	627.3	294.1	304.5	382.3	463.1	533.6	474.8	472.8
1975	440.3	474.6	714.1	774.2	430.0	274.0	333.4	380.6	381.7	511.2	462.0	484.1
1976	434.8	501.8	757.2	796.8	899.3	885.9	649.6	493.6	572.5	660.8	690.0	636.9
1977	553.1	617.8	810.8	844.0	1029.4	1200.7	859.3	693.7	595.7	593.7	624.1	721.5
1978	753.7	696.8	831.4	777.8	648.7	593.0	290.4	247.2	378.3	510.8	466.4	437.7
1979	512.9	505.1	733.9	712.2	424.1	297.6	341.7	312.0	460.3	599.9	510.6	516.7
1980	473.4	524.7	766.1	380.7	328.4	216.6	321.9	356.7	355.0	432.6	431.7	466.9
1981	462.5	502.5	752.9	795.4	861.2	611.3	449.8	438.8	590.1	638.2	620.4	598.7
1982	522.0	579.1	769.4	689.3	317.1	299.7	180.6	175.1	331.4	388.6	327.5	249.7
1983	195.6	205.9	272.6	307.2	297.6	250.4	182.8	200.9	202.5	220.1	177.4	226.8
1984	342.0	170.0	231.5	305.3	219.0	309.8	325.0	375.3	480.1	591.4	523.1	431.3
1985	389.6	479.6	780.8	792.8	783.2	584.1	399.1	452.2	585.8	669.0	610.8	561.0
1986	514.8	554.1	757.8	822.4	438.2	267.3	253.0	253.8	369.1	518.4	455.0	423.1
1987	405.1	429.0	701.0	764.4	875.8	751.0	604.2	481.2	578.6	647.6	574.6	598.2
1988	549.2	594.0	796.8	841.8	976.9	938.1	698.4	628.8	599.7	577.8	539.3	611.1
1989	617.3	634.2	807.2	846.5	959.0	860.0	610.4	680.0	669.1	644.9	647.0	603.1
1990	577.3	623.2	804.9	852.7	954.1	941.3	793.4	669.2	569.6	621.2	688.6	680.2
1991	611.3	625.7	808.6	869.7	996.5	764.5	626.6	673.5	587.0	645.5	705.7	665.9
1992	637.4	633.9	816.1	875.1	868.9	809.5	810.6	749.1	518.6	454.5	552.7	649.8
1993	700.6	674.3	838.2	816.5	826.4	715.4	482.1	489.3	681.5	772.9	550.3	497.3
1994	505.8	556.2	799.6	862.8	912.3	934.9	733.4	640.2	570.9	696.0	742.6	690.9
1995	657.2	650.9	821.6	865.1	744.3	389.2	221.3	155.4	292.3	254.3	309.7	451.8
1996	463.3	510.0	759.7	840.2	459.1	319.3	317.2	333.2	461.0	567.7	498.3	485.7
1997	462.2	452.9	307.4	251.7	178.3	207.0	315.5	330.2	443.0	596.0	535.4	485.6
1998	479.0	565.9	776.5	690.5	443.6	268.3	191.2	172.5	255.3	253.1	284.7	309.1
1999	355.2	441.2	671.8	567.9	250.7	349.9	345.0	361.1	432.1	610.8	569.5	525.0
2000	497.6	554.2	793.2	793.4	444.4	273.9	335.9	371.1	565.5	636.7	579.6	498.9
2001	449.6	513.8	759.9	798.9	872.6	691.2	421.3	453.1	595.5	654.7	567.1	578.7
2002	549.9	590.5	796.0	807.1	826.9	786.3	545.2	548.6	586.8	647.4	644.2	603.3
2003	591.4	623.7	799.5	843.6	810.7	808.7	479.3	461.6	512.5	630.7	625.7	601.1
Average	503.6	536.1	729.0	722.6	659.5	555.7	439.5	428.3	490.7	564.3	537.6	528.6
Critical	552.7	593.2	799.2	849.0	948.2	925.0	738.8	649.7	573.4	607.1	649.0	665.2
Dry	479.0	524.9	766.3	800.9	863.1	714.0	505.0	509.0	601.0	650.3	610.7	590.5
BN	507.5	535.2	757.1	769.3	642.9	569.6	438.0	390.6	520.8	624.4	564.5	557.5
AN	592.9	612.6	802.3	764.3	638.1	498.5	376.4	380.7	496.9	596.3	527.1	500.5
Wet	446.6	475.4	635.9	592.1	422.5	308.2	277.6	299.6	387.8	477.5	444.6	434.9

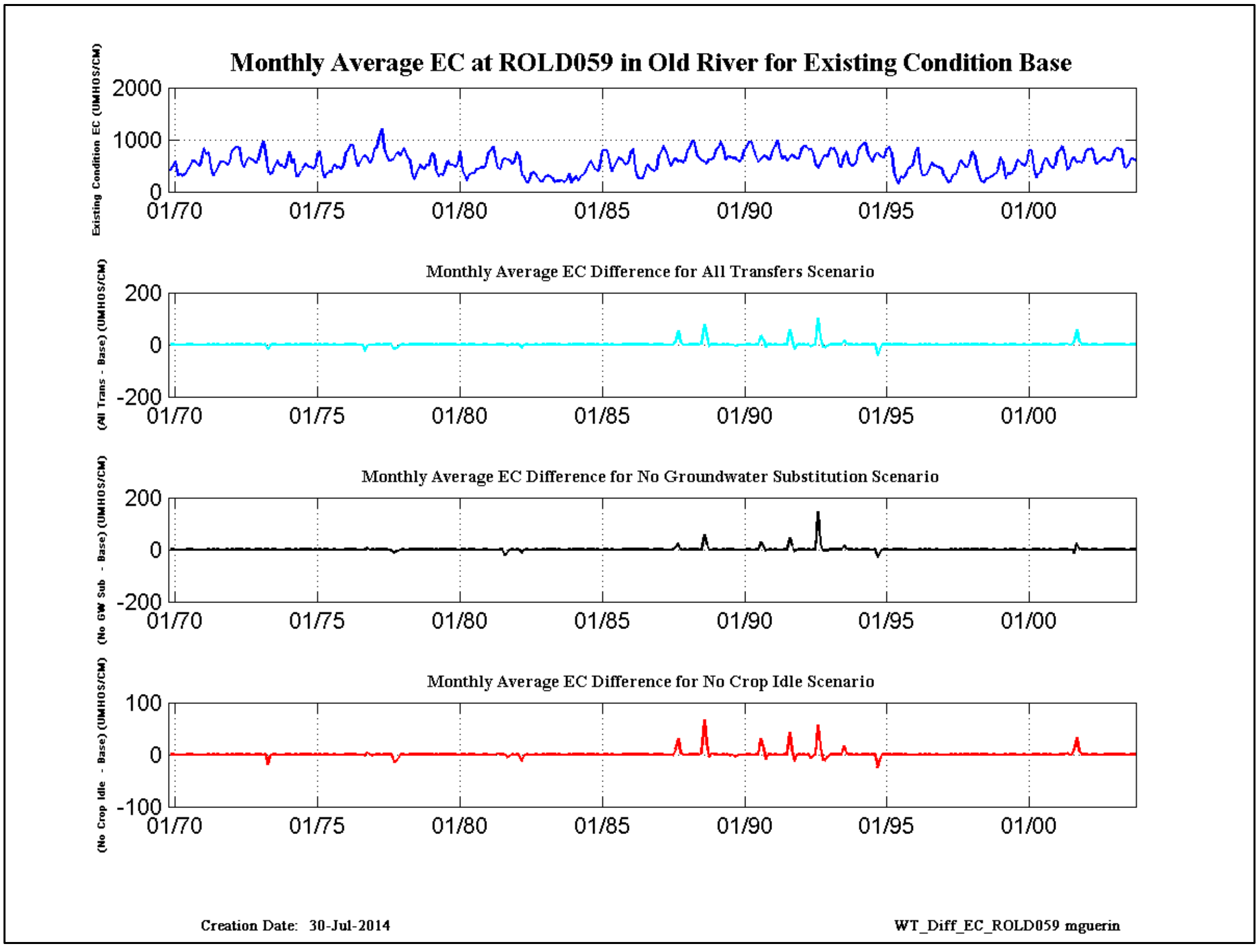


Figure 1-7. Monthly Average Old River location (ROLD059) EC for the Base condition and change from Base for the scenarios.

Table 1-14. CCWD Contra Costa Canal Intake (CHCCC006) salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.1	-2.6	-8.3	-1.9	-0.3	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	26.6	-7.1	-63.0
1977	-67.4	-46.0	-25.2	-24.8	-8.4	0.1	1.8	1.0	1.9	10.1	-1.9	-10.2
1978	-51.4	-34.0	-18.1	-1.7	0.8	0.5	0.2	0.1	0.2	0.2	0.3	0.2
1979	0.0	0.0	0.0	0.0	0.4	0.4	0.2	0.3	0.1	0.1	0.1	0.0
1980	-0.2	-0.3	2.9	3.2	7.0	11.6	0.6	0.3	0.1	0.0	0.0	0.0
1981	0.0	0.0	-0.4	-0.1	0.2	0.1	0.0	0.3	0.6	-4.0	7.6	32.4
1982	-35.5	-24.0	-2.6	0.2	-5.6	-5.9	-0.6	-0.1	-0.2	-0.1	0.0	0.0
1983	0.0	0.1	0.0	0.0	0.3	0.3	0.2	-0.1	0.1	0.1	-0.1	0.0
1984	0.0	0.2	0.1	0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0
1985	0.0	0.1	0.3	0.4	0.3	0.2	0.3	0.2	0.2	-0.3	-0.5	-0.8
1986	-0.7	-0.5	-0.8	0.7	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.1	-0.1	-0.5	0.2	0.1	2.5	3.4	1.6	15.3	33.4	-24.6
1988	-48.8	-33.1	-20.6	-1.3	0.2	2.7	2.8	3.9	2.9	28.7	53.0	-31.7
1989	-58.0	-46.2	-24.9	7.6	5.0	3.4	1.3	4.0	1.4	13.5	10.6	-11.9
1990	-21.9	-16.7	-12.7	-10.4	0.0	2.3	2.3	1.3	2.2	99.6	17.4	-44.4
1991	-57.7	-43.7	-28.1	-21.3	-4.7	-0.4	0.6	0.8	5.0	83.8	11.8	-37.7
1992	-48.7	-36.0	-22.8	-20.0	-9.6	-0.1	0.4	2.9	1.8	31.9	48.3	-23.5
1993	-47.3	-27.2	-14.2	4.9	1.6	1.0	0.7	0.8	-4.8	-2.7	1.3	1.0
1994	0.1	0.1	0.0	0.3	3.2	1.5	0.9	0.6	1.1	-5.4	-22.6	43.2
1995	-10.9	-6.9	-11.4	1.0	0.9	0.5	0.2	0.1	0.1	0.1	0.1	0.5
1996	0.1	0.0	0.1	0.4	0.3	0.1	0.1	0.2	0.1	0.3	0.5	0.4
1997	0.1	0.0	0.0	-0.2	-0.3	-0.1	0.0	0.1	0.1	-0.1	-0.3	-0.7
1998	0.1	0.1	0.2	0.9	0.2	0.1	-0.1	0.2	0.2	0.0	0.0	0.0
1999	0.0	0.2	0.2	0.0	0.0	0.0	0.1	0.3	0.1	0.2	0.2	0.2
2000	0.0	0.0	-0.1	-0.5	0.1	0.1	0.2	0.2	0.0	-0.1	-0.2	0.0
2001	0.0	0.0	-0.2	-1.0	0.2	0.1	0.2	0.7	1.9	32.1	39.8	-6.0
2002	-34.0	-25.5	-0.9	1.0	0.5	0.4	0.2	0.2	1.0	-0.2	-0.7	-2.5
2003	-2.6	-1.1	-0.8	0.6	0.1	0.1	0.1	0.2	0.2	7.6	3.1	-7.6
Average	-14.3	-10.0	-5.3	-1.8	-0.2	0.5	0.2	0.6	0.5	9.9	5.7	-5.5
Critical	-34.9	-25.1	-15.6	-11.1	-2.8	0.9	1.3	1.5	2.2	39.3	14.1	-23.9
Dry	-15.3	-11.9	-4.4	1.2	1.1	0.7	0.7	1.5	1.1	9.4	15.0	-2.2
BN	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.1	0.0	0.0	0.0
AN	-16.9	-10.4	-5.1	1.1	1.6	1.8	-1.1	0.0	-0.8	0.8	0.7	-1.1
Wet	-3.6	-2.4	-1.1	0.2	-0.3	-0.4	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-15. CCWD Contra Costa Canal Intake (CHCCC006) salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.7	-2.2	-0.4	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	4.2	-0.8	-8.5
1977	-7.8	-5.1	-2.9	-2.1	-1.2	0.0	0.4	0.3	0.4	1.7	-0.3	-1.0
1978	-4.8	-4.1	-2.0	-0.3	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.4	0.6	1.0	2.2	0.2	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.1	0.2	-0.9	1.1	4.0
1982	-3.6	-2.6	-0.8	0.0	-1.7	-1.4	-0.2	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1
1986	-0.1	-0.1	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	-0.1	0.0	0.0	0.6	0.9	0.5	4.3	6.8	-4.3
1988	-6.6	-4.6	-2.7	-0.3	0.0	0.6	0.7	1.0	0.8	7.8	9.0	-4.9
1989	-7.2	-4.9	-2.9	0.7	0.7	0.7	0.3	1.2	0.5	2.7	1.3	-1.5
1990	-3.0	-2.2	-1.6	-1.2	0.0	0.7	0.7	0.4	0.6	17.2	2.0	-5.7
1991	-6.2	-4.7	-2.8	-2.1	-0.7	-0.1	0.1	0.2	1.4	13.1	1.3	-5.0
1992	-5.5	-4.0	-2.5	-2.0	-1.2	0.0	0.1	0.8	0.6	8.2	7.3	-3.0
1993	-5.5	-3.9	-1.7	0.6	0.3	0.3	0.2	0.2	-1.6	-1.1	0.3	0.2
1994	0.1	0.0	0.0	0.0	0.6	0.4	0.3	0.2	0.3	-0.9	-2.2	5.1
1995	-1.2	-1.1	-1.5	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.2
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1
1997	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1998	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1999	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0
2000	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.2	0.6	9.5	8.2	-1.1
2002	-4.7	-3.6	-0.1	0.3	0.2	0.1	0.1	0.0	0.3	0.0	-0.1	-0.3
2003	-0.3	-0.1	-0.1	0.2	0.0	0.0	0.0	0.0	0.1	2.7	0.8	-1.4
Average	-1.7	-1.2	-0.6	-0.2	0.0	0.1	0.1	0.2	0.2	2.0	1.0	-0.8
Critical	-4.1	-2.9	-1.8	-1.1	-0.4	0.2	0.3	0.4	0.6	7.3	2.3	-3.3
Dry	-2.0	-1.4	-0.5	0.1	0.2	0.2	0.2	0.4	0.4	2.6	2.9	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.8	-1.4	-0.6	0.2	0.3	0.3	-0.3	0.0	-0.3	0.3	0.2	-0.2
Wet	-0.4	-0.3	-0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-16. CVP-Jones Intake (CHDMC006) salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.1	0.1	0.0	-0.2	-0.2	0.0	0.0	0.1	0.1	0.1	0.0	0.0
1971	0.0	-0.1	0.0	0.0	0.1	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.1	0.1	0.3	-0.2	0.0	0.0	0.0	-0.1
1973	0.0	0.0	0.1	-0.1	0.1	-15.3	-2.9	0.3	-0.2	-0.1	-0.1	-0.1
1974	-0.2	0.0	0.1	-0.1	0.0	0.2	-0.2	0.1	0.2	0.1	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.1	-0.3	-0.1	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	21.3	-4.8	-47.9
1977	-36.9	-21.0	-11.4	-13.1	1.9	9.7	10.8	3.2	1.5	-9.4	-29.3	-24.1
1978	-38.7	-16.7	-7.7	-1.2	0.2	0.2	0.0	0.3	0.2	0.2	0.2	0.2
1979	0.1	0.1	0.0	0.0	0.4	0.0	0.3	0.2	0.1	0.1	0.1	0.0
1980	-0.1	0.1	2.3	0.4	-2.4	-0.5	0.3	0.2	0.1	-0.1	-0.1	0.0
1981	0.1	0.1	-0.2	0.0	0.0	-0.2	1.3	0.6	1.1	-2.5	9.3	9.0
1982	-19.1	-10.7	-1.1	0.2	-10.7	-1.7	0.4	-0.4	-0.3	-0.3	0.1	-0.2
1983	-0.3	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.4	0.0
1984	0.2	-0.2	0.1	0.0	0.1	0.1	0.2	-0.1	0.1	0.1	0.0	0.0
1985	0.0	0.0	0.1	0.3	0.2	0.2	0.4	0.0	0.2	-0.2	-0.4	-0.5
1986	-0.2	-0.3	-0.1	0.5	0.1	0.4	0.1	0.0	0.3	0.1	0.0	-0.1
1987	0.1	0.3	0.1	-0.1	0.1	-0.1	0.8	2.1	3.0	7.2	-5.5	-29.4
1988	-29.5	-15.8	-8.3	-1.0	0.3	10.6	1.5	7.0	6.8	9.3	24.1	-27.2
1989	-39.8	-21.7	-9.1	4.8	6.9	1.4	0.2	15.1	3.5	-0.7	6.8	-3.4
1990	-10.2	-8.6	-4.9	-4.2	-0.2	0.9	0.8	0.2	0.8	42.5	16.8	-32.1
1991	-40.5	-22.2	-11.4	-3.4	-1.7	-0.2	0.0	0.2	3.7	36.6	12.5	-29.7
1992	-31.7	-17.8	-5.7	-8.0	-1.7	-0.2	-4.3	15.4	3.7	18.3	22.4	-30.5
1993	-32.3	-14.9	-5.4	1.1	0.7	0.5	0.4	0.4	-18.7	-3.6	0.8	0.5
1994	0.1	0.0	-0.1	0.3	1.5	0.7	0.4	-0.1	0.3	-8.5	-18.3	19.5
1995	-6.0	-2.7	-5.1	0.0	0.2	0.3	0.2	0.1	0.3	-0.2	0.2	0.2
1996	-0.1	-0.1	0.0	-0.1	0.2	-0.3	0.3	0.0	0.1	0.2	0.2	0.2
1997	0.0	-0.1	-0.2	-0.4	-0.2	0.1	0.0	0.4	0.1	0.3	-0.2	-0.4
1998	0.5	1.7	0.2	0.4	0.3	-0.3	0.0	0.4	0.2	-0.2	-0.2	0.1
1999	-0.1	0.1	0.0	-0.2	0.0	0.0	0.4	0.3	0.3	0.1	0.1	0.1
2000	0.1	0.0	-0.1	-0.3	0.2	0.3	0.3	-0.3	0.0	0.2	-0.1	0.0
2001	0.0	-0.1	-0.3	-0.4	0.1	0.2	2.6	0.3	2.6	16.4	11.4	-17.4
2002	-22.9	-9.8	1.1	0.3	0.3	0.2	0.1	0.0	1.1	-0.1	-0.5	-1.6
2003	-1.4	-0.7	-0.3	0.4	0.2	0.2	0.3	0.0	0.1	3.7	1.8	-3.8
Average	-9.1	-4.7	-2.0	-0.7	-0.1	0.2	0.4	1.3	0.3	3.8	1.4	-6.4
Critical	-21.2	-12.2	-6.0	-4.2	0.0	3.1	1.3	3.7	2.4	15.7	3.3	-24.6
Dry	-10.4	-5.2	-1.4	0.8	1.2	0.3	0.9	3.0	1.9	3.3	3.5	-7.2
BN	0.1	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.1	0.1	0.0	0.0
AN	-12.1	-5.4	-1.9	0.1	-0.1	-2.4	-0.3	0.1	-3.1	0.0	0.4	-0.5
Wet	-2.0	-0.9	-0.5	0.0	-0.7	-0.1	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-17. CVP-Jones Intake (CHDMC006) salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-4.1	-0.8	0.1	-0.1	0.0	0.0	0.0
1974	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	-0.7	-7.9
1977	-5.6	-3.0	-1.5	-1.4	0.2	1.1	1.6	0.5	0.3	-1.7	-4.8	-3.2
1978	-4.7	-2.4	-1.0	-0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.4	0.1	-0.7	-0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.3	-0.6	1.7	1.4
1982	-2.7	-1.7	-0.2	0.0	-3.3	-0.5	0.2	-0.2	-0.1	-0.1	0.0	-0.1
1983	-0.2	0.0	-0.1	0.0	0.1	0.1	0.1	-0.2	0.1	-0.1	-0.2	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	-0.1
1986	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.4	0.8	2.1	-1.2	-5.8
1988	-4.9	-2.6	-1.2	-0.2	0.0	1.2	0.2	1.2	1.5	2.6	4.9	-4.8
1989	-5.9	-3.0	-1.2	0.5	0.8	0.2	0.0	2.7	1.1	-0.2	1.1	-0.6
1990	-1.8	-1.4	-0.7	-0.6	0.0	0.1	0.1	0.0	0.2	8.3	2.5	-5.0
1991	-5.5	-3.0	-1.4	-0.4	-0.2	0.0	0.0	0.0	1.0	6.7	1.8	-4.7
1992	-4.5	-2.5	-0.7	-0.9	-0.2	0.0	-0.6	2.9	1.1	5.4	4.2	-4.8
1993	-4.7	-2.4	-0.7	0.1	0.1	0.1	0.1	0.1	-3.7	-1.0	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.1	-1.5	-2.4	2.9
1995	-0.8	-0.5	-0.7	0.0	0.0	0.1	0.1	0.0	0.1	-0.1	0.1	0.1
1996	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.0	0.1	-0.1	-0.1
1998	0.1	0.4	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.1	0.0
1999	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.1	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.6	0.1	0.7	4.9	2.6	-3.4
2002	-3.9	-1.7	0.2	0.1	0.0	0.0	0.0	0.0	0.3	0.0	-0.1	-0.3
2003	-0.2	-0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	1.3	0.5	-0.8
Average	-1.3	-0.7	-0.3	-0.1	-0.1	0.0	0.1	0.2	0.1	0.9	0.3	-1.1
Critical	-3.2	-1.8	-0.8	-0.5	0.0	0.4	0.2	0.7	0.6	3.3	0.8	-3.9
Dry	-1.6	-0.8	-0.2	0.1	0.2	0.0	0.2	0.6	0.5	1.0	0.7	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.6	-0.8	-0.2	0.0	-0.1	-0.7	-0.1	0.0	-0.6	0.1	0.1	-0.1
Wet	-0.3	-0.2	-0.1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-18. SWP-Clifton Court Intake (CHWST000) salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.1	0.1	0.3	-0.2	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	-0.1	0.2	-10.7	-2.2	0.3	-0.3	0.0	0.0	0.0
1974	-0.1	0.0	0.1	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.1	-0.3	-0.1	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3	29.0	-9.2	-58.3
1977	-50.0	-27.3	-15.8	-17.1	-1.7	6.3	7.7	3.2	1.6	-3.2	-32.5	-28.1
1978	-47.1	-21.1	-10.3	-1.5	0.5	0.4	0.0	0.3	0.2	0.2	0.2	0.2
1979	0.1	0.1	0.0	0.1	0.3	0.1	0.4	0.2	0.1	0.1	0.1	0.0
1980	-0.2	0.2	3.5	1.4	-1.6	-0.4	0.3	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	-0.2	0.0	0.1	-0.1	1.2	0.6	1.2	-3.2	15.3	11.2
1982	-24.8	-13.6	-1.6	0.3	-8.2	-3.6	0.4	-0.4	-0.3	-0.1	0.0	0.0
1983	-0.1	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.2	-0.1
1984	0.1	-0.1	0.2	0.0	0.1	0.1	0.2	-0.1	0.0	0.0	-0.1	0.0
1985	0.0	0.1	0.2	0.3	0.2	0.4	0.4	0.1	0.3	-0.2	-0.4	-0.6
1986	-0.3	-0.4	-0.2	0.5	0.1	0.4	0.1	0.0	0.2	0.1	0.0	0.0
1987	0.0	0.2	0.1	-0.2	0.1	0.0	1.7	2.7	3.1	8.3	11.5	-32.8
1988	-36.1	-20.1	-10.9	-1.2	0.2	12.8	2.2	8.5	5.2	12.6	32.2	-30.0
1989	-47.6	-27.6	-11.7	6.4	7.1	2.5	0.8	12.0	2.9	-0.9	9.3	-4.5
1990	-13.4	-10.9	-6.8	-5.6	-0.2	1.2	1.3	0.6	1.0	52.9	20.2	-37.4
1991	-49.8	-28.3	-15.3	-7.6	-2.8	-0.5	0.1	0.4	3.9	45.3	14.4	-30.8
1992	-39.6	-22.5	-11.1	-11.4	-3.9	-0.2	-2.1	9.4	3.4	18.5	23.2	-33.3
1993	-38.3	-18.1	-6.9	2.0	1.1	0.8	0.5	0.4	-14.4	-4.6	1.0	0.7
1994	0.1	0.1	0.0	0.6	2.0	0.9	0.6	0.1	0.5	-9.9	-18.2	25.9
1995	-7.8	-3.8	-6.9	0.2	0.5	0.3	0.2	0.1	0.2	-0.1	0.1	0.3
1996	0.0	-0.1	0.0	0.0	0.2	-0.1	0.4	0.0	0.1	0.2	0.4	0.2
1997	0.0	-0.1	-0.1	-0.4	-0.2	0.0	-0.1	0.4	0.2	0.0	-0.2	-0.6
1998	0.3	0.9	0.2	0.5	0.3	-0.1	0.0	0.4	0.2	-0.1	-0.1	0.0
1999	0.0	0.1	0.1	-0.1	0.0	0.0	0.4	0.3	0.2	0.2	0.2	0.1
2000	0.0	0.0	0.0	-0.3	0.2	0.2	0.4	-0.3	0.0	0.1	-0.1	0.0
2001	0.0	0.0	-0.2	-0.6	0.1	0.1	2.4	0.3	2.8	19.1	20.9	-18.4
2002	-28.2	-12.7	1.5	0.6	0.4	0.3	0.2	0.0	1.5	-0.1	-0.6	-2.1
2003	-1.7	-0.9	-0.4	0.4	0.2	0.2	0.3	0.0	0.2	4.9	2.0	-5.0
Average	-11.3	-6.1	-2.7	-1.0	-0.1	0.3	0.5	1.2	0.4	5.0	2.6	-7.2
Critical	-27.0	-15.6	-8.6	-6.0	-0.9	2.9	1.4	3.2	2.3	20.8	4.3	-27.4
Dry	-12.6	-6.7	-1.7	1.1	1.3	0.5	1.1	2.6	2.0	3.8	9.3	-7.9
BN	0.0	0.0	0.0	0.0	0.2	0.1	0.3	0.0	0.1	0.0	0.0	0.0
AN	-14.5	-6.6	-2.3	0.3	0.1	-1.6	-0.1	0.2	-2.4	0.1	0.5	-0.7
Wet	-2.5	-1.3	-0.7	0.1	-0.5	-0.2	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-19. SWP-Clifton Court Intake (CHWST000) salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.9	-0.6	0.1	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.8	-1.3	-9.3
1977	-6.9	-3.7	-2.0	-1.8	-0.2	0.9	1.4	0.6	0.3	-0.6	-5.1	-3.5
1978	-5.4	-3.0	-1.3	-0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.6	0.3	-0.5	-0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.0	0.0	0.3	0.1	0.3	-0.8	2.7	1.6
1982	-3.2	-2.1	-0.4	0.1	-2.3	-1.0	0.2	-0.2	-0.1	0.0	0.0	0.0
1983	-0.1	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	-0.1	-0.1	0.0
1984	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1
1986	0.0	-0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.6	0.9	2.5	2.7	-6.4
1988	-5.6	-3.3	-1.6	-0.2	0.0	1.8	0.4	1.6	1.2	3.6	6.5	-5.2
1989	-6.7	-3.6	-1.5	0.7	0.9	0.4	0.1	2.5	1.0	-0.2	1.4	-0.7
1990	-2.2	-1.7	-1.0	-0.8	0.0	0.2	0.3	0.1	0.3	10.0	2.8	-5.7
1991	-6.4	-3.6	-1.8	-0.9	-0.3	-0.1	0.0	0.1	1.1	8.0	2.0	-4.8
1992	-5.3	-3.0	-1.4	-1.3	-0.5	0.0	-0.4	2.1	1.0	5.3	4.2	-5.1
1993	-5.4	-2.9	-0.9	0.3	0.2	0.2	0.1	0.1	-3.7	-1.7	0.3	0.2
1994	0.0	0.0	0.0	0.1	0.3	0.2	0.1	0.0	0.1	-1.6	-2.3	3.7
1995	-1.1	-0.7	-1.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.1
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1
1998	0.1	0.3	0.1	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0
2000	0.0	0.0	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.6	0.1	0.8	6.1	5.0	-3.7
2002	-4.5	-2.1	0.3	0.1	0.1	0.1	0.0	0.0	0.4	0.0	-0.1	-0.3
2003	-0.2	-0.1	-0.1	0.1	0.0	0.0	0.1	0.0	0.1	1.9	0.6	-1.2
Average	-1.6	-0.9	-0.4	-0.1	0.0	0.0	0.1	0.2	0.1	1.1	0.6	-1.2
Critical	-3.8	-2.2	-1.1	-0.7	-0.1	0.4	0.3	0.6	0.6	4.2	1.0	-4.3
Dry	-1.9	-0.9	-0.2	0.1	0.2	0.1	0.2	0.6	0.6	1.2	1.9	-1.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.8	-1.0	-0.3	0.1	0.0	-0.5	0.0	0.0	-0.6	0.0	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-20. Old River near Middle River location salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.3	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.2	0.2	0.2	0.3	-0.3	0.3	0.3	-0.3	-0.4
1973	0.3	0.1	0.2	-0.2	0.1	-20.9	-1.4	0.3	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.2	-0.2	0.1	0.3	0.2	0.3	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.1	0.2	0.3	0.0	-0.2	0.0	-0.2	-0.3	0.1
1977	-0.1	0.1	-0.1	0.3	0.1	0.2	0.2	0.4	0.0	0.0	-0.4	-0.1
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	1.6	0.5	0.0	-0.2	-0.1	-0.2
1982	0.3	-0.3	0.3	0.0	-13.9	-1.1	0.4	-0.4	-0.3	-0.3	0.4	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.3	0.3	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.4	-0.4	-0.4	0.3
1986	0.5	0.0	0.4	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.3	0.1	-0.4	-0.4
1988	-0.4	0.3	-0.1	0.0	0.4	0.1	0.4	-0.2	0.1	-0.6	0.1	0.2
1989	0.1	0.3	0.1	-0.4	-0.4	0.3	-0.4	0.2	0.1	0.2	-0.3	-0.2
1990	-0.2	-0.2	0.0	0.2	0.3	-0.2	-0.4	0.1	-0.3	-1.1	-0.3	0.1
1991	-0.1	0.3	-0.3	0.2	-0.3	0.0	-0.3	0.1	0.1	-3.5	-0.8	0.1
1992	-0.2	0.4	-0.1	0.3	-0.1	0.1	-9.1	-0.8	0.2	-23.1	-2.9	0.1
1993	0.1	-0.2	0.4	0.2	0.1	0.1	0.5	0.4	18.4	1.4	0.4	-0.1
1994	0.0	0.0	-0.4	-0.4	0.1	0.2	0.3	-0.4	-0.4	0.2	-0.1	-0.4
1995	0.1	0.2	0.3	-0.1	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.4
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.3	0.4	-0.1	0.1	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.4	0.3
1998	0.2	-0.3	0.2	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	0.0	0.4	0.3	0.5	-0.3	0.0	-0.1
2000	0.2	-0.3	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.3	0.0	0.3	2.9	-0.2	-0.4	-0.4	-0.4	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	0.0	-0.3	-0.1	0.3	0.0
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-0.1	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.3	-0.6	-0.1	0.0	0.6	-0.8	-0.2	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	-1.3	-0.2	-0.1	-4.0	-0.7	0.0
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.7	0.1	-0.1	-0.1	-0.2	-0.1
BN	0.2	0.0	0.1	-0.2	0.3	0.1	0.3	-0.1	0.3	0.3	-0.1	-0.1
AN	0.1	-0.1	0.0	0.0	0.2	-3.4	0.0	0.1	3.1	0.1	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.0	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-21. Old River near Middle River location salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	-0.1
1973	0.1	0.0	0.0	0.0	0.0	-6.0	-0.4	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.4	0.1	0.0	0.0	0.0	0.0
1982	0.1	-0.1	0.0	0.0	-4.7	-0.4	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.2	-0.1	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.1	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	-1.1	-0.1	0.0	-3.1	-0.4	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	2.7	0.2	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-0.1	-0.1	-0.1	-0.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.1	-0.1	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-0.5	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-22. CCWD Old River Intake (ROLD034) salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.2	-8.7	-3.7	-0.2	-0.3	0.0	0.0	0.0
1974	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	30.7	-32.4	-62.4
1977	-57.3	-31.3	-21.2	-19.6	-5.3	1.8	3.8	2.1	1.8	0.9	-27.4	-34.0
1978	-51.0	-23.6	-13.3	-1.9	0.7	0.5	0.0	0.3	0.2	0.2	0.2	0.2
1979	0.1	0.0	0.0	0.2	0.4	0.2	0.3	0.2	0.1	0.1	0.1	0.0
1980	-0.3	0.3	4.1	2.3	7.8	-0.3	0.3	0.3	0.1	0.0	0.0	0.0
1981	0.0	-0.1	-0.3	0.1	0.2	0.0	0.2	0.4	0.9	-3.8	17.3	10.0
1982	-29.2	-15.4	-1.8	0.2	-8.2	-4.4	0.4	-0.4	-0.2	-0.1	0.0	0.0
1983	-0.1	0.0	-0.1	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.1	-0.1
1984	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	-0.1	0.0
1985	0.0	0.1	0.3	0.3	0.2	0.4	0.3	0.2	0.2	-0.3	-0.5	-0.7
1986	-0.4	-0.6	-0.3	0.6	0.1	0.4	0.1	0.0	0.1	0.1	0.0	0.0
1987	0.0	0.1	-0.1	-0.3	0.1	0.1	4.2	4.3	2.4	12.4	19.7	-32.4
1988	-40.3	-23.1	-14.1	-1.4	0.0	6.0	3.1	6.9	4.1	21.5	29.0	-34.7
1989	-52.1	-32.0	-13.6	9.2	7.5	3.9	1.5	6.5	2.2	-1.0	9.4	-5.7
1990	-15.5	-12.8	-10.4	-7.1	0.0	1.9	1.9	1.2	1.3	57.0	18.7	-41.7
1991	-54.3	-31.5	-22.0	-14.4	-4.2	-0.9	0.4	0.7	4.3	48.6	13.0	-33.7
1992	-44.7	-25.2	-18.4	-16.5	-8.4	-0.3	0.3	4.6	2.9	26.5	23.8	-36.7
1993	-41.5	-19.5	-8.1	3.9	1.6	1.0	0.6	0.6	-8.4	-3.7	1.1	0.7
1994	0.1	0.1	0.0	1.0	2.7	1.1	0.8	0.6	0.6	-11.3	-16.8	30.7
1995	-8.7	-4.9	-8.4	0.7	0.8	0.3	0.2	0.1	0.1	0.1	0.1	0.4
1996	0.0	-0.1	0.1	0.2	0.2	0.0	0.3	0.0	0.1	0.3	0.4	0.2
1997	0.0	-0.1	-0.1	-0.4	-0.3	-0.1	0.0	0.3	0.2	-0.1	-0.2	-0.7
1998	0.3	0.3	0.3	0.7	0.3	0.0	0.0	0.4	0.3	0.0	-0.1	0.0
1999	0.0	0.2	0.1	0.0	0.0	0.0	0.4	0.3	0.1	0.2	0.2	0.1
2000	0.0	0.0	-0.2	-0.4	0.1	0.2	0.3	-0.1	0.0	0.0	-0.1	0.0
2001	0.0	0.0	-0.5	-0.7	0.2	0.1	0.7	0.7	2.6	24.7	25.4	-17.4
2002	-31.3	-14.2	2.3	0.9	0.5	0.4	0.2	0.1	1.4	-0.2	-0.7	-2.3
2003	-1.9	-1.1	-0.5	0.5	0.1	0.1	0.2	0.2	0.2	6.4	2.0	-5.6
Average	-12.6	-6.9	-3.7	-1.2	-0.1	0.1	0.5	0.9	0.5	6.1	2.4	-7.8
Critical	-30.3	-17.7	-12.3	-8.3	-2.2	1.4	1.5	2.3	2.2	24.9	1.1	-30.4
Dry	-13.9	-7.7	-2.0	1.6	1.5	0.8	1.2	2.1	1.6	5.3	11.8	-8.1
BN	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.1	0.1	0.0	0.0	0.0
AN	-15.8	-7.3	-3.0	0.8	1.7	-1.2	-0.4	0.2	-1.4	0.5	0.5	-0.8
Wet	-2.9	-1.6	-0.8	0.2	-0.5	-0.3	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-23. CCWD Old River Intake (ROLD034) salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.6	-1.0	-0.1	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	4.7	-4.1	-9.3
1977	-7.3	-4.0	-2.6	-1.9	-0.8	0.3	0.8	0.5	0.4	0.2	-4.0	-3.9
1978	-5.5	-3.2	-1.7	-0.3	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.1	0.6	0.5	2.2	-0.1	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.1	0.3	-0.9	2.8	1.3
1982	-3.4	-2.2	-0.6	0.1	-2.4	-1.3	0.2	-0.2	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.2	0.1	0.1	-0.2	0.1	0.0	-0.1	0.0
1984	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1
1986	-0.1	-0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.1	0.0	-0.1	0.0	0.0	0.8	1.0	0.7	3.7	4.4	-6.0
1988	-6.0	-3.6	-2.1	-0.3	0.0	1.2	0.7	1.5	1.0	6.1	5.5	-5.7
1989	-6.9	-3.9	-1.6	0.9	1.1	0.7	0.3	1.8	0.8	-0.2	1.3	-0.8
1990	-2.4	-1.9	-1.4	-1.0	0.0	0.5	0.5	0.3	0.3	9.9	2.4	-5.9
1991	-6.5	-3.7	-2.4	-1.6	-0.6	-0.2	0.1	0.2	1.2	7.8	1.7	-5.0
1992	-5.6	-3.1	-2.2	-1.8	-1.1	-0.1	0.1	1.2	0.9	7.3	4.0	-5.2
1993	-5.6	-3.1	-1.0	0.5	0.3	0.3	0.1	0.1	-2.5	-1.5	0.3	0.2
1994	0.0	0.0	0.0	0.1	0.5	0.3	0.2	0.1	0.2	-1.7	-2.0	4.0
1995	-1.1	-0.9	-1.1	0.1	0.2	0.1	0.1	0.0	0.1	0.0	0.1	0.2
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1
1998	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0
2000	0.0	0.0	-0.1	-0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.2	0.8	7.7	5.8	-3.3
2002	-4.8	-2.3	0.4	0.2	0.1	0.1	0.0	0.0	0.4	0.0	-0.1	-0.3
2003	-0.2	-0.2	-0.1	0.1	0.0	0.0	0.0	0.0	0.1	2.4	0.5	-1.2
Average	-1.6	-0.9	-0.5	-0.1	0.0	0.0	0.1	0.2	0.1	1.3	0.5	-1.2
Critical	-4.0	-2.3	-1.5	-0.9	-0.3	0.3	0.3	0.6	0.6	4.9	0.5	-4.4
Dry	-2.0	-1.0	-0.2	0.2	0.2	0.2	0.2	0.5	0.5	1.7	2.4	-1.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.9	-1.1	-0.4	0.1	0.5	-0.4	-0.1	0.0	-0.4	0.2	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-24. Old River location (ROLD059) salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.1	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.2	-0.2
1971	-0.1	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.2	-0.2	-0.2
1972	0.1	-0.2	0.2	-0.2	0.1	0.2	0.3	-0.3	0.0	0.2	-0.1	-0.3
1973	0.2	0.1	0.2	-0.1	0.1	-18.2	-2.1	0.3	0.1	-0.3	-0.2	-0.3
1974	-0.4	0.3	0.1	-0.1	0.0	0.2	-0.2	0.1	0.3	0.2	0.3	0.4
1975	-0.1	0.1	-0.2	0.3	0.0	0.1	0.1	-0.3	-0.1	0.3	0.0	0.0
1976	-0.1	-0.3	0.1	0.1	0.2	0.3	0.0	-0.2	0.0	-0.2	-24.9	-4.7
1977	0.0	-1.1	-0.2	0.3	0.1	0.0	0.5	0.3	0.9	2.2	-17.0	-15.4
1978	-9.4	-0.2	0.1	-0.3	0.0	0.1	0.0	0.3	0.3	0.2	0.2	0.4
1979	0.2	0.3	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.2	0.1	0.1
1980	0.2	-0.2	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.2	-0.3	-0.1
1981	0.3	0.1	-0.1	-0.1	-0.1	-0.3	1.4	0.6	0.1	-0.1	-5.7	-1.8
1982	0.3	-0.2	0.3	-0.1	-12.5	-1.4	0.4	-0.4	-0.3	-0.3	0.3	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.1	0.3	0.2	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.3	-0.3	-0.3	0.1
1986	0.4	0.1	0.4	0.4	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.2	0.3	0.1	0.1	0.0	-0.1	-0.2	0.0	-1.3	11.0	52.5	8.6
1988	-0.1	-0.1	0.0	0.0	0.4	0.2	0.4	-0.1	2.3	77.1	36.8	-6.6
1989	1.8	0.3	0.1	-0.2	-0.4	0.2	-0.3	0.1	-1.3	-0.5	-4.8	-2.2
1990	-0.2	-0.3	-0.2	0.2	0.3	-0.2	-0.4	0.0	0.5	34.3	19.4	-10.7
1991	0.4	0.1	-0.4	0.2	-0.2	0.0	-0.3	0.0	-0.5	57.0	21.1	-16.5
1992	-0.2	0.1	-0.2	0.3	-0.1	0.1	-7.7	-1.8	0.5	100.8	27.5	-8.9
1993	-10.5	-5.1	0.3	0.3	0.2	0.2	0.4	0.4	16.3	2.7	0.3	0.0
1994	0.0	0.0	-0.3	-0.3	0.0	0.2	0.3	-0.4	0.1	0.1	-41.7	-18.0
1995	0.2	0.5	0.3	0.0	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.3
1996	-0.4	-0.2	-0.2	-0.2	0.2	-0.3	0.4	0.0	0.1	-0.1	-0.1	0.1
1997	-0.3	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.3	0.2
1998	0.2	-0.2	0.1	0.3	0.3	-0.3	0.0	0.4	0.2	-0.2	-0.4	0.1
1999	-0.3	0.0	-0.3	-0.4	0.0	0.0	0.4	0.3	0.4	-0.2	0.0	0.0
2000	0.1	-0.2	-0.3	-0.2	0.2	0.3	0.4	-0.3	0.1	0.0	-0.1	0.0
2001	-0.1	-0.2	-0.3	0.2	0.0	0.3	2.8	0.0	-0.7	9.5	57.5	13.8
2002	0.2	0.1	0.3	-0.1	-0.1	0.2	0.1	0.0	-0.4	-0.2	0.3	0.1
2003	0.0	0.1	0.0	0.2	0.4	0.5	0.3	0.0	-0.2	0.3	0.0	0.2
Average	-0.5	-0.2	0.0	0.0	-0.3	-0.5	0.0	0.0	0.6	8.6	3.5	-1.8
Critical	0.0	-0.2	-0.2	0.1	0.1	0.1	-1.0	-0.3	0.5	38.8	3.0	-11.5
Dry	0.4	0.1	0.0	0.0	-0.1	0.0	0.7	0.1	-0.7	3.2	16.6	3.1
BN	0.2	0.1	0.1	-0.1	0.3	0.1	0.3	0.0	0.1	0.2	0.0	-0.1
AN	-3.2	-0.9	0.0	0.0	0.2	-2.9	-0.1	0.1	2.8	0.4	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.9	-0.1	0.1	0.0	0.2	0.0	0.0	0.0

Table 1-25. Old River location (ROLD059) salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	-0.1
1973	0.0	0.0	0.0	0.0	0.0	-4.8	-0.6	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.6	-0.7
1977	0.0	-0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	-2.7	-2.1
1978	-1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.3	0.1	0.0	0.0	-0.9	-0.3
1982	0.1	0.0	0.0	0.0	-3.9	-0.5	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	-0.1	-0.3	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0
1986	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	1.7	9.1	1.4
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4	13.3	6.8	-1.1
1989	0.3	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.2	-0.1	-0.7	-0.4
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.5	2.8	-1.6
1991	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	8.8	3.0	-2.5
1992	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.2	0.1	22.2	5.0	-1.4
1993	-1.5	-0.8	0.0	0.0	0.0	0.0	0.1	0.1	2.4	0.4	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-5.6	-2.6
1995	0.0	0.1	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.1	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.0
1998	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.1	0.0
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-0.1	1.5	10.1	2.4
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	1.6	0.7	-0.3
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	7.2	0.8	-1.7
Dry	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	-0.1	0.5	2.9	0.5
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.4	-0.1	0.0	0.0	0.0	-0.8	0.0	0.0	0.4	0.1	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Table 1-26. CCWD Contra Costa Canal Intake (CHCCC006) salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-4.2	22.2	18.8	-32.4
1977	-31.9	-20.6	-9.7	-6.5	-2.1	-0.7	-0.3	-0.8	-5.0	4.2	9.6	14.6
1978	-18.4	-17.2	-8.4	-1.4	0.4	0.3	0.1	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-18.9	-13.6	36.7
1982	-15.8	-7.9	-2.3	0.2	-5.7	-5.9	-0.6	-0.1	-0.2	-0.1	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.3	0.3	0.2	-0.1	0.1	0.1	-0.1	-0.1
1984	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	9.2	20.9	-10.5
1988	-17.9	-12.4	-7.0	-1.6	-0.4	-0.1	0.0	0.0	0.4	15.5	35.4	-9.0
1989	-20.5	-16.7	-7.4	-4.6	-1.7	-0.6	0.3	0.4	0.2	-2.5	-2.0	6.9
1990	-1.3	-0.7	-0.3	-0.3	0.3	1.4	1.1	0.4	-1.2	73.0	15.6	-16.4
1991	-19.0	-18.4	-10.5	-6.1	-2.3	-0.7	-0.2	-0.2	-1.9	63.3	11.4	-15.2
1992	-17.3	-15.1	-8.2	-5.1	-1.5	-0.1	0.0	0.0	0.9	17.1	29.7	1.3
1993	-13.7	-9.7	-5.5	-1.5	0.9	0.5	0.2	0.5	-5.1	-2.9	0.8	0.7
1994	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-16.7	-24.4	26.0
1995	2.0	-1.9	-2.9	-1.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.1
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.2	-0.3	-0.1	0.0	0.0	0.1	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.2	0.2	0.0	-0.1	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	16.6	19.4	4.5
2002	-7.7	-9.0	-3.7	-1.0	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.1
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	2.5	-1.9	-8.7
Average	-4.7	-3.8	-1.9	-0.9	-0.3	-0.1	0.0	0.0	-0.4	5.4	3.5	0.0
Critical	-12.5	-9.6	-5.1	-2.8	-0.9	0.0	0.1	-0.1	-1.7	25.5	13.7	-4.4
Dry	-4.7	-4.3	-1.8	-0.9	-0.3	-0.1	0.0	0.1	0.1	0.8	4.2	6.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
AN	-5.3	-4.5	-2.3	-0.5	0.2	0.2	0.1	0.2	-0.8	0.0	-0.2	-1.3
Wet	-1.1	-0.8	-0.4	-0.1	-0.4	-0.4	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-27. CCWD Contra Costa Canal Intake (CHCCC006) salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	3.5	2.0	-4.4
1977	-3.7	-2.3	-1.1	-0.6	-0.3	-0.1	-0.1	-0.2	-1.0	0.7	1.3	1.5
1978	-1.7	-2.1	-0.9	-0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.3	-1.9	4.5
1982	-1.6	-0.9	-0.7	0.0	-1.7	-1.4	-0.2	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.6	4.2	-1.9
1988	-2.4	-1.7	-0.9	-0.3	-0.1	0.0	0.0	0.0	0.1	4.2	6.0	-1.4
1989	-2.6	-1.8	-0.9	-0.4	-0.2	-0.1	0.1	0.1	0.1	-0.5	-0.2	0.9
1990	-0.2	-0.1	0.0	0.0	0.1	0.4	0.3	0.1	-0.3	12.6	1.8	-2.1
1991	-2.0	-2.0	-1.0	-0.6	-0.3	-0.1	0.0	0.0	-0.5	9.9	1.3	-2.0
1992	-2.0	-1.7	-0.9	-0.5	-0.2	0.0	0.0	0.0	0.3	4.4	4.5	0.2
1993	-1.6	-1.4	-0.7	-0.2	0.2	0.1	0.0	0.1	-1.7	-1.2	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-2.7	-2.4	3.1
1995	0.2	-0.3	-0.4	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.9	4.0	0.8
2002	-1.1	-1.3	-0.4	-0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-0.5	-1.6
Average	-0.5	-0.5	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	1.0	0.6	-0.1
Critical	-1.5	-1.1	-0.6	-0.3	-0.1	0.0	0.0	0.0	-0.4	4.7	2.1	-0.7
Dry	-0.6	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.5	1.0	0.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.6	-0.3	-0.1	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-28. CVP-Jones Intake (CHDMC006) salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.1	0.1	0.0	-0.2	-0.2	0.0	0.0	0.1	0.1	0.1	0.0	0.0
1971	0.0	-0.1	0.0	0.0	0.1	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.1	0.1	0.3	-0.2	0.0	0.0	0.0	-0.1
1973	0.0	0.0	0.1	-0.1	0.1	0.3	-0.1	0.3	0.1	0.0	0.0	-0.1
1974	-0.2	0.0	0.1	-0.1	0.0	0.2	-0.2	0.1	0.2	0.1	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.1	-0.3	-0.1	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-1.5	20.5	14.2	-22.4
1977	-17.4	-9.8	-4.4	-3.4	-0.7	-0.3	-0.1	0.2	-2.1	-9.9	-18.9	-10.1
1978	-18.5	-9.1	-3.8	-0.9	0.1	0.1	0.0	0.3	0.2	0.1	0.1	0.1
1979	0.1	0.1	0.0	0.0	0.2	-0.1	0.3	0.2	0.1	0.0	0.0	0.0
1980	0.1	0.0	-0.1	0.1	0.2	-0.4	0.3	0.2	0.1	-0.1	-0.1	0.0
1981	0.1	0.1	0.0	-0.1	-0.1	-0.2	-0.3	0.3	-0.3	-2.2	0.2	14.7
1982	-7.6	-5.0	-1.0	0.2	-10.7	-1.7	0.4	-0.4	-0.3	-0.3	0.1	-0.2
1983	-0.3	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.4	0.0
1984	0.2	-0.2	0.1	0.0	0.1	0.1	0.2	-0.1	0.1	0.1	0.1	0.0
1985	0.0	0.0	-0.1	0.1	0.1	-0.1	0.3	0.0	0.0	0.0	-0.1	0.0
1986	0.1	0.1	0.1	0.2	0.1	0.4	0.1	0.0	0.3	0.1	0.0	-0.1
1987	0.1	0.1	0.1	0.0	0.0	-0.1	-0.2	-0.1	0.2	3.1	-2.7	-13.8
1988	-11.7	-6.3	-3.0	-0.8	0.3	0.1	0.3	-0.1	0.1	3.2	18.0	-8.4
1989	-15.3	-8.1	-3.3	-2.3	-0.9	0.0	-0.2	0.2	0.2	-2.1	0.4	2.6
1990	-0.8	-0.4	-0.2	-0.1	0.2	0.5	0.4	0.1	-0.3	24.1	14.7	-13.7
1991	-17.0	-9.6	-4.4	-1.0	-1.1	-0.2	-0.2	0.0	-1.2	21.4	12.1	-13.5
1992	-13.5	-8.0	-2.3	-2.2	-0.4	-0.1	-0.2	0.0	0.3	20.3	11.1	-11.4
1993	-11.2	-5.6	-2.9	-0.4	0.4	0.3	0.4	0.4	-18.8	-3.8	0.6	0.3
1994	0.1	0.0	-0.1	-0.1	0.0	0.1	0.2	-0.2	-0.2	-16.6	-17.9	12.8
1995	0.9	-1.1	-1.6	-0.4	-0.1	0.3	0.2	0.1	0.3	-0.2	0.1	0.0
1996	-0.2	-0.1	-0.1	-0.1	0.1	-0.3	0.3	0.0	0.1	0.0	0.0	0.0
1997	-0.1	-0.1	-0.2	-0.4	-0.2	0.1	0.0	0.4	0.1	0.0	-0.1	0.1
1998	0.1	-0.1	0.0	0.2	0.3	-0.3	0.0	0.4	0.2	-0.2	-0.2	0.0
1999	-0.1	0.0	-0.1	-0.3	0.0	0.0	0.4	0.3	0.2	0.0	0.0	0.0
2000	0.0	0.0	-0.1	-0.1	0.2	0.3	0.3	-0.3	0.0	0.0	0.0	0.0
2001	0.0	-0.1	-0.1	0.1	0.0	0.2	0.1	-0.3	-0.2	21.9	9.1	-6.3
2002	-7.7	-4.0	-1.7	-0.4	0.0	0.2	0.1	0.0	0.0	0.1	0.1	0.0
2003	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.0	0.0	1.6	-1.4	-4.0
Average	-3.5	-2.0	-0.9	-0.4	-0.3	0.0	0.1	0.0	-0.6	2.4	1.1	-2.2
Critical	-8.6	-4.9	-2.1	-1.1	-0.2	0.0	0.1	0.0	-0.7	9.0	4.8	-9.5
Dry	-3.8	-2.0	-0.9	-0.4	-0.1	0.0	0.0	0.0	0.0	3.5	1.2	-0.4
BN	0.1	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.1	0.0	0.0	0.0
AN	-4.9	-2.4	-1.1	-0.2	0.2	0.2	0.2	0.1	-3.1	-0.4	-0.1	-0.6
Wet	-0.5	-0.5	-0.2	0.0	-0.8	-0.1	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-29. CVP-Jones Intake (CHDMC006) salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
1974	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	3.5	2.1	-3.7
1977	-2.6	-1.4	-0.6	-0.4	-0.1	0.0	0.0	0.0	-0.4	-1.8	-3.1	-1.3
1978	-2.3	-1.3	-0.5	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	-0.1	-0.6	0.0	2.3
1982	-1.1	-0.8	-0.2	0.0	-3.3	-0.5	0.2	-0.2	-0.1	-0.1	0.0	-0.1
1983	-0.2	0.0	-0.1	0.0	0.1	0.1	0.1	-0.2	0.1	-0.1	-0.2	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	-0.6	-2.7
1988	-1.9	-1.1	-0.4	-0.1	0.0	0.0	0.0	0.0	0.0	0.9	3.6	-1.5
1989	-2.3	-1.1	-0.4	-0.3	-0.1	0.0	0.0	0.0	0.1	-0.5	0.1	0.4
1990	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	-0.1	4.7	2.1	-2.1
1991	-2.3	-1.3	-0.5	-0.1	-0.1	0.0	0.0	0.0	-0.3	3.9	1.7	-2.2
1992	-1.9	-1.1	-0.3	-0.3	0.0	0.0	0.0	0.0	0.1	6.0	2.1	-1.8
1993	-1.6	-0.9	-0.4	-0.1	0.1	0.1	0.1	0.1	-3.7	-1.0	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.8	-2.4	1.9
1995	0.1	-0.2	-0.2	-0.1	0.0	0.1	0.1	0.0	0.1	-0.1	0.0	0.0
1996	-0.1	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.1	0.0
1999	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	6.5	2.1	-1.2
2002	-1.3	-0.7	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.6	-0.4	-0.9
Average	-0.5	-0.3	-0.1	0.0	-0.1	0.0	0.0	0.0	-0.1	0.6	0.2	-0.4
Critical	-1.3	-0.7	-0.3	-0.1	0.0	0.0	0.0	0.0	-0.1	2.0	0.9	-1.5
Dry	-0.6	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.3	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.4	-0.2	0.0	0.0	0.0	0.1	0.0	-0.6	-0.1	0.0	-0.1
Wet	-0.1	-0.1	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-30. SWP-Clifton Court Intake (CHWST000) salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.1	0.1	0.3	-0.2	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	-0.1	0.0	0.2	-0.1	0.3	0.1	0.0	0.0	0.0
1974	-0.1	0.0	0.1	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.1	-0.3	-0.1	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-2.3	28.1	16.4	-28.2
1977	-23.4	-12.5	-5.8	-4.3	-1.3	-0.6	-0.2	0.0	-3.0	-7.0	-20.6	-11.3
1978	-22.3	-11.3	-5.0	-1.1	0.2	0.2	0.0	0.3	0.2	0.1	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.2	-0.4	0.3	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.1	0.0	0.0	0.0	-0.2	-0.3	0.2	-0.2	-12.1	3.0	18.0
1982	-10.0	-6.3	-1.4	0.2	-8.2	-3.6	0.4	-0.4	-0.3	-0.1	0.0	0.0
1983	-0.1	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.2	-0.1
1984	0.1	-0.1	0.2	0.0	0.0	0.1	0.2	-0.1	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.1	0.1	-0.1	0.3	0.0	0.0	0.0	0.0	0.0
1986	0.1	0.0	0.0	0.1	0.1	0.4	0.1	0.0	0.2	0.1	0.0	-0.1
1987	0.0	0.1	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.2	4.9	8.2	-15.3
1988	-14.0	-7.9	-4.0	-1.1	0.1	0.0	0.2	0.0	0.1	5.6	22.4	-8.6
1989	-17.8	-10.2	-4.4	-2.8	-1.2	-0.3	-0.1	0.3	0.2	-2.4	0.7	3.5
1990	-1.0	-0.4	-0.2	-0.2	0.2	0.8	0.7	0.3	-0.5	30.9	17.9	-15.7
1991	-20.5	-12.1	-5.8	-2.4	-1.7	-0.4	-0.2	-0.1	-1.3	27.1	14.1	-13.3
1992	-16.6	-9.9	-4.2	-3.0	-0.9	-0.1	-0.1	0.0	0.4	9.1	11.5	-12.0
1993	-13.2	-6.7	-3.9	-0.8	0.6	0.4	0.4	0.4	-14.6	-4.8	0.7	0.5
1994	0.1	0.0	0.0	0.0	0.0	0.1	0.1	-0.2	-0.2	-18.9	-19.2	16.8
1995	1.0	-1.4	-2.2	-0.6	0.0	0.2	0.2	0.1	0.2	-0.1	0.0	0.0
1996	-0.1	-0.1	-0.1	-0.1	0.1	-0.1	0.4	0.0	0.0	0.0	0.0	0.0
1997	0.0	-0.1	-0.1	-0.4	-0.2	0.0	-0.1	0.4	0.1	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.2	0.3	-0.1	0.0	0.4	0.2	-0.1	-0.1	0.0
1999	0.0	0.0	0.0	-0.1	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	-0.1	0.1	0.2	0.4	-0.3	-0.1	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.2	0.0	12.4	13.8	-6.0
2002	-9.3	-5.3	-2.5	-0.6	0.1	0.2	0.1	0.0	0.1	0.2	0.1	0.1
2003	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.0	0.0	1.5	-1.6	-5.2
Average	-4.3	-2.5	-1.2	-0.5	-0.3	-0.1	0.1	0.0	-0.6	2.2	2.0	-2.3
Critical	-10.8	-6.1	-2.9	-1.6	-0.5	0.0	0.1	0.0	-1.0	10.7	6.1	-10.3
Dry	-4.5	-2.6	-1.2	-0.6	-0.2	0.0	0.0	0.0	0.0	0.5	4.3	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0
AN	-5.9	-3.0	-1.5	-0.3	0.2	0.1	0.2	0.2	-2.4	-0.5	-0.2	-0.8
Wet	-0.7	-0.6	-0.3	0.0	-0.6	-0.2	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-31. SWP-Clifton Court Intake (CHWST000) salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	4.7	2.3	-4.5
1977	-3.3	-1.7	-0.7	-0.5	-0.2	-0.1	0.0	0.0	-0.6	-1.3	-3.2	-1.4
1978	-2.6	-1.6	-0.7	-0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	-3.1	0.5	2.6
1982	-1.3	-1.0	-0.4	0.0	-2.4	-1.1	0.2	-0.2	-0.1	0.0	0.0	0.0
1983	-0.1	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	-0.1	-0.1	0.0
1984	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.5	1.9	-3.0
1988	-2.2	-1.3	-0.6	-0.2	0.0	0.0	0.0	0.0	0.0	1.6	4.5	-1.5
1989	-2.5	-1.3	-0.6	-0.3	-0.1	0.0	0.0	0.1	0.1	-0.5	0.1	0.6
1990	-0.2	-0.1	0.0	0.0	0.0	0.2	0.1	0.0	-0.1	5.8	2.5	-2.4
1991	-2.6	-1.5	-0.7	-0.3	-0.2	-0.1	0.0	0.0	-0.4	4.8	1.9	-2.1
1992	-2.2	-1.3	-0.5	-0.3	-0.1	0.0	0.0	0.0	0.1	2.6	2.1	-1.8
1993	-1.9	-1.1	-0.5	-0.1	0.1	0.1	0.1	0.1	-3.8	-1.7	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.1	-2.4	2.4
1995	0.1	-0.3	-0.3	-0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	3.9	3.3	-1.2
2002	-1.5	-0.9	-0.4	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.6	-0.5	-1.2
Average	-0.6	-0.4	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.5	0.4	-0.4
Critical	-1.5	-0.8	-0.4	-0.2	-0.1	0.0	0.0	0.0	-0.2	2.2	1.1	-1.6
Dry	-0.7	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.3	1.0	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.7	-0.4	-0.2	0.0	0.0	0.0	0.1	0.0	-0.6	-0.2	0.0	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-32. Old River near Middle River salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.3	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.2	0.2	0.2	0.3	-0.3	0.3	0.3	-0.3	-0.4
1973	0.3	0.1	0.2	-0.2	0.2	0.4	-0.1	0.3	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.2	-0.2	0.1	0.3	0.2	0.3	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.1	0.2	0.3	0.0	-0.2	0.0	-0.2	-0.2	0.1
1977	-0.1	0.1	-0.1	0.3	0.1	0.2	0.2	0.4	0.0	0.0	-0.4	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	-0.3	0.4	0.0	-24.6	-2.6	-0.2
1982	0.3	-0.3	0.3	0.0	-13.9	-1.1	0.4	-0.4	-0.3	-0.3	0.4	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.3	0.2	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.4	-0.4	-0.4	0.3
1986	0.5	0.0	0.4	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.3	0.1	-0.3	-0.4
1988	-0.4	0.3	-0.1	0.0	0.4	0.1	0.4	-0.2	0.1	-0.5	0.2	0.2
1989	0.1	0.3	0.1	-0.4	-0.4	0.3	-0.4	0.2	0.1	0.2	-0.3	-0.2
1990	-0.2	-0.2	0.0	0.2	0.3	-0.2	-0.4	0.1	-0.3	-0.2	0.0	0.1
1991	-0.1	0.3	-0.3	0.2	-0.3	0.0	-0.3	0.1	0.1	-1.9	-0.6	0.1
1992	-0.2	0.4	-0.1	0.3	-0.1	0.1	-0.4	0.2	0.2	-110.4	-25.7	0.0
1993	0.1	-0.2	0.4	0.2	0.1	0.1	0.5	0.4	18.4	1.4	0.4	-0.1
1994	0.0	0.0	-0.4	-0.4	0.1	0.2	0.3	-0.4	-0.4	0.5	0.0	-0.4
1995	0.1	0.2	0.3	-0.1	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.4
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.3	0.4	-0.1	0.1	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.4	0.3
1998	0.2	-0.3	0.2	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	0.0	0.4	0.3	0.5	-0.3	0.0	-0.1
2000	0.2	-0.3	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.3	0.0	0.3	0.1	-0.4	-0.4	-31.4	-3.9	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	0.0	-0.3	-0.1	0.2	0.0
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-0.1	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.6	-4.9	-1.0	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	0.0	0.0	-0.1	-16.1	-3.8	0.0
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-9.4	-1.2	-0.1
BN	0.2	0.0	0.1	-0.2	0.3	0.1	0.3	-0.1	0.3	0.3	-0.1	-0.1
AN	0.1	-0.1	0.0	0.0	0.2	0.2	0.2	0.1	3.1	0.1	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.0	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-33. Old River near Middle River salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	-0.1
1973	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	0.0	-3.9	-0.4	0.0
1982	0.1	-0.1	0.0	0.0	-4.7	-0.4	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.1	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-14.8	-3.3	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	2.7	0.2	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	0.0	-0.1
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-4.8	-0.6	-0.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	-0.7	-0.1	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.2	-0.5	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-0.2	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-34. CCWD Old River Intake (ROLD034) salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.2	0.1	0.0	0.0	0.0
1974	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-3.2	30.0	0.9	-31.8
1977	-26.7	-14.2	-7.4	-4.9	-1.9	-0.8	-0.3	-0.4	-3.7	-3.0	-16.1	-13.4
1978	-24.1	-12.4	-6.4	-1.4	0.4	0.3	0.0	0.3	0.2	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.2	-0.4	0.2	0.3	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-15.3	3.9	19.5
1982	-11.8	-7.1	-1.7	0.2	-8.3	-4.4	0.4	-0.4	-0.3	-0.1	0.0	0.0
1983	-0.1	-0.1	-0.1	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.1	-0.1
1984	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.1	0.4	0.1	0.0	0.1	0.1	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7.5	13.8	-14.6
1988	-15.1	-8.7	-5.2	-1.5	-0.3	-0.1	0.0	0.0	0.2	11.3	20.9	-10.7
1989	-19.1	-11.4	-5.5	-3.5	-1.6	-0.6	0.2	0.4	0.2	-2.6	0.9	3.7
1990	-1.2	-0.4	-0.2	-0.2	0.3	1.2	1.0	0.5	-0.7	34.1	17.6	-16.9
1991	-22.1	-13.5	-7.9	-4.9	-2.4	-0.9	-0.2	-0.1	-1.5	30.0	13.8	-13.9
1992	-18.4	-10.9	-6.3	-4.0	-1.6	-0.1	0.0	0.0	0.6	14.3	11.4	-13.0
1993	-14.1	-7.0	-4.9	-1.4	0.8	0.5	0.3	0.4	-8.7	-3.9	0.7	0.5
1994	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-21.0	-16.9	20.8
1995	0.7	-1.6	-2.8	-1.0	0.1	0.1	0.2	0.1	0.1	0.1	0.0	0.0
1996	-0.1	-0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	-0.4	-0.3	-0.1	0.0	0.3	0.1	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.4	0.3	0.0	-0.1	0.0
1999	0.0	0.0	0.0	-0.1	0.0	0.0	0.4	0.3	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.3	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	14.6	14.8	-4.3
2002	-10.0	-6.1	-3.3	-0.9	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	2.1	-2.0	-5.9
Average	-4.8	-2.7	-1.5	-0.7	-0.4	-0.1	0.1	0.1	-0.5	2.9	1.9	-2.4
Critical	-11.9	-6.8	-3.9	-2.2	-0.9	-0.1	0.1	0.0	-1.2	13.7	4.5	-11.3
Dry	-4.8	-2.9	-1.5	-0.7	-0.2	-0.1	0.0	0.1	0.1	0.7	5.6	0.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0
AN	-6.4	-3.2	-1.9	-0.5	0.2	0.1	0.2	0.2	-1.4	-0.3	-0.2	-0.9
Wet	-0.9	-0.7	-0.3	-0.1	-0.6	-0.3	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-35. CCWD Old River Intake (ROLD034) salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	4.6	0.1	-4.8
1977	-3.4	-1.8	-0.9	-0.5	-0.3	-0.1	-0.1	-0.1	-0.8	-0.5	-2.3	-1.5
1978	-2.6	-1.7	-0.8	-0.2	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.7	0.6	2.6
1982	-1.4	-1.0	-0.6	0.0	-2.4	-1.3	0.2	-0.2	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.2	0.1	0.1	-0.2	0.1	0.0	-0.1	0.0
1984	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.2	3.1	-2.7
1988	-2.2	-1.4	-0.7	-0.3	-0.1	0.0	0.0	0.0	0.1	3.2	4.0	-1.8
1989	-2.5	-1.4	-0.7	-0.4	-0.2	-0.1	0.0	0.1	0.1	-0.6	0.1	0.6
1990	-0.2	-0.1	0.0	0.0	0.1	0.3	0.3	0.1	-0.2	5.9	2.3	-2.4
1991	-2.7	-1.6	-0.9	-0.5	-0.3	-0.1	0.0	0.0	-0.4	4.8	1.8	-2.0
1992	-2.3	-1.4	-0.7	-0.4	-0.2	0.0	0.0	0.0	0.2	3.9	1.9	-1.8
1993	-1.9	-1.1	-0.6	-0.2	0.2	0.1	0.1	0.1	-2.6	-1.5	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-3.2	-2.0	2.7
1995	0.1	-0.3	-0.4	-0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	3.4	-0.8
2002	-1.5	-1.0	-0.6	-0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	-0.5	-1.3
Average	-0.6	-0.4	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.6	0.4	-0.4
Critical	-1.5	-0.9	-0.5	-0.3	-0.1	0.0	0.0	0.0	-0.3	2.7	0.8	-1.7
Dry	-0.7	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.4	1.2	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.8	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.1	-0.4	-0.1	-0.1	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-36. Old River location (ROLD059) salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.1	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.2	-0.2
1971	-0.1	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.2	-0.2	-0.2
1972	0.1	-0.2	0.2	-0.2	0.1	0.2	0.3	-0.3	0.0	0.2	-0.1	-0.3
1973	0.2	0.1	0.2	-0.1	0.1	0.4	-0.1	0.3	0.1	-0.3	-0.2	-0.3
1974	-0.4	0.3	0.1	-0.1	0.0	0.2	-0.2	0.1	0.3	0.2	0.3	0.4
1975	-0.1	0.1	-0.2	0.3	0.0	0.1	0.1	-0.3	-0.1	0.3	0.0	0.0
1976	-0.1	-0.3	0.1	0.1	0.2	0.3	0.0	-0.2	-0.6	-0.3	1.7	4.3
1977	-0.1	0.0	-0.1	0.2	0.2	0.2	0.2	0.3	-1.3	-2.0	-13.0	-6.8
1978	-4.1	-1.1	0.1	-0.3	0.0	0.1	0.0	0.3	0.3	0.2	0.2	0.4
1979	0.2	0.3	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.2	0.1	0.1
1980	0.2	-0.2	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.2	-0.3	-0.1
1981	0.3	0.1	-0.1	-0.1	-0.1	-0.3	-0.3	0.3	0.0	-22.9	-10.3	-0.8
1982	0.3	-0.2	0.3	-0.1	-12.5	-1.4	0.4	-0.4	-0.3	-0.3	0.3	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.1	0.3	0.2	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.3	-0.4	-0.4	0.1
1986	0.4	0.1	0.4	0.4	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.2	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.1	9.1	23.3	1.8
1988	-0.4	0.1	0.0	0.0	0.4	0.2	0.4	-0.2	0.0	57.3	21.8	-1.0
1989	-0.1	0.2	0.1	-0.3	-0.4	0.2	-0.3	0.1	0.1	0.2	-0.8	-0.5
1990	-0.2	-0.2	-0.1	0.2	0.3	-0.2	-0.4	0.0	-0.1	29.6	15.1	-4.7
1991	-0.2	0.1	-0.3	0.1	-0.2	0.0	-0.3	0.0	-0.4	47.2	16.7	-7.2
1992	-0.7	0.2	0.0	0.2	-0.1	0.1	-0.3	0.1	-0.5	147.4	20.9	-3.4
1993	-3.0	-2.2	0.3	0.2	0.1	0.1	0.4	0.4	16.3	2.7	0.3	0.0
1994	0.0	0.0	-0.3	-0.3	0.0	0.2	0.3	-0.4	-0.2	0.1	-28.2	-10.5
1995	-0.6	0.2	0.3	0.0	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.3
1996	-0.4	-0.2	-0.2	-0.2	0.2	-0.3	0.4	0.0	0.1	-0.1	-0.1	0.1
1997	-0.3	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.3	0.2
1998	0.2	-0.2	0.1	0.3	0.3	-0.3	0.0	0.4	0.2	-0.2	-0.4	0.1
1999	-0.3	0.0	-0.3	-0.4	0.0	0.0	0.4	0.3	0.4	-0.2	0.0	0.0
2000	0.1	-0.2	-0.3	-0.2	0.2	0.3	0.4	-0.3	0.1	0.0	-0.1	0.0
2001	-0.1	-0.2	-0.3	0.2	0.0	0.3	0.1	-0.3	-0.5	-15.5	26.2	5.6
2002	0.1	0.1	0.3	-0.1	-0.1	0.2	0.1	0.0	-0.1	-0.1	0.1	0.1
2003	0.0	0.1	0.0	0.2	0.4	0.5	0.3	0.0	-0.1	0.1	0.1	0.2
Average	-0.3	-0.1	0.0	0.0	-0.3	0.0	0.1	0.0	0.5	7.4	2.1	-0.7
Critical	-0.2	0.0	-0.1	0.1	0.1	0.1	0.0	0.0	-0.5	39.9	5.0	-4.2
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-4.9	6.3	1.0
BN	0.2	0.1	0.1	-0.1	0.3	0.1	0.3	0.0	0.1	0.2	0.0	-0.1
AN	-1.1	-0.6	0.0	0.0	0.2	0.2	0.2	0.1	2.8	0.4	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-0.9	-0.1	0.1	0.0	0.2	0.0	0.0	0.0

Table 1-37. Old River location (ROLD059) salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	-0.1
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.2	0.7
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3	-2.1	-0.9
1978	-0.5	-0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	0.0	-3.6	-1.7	-0.1
1982	0.1	0.0	0.0	0.0	-3.9	-0.5	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	-0.1	-0.3	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	-0.1	0.0
1986	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	4.0	0.3
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	9.9	4.0	-0.2
1989	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	2.2	-0.7
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	7.3	2.4	-1.1
1992	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	32.4	3.8	-0.5
1993	-0.4	-0.3	0.0	0.0	0.0	0.0	0.1	0.1	2.4	0.4	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-3.8	-1.5
1995	-0.1	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.1	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.0
1998	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.1	0.0
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-2.4	4.6	1.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	1.5	0.4	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	7.7	1.0	-0.6
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	1.1	0.2
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.1	-0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Table 1-38. CCWD Contra Costa Canal Intake (CHCCC006) salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.1	-2.6	-8.3	-1.9	-0.3	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	28.7	14.1	-50.2
1977	-55.3	-35.8	-19.9	-21.0	-7.1	0.5	2.0	1.1	1.6	6.1	1.3	-2.3
1978	-33.3	-22.1	-12.3	-0.6	0.9	0.5	0.2	0.1	0.2	0.2	0.3	0.2
1979	0.0	0.0	0.0	0.0	0.4	0.4	0.2	0.3	0.1	0.1	0.1	0.0
1980	-0.2	-0.3	2.9	3.2	7.0	11.6	0.6	0.3	0.1	0.0	0.0	0.0
1981	0.0	0.0	-0.4	-0.1	0.2	0.1	0.0	0.3	0.6	-3.5	8.8	32.0
1982	-35.4	-23.7	-2.6	0.2	-5.6	-5.9	-0.6	-0.1	-0.2	-0.1	0.0	0.0
1983	0.0	0.1	0.0	0.0	0.3	0.3	0.2	-0.1	0.1	0.1	-0.1	0.0
1984	0.0	0.2	0.1	0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0
1985	0.0	0.1	0.3	0.4	0.3	0.2	0.3	0.2	0.2	-0.3	-0.5	-0.8
1986	-0.7	-0.5	-0.8	0.7	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.1	-0.1	-0.5	0.2	0.1	2.5	3.3	1.4	9.8	21.1	-24.7
1988	-40.6	-26.2	-16.5	-0.4	0.4	2.8	2.8	3.9	2.7	18.1	34.4	-25.5
1989	-43.9	-34.9	-20.0	10.6	6.1	3.8	1.4	4.0	1.4	13.5	10.6	-11.9
1990	-21.9	-16.7	-12.7	-10.4	0.0	2.3	2.3	1.3	1.8	73.2	4.2	-34.6
1991	-43.1	-32.8	-21.7	-17.5	-3.2	0.1	0.7	0.8	4.3	57.2	-2.4	-28.5
1992	-34.4	-25.1	-17.0	-16.5	-8.4	0.1	0.5	2.9	1.5	18.1	31.9	-18.6
1993	-38.1	-21.2	-10.9	5.8	1.7	1.0	0.7	0.8	-4.8	-2.7	1.3	1.0
1994	0.1	0.1	0.0	0.3	3.2	1.5	0.9	0.6	1.1	0.7	-13.3	14.6
1995	-10.8	-4.7	-8.6	2.0	0.9	0.5	0.2	0.1	0.1	0.1	0.1	0.5
1996	0.1	0.0	0.1	0.4	0.3	0.1	0.1	0.2	0.1	0.3	0.5	0.4
1997	0.1	0.0	0.0	-0.2	-0.3	-0.1	0.0	0.1	0.1	-0.1	-0.3	-0.7
1998	0.1	0.1	0.2	0.9	0.2	0.1	-0.1	0.2	0.2	0.0	0.0	0.0
1999	0.0	0.2	0.2	0.0	0.0	0.0	0.1	0.3	0.1	0.2	0.2	0.2
2000	0.0	0.0	-0.1	-0.5	0.1	0.1	0.2	0.2	0.0	-0.1	-0.2	0.0
2001	0.0	0.0	-0.2	-1.0	0.2	0.1	0.2	0.7	1.8	23.2	28.2	-5.3
2002	-25.9	-19.0	1.6	1.3	0.5	0.4	0.2	0.2	1.0	-0.2	-0.7	-2.5
2003	-2.6	-1.1	-0.8	0.6	0.1	0.1	0.1	0.2	0.2	7.6	3.1	-7.6
Average	-11.3	-7.7	-4.1	-1.2	0.0	0.5	0.2	0.6	0.5	7.4	4.2	-4.8
Critical	-27.9	-19.5	-12.6	-9.4	-2.2	1.1	1.3	1.6	1.9	28.9	10.0	-20.7
Dry	-11.6	-9.0	-3.1	1.8	1.2	0.8	0.8	1.4	1.1	7.1	11.2	-2.2
BN	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.1	0.0	0.0	0.0
AN	-12.4	-7.4	-3.5	1.4	1.7	1.8	-1.1	0.0	-0.8	0.8	0.7	-1.1
Wet	-3.6	-2.2	-0.9	0.3	-0.3	-0.4	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-39. CCWD Contra Costa Canal Intake (CHCCC006) salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.7	-2.2	-0.4	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	4.5	1.5	-6.8
1977	-6.4	-4.0	-2.3	-1.8	-1.0	0.1	0.5	0.3	0.3	1.0	0.2	-0.2
1978	-3.1	-2.7	-1.4	-0.1	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.4	0.6	1.0	2.2	0.2	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.1	0.2	-0.8	1.2	3.9
1982	-3.6	-2.6	-0.8	0.0	-1.7	-1.4	-0.2	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1
1986	-0.1	-0.1	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	-0.1	0.0	0.0	0.6	0.8	0.4	2.7	4.3	-4.4
1988	-5.5	-3.7	-2.1	-0.1	0.1	0.6	0.7	1.0	0.8	4.9	5.8	-3.9
1989	-5.5	-3.7	-2.3	1.0	0.8	0.7	0.3	1.2	0.5	2.7	1.3	-1.5
1990	-3.0	-2.2	-1.6	-1.2	0.0	0.7	0.7	0.4	0.5	12.6	0.5	-4.4
1991	-4.6	-3.5	-2.2	-1.7	-0.5	0.0	0.2	0.2	1.2	8.9	-0.3	-3.8
1992	-3.9	-2.8	-1.8	-1.6	-1.1	0.0	0.1	0.8	0.5	4.7	4.8	-2.4
1993	-4.4	-3.1	-1.3	0.8	0.3	0.3	0.2	0.2	-1.6	-1.1	0.3	0.2
1994	0.1	0.0	0.0	0.0	0.6	0.4	0.3	0.2	0.3	0.1	-1.3	1.7
1995	-1.1	-0.8	-1.1	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.2
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1
1997	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1998	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1999	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0
2000	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.2	0.6	6.9	5.8	-1.0
2002	-3.6	-2.7	0.2	0.3	0.2	0.1	0.1	0.0	0.3	0.0	-0.1	-0.3
2003	-0.3	-0.1	-0.1	0.2	0.0	0.0	0.0	0.0	0.1	2.7	0.8	-1.4
Average	-1.3	-0.9	-0.5	-0.1	0.0	0.1	0.1	0.2	0.1	1.5	0.7	-0.7
Critical	-3.3	-2.3	-1.4	-0.9	-0.3	0.3	0.3	0.4	0.5	5.2	1.6	-2.8
Dry	-1.5	-1.1	-0.4	0.2	0.2	0.2	0.2	0.4	0.4	1.9	2.1	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.3	-1.0	-0.4	0.2	0.3	0.3	-0.3	0.0	-0.3	0.3	0.2	-0.2
Wet	-0.4	-0.2	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-40. CVP-Jones Intake (CHDMC006) salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.1	0.1	0.0	-0.2	-0.2	0.0	0.0	0.1	0.1	0.1	0.0	0.0
1971	0.0	-0.1	0.0	0.0	0.1	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.1	0.1	0.3	-0.2	0.0	0.0	0.0	-0.1
1973	0.0	0.0	0.1	-0.1	0.1	-15.3	-2.9	0.3	-0.2	-0.1	-0.1	-0.1
1974	-0.2	0.0	0.1	-0.1	0.0	0.2	-0.2	0.1	0.2	0.1	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.1	-0.3	-0.1	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1	24.3	11.4	-34.3
1977	-29.5	-16.1	-9.0	-11.1	2.4	10.0	10.9	3.2	1.5	-5.6	-22.9	-19.6
1978	-26.7	-10.5	-5.1	-0.7	0.3	0.2	0.0	0.3	0.2	0.2	0.2	0.2
1979	0.1	0.1	0.0	0.0	0.4	0.0	0.3	0.2	0.1	0.1	0.1	0.0
1980	-0.1	0.1	2.3	0.4	-2.4	-0.5	0.3	0.2	0.1	-0.1	-0.1	0.0
1981	0.1	0.1	-0.2	0.0	0.0	-0.2	1.3	0.6	1.1	-2.2	9.9	8.8
1982	-19.0	-10.5	-1.1	0.2	-10.7	-1.7	0.4	-0.4	-0.3	-0.3	0.1	-0.2
1983	-0.3	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.4	0.0
1984	0.2	-0.2	0.1	0.0	0.1	0.1	0.2	-0.1	0.1	0.1	0.0	0.0
1985	0.0	0.0	0.1	0.3	0.2	0.2	0.4	0.0	0.2	-0.2	-0.4	-0.5
1986	-0.2	-0.3	-0.1	0.5	0.1	0.4	0.1	0.0	0.3	0.1	0.0	-0.1
1987	0.1	0.3	0.1	-0.1	0.1	-0.1	0.8	2.1	2.9	3.8	-6.5	-24.7
1988	-23.9	-12.3	-6.5	-0.5	0.3	10.6	1.5	7.0	6.8	3.6	16.5	-18.9
1989	-29.4	-16.1	-6.8	6.2	7.3	1.5	0.2	15.1	3.5	-0.7	6.8	-3.4
1990	-10.2	-8.6	-4.9	-4.2	-0.2	0.9	0.8	0.2	0.8	24.0	7.4	-24.3
1991	-30.8	-16.5	-8.8	-2.8	-1.1	-0.1	0.0	0.2	3.4	17.2	2.9	-21.1
1992	-22.4	-12.0	-4.1	-6.5	-1.5	-0.1	-4.3	15.4	3.5	9.0	11.2	-25.6
1993	-25.7	-11.3	-3.7	1.4	0.7	0.5	0.4	0.4	-18.7	-3.6	0.8	0.5
1994	0.1	0.0	-0.1	0.3	1.5	0.7	0.4	-0.1	0.3	-1.6	-12.5	4.7
1995	-6.0	-1.5	-3.6	0.3	0.2	0.3	0.2	0.1	0.3	-0.2	0.2	0.2
1996	-0.1	-0.1	0.0	-0.1	0.2	-0.3	0.3	0.0	0.1	0.2	0.2	0.2
1997	0.0	-0.1	-0.2	-0.4	-0.2	0.1	0.0	0.4	0.1	0.3	-0.2	-0.4
1998	0.5	1.7	0.2	0.4	0.3	-0.3	0.0	0.4	0.2	-0.2	-0.2	0.1
1999	-0.1	0.1	0.0	-0.2	0.0	0.0	0.4	0.3	0.3	0.1	0.1	0.1
2000	0.1	0.0	-0.1	-0.3	0.2	0.3	0.3	-0.3	0.0	0.2	-0.1	0.0
2001	0.0	-0.1	-0.3	-0.4	0.1	0.2	2.6	0.3	2.6	11.2	9.7	-12.8
2002	-17.5	-6.8	2.1	0.5	0.3	0.2	0.1	0.0	1.1	-0.1	-0.5	-1.6
2003	-1.4	-0.7	-0.3	0.4	0.2	0.2	0.3	0.0	0.1	3.7	1.8	-3.8
Average	-7.1	-3.6	-1.5	-0.5	0.0	0.3	0.5	1.3	0.3	2.4	1.0	-5.2
Critical	-16.7	-9.4	-4.8	-3.5	0.2	3.1	1.3	3.7	2.3	10.1	2.0	-19.9
Dry	-7.8	-3.8	-0.9	1.1	1.3	0.3	0.9	3.0	1.9	2.0	3.2	-5.7
BN	0.1	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.1	0.1	0.0	0.0
AN	-9.0	-3.7	-1.1	0.2	-0.1	-2.4	-0.3	0.1	-3.1	0.0	0.4	-0.5
Wet	-1.9	-0.8	-0.4	0.1	-0.7	-0.1	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-41. CVP-Jones Intake (CHDMC006) salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-4.1	-0.8	0.1	-0.1	0.0	0.0	0.0
1974	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	1.7	-5.7
1977	-4.5	-2.3	-1.2	-1.2	0.3	1.2	1.6	0.5	0.3	-1.0	-3.7	-2.6
1978	-3.3	-1.5	-0.7	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.4	0.1	-0.7	-0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.3	-0.6	1.8	1.4
1982	-2.7	-1.7	-0.2	0.0	-3.3	-0.5	0.2	-0.2	-0.1	-0.1	0.0	-0.1
1983	-0.2	0.0	-0.1	0.0	0.1	0.1	0.1	-0.2	0.1	-0.1	-0.2	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	-0.1
1986	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.4	0.8	1.1	-1.4	-4.8
1988	-4.0	-2.1	-0.9	-0.1	0.0	1.2	0.2	1.2	1.5	1.0	3.3	-3.3
1989	-4.4	-2.2	-0.9	0.7	0.9	0.2	0.0	2.7	1.1	-0.2	1.1	-0.6
1990	-1.8	-1.4	-0.7	-0.6	0.0	0.1	0.1	0.0	0.2	4.7	1.1	-3.8
1991	-4.2	-2.2	-1.1	-0.3	-0.1	0.0	0.0	0.0	0.9	3.1	0.4	-3.4
1992	-3.2	-1.7	-0.5	-0.7	-0.2	0.0	-0.6	2.9	1.0	2.7	2.1	-4.0
1993	-3.8	-1.8	-0.5	0.2	0.1	0.1	0.1	0.1	-3.7	-1.0	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.1	-0.3	-1.7	0.7
1995	-0.8	-0.3	-0.5	0.0	0.0	0.1	0.1	0.0	0.1	-0.1	0.1	0.1
1996	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.0	0.1	-0.1	-0.1
1998	0.1	0.4	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.1	0.0
1999	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.1	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.6	0.1	0.7	3.3	2.2	-2.5
2002	-3.0	-1.2	0.3	0.1	0.0	0.0	0.0	0.0	0.3	0.0	-0.1	-0.3
2003	-0.2	-0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	1.3	0.5	-0.8
Average	-1.1	-0.5	-0.2	-0.1	-0.1	0.0	0.1	0.2	0.1	0.5	0.2	-0.9
Critical	-2.5	-1.4	-0.6	-0.4	0.0	0.4	0.2	0.7	0.6	2.1	0.5	-3.2
Dry	-1.2	-0.5	-0.1	0.1	0.2	0.0	0.2	0.6	0.5	0.6	0.6	-1.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.2	-0.6	-0.1	0.0	-0.1	-0.7	-0.1	0.0	-0.6	0.1	0.1	-0.1
Wet	-0.3	-0.1	-0.1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-42. SWP-Clifton Court Intake (CHWST000) salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.1	0.1	0.3	-0.2	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	-0.1	0.2	-10.7	-2.2	0.3	-0.3	0.0	0.0	0.0
1974	-0.1	0.0	0.1	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.1	-0.3	-0.1	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3	32.7	11.8	-43.4
1977	-40.1	-21.0	-12.6	-14.5	-0.9	6.7	7.9	3.3	1.4	-3.7	-25.4	-23.7
1978	-32.4	-13.3	-6.9	-0.8	0.5	0.4	0.0	0.3	0.2	0.2	0.2	0.2
1979	0.1	0.1	0.0	0.1	0.3	0.1	0.4	0.2	0.1	0.1	0.1	0.0
1980	-0.2	0.2	3.5	1.4	-1.6	-0.4	0.3	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	-0.2	0.0	0.1	-0.1	1.2	0.6	1.2	-2.8	16.0	10.9
1982	-24.7	-13.5	-1.6	0.3	-8.2	-3.6	0.4	-0.4	-0.3	-0.1	0.0	0.0
1983	-0.1	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.2	-0.1
1984	0.1	-0.1	0.2	0.0	0.1	0.1	0.2	-0.1	0.0	0.0	-0.1	0.0
1985	0.0	0.1	0.2	0.3	0.2	0.4	0.4	0.1	0.3	-0.2	-0.4	-0.6
1986	-0.3	-0.4	-0.2	0.5	0.1	0.4	0.1	0.0	0.2	0.1	0.0	0.0
1987	0.0	0.2	0.1	-0.2	0.1	0.0	1.7	2.7	3.0	4.9	5.9	-28.4
1988	-29.2	-15.7	-8.6	-0.6	0.3	12.8	2.2	8.5	5.1	6.6	20.4	-21.7
1989	-35.6	-20.7	-8.7	8.2	7.8	2.8	0.8	12.0	2.9	-0.9	9.3	-4.5
1990	-13.4	-10.9	-6.8	-5.6	-0.2	1.2	1.3	0.6	1.0	30.7	9.6	-29.0
1991	-38.1	-21.1	-11.8	-6.2	-1.7	-0.2	0.2	0.4	3.6	21.6	3.9	-22.7
1992	-28.2	-15.4	-8.1	-9.4	-3.4	-0.1	-2.1	9.4	3.2	9.1	11.8	-28.7
1993	-30.6	-13.9	-4.7	2.5	1.2	0.8	0.5	0.4	-14.4	-4.6	1.0	0.7
1994	0.1	0.1	0.0	0.6	2.0	0.9	0.6	0.1	0.5	-2.0	-13.8	7.3
1995	-7.7	-2.2	-4.9	0.7	0.6	0.3	0.2	0.1	0.2	-0.1	0.1	0.3
1996	0.0	-0.1	0.0	0.0	0.2	-0.1	0.4	0.0	0.1	0.2	0.4	0.2
1997	0.0	-0.1	-0.1	-0.4	-0.2	0.0	-0.1	0.4	0.2	0.0	-0.2	-0.6
1998	0.3	0.9	0.2	0.5	0.3	-0.1	0.0	0.4	0.2	-0.1	-0.1	0.0
1999	0.0	0.1	0.1	-0.1	0.0	0.0	0.4	0.3	0.2	0.2	0.2	0.1
2000	0.0	0.0	0.0	-0.3	0.2	0.2	0.4	-0.3	0.0	0.1	-0.1	0.0
2001	0.0	0.0	-0.2	-0.6	0.1	0.1	2.4	0.3	2.8	13.3	15.3	-14.3
2002	-21.6	-8.8	2.9	0.7	0.4	0.3	0.2	0.0	1.5	-0.1	-0.6	-2.1
2003	-1.7	-0.9	-0.4	0.4	0.2	0.2	0.3	0.0	0.2	4.9	2.0	-5.0
Average	-8.9	-4.6	-2.0	-0.7	0.0	0.4	0.5	1.2	0.4	3.2	2.0	-6.0
Critical	-21.3	-12.0	-6.8	-5.1	-0.5	3.0	1.4	3.2	2.2	13.6	2.6	-23.1
Dry	-9.5	-4.9	-1.0	1.4	1.5	0.6	1.1	2.6	1.9	2.4	7.6	-6.5
BN	0.0	0.0	0.0	0.0	0.2	0.1	0.3	0.0	0.1	0.0	0.0	0.0
AN	-10.8	-4.6	-1.4	0.5	0.1	-1.6	-0.1	0.2	-2.4	0.1	0.5	-0.7
Wet	-2.5	-1.2	-0.5	0.1	-0.5	-0.2	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-43. SWP-Clifton Court Intake (CHWST000) salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.9	-0.6	0.1	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.4	1.7	-6.9
1977	-5.6	-2.9	-1.6	-1.5	-0.1	1.0	1.4	0.6	0.3	-0.7	-3.9	-3.0
1978	-3.7	-1.9	-0.9	-0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.6	0.3	-0.5	-0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.0	0.0	0.3	0.1	0.3	-0.7	2.8	1.6
1982	-3.2	-2.0	-0.4	0.1	-2.3	-1.0	0.2	-0.2	-0.1	0.0	0.0	0.0
1983	-0.1	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	-0.1	-0.1	0.0
1984	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1
1986	0.0	-0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.6	0.9	1.5	1.4	-5.6
1988	-4.6	-2.5	-1.3	-0.1	0.0	1.8	0.4	1.6	1.2	1.9	4.1	-3.8
1989	-5.0	-2.7	-1.1	0.9	1.0	0.4	0.1	2.5	1.0	-0.2	1.4	-0.7
1990	-2.2	-1.7	-1.0	-0.8	0.0	0.2	0.3	0.1	0.2	5.8	1.3	-4.4
1991	-4.9	-2.6	-1.4	-0.7	-0.2	0.0	0.0	0.1	1.0	3.8	0.5	-3.5
1992	-3.8	-2.0	-1.0	-1.1	-0.4	0.0	-0.4	2.1	0.9	2.6	2.1	-4.4
1993	-4.3	-2.2	-0.6	0.3	0.2	0.2	0.1	0.1	-3.7	-1.7	0.3	0.2
1994	0.0	0.0	0.0	0.1	0.3	0.2	0.1	0.0	0.1	-0.3	-1.7	1.0
1995	-1.0	-0.4	-0.7	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.1
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1
1998	0.1	0.3	0.1	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0
2000	0.0	0.0	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.6	0.1	0.8	4.2	3.7	-2.9
2002	-3.5	-1.5	0.5	0.1	0.1	0.1	0.0	0.0	0.4	0.0	-0.1	-0.3
2003	-0.2	-0.1	-0.1	0.1	0.0	0.0	0.1	0.0	0.1	1.9	0.6	-1.2
Average	-1.2	-0.7	-0.3	-0.1	0.0	0.0	0.1	0.2	0.1	0.7	0.4	-1.0
Critical	-3.0	-1.7	-0.9	-0.6	-0.1	0.4	0.3	0.6	0.5	2.7	0.6	-3.6
Dry	-1.4	-0.7	-0.1	0.2	0.2	0.1	0.2	0.6	0.6	0.8	1.5	-1.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.4	-0.7	-0.2	0.1	0.0	-0.5	0.0	0.0	-0.6	0.0	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-44. Old River near Middle River location salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.3	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.2	0.2	0.2	0.3	-0.3	0.3	0.3	-0.3	-0.4
1973	0.3	0.1	0.2	-0.2	0.1	-20.9	-1.4	0.3	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.2	-0.2	0.1	0.3	0.2	0.3	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.1	0.2	0.3	0.0	-0.2	0.0	-0.2	-0.2	0.1
1977	-0.1	0.1	-0.1	0.3	0.1	0.2	0.2	0.4	0.0	0.0	-0.4	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	1.6	0.5	0.0	-0.2	-0.1	-0.2
1982	0.3	-0.3	0.3	0.0	-13.9	-1.1	0.4	-0.4	-0.3	-0.3	0.4	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.3	0.3	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.4	-0.4	-0.4	0.3
1986	0.5	0.0	0.4	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.3	0.1	-0.3	-0.4
1988	-0.4	0.3	-0.1	0.0	0.4	0.1	0.4	-0.2	0.1	-0.6	0.2	0.2
1989	0.1	0.3	0.1	-0.4	-0.4	0.3	-0.4	0.2	0.1	0.2	-0.3	-0.2
1990	-0.2	-0.2	0.0	0.2	0.3	-0.2	-0.4	0.1	-0.3	-0.3	0.0	0.1
1991	-0.1	0.3	-0.3	0.2	-0.3	0.0	-0.3	0.1	0.1	-1.5	-0.6	0.1
1992	-0.2	0.4	-0.1	0.3	-0.1	0.1	-9.1	-0.8	0.2	-11.9	-1.4	0.1
1993	0.1	-0.2	0.4	0.2	0.1	0.1	0.5	0.4	18.4	1.4	0.4	-0.1
1994	0.0	0.0	-0.4	-0.4	0.1	0.2	0.3	-0.4	-0.4	0.1	0.0	-0.4
1995	0.1	0.2	0.3	-0.1	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.4
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.3	0.4	-0.1	0.1	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.4	0.3
1998	0.2	-0.3	0.2	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	0.0	0.4	0.3	0.5	-0.3	0.0	-0.1
2000	0.2	-0.3	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.3	0.0	0.3	2.9	-0.2	-0.4	-0.4	-0.3	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	0.0	-0.3	-0.1	0.3	0.0
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-0.1	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.3	-0.6	-0.1	0.0	0.6	-0.4	-0.1	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	-1.3	-0.2	-0.1	-2.0	-0.3	0.0
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.7	0.1	-0.1	-0.1	-0.2	-0.1
BN	0.2	0.0	0.1	-0.2	0.3	0.1	0.3	-0.1	0.3	0.3	-0.1	-0.1
AN	0.1	-0.1	0.0	0.0	0.2	-3.4	0.0	0.1	3.1	0.1	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.0	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-45. Old River near Middle River location salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	-0.1
1973	0.1	0.0	0.0	0.0	0.0	-6.0	-0.4	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.4	0.1	0.0	0.0	0.0	0.0
1982	0.1	-0.1	0.0	0.0	-4.7	-0.4	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	-1.1	-0.1	0.0	-1.6	-0.2	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	2.7	0.2	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-0.1	-0.1	-0.1	-0.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.1	-0.1	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-0.3	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-46. CCWD Old River Intake (ROLD034) salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.2	-8.7	-3.7	-0.2	-0.3	0.0	0.0	0.0
1974	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	35.0	-7.2	-49.1
1977	-46.0	-24.0	-17.1	-16.7	-4.1	2.2	4.0	2.1	1.5	-0.6	-23.2	-27.8
1978	-34.9	-15.0	-9.0	-0.8	0.8	0.5	0.0	0.3	0.2	0.2	0.2	0.2
1979	0.1	0.0	0.0	0.2	0.4	0.2	0.3	0.2	0.1	0.1	0.1	0.0
1980	-0.3	0.3	4.1	2.3	7.8	-0.3	0.3	0.3	0.1	0.0	0.0	0.0
1981	0.0	-0.1	-0.3	0.1	0.2	0.0	0.2	0.4	0.9	-3.4	18.0	9.7
1982	-29.0	-15.2	-1.8	0.2	-8.2	-4.4	0.4	-0.4	-0.2	-0.1	0.0	0.0
1983	-0.1	0.0	-0.1	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.1	-0.1
1984	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	-0.1	0.0
1985	0.0	0.1	0.3	0.3	0.2	0.4	0.3	0.2	0.2	-0.3	-0.5	-0.7
1986	-0.4	-0.6	-0.3	0.6	0.1	0.4	0.1	0.0	0.1	0.1	0.0	0.0
1987	0.0	0.1	-0.1	-0.3	0.1	0.1	4.2	4.3	2.3	7.9	11.6	-29.4
1988	-32.8	-18.2	-11.1	-0.5	0.3	6.0	3.1	6.9	4.0	13.1	17.6	-26.3
1989	-39.2	-24.2	-9.9	11.5	8.5	4.3	1.6	6.6	2.2	-1.0	9.4	-5.7
1990	-15.5	-12.8	-10.4	-7.1	0.0	1.9	1.9	1.2	1.2	33.6	7.7	-32.8
1991	-41.6	-23.5	-17.1	-11.4	-2.6	-0.3	0.6	0.7	3.8	23.8	2.3	-25.1
1992	-31.9	-17.3	-13.9	-13.8	-7.3	-0.1	0.4	4.6	2.7	14.7	11.4	-31.9
1993	-33.3	-15.0	-5.4	4.8	1.6	1.0	0.6	0.6	-8.4	-3.7	1.1	0.7
1994	0.1	0.1	0.0	1.0	2.7	1.1	0.8	0.6	0.6	-2.5	-12.0	9.6
1995	-8.2	-3.1	-5.9	1.6	0.8	0.3	0.2	0.1	0.1	0.1	0.1	0.4
1996	0.0	-0.1	0.1	0.2	0.2	0.0	0.3	0.0	0.1	0.3	0.4	0.2
1997	0.0	-0.1	-0.1	-0.4	-0.3	-0.1	0.0	0.3	0.2	-0.1	-0.2	-0.7
1998	0.3	0.3	0.3	0.7	0.3	0.0	0.0	0.4	0.3	0.0	-0.1	0.0
1999	0.0	0.2	0.1	0.0	0.0	0.0	0.4	0.3	0.1	0.2	0.2	0.1
2000	0.0	0.0	-0.2	-0.4	0.1	0.2	0.3	-0.1	0.0	0.0	-0.1	0.0
2001	0.0	0.0	-0.5	-0.7	0.2	0.1	0.7	0.7	2.5	17.7	17.6	-14.5
2002	-24.2	-9.7	4.1	1.1	0.5	0.4	0.2	0.1	1.4	-0.2	-0.7	-2.3
2003	-1.9	-1.1	-0.5	0.5	0.1	0.1	0.2	0.2	0.2	6.4	2.0	-5.6
Average	-10.0	-5.3	-2.8	-0.8	0.1	0.2	0.5	0.9	0.5	4.1	1.6	-6.8
Critical	-24.0	-13.7	-10.0	-6.9	-1.6	1.6	1.5	2.4	2.0	16.7	-0.5	-26.2
Dry	-10.6	-5.6	-1.1	2.0	1.6	0.9	1.2	2.1	1.6	3.5	9.3	-7.1
BN	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.1	0.1	0.0	0.0	0.0
AN	-11.7	-5.1	-1.8	1.1	1.8	-1.2	-0.4	0.2	-1.4	0.5	0.5	-0.8
Wet	-2.9	-1.4	-0.6	0.2	-0.5	-0.3	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-47. CCWD Old River Intake (ROLD034) salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.6	-1.0	-0.1	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	5.4	-0.9	-7.3
1977	-5.8	-3.1	-2.1	-1.7	-0.6	0.4	0.9	0.5	0.3	-0.1	-3.4	-3.2
1978	-3.8	-2.0	-1.1	-0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.1	0.6	0.5	2.2	-0.1	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.1	0.3	-0.8	2.9	1.3
1982	-3.4	-2.2	-0.6	0.1	-2.4	-1.3	0.2	-0.2	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.2	0.1	0.1	-0.2	0.1	0.0	-0.1	0.0
1984	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	-0.1	-0.1	-0.1
1986	-0.1	-0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.1	0.0	-0.1	0.0	0.0	0.8	1.0	0.7	2.3	2.6	-5.5
1988	-4.9	-2.8	-1.6	-0.1	0.0	1.2	0.7	1.5	1.0	3.7	3.4	-4.3
1989	-5.2	-3.0	-1.2	1.2	1.2	0.7	0.3	1.8	0.8	-0.2	1.3	-0.8
1990	-2.4	-1.9	-1.4	-1.0	0.0	0.5	0.5	0.3	0.3	5.9	1.0	-4.6
1991	-5.0	-2.8	-1.9	-1.2	-0.4	-0.1	0.1	0.2	1.0	3.8	0.3	-3.7
1992	-4.0	-2.1	-1.6	-1.5	-0.9	0.0	0.1	1.2	0.8	4.1	1.9	-4.5
1993	-4.5	-2.4	-0.7	0.7	0.3	0.3	0.1	0.1	-2.5	-1.5	0.3	0.2
1994	0.0	0.0	0.0	0.1	0.5	0.3	0.2	0.1	0.2	-0.4	-1.4	1.3
1995	-1.0	-0.6	-0.8	0.2	0.2	0.1	0.1	0.0	0.1	0.0	0.1	0.2
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1
1998	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0
2000	0.0	0.0	-0.1	-0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.2	0.7	5.5	4.0	-2.7
2002	-3.7	-1.5	0.7	0.3	0.1	0.1	0.0	0.0	0.4	0.0	-0.1	-0.3
2003	-0.2	-0.2	-0.1	0.1	0.0	0.0	0.0	0.0	0.1	2.4	0.5	-1.2
Average	-1.3	-0.7	-0.3	-0.1	0.0	0.0	0.1	0.2	0.1	0.9	0.4	-1.0
Critical	-3.1	-1.8	-1.2	-0.8	-0.2	0.3	0.3	0.6	0.5	3.2	0.1	-3.8
Dry	-1.5	-0.7	-0.1	0.2	0.3	0.2	0.2	0.5	0.5	1.1	1.8	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.4	-0.8	-0.2	0.2	0.5	-0.4	-0.1	0.0	-0.4	0.2	0.1	-0.2
Wet	-0.3	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-48. Old River location (ROLD059) salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.1	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.2	-0.2
1971	-0.1	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.2	-0.2	-0.2
1972	0.1	-0.2	0.2	-0.2	0.1	0.2	0.3	-0.3	0.0	0.2	-0.1	-0.3
1973	0.2	0.1	0.2	-0.1	0.1	-18.2	-2.1	0.3	0.1	-0.3	-0.2	-0.3
1974	-0.4	0.3	0.1	-0.1	0.0	0.2	-0.2	0.1	0.3	0.2	0.3	0.4
1975	-0.1	0.1	-0.2	0.3	0.0	0.1	0.1	-0.3	-0.1	0.3	0.0	0.0
1976	-0.1	-0.3	0.1	0.1	0.2	0.3	0.0	-0.2	0.0	-0.2	-1.6	3.7
1977	0.0	-1.1	-0.2	0.3	0.1	0.0	0.5	0.3	0.9	0.3	-13.9	-13.4
1978	-7.9	0.3	0.1	-0.3	0.0	0.1	0.0	0.3	0.3	0.2	0.2	0.4
1979	0.2	0.3	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.2	0.1	0.1
1980	0.2	-0.2	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.2	-0.3	-0.1
1981	0.3	0.1	-0.1	-0.1	-0.1	-0.3	1.4	0.6	0.1	-0.1	-5.6	-1.8
1982	0.3	-0.2	0.3	-0.1	-12.5	-1.4	0.4	-0.4	-0.3	-0.3	0.3	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.2	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.1	0.3	0.2	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.3	-0.3	-0.3	0.1
1986	0.4	0.1	0.4	0.4	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.2	0.3	0.1	0.1	0.0	-0.1	-0.2	0.0	-1.3	10.4	31.0	2.7
1988	-0.1	-0.1	0.0	0.0	0.4	0.2	0.4	-0.1	2.3	67.9	24.0	-4.3
1989	2.0	0.3	0.1	-0.2	-0.4	0.2	-0.3	0.1	-1.3	-0.5	-4.8	-2.2
1990	-0.2	-0.3	-0.2	0.2	0.3	-0.2	-0.4	0.0	0.5	30.4	11.5	-8.6
1991	0.6	0.1	-0.4	0.2	-0.2	0.0	-0.3	0.0	-0.6	42.0	10.1	-13.2
1992	-0.4	0.1	-0.2	0.3	-0.1	0.1	-7.7	-1.8	0.5	56.2	14.2	-10.2
1993	-11.6	-4.3	0.3	0.2	0.2	0.2	0.4	0.4	16.3	2.7	0.3	0.0
1994	0.0	0.0	-0.3	-0.3	0.0	0.2	0.3	-0.4	0.1	0.1	-24.9	-10.3
1995	0.4	0.5	0.3	0.0	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.3
1996	-0.4	-0.2	-0.2	-0.2	0.2	-0.3	0.4	0.0	0.1	-0.1	-0.1	0.1
1997	-0.3	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.3	0.2
1998	0.2	-0.2	0.1	0.3	0.3	-0.3	0.0	0.4	0.2	-0.2	-0.4	0.1
1999	-0.3	0.0	-0.3	-0.4	0.0	0.0	0.4	0.3	0.4	-0.2	0.0	0.0
2000	0.1	-0.2	-0.3	-0.2	0.2	0.3	0.4	-0.3	0.1	0.0	-0.1	0.0
2001	-0.1	-0.2	-0.3	0.2	0.0	0.3	2.8	0.0	-0.7	9.2	34.0	6.3
2002	0.2	0.1	0.3	-0.1	-0.1	0.2	0.1	0.0	-0.4	-0.2	0.3	0.1
2003	0.0	0.1	0.0	0.2	0.4	0.5	0.3	0.0	-0.2	0.3	0.0	0.2
Average	-0.5	-0.2	0.0	0.0	-0.3	-0.5	0.0	0.0	0.6	6.4	2.2	-1.5
Critical	0.0	-0.2	-0.2	0.1	0.1	0.1	-1.0	-0.3	0.5	28.1	2.8	-8.0
Dry	0.4	0.1	0.0	0.0	-0.1	0.0	0.7	0.1	-0.7	3.1	9.1	0.9
BN	0.2	0.1	0.1	-0.1	0.3	0.1	0.3	0.0	0.1	0.2	0.0	-0.1
AN	-3.2	-0.7	0.0	0.0	0.2	-2.9	-0.1	0.1	2.8	0.4	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.9	-0.1	0.1	0.0	0.2	0.0	0.0	0.0

Table 1-49. Old River location (ROLD059) salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	-0.1
1973	0.0	0.0	0.0	0.0	0.0	-4.8	-0.6	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.6
1977	0.0	-0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	-2.2	-1.9
1978	-1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.3	0.1	0.0	0.0	-0.9	-0.3
1982	0.1	0.0	0.0	0.0	-3.9	-0.5	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	-0.1	-0.3	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0
1986	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	1.6	5.4	0.4
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4	11.8	4.4	-0.7
1989	0.3	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.2	-0.1	-0.7	-0.4
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	4.9	1.7	-1.3
1991	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	6.5	1.4	-2.0
1992	-0.1	0.0	0.0	0.0	0.0	0.0	-0.9	-0.2	0.1	12.4	2.6	-1.6
1993	-1.7	-0.6	0.0	0.0	0.0	0.0	0.1	0.1	2.4	0.4	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-3.3	-1.5
1995	0.1	0.1	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.1	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.0
1998	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.1	0.0
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-0.1	1.4	6.0	1.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	1.1	0.4	-0.2
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	5.1	0.6	-1.2
Dry	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	-0.1	0.5	1.6	0.2
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.4	-0.1	0.0	0.0	0.0	-0.8	0.0	0.0	0.4	0.1	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Table 1-50. Sacramento River location RSAC081 Base Salinity (EC)

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	1646.4	1324.8	199.8	182.1	185.8	187.4	441.6	948.7	2200.1	1905.2	3907.6	1127.7
1971	1427.2	1129.0	216.5	187.1	212.6	191.7	231.4	211.3	430.5	1534.8	4318.5	1207.5
1972	1464.0	1228.0	2455.0	2096.7	654.8	229.6	534.9	1437.5	3087.7	2715.8	4701.5	6474.6
1973	8653.2	3954.5	694.9	208.2	200.0	192.0	249.8	356.2	1153.6	2093.6	4438.5	2596.9
1974	3457.1	318.8	185.0	181.8	187.7	183.4	186.1	230.4	488.8	1667.2	3846.7	1086.7
1975	1514.7	1139.7	2635.4	3364.5	364.6	188.6	213.1	207.1	253.7	1352.0	4193.7	1195.0
1976	1442.6	1034.2	2571.0	4388.8	3139.6	1663.8	1870.6	4496.7	6944.6	6633.5	7753.6	9572.2
1977	11066.8	10382.5	10091.9	4846.6	3205.9	3126.5	3398.9	5570.2	7931.9	8756.1	9447.2	10645.0
1978	10568.5	10478.2	5162.3	283.2	208.2	202.1	215.8	234.0	580.6	1853.3	4413.1	2728.0
1979	3428.8	2768.1	4119.6	1341.7	248.8	228.7	308.0	350.7	1316.4	3061.7	5134.7	7182.8
1980	8599.8	6067.0	3213.8	254.5	198.4	199.7	232.4	341.4	785.7	1976.0	4548.3	2820.4
1981	3317.7	2638.2	3832.6	1360.2	296.0	279.6	531.2	1464.3	2885.3	4401.2	6146.3	7884.3
1982	9685.4	1332.0	190.7	200.7	187.4	198.4	181.8	181.9	259.3	1412.5	4559.1	1433.0
1983	667.2	236.4	188.6	209.8	194.2	184.5	186.8	181.7	184.7	201.4	374.5	341.0
1984	853.5	207.0	182.0	193.0	193.3	187.5	290.9	686.1	2007.4	2027.4	4193.7	1282.1
1985	1584.0	700.7	786.6	1544.8	1051.2	883.5	804.3	1272.9	3082.6	4500.6	6505.3	7290.0
1986	8442.9	8743.4	4072.9	720.2	186.8	189.8	232.1	331.1	1130.5	2264.3	4660.0	1523.2
1987	1647.5	1538.3	3601.9	3538.7	932.3	288.6	1057.6	2658.1	3527.0	4984.3	7090.0	8585.7
1988	9806.0	9565.3	3663.9	434.9	579.0	2175.5	2566.8	3074.8	3773.3	6078.9	7993.9	9304.3
1989	11353.2	9275.8	8335.7	5354.0	4001.3	372.2	259.2	828.2	3030.5	4824.6	5543.1	5916.1
1990	7681.6	8791.1	9005.4	2761.9	1213.6	1710.8	2111.2	3159.0	5730.9	7422.4	8259.4	9521.1
1991	10897.9	11245.0	10662.5	7448.6	4601.1	571.6	746.4	2999.1	6006.4	7479.8	8079.1	9579.2
1992	10967.8	10816.0	10717.3	7410.9	770.3	392.7	1057.6	3238.9	4028.4	6142.8	8445.7	9382.3
1993	9789.9	9650.1	6832.6	399.5	218.7	203.8	196.4	204.9	257.6	1320.7	4299.0	2377.9
1994	3103.9	2688.5	3936.8	3894.7	837.5	1190.4	1530.8	2053.9	4787.5	6217.2	7303.6	8641.2
1995	8028.6	8430.3	6408.8	317.4	198.4	181.1	193.7	178.2	182.1	255.5	1165.5	1052.0
1996	1017.6	1103.8	818.4	212.3	191.2	188.2	193.2	194.0	587.4	2024.9	4609.6	1095.6
1997	1582.3	1086.1	201.3	184.9	190.3	215.8	307.5	581.3	2035.6	1869.9	3991.4	1210.5
1998	1833.7	1329.5	1518.6	333.0	189.8	194.1	186.5	181.1	181.2	212.3	649.6	528.3
1999	1251.1	625.0	218.9	192.5	188.6	183.9	202.5	280.4	886.5	1907.2	4497.4	1197.5
2000	1688.7	1097.6	2911.9	1101.0	201.9	189.9	220.6	348.4	2057.3	2174.1	4089.8	2580.9
2001	3522.7	2665.4	3939.7	2498.4	360.1	239.2	541.2	1836.9	2968.6	4830.1	6722.2	8521.5
2002	9490.2	8327.7	1127.9	202.9	360.7	442.1	439.5	829.3	3219.4	4875.7	6143.2	8167.2
2003	9135.9	9095.5	994.0	191.8	212.7	281.8	225.1	194.3	1240.9	1959.0	4008.1	2590.8
Average	5312.3	4441.6	3402.8	1707.1	769.5	515.8	651.3	1216.0	2330.1	3321.7	5177.4	4607.1
Critical	7852.4	7789.0	7235.5	4455.2	2049.6	1547.3	1897.5	3513.2	5600.4	6961.5	8183.2	9520.8
Dry	5152.5	4191.0	3604.1	2416.5	1166.9	417.5	605.5	1481.6	3118.9	4736.1	6358.4	7727.5
BN	2446.4	1998.0	3287.3	1719.2	451.8	229.2	421.5	894.1	2202.1	2888.8	4918.1	6828.7
AN	8072.7	6723.8	3301.6	406.4	206.7	211.5	223.3	279.8	1012.6	1896.1	4299.5	2615.8
Wet	3185.2	2077.4	1310.5	498.4	205.4	190.3	234.4	337.9	832.9	1433.4	3459.0	1098.5

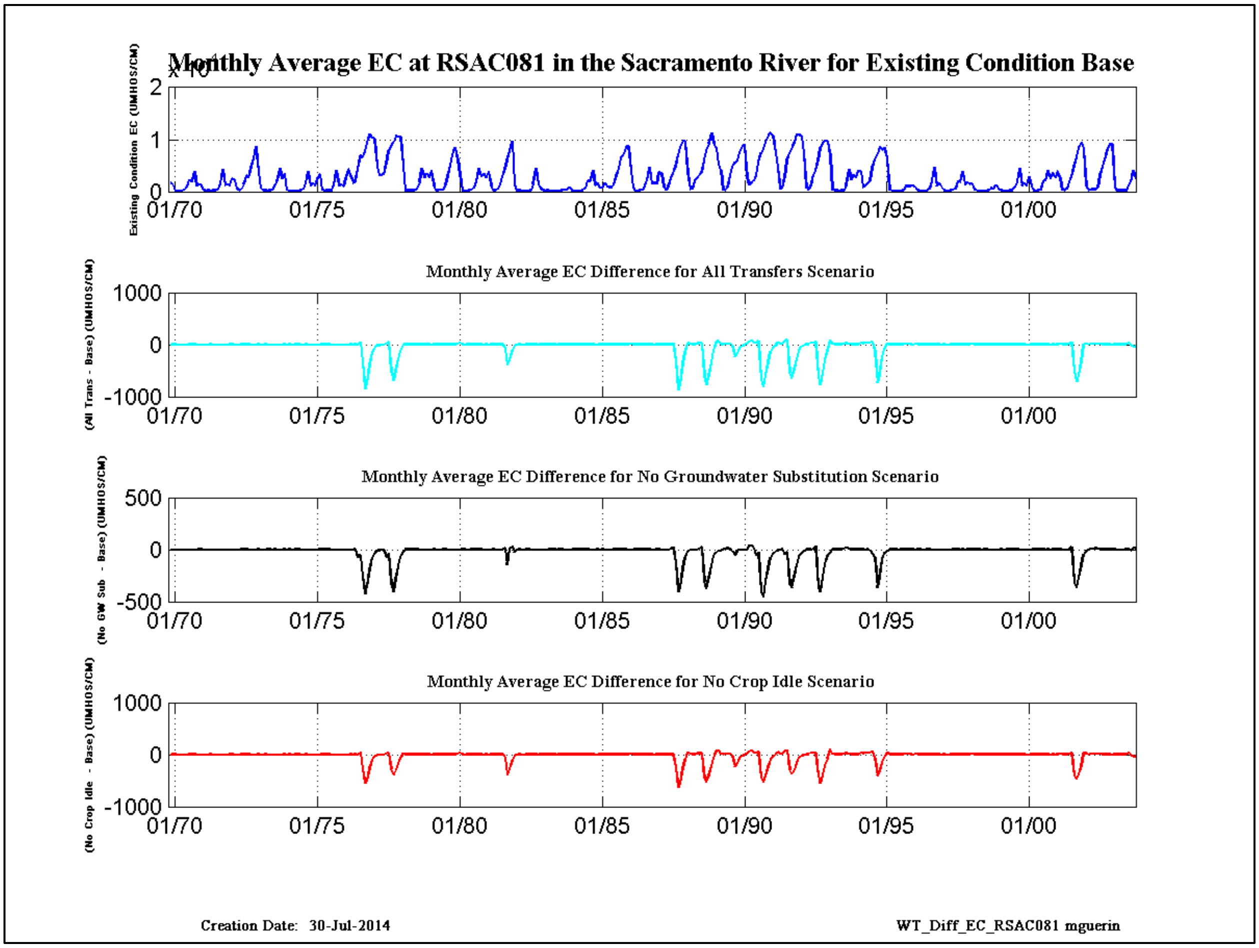


Figure 1-8. Sacramento River location RSAC081 EC for the Base condition and change from Base for the scenarios.

Table 1-51. Sacramento River location RSAC092 Base Salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	325.3	262.6	181.4	180.4	181.0	182.0	205.6	234.8	395.3	314.1	714.3	306.3
1971	280.8	239.8	186.7	182.6	185.6	181.6	191.1	185.6	191.9	269.6	794.0	324.4
1972	286.0	252.3	390.7	380.6	216.3	186.1	208.0	291.7	584.1	437.0	910.7	1537.5
1973	2423.2	702.4	249.3	196.4	190.0	183.7	199.7	203.3	253.4	339.4	866.3	469.5
1974	593.9	186.3	181.9	179.3	182.7	180.3	179.8	189.9	198.7	292.1	689.0	289.6
1975	285.1	243.8	420.3	572.1	200.9	182.5	191.2	185.6	187.2	262.4	790.0	312.6
1976	277.3	239.1	405.9	810.0	520.9	311.7	346.2	1081.9	2045.6	1434.9	2455.9	3347.2
1977	3955.2	3218.6	2950.3	960.3	597.5	574.0	612.4	1388.8	2491.8	2786.2	2938.4	4120.7
1978	3712.3	3413.9	916.4	207.5	194.3	190.9	193.5	196.6	211.1	314.0	845.9	509.3
1979	573.2	451.6	689.1	351.6	214.1	197.9	204.8	208.2	278.9	495.9	1049.1	1807.0
1980	2275.5	1263.0	509.8	192.0	187.7	184.4	192.2	204.2	232.1	342.3	884.8	510.0
1981	597.7	388.8	612.9	333.6	198.0	191.6	213.3	305.0	510.4	785.5	1428.8	2135.1
1982	2813.3	341.7	181.1	192.8	180.7	190.6	178.6	179.1	186.2	290.4	932.8	314.1
1983	194.3	184.9	181.5	192.5	184.6	180.9	181.1	177.8	179.0	187.6	188.9	182.0
1984	205.5	178.4	179.3	183.9	184.1	181.5	198.9	222.7	365.3	336.1	817.3	323.9
1985	317.6	209.4	209.4	285.2	232.7	230.2	232.3	269.6	571.1	805.7	1614.9	1761.2
1986	2392.5	2126.4	783.3	247.9	182.8	182.3	201.0	205.5	268.5	360.6	916.2	342.0
1987	311.4	276.1	611.0	634.8	247.0	196.0	273.8	490.1	648.8	1035.8	2051.2	2649.8
1988	3059.2	2812.8	692.9	217.8	222.3	447.7	452.5	563.5	744.5	1432.0	2514.7	3208.5
1989	4188.3	2468.3	2037.2	1038.5	755.8	196.3	192.1	219.2	547.1	902.2	1174.0	1321.4
1990	1919.4	2472.4	2567.5	503.4	267.5	316.7	366.8	606.7	1535.9	1840.2	2539.2	3276.6
1991	3927.6	3974.9	3457.8	1856.7	810.5	226.8	241.9	616.6	1537.6	1896.9	2442.6	3350.8
1992	3911.7	3633.5	3508.1	1680.2	257.4	216.3	256.5	622.9	789.0	1476.9	2643.3	3117.5
1993	3185.4	3010.1	1410.8	227.4	201.6	189.6	185.1	186.4	184.9	257.6	829.5	448.9
1994	518.5	450.6	666.2	719.0	254.0	276.0	286.5	368.1	1204.6	1269.8	1975.0	2480.5
1995	2327.6	2205.0	1360.9	204.7	186.5	179.1	182.2	176.2	179.1	196.9	244.5	223.7
1996	218.2	225.7	209.4	188.8	184.6	181.1	183.9	182.6	210.3	331.9	897.8	314.9
1997	322.7	228.8	185.9	181.0	182.7	185.1	192.8	215.9	387.7	313.8	769.3	314.2
1998	360.1	255.8	268.1	206.1	184.8	182.6	179.9	177.6	177.8	190.1	201.6	189.4
1999	235.0	205.5	180.3	185.1	182.5	180.0	188.6	194.5	225.7	314.7	855.3	321.7
2000	344.3	230.5	471.5	290.1	188.3	181.4	190.9	201.4	405.4	365.7	760.8	467.0
2001	647.5	407.5	651.7	479.9	212.3	193.8	219.0	371.1	536.3	974.7	1822.6	2643.4
2002	2825.1	2062.6	315.7	190.0	197.1	195.1	198.0	235.1	689.0	896.0	1464.0	2225.5
2003	2771.6	2431.9	292.4	183.7	185.7	186.1	188.0	182.8	278.6	323.4	730.5	489.3
Average	1546.5	1213.4	827.0	430.5	257.5	218.9	232.6	333.6	571.6	708.0	1257.4	1342.2
Critical	2509.8	2400.3	2035.5	963.9	418.6	338.5	366.1	749.8	1478.4	1733.9	2501.3	3271.7
Dry	1481.3	968.8	739.7	493.7	307.2	200.5	221.4	315.0	583.8	900.0	1592.6	2122.7
BN	429.6	352.0	539.9	366.1	215.2	192.0	206.4	249.9	431.5	466.4	979.9	1672.3
AN	2452.1	1842.0	641.7	216.2	191.3	186.0	191.6	195.8	260.9	323.7	819.6	482.4
Wet	811.9	529.6	346.2	222.9	184.9	182.3	188.8	194.4	242.5	281.5	677.8	289.1

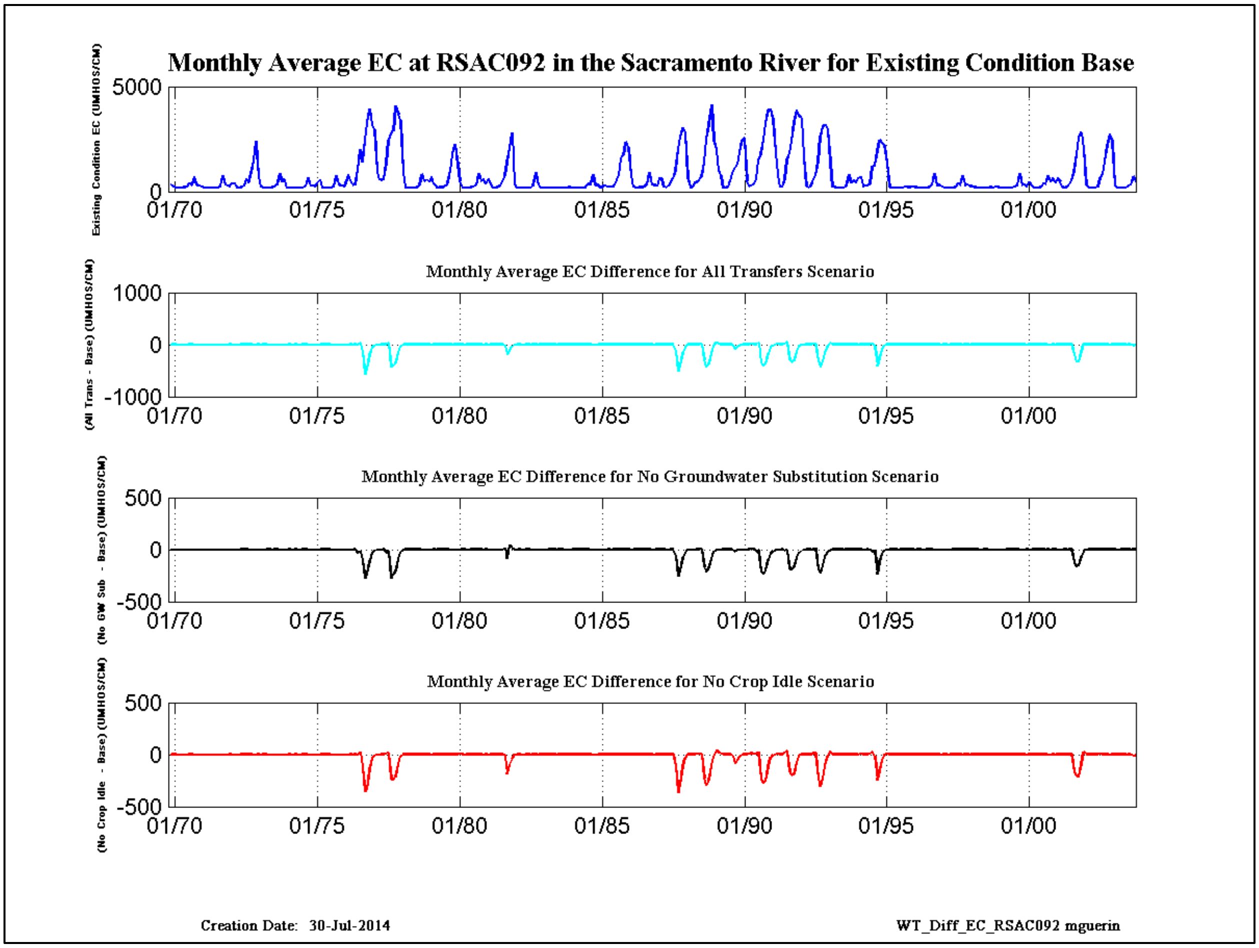


Figure 1-9. Sacramento River location Sacramento River location RSAC092 EC for the Base condition and change from Base for the scenarios.

Table 1-52. Sacramento River location RSA101 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	187.5	183.7	178.6	180.0	179.5	179.3	188.5	187.3	192.3	186.8	221.8	185.3
1971	187.7	185.8	183.9	180.6	182.4	178.5	182.0	178.7	180.1	183.0	227.6	187.8
1972	188.6	183.4	195.7	204.6	187.0	180.4	186.1	190.2	201.1	198.0	245.3	317.1
1973	400.5	242.1	190.1	192.6	187.3	180.8	187.3	185.3	186.1	189.1	235.2	200.2
1974	198.5	177.8	181.0	178.6	180.3	179.0	177.3	181.3	182.1	183.9	214.2	185.5
1975	186.9	183.3	199.0	218.8	186.1	180.4	183.2	179.0	180.2	182.3	219.0	187.3
1976	186.5	182.0	194.7	239.8	211.3	194.3	193.4	247.7	351.3	293.8	423.6	502.0
1977	572.4	456.8	449.1	259.6	224.5	209.6	206.6	266.2	408.3	443.6	441.4	643.8
1978	539.2	499.2	246.5	196.8	188.5	186.8	182.4	183.5	185.3	185.8	229.7	207.7
1979	200.7	197.2	223.9	217.5	203.4	189.4	189.4	186.4	186.5	201.4	255.2	340.6
1980	378.3	271.5	217.8	183.4	184.4	180.3	184.3	185.7	188.4	186.5	229.0	203.6
1981	198.9	189.8	216.9	202.2	185.4	184.1	189.0	192.7	196.5	230.4	297.9	370.8
1982	431.6	188.4	178.4	190.0	179.0	188.3	177.9	178.9	180.8	185.5	223.8	186.8
1983	178.6	182.3	178.7	186.6	182.0	180.1	180.1	177.0	176.7	180.1	179.8	178.2
1984	179.7	176.8	178.5	179.6	180.0	179.1	185.8	187.8	190.3	188.3	229.0	185.4
1985	188.5	184.2	185.0	195.0	188.9	193.8	192.3	190.1	200.7	233.3	319.0	329.8
1986	398.4	364.2	251.4	200.8	182.1	180.1	188.1	187.4	191.2	189.1	236.3	192.4
1987	185.5	183.0	210.7	229.6	191.0	185.0	195.4	200.5	205.9	239.9	353.0	408.5
1988	462.6	428.0	227.1	194.3	196.3	208.2	199.2	204.1	215.2	280.0	416.6	505.4
1989	671.4	388.3	373.9	276.1	242.4	180.5	183.5	184.0	197.7	245.7	279.8	289.6
1990	335.9	417.8	435.1	217.2	201.7	197.3	193.5	204.8	301.2	327.8	432.0	508.3
1991	620.6	639.3	574.3	350.6	231.2	190.0	195.5	209.2	287.2	341.5	415.3	524.3
1992	600.3	558.8	553.7	320.6	195.0	199.5	196.0	206.0	214.4	283.8	422.8	473.6
1993	471.8	454.6	286.8	205.0	196.0	184.1	179.0	179.2	178.8	182.6	229.8	200.8
1994	199.2	198.7	225.4	242.7	197.1	196.9	189.5	190.1	261.1	277.4	367.0	395.7
1995	393.7	338.7	299.3	192.7	182.7	179.0	179.5	176.2	177.1	183.1	181.9	180.0
1996	180.5	181.2	185.0	185.1	182.8	179.2	178.6	177.0	183.9	188.0	239.5	184.7
1997	189.7	181.8	181.0	180.2	181.7	182.7	184.7	187.5	192.8	186.2	221.7	188.3
1998	191.4	183.2	186.8	190.0	184.0	180.2	177.7	176.9	176.1	180.7	180.0	178.4
1999	181.2	180.2	177.4	182.1	180.3	178.6	181.0	182.0	183.2	186.6	235.3	186.3
2000	192.7	181.3	200.9	196.8	184.2	178.8	183.4	184.6	193.4	189.4	226.1	202.3
2001	202.3	193.6	220.6	218.5	195.9	186.2	191.6	197.8	198.4	232.5	316.6	393.3
2002	408.5	334.1	198.3	186.1	188.6	184.7	184.6	191.9	216.2	243.4	303.1	378.8
2003	450.0	379.4	188.5	181.3	183.0	182.5	181.8	177.4	185.4	188.9	226.0	205.4
Average	315.9	278.5	246.3	210.4	191.9	185.8	186.7	191.6	210.2	223.5	278.6	294.3
Critical	425.4	411.6	379.9	260.7	208.2	199.4	196.2	218.3	291.3	321.1	416.9	507.6
Dry	309.2	245.5	234.2	217.9	198.7	185.7	189.4	192.8	202.6	237.5	311.6	361.8
BN	194.6	190.3	209.8	211.0	195.2	184.9	187.8	188.3	193.8	199.7	250.2	328.9
AN	405.4	338.0	221.8	192.6	187.2	182.2	183.0	182.6	186.2	187.0	229.3	203.3
Wet	237.3	208.2	196.9	188.1	181.8	180.4	181.9	181.3	183.6	184.9	216.1	185.1

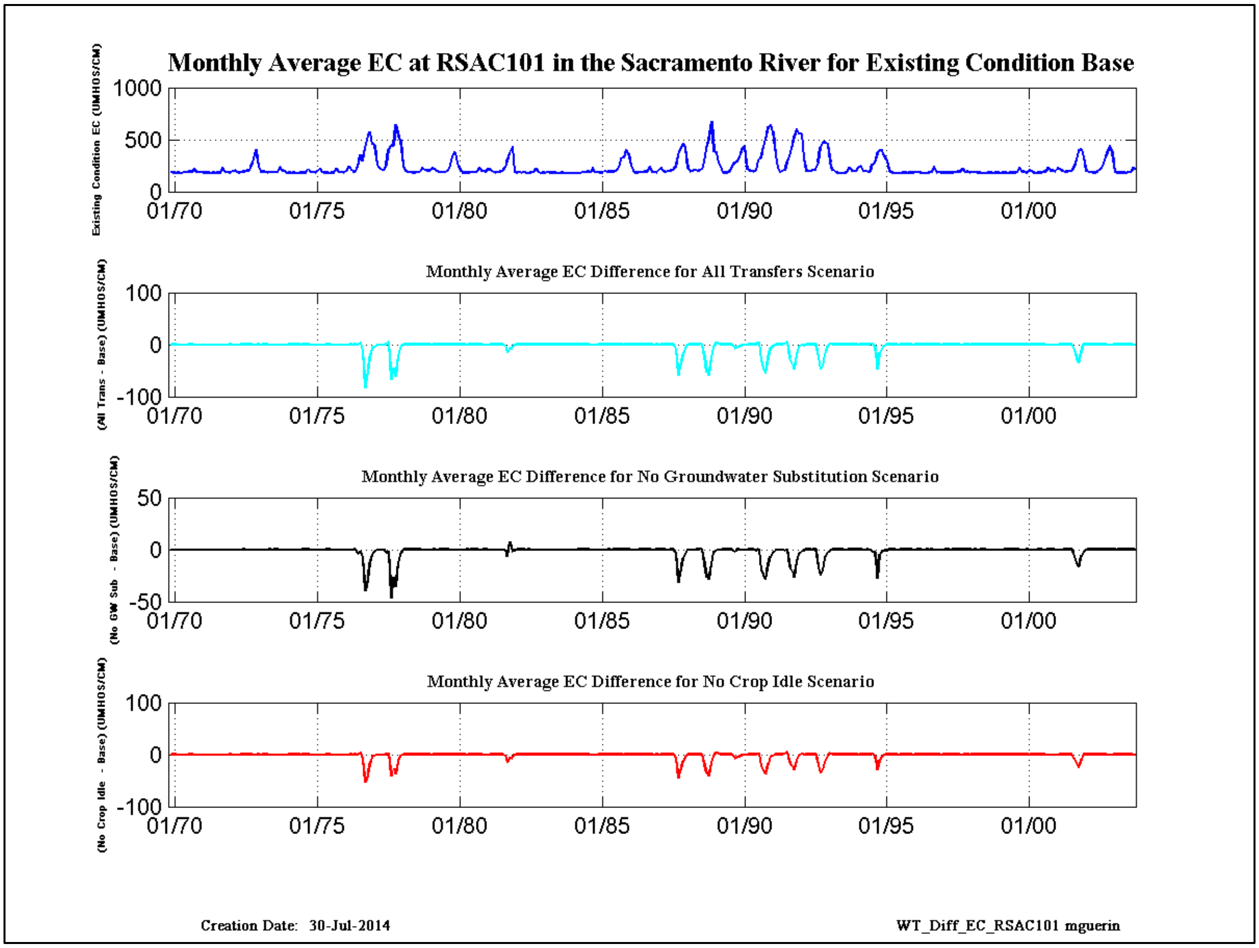


Figure 1-10. Sacramento River location Sacramento River location RSAC101 EC for the Base condition and change from Base for the scenarios.

Table 1-53. San Joaquin River location RSAN007 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	835.0	616.6	204.5	231.8	211.2	200.5	261.7	434.7	1017.8	1084.5	2458.5	1056.3
1971	738.0	652.6	227.0	203.8	203.1	201.5	219.9	217.4	260.3	848.2	2834.4	1054.8
1972	764.4	621.0	1408.2	1282.9	420.4	221.3	291.7	658.5	1571.2	1697.8	3095.7	4599.2
1973	6050.8	2913.3	589.5	263.4	252.2	223.4	231.1	261.3	548.3	1172.2	2836.8	1850.3
1974	1879.0	486.4	199.5	212.1	206.8	208.9	209.8	221.1	276.9	877.3	2412.9	990.3
1975	833.9	670.4	1549.0	2046.9	419.7	221.7	218.7	220.7	214.4	726.3	2731.4	1067.3
1976	758.7	584.0	1496.8	2755.6	2011.8	1019.0	892.7	2462.5	4091.1	4725.5	5071.2	6557.3
1977	7536.2	6978.8	7160.7	3604.9	1761.6	1664.6	1774.1	3145.6	4872.7	5648.8	6765.6	7578.7
1978	6831.1	6908.7	3632.1	430.7	260.3	256.7	262.8	236.5	305.4	997.3	2876.6	1966.2
1979	1932.3	1657.3	2624.6	1178.2	298.5	244.9	243.6	264.4	637.3	1895.6	3512.6	5222.0
1980	6058.2	4122.0	2122.2	354.4	272.5	241.9	217.0	253.1	367.8	964.3	2906.2	1986.2
1981	1686.4	1492.8	2452.1	1133.1	277.8	229.5	300.8	655.9	1425.5	2874.6	4187.3	5709.9
1982	6912.7	1502.4	243.2	241.2	222.2	232.5	201.4	184.9	205.4	666.3	2817.0	993.4
1983	361.0	216.2	210.9	273.3	278.6	247.0	206.4	190.6	197.7	207.3	236.0	216.0
1984	455.3	214.8	207.5	221.5	213.8	197.7	232.2	347.1	957.5	1171.6	2634.8	1171.9
1985	778.0	480.1	451.6	804.3	565.8	438.6	388.4	574.1	1557.3	2913.7	4350.9	5280.5
1986	5609.3	6116.8	2816.9	541.5	268.6	254.2	241.8	247.7	494.9	1249.9	2971.3	1078.9
1987	695.1	700.3	2139.3	2197.7	658.7	255.5	510.4	1360.4	1837.8	3073.3	4439.0	5795.2
1988	6465.7	6302.4	2603.8	386.3	325.7	1041.8	1289.5	1518.7	1837.2	3814.6	5122.1	6202.2
1989	7766.1	6291.9	5774.5	3671.6	2219.3	374.0	228.6	407.8	1600.4	3233.3	3837.9	4111.3
1990	5162.9	5873.8	6042.1	1969.3	677.7	869.3	1039.5	1551.2	3228.9	5192.0	5633.9	6601.3
1991	7330.7	7700.6	7336.2	4508.5	2566.9	511.7	408.6	1526.6	3661.1	5278.1	5501.4	6573.2
1992	7412.5	7246.5	7299.7	5034.2	805.9	301.0	506.6	1708.7	2199.6	3951.1	5760.5	6589.7
1993	6262.0	6199.7	4784.8	603.3	283.2	235.6	223.5	219.6	216.4	707.3	2776.2	1836.9
1994	1773.2	1615.5	2546.1	2543.5	693.2	609.5	747.6	957.7	2574.1	4477.8	5109.1	6279.9
1995	4808.9	5412.4	4530.9	502.7	245.5	240.6	227.6	183.3	188.1	223.5	594.4	583.0
1996	465.9	519.7	452.2	234.3	249.6	220.3	220.6	222.3	314.5	1131.3	3028.3	1191.8
1997	817.8	624.8	234.0	251.7	212.1	200.0	225.1	306.8	968.6	1098.6	2537.4	1139.8
1998	932.5	716.9	863.6	360.3	323.2	246.1	203.8	187.6	193.5	214.3	351.9	294.6
1999	669.9	431.8	202.9	206.0	224.5	200.8	218.2	238.7	426.4	1063.1	2943.9	1169.7
2000	818.4	656.0	1750.7	931.7	276.4	225.7	214.0	255.0	1032.2	1254.6	2572.1	1854.1
2001	1870.7	1567.0	2443.2	1708.4	343.1	233.0	303.3	845.3	1481.5	2978.7	4214.5	5764.0
2002	6314.0	5548.3	1073.7	237.0	252.5	274.2	267.3	401.5	1701.3	3306.7	4146.0	5891.4
2003	5996.6	6213.6	1205.5	222.0	202.8	216.9	215.4	216.2	632.4	1131.0	2536.2	1841.0
Average	3399.5	2936.9	2320.0	1216.1	550.2	369.4	395.4	667.2	1267.5	2113.3	3406.0	3297.0
Critical	5205.7	5186.0	4926.5	2971.8	1263.3	859.6	951.2	1838.7	3209.3	4726.9	5566.3	6626.1
Dry	3185.1	2680.1	2389.1	1625.4	719.5	300.8	333.2	707.5	1600.6	3063.4	4195.9	5425.4
BN	1348.4	1139.1	2016.4	1230.5	359.5	233.1	267.6	461.5	1104.2	1796.7	3304.2	4910.6
AN	5336.2	4502.2	2347.5	467.6	257.9	233.4	227.3	240.3	517.1	1037.8	2750.7	1889.1
Wet	1947.6	1398.6	918.6	425.2	252.2	220.9	222.1	246.4	439.7	812.5	2196.3	923.7

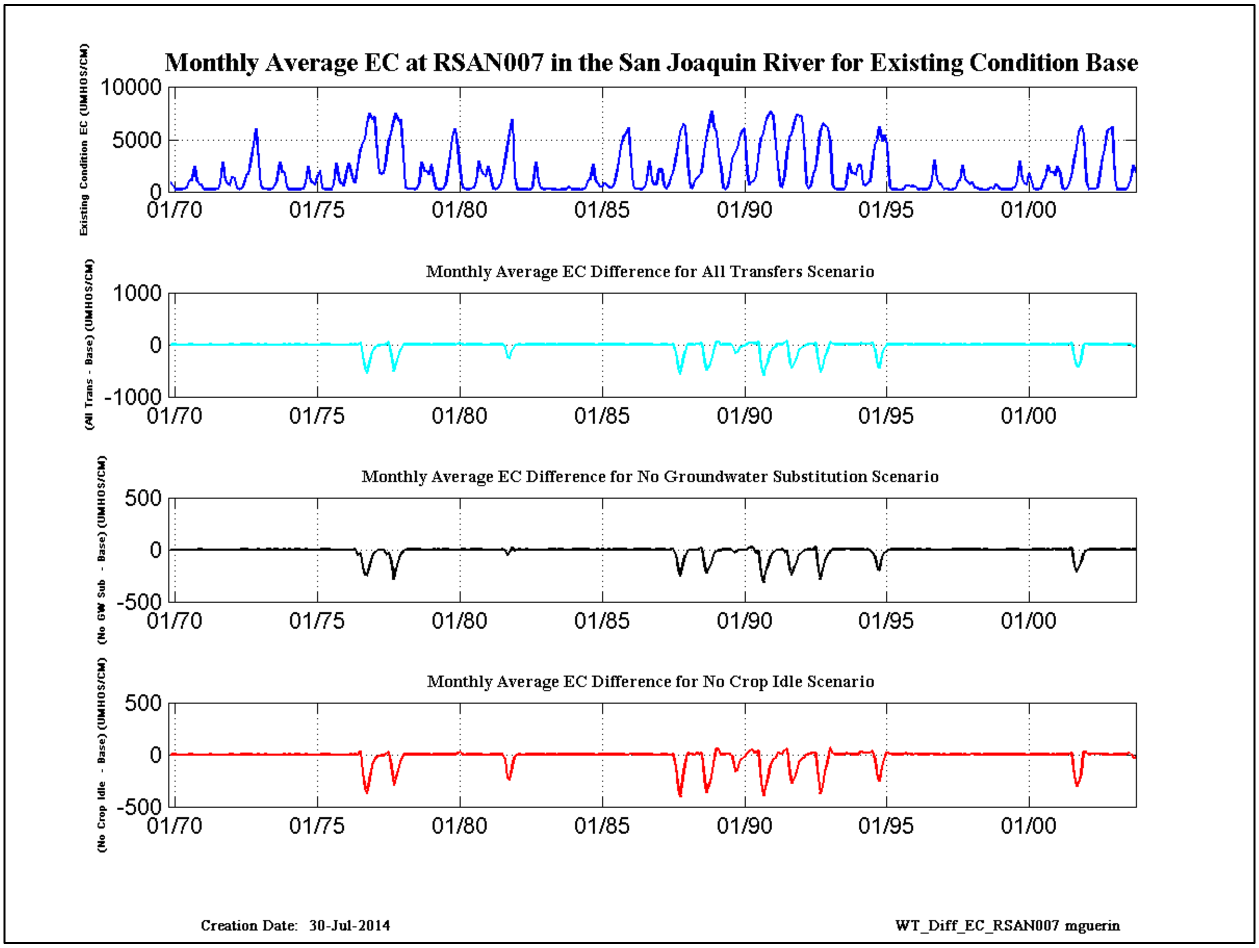


Figure 1-11. San Joaquin River location RSAN007 EC for the Base condition and change from Base for the scenarios.

Table 1-54. San Joaquin River location RSAN018 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	316.8	247.5	206.4	232.0	212.4	205.6	225.3	242.2	279.1	460.9	1027.0	1011.5
1971	336.6	343.8	220.1	208.8	207.8	208.0	229.4	224.9	208.7	359.4	1254.2	1018.0
1972	348.0	271.7	570.6	638.6	285.8	223.1	230.6	268.3	383.0	791.7	1389.2	2233.7
1973	2365.0	1988.4	541.1	268.4	252.8	227.1	239.8	251.3	246.5	475.0	1138.2	872.6
1974	532.4	317.2	202.0	215.6	212.7	211.2	214.0	226.5	218.4	320.8	931.2	869.0
1975	378.0	359.4	651.4	867.3	312.4	222.4	227.5	225.9	210.7	291.5	1041.7	974.2
1976	342.3	286.9	606.2	1116.1	869.5	494.1	317.2	573.3	976.2	2202.6	1702.1	2091.3
1977	2378.0	2138.4	2655.6	1819.4	652.3	480.9	461.6	727.4	1252.5	1619.8	2490.7	2716.9
1978	2029.0	2031.6	1647.0	363.3	270.8	264.6	272.4	240.0	226.0	359.2	1169.9	1013.7
1979	607.7	670.2	1211.6	773.6	304.1	247.2	242.0	255.7	254.6	804.2	1590.1	2463.4
1980	2513.9	1670.6	1263.7	309.1	269.8	236.4	220.8	246.0	239.8	293.3	1076.7	934.1
1981	424.8	532.1	1156.6	842.8	276.7	226.9	252.2	271.7	350.5	1296.1	1804.4	2526.2
1982	2789.2	1438.8	237.3	244.8	219.9	234.3	197.6	183.4	200.2	242.2	888.8	424.1
1983	215.0	202.4	214.3	274.9	274.1	241.5	202.2	189.7	198.3	208.5	198.5	185.6
1984	244.5	195.1	208.4	227.5	216.2	201.3	232.3	247.6	286.4	497.6	1013.7	1015.3
1985	316.4	317.2	272.5	328.5	295.0	250.5	261.6	263.8	376.5	1288.8	1733.2	2479.8
1986	2000.4	2506.0	1533.1	413.7	266.9	249.3	247.3	235.8	235.9	455.7	1170.9	522.2
1987	220.4	236.0	816.8	966.7	426.9	251.4	269.1	388.6	457.2	987.4	1257.7	1868.6
1988	2007.9	1919.6	1322.3	342.5	254.6	318.8	369.0	381.1	400.3	1166.7	1510.5	1897.4
1989	2531.0	2182.3	2366.9	1781.4	798.7	293.4	233.5	232.0	417.0	1518.9	1898.5	1942.7
1990	1953.0	2035.2	2062.3	1044.8	392.1	333.3	321.0	362.2	730.2	2054.7	2077.3	2267.3
1991	2350.0	2492.1	2539.2	1403.3	756.2	336.4	274.7	386.7	988.1	2198.8	1982.9	2173.9
1992	2346.8	2255.3	2383.3	1905.9	512.2	281.3	255.0	424.6	543.5	1276.6	1939.2	2296.5
1993	1788.1	1735.9	1981.3	460.4	289.4	240.7	234.3	230.5	216.4	297.4	1125.3	1007.2
1994	602.8	668.8	1235.2	1222.9	481.7	293.1	279.5	280.8	550.8	2228.3	2173.4	2627.8
1995	1505.1	1555.3	2062.3	418.4	245.6	239.5	224.5	179.7	193.3	222.4	252.3	269.1
1996	212.7	225.6	254.3	232.4	244.6	217.7	229.5	228.5	219.4	451.1	1285.2	1131.8
1997	337.5	295.2	235.7	248.0	207.3	198.4	215.6	244.4	286.5	462.1	970.8	1034.8
1998	336.8	296.1	421.2	316.5	313.5	237.0	203.0	186.2	196.6	216.3	212.7	197.6
1999	298.6	318.9	201.0	215.4	224.2	202.0	230.2	237.6	223.4	433.2	1263.1	1104.5
2000	320.9	314.6	728.2	570.2	276.5	224.5	222.3	245.6	309.4	493.5	1034.3	973.6
2001	500.3	613.6	1090.9	963.3	313.6	240.0	257.8	293.7	360.7	947.8	1236.8	1827.8
2002	1954.9	1872.4	704.4	242.0	228.0	219.0	229.1	257.1	438.0	1539.9	1694.4	2589.1
2003	2054.2	2204.6	866.7	222.5	207.9	205.4	224.9	225.6	250.7	512.3	1102.1	991.7
Average	1160.6	1080.6	1019.7	638.3	340.4	257.5	251.4	284.1	380.1	852.2	1312.9	1457.4
Critical	1711.6	1685.2	1829.1	1265.0	559.8	362.5	325.4	448.0	777.4	1821.1	1982.3	2295.9
Dry	991.3	958.9	1068.0	854.1	389.8	246.9	250.5	284.5	400.0	1263.2	1604.2	2205.7
BN	477.8	470.9	891.1	706.1	295.0	235.2	236.3	262.0	318.8	797.9	1489.6	2348.6
AN	1845.2	1657.6	1171.3	365.6	261.2	233.1	235.7	239.8	248.2	405.1	1107.7	965.5
Wet	731.0	638.6	511.4	316.6	242.9	220.6	221.4	219.4	227.4	355.5	885.4	750.6

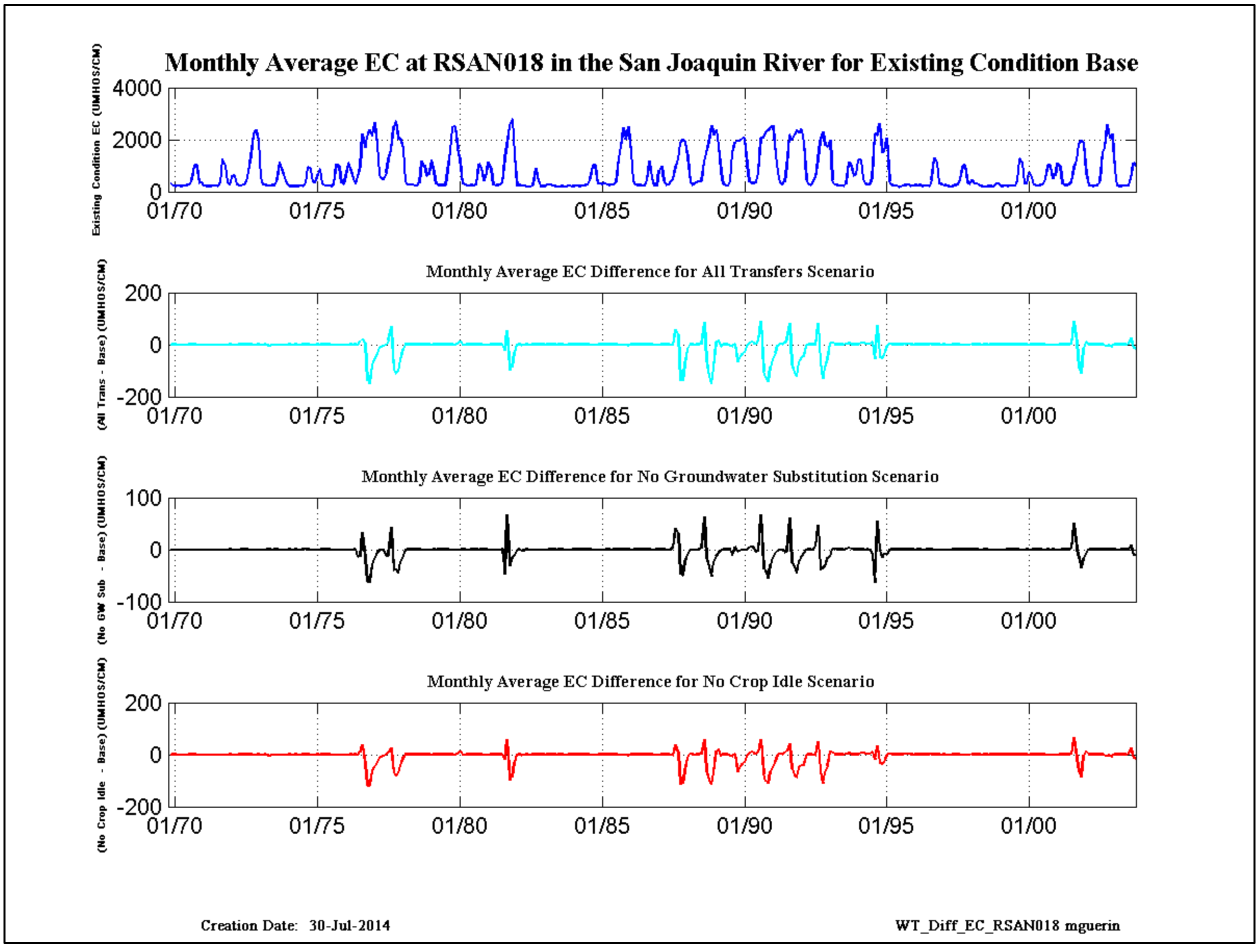


Figure 1-12. San Joaquin River location RSAN018 EC for the Base condition and change from Base for the scenarios.

Table 1-55. San Joaquin River location San Joaquin River location RSAN032 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	205.0	212.4	196.9	196.4	192.5	196.8	225.4	228.5	207.1	204.9	276.4	441.8
1971	222.1	217.0	202.3	196.1	200.1	199.9	223.7	207.4	188.4	194.7	305.8	446.2
1972	223.7	213.1	248.3	321.4	236.7	207.3	237.3	246.7	216.1	244.8	355.2	503.0
1973	559.6	747.2	331.5	228.8	215.2	206.0	232.9	233.9	201.0	207.2	291.1	253.0
1974	213.8	194.7	190.7	196.1	199.7	195.0	194.1	211.2	197.9	192.9	248.1	348.6
1975	224.3	224.9	274.8	375.2	233.8	200.8	218.7	201.3	195.7	191.7	256.2	377.0
1976	213.2	204.2	249.8	433.5	355.6	272.5	253.9	294.4	333.2	463.7	533.5	533.0
1977	623.4	559.5	716.3	687.2	379.9	294.2	268.9	306.7	377.4	431.0	520.1	746.4
1978	634.0	567.9	565.4	259.8	241.6	234.5	234.8	219.3	210.6	200.9	283.2	270.5
1979	223.2	244.1	397.7	404.3	265.4	222.5	232.9	232.7	200.6	240.7	367.6	517.4
1980	524.7	433.4	514.1	210.0	211.5	199.1	214.2	230.6	217.3	200.2	262.3	251.4
1981	208.3	228.6	394.3	412.8	229.1	225.0	257.2	255.2	215.3	319.0	430.4	535.5
1982	588.5	453.4	194.2	213.7	187.9	204.0	173.7	174.2	194.7	200.7	234.6	199.3
1983	186.7	191.9	193.8	222.9	205.4	183.2	182.2	174.7	181.6	191.3	182.8	178.7
1984	190.1	178.6	188.1	204.6	195.9	194.1	229.6	233.4	204.8	206.8	271.5	384.7
1985	212.6	210.9	209.8	229.5	223.5	238.6	259.1	246.0	217.1	322.2	428.2	508.0
1986	492.8	551.9	548.5	287.6	193.7	193.7	224.6	216.8	216.2	207.3	286.0	217.1
1987	198.1	201.5	284.9	429.3	272.0	240.3	269.4	262.4	223.4	264.2	356.3	425.7
1988	496.5	492.0	490.5	264.5	251.5	267.5	262.1	260.1	232.2	285.3	418.7	499.2
1989	650.3	570.5	667.8	708.4	423.7	227.0	222.3	216.3	206.5	368.3	462.2	448.0
1990	452.7	525.2	594.4	456.6	274.2	236.3	229.4	237.6	270.8	431.6	541.9	564.9
1991	661.0	691.5	748.4	636.1	398.2	267.7	259.6	246.2	282.2	464.2	525.7	547.1
1992	635.2	627.6	707.5	675.6	317.1	253.8	235.2	241.2	227.8	300.4	464.8	543.5
1993	513.2	490.6	590.2	292.8	239.8	215.6	214.0	213.6	205.4	192.4	280.5	263.2
1994	228.1	263.2	435.5	534.9	297.4	242.4	229.5	231.2	247.1	473.5	555.2	545.5
1995	469.3	390.3	574.1	264.1	208.2	197.3	188.8	169.1	190.3	203.9	188.1	182.6
1996	189.8	202.7	205.5	218.3	205.2	195.8	212.7	201.0	197.9	204.0	310.3	411.6
1997	218.4	207.5	205.2	183.0	184.0	192.0	212.3	240.1	212.5	202.9	259.3	407.5
1998	219.8	206.1	228.5	270.5	230.6	196.8	184.5	175.3	186.5	198.0	186.0	180.3
1999	194.4	210.9	189.8	211.1	194.9	189.6	221.6	218.6	194.5	200.5	306.2	419.5
2000	221.6	210.9	277.8	308.7	230.9	198.8	219.4	232.8	208.4	206.0	274.2	262.6
2001	219.9	250.4	357.7	446.9	258.6	229.0	267.1	258.9	216.1	256.3	331.0	419.0
2002	487.1	472.5	319.9	214.5	215.6	210.5	229.3	248.6	229.0	360.7	430.2	530.4
2003	545.4	506.2	352.6	196.2	199.5	198.8	226.4	204.1	194.3	211.7	292.9	275.7
Average	363.1	357.5	377.8	335.0	246.1	218.4	227.9	228.5	220.6	266.0	344.6	401.1
Critical	472.9	480.5	563.2	526.9	324.8	262.1	248.4	259.6	281.5	407.1	508.6	568.5
Dry	329.4	322.4	372.4	406.9	270.4	228.4	250.7	247.9	217.9	315.1	406.4	477.7
BN	223.4	228.6	323.0	362.8	251.0	214.9	235.1	239.7	208.3	242.8	361.4	510.2
AN	499.8	492.7	438.6	249.4	223.1	208.8	223.6	222.4	206.2	203.1	280.7	262.7
Wet	278.1	264.8	260.9	233.8	202.5	195.3	207.1	204.0	197.5	200.0	254.7	322.7

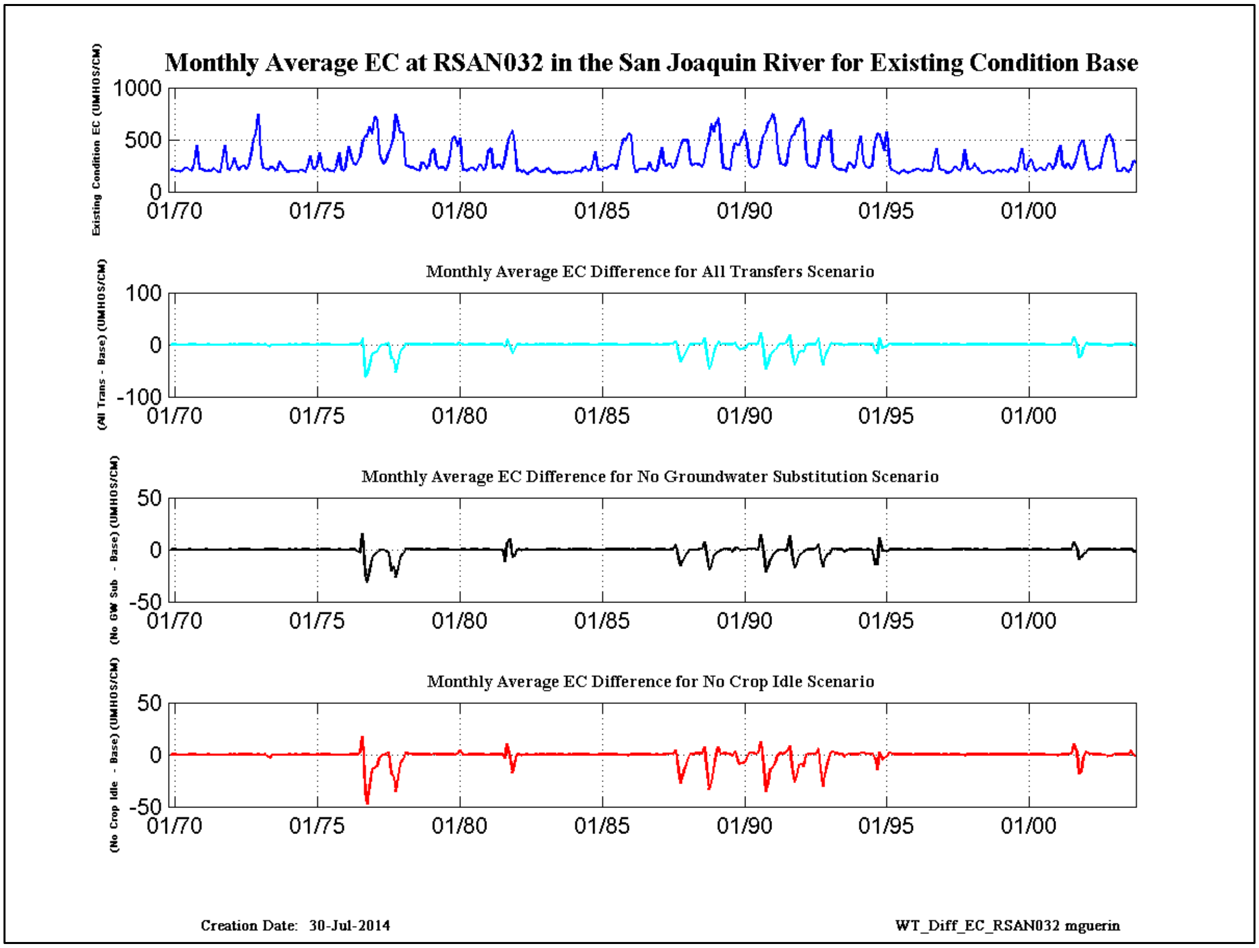


Figure 1-13. San Joaquin River location San Joaquin River location RSAN032 EC for the Base condition and change from Base for the scenarios.

Table 1-56. Sacramento River location RSAC081 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.6	-2.1	-0.8	-0.2	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-1.9	48.6	-322.8	-853.9	-759.1
1977	-371.1	-144.9	-71.7	-19.4	-13.1	-4.2	-1.5	13.6	50.6	-507.1	-685.3	-496.2
1978	-279.5	-108.8	-3.1	2.0	0.5	0.2	0.2	0.6	4.6	5.6	2.1	0.5
1979	0.2	0.1	-0.7	7.3	0.8	0.5	1.6	1.9	2.1	0.8	0.4	0.0
1980	1.5	18.9	35.0	1.5	-0.3	0.1	0.3	0.9	0.8	0.2	0.1	0.0
1981	-0.1	0.5	-0.8	5.1	0.9	0.6	1.9	6.3	7.1	-64.7	-391.8	-284.8
1982	-111.0	-22.4	-0.1	0.1	-0.3	-0.3	0.0	0.0	0.6	1.3	0.7	-0.1
1983	8.9	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.3	0.8
1984	4.1	0.2	0.0	0.0	0.0	0.0	0.4	2.4	2.1	0.5	0.1	0.0
1985	-0.3	5.3	4.3	7.2	5.3	1.5	1.5	3.5	3.1	1.6	1.7	1.6
1986	1.2	1.0	10.7	2.6	0.0	0.0	0.2	0.4	0.4	0.1	0.1	0.0
1987	0.0	0.0	0.3	3.7	1.8	0.4	0.8	3.9	20.8	-308.9	-871.8	-773.7
1988	-354.8	-143.3	26.1	11.3	2.7	3.0	27.8	22.9	36.6	-591.8	-766.7	-585.0
1989	-320.1	-110.7	57.0	66.3	8.7	4.7	10.0	17.5	10.2	-32.3	-239.6	-169.8
1990	-64.2	-25.7	-10.9	21.6	63.3	82.3	36.1	35.8	68.5	-677.3	-802.9	-591.6
1991	-336.2	-136.6	-65.3	-23.8	39.9	14.0	20.0	67.3	96.6	-537.6	-640.9	-471.7
1992	-263.6	-102.8	-49.7	-22.7	8.9	9.0	33.5	39.8	46.9	-603.1	-766.2	-553.6
1993	-292.1	-107.8	86.7	11.8	0.9	1.4	0.3	1.6	10.8	25.9	11.0	2.7
1994	1.2	0.7	-0.7	45.1	23.2	30.8	32.4	34.2	58.2	-125.8	-721.0	-579.0
1995	-235.0	-87.2	18.4	3.8	0.4	0.0	0.1	0.0	0.1	1.3	19.6	9.9
1996	1.8	0.0	13.7	1.1	0.0	0.0	0.0	0.1	5.4	7.8	2.7	0.3
1997	0.0	-1.3	0.1	0.0	0.0	0.5	1.7	4.9	5.3	1.9	0.1	0.6
1998	0.4	0.1	9.9	1.6	0.0	0.0	0.0	0.0	0.0	0.1	4.3	3.8
1999	2.7	4.7	0.7	0.0	0.0	0.0	0.1	0.7	4.9	3.7	1.3	0.2
2000	0.0	0.0	-0.1	9.5	0.1	0.0	0.3	1.1	2.4	1.1	0.2	0.0
2001	0.0	-0.1	1.6	10.4	1.7	0.4	2.3	25.2	47.5	-507.6	-708.3	-599.8
2002	-311.9	1.8	18.8	0.7	14.2	15.4	18.6	19.7	18.1	6.9	6.2	5.7
2003	1.1	-1.0	6.9	0.1	0.5	2.2	0.7	0.1	29.3	-14.5	-44.6	-34.1
Average	-85.8	-28.2	2.6	4.3	4.7	4.8	5.5	8.9	17.1	-124.5	-218.9	-172.7
Critical	-198.4	-79.0	-24.6	1.7	17.8	19.3	21.3	30.3	58.0	-480.8	-748.1	-576.6
Dry	-105.4	-17.2	13.5	15.6	5.4	3.8	5.9	12.7	17.8	-150.8	-367.3	-303.5
BN	0.1	0.0	-0.4	3.6	0.4	0.2	0.8	1.0	1.1	0.4	0.2	0.0
AN	-94.8	-33.1	20.9	4.1	0.3	0.6	-0.1	0.6	8.0	3.1	-5.2	-5.1
Wet	-25.2	-8.0	4.1	0.7	0.0	0.0	0.2	0.7	1.4	1.3	2.3	1.2

Table 1-57. Sacramento River location RSAC081 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.3	-0.8	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-4.9	-11.0	-7.9
1977	-3.4	-1.4	-0.7	-0.4	-0.4	-0.1	0.0	0.2	0.6	-5.8	-7.3	-4.7
1978	-2.6	-1.0	-0.1	0.7	0.2	0.1	0.1	0.3	0.8	0.3	0.0	0.0
1979	0.0	0.0	0.0	0.5	0.3	0.2	0.5	0.5	0.2	0.0	0.0	0.0
1980	0.0	0.3	1.1	0.6	-0.2	0.0	0.1	0.3	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.4	0.3	0.2	0.4	0.4	0.2	-1.5	-6.4	-3.6
1982	-1.1	-1.7	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.2	0.1	0.0	0.0
1983	1.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2
1984	0.5	0.1	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.0	0.0	0.0
1985	0.0	0.8	0.6	0.5	0.5	0.2	0.2	0.3	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.3	0.4	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.6	-6.2	-12.3	-9.0
1988	-3.6	-1.5	0.7	2.6	0.5	0.1	1.1	0.7	1.0	-9.7	-9.6	-6.3
1989	-2.8	-1.2	0.7	1.2	0.2	1.3	3.9	2.1	0.3	-0.7	-4.3	-2.9
1990	-0.8	-0.3	-0.1	0.8	5.2	4.8	1.7	1.1	1.2	-9.1	-9.7	-6.2
1991	-3.1	-1.2	-0.6	-0.3	0.9	2.5	2.7	2.2	1.6	-7.2	-7.9	-4.9
1992	-2.4	-1.0	-0.5	-0.3	1.2	2.3	3.2	1.2	1.2	-9.8	-9.1	-5.9
1993	-3.0	-1.1	1.3	2.9	0.4	0.7	0.2	0.8	4.2	2.0	0.3	0.1
1994	0.0	0.0	0.0	1.2	2.8	2.6	2.1	1.7	1.2	-2.0	-9.9	-6.7
1995	-2.9	-1.0	0.3	1.2	0.2	0.0	0.0	0.0	0.1	0.5	1.7	0.9
1996	0.2	0.0	1.7	0.5	0.0	0.0	0.0	0.0	0.9	0.4	0.1	0.0
1997	0.0	-0.1	0.1	0.0	0.0	0.2	0.6	0.8	0.3	0.1	0.0	0.1
1998	0.0	0.0	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.7
1999	0.2	0.7	0.3	0.0	0.0	0.0	0.0	0.3	0.6	0.2	0.0	0.0
2000	0.0	0.0	0.0	0.9	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.4	0.5	0.1	0.4	1.4	1.6	-10.5	-10.5	-7.0
2002	-3.3	0.0	1.7	0.3	3.9	3.5	4.2	2.4	0.6	0.1	0.1	0.1
2003	0.0	0.0	0.7	0.1	0.2	0.8	0.3	0.1	2.4	-0.7	-1.1	-1.3
Average	-0.8	-0.3	0.2	0.4	0.5	0.6	0.6	0.5	0.6	-1.9	-2.8	-1.9
Critical	-1.9	-0.8	-0.2	0.5	1.4	1.7	1.5	1.0	1.1	-6.9	-9.2	-6.1
Dry	-1.0	-0.1	0.5	0.5	0.9	0.9	1.5	1.1	0.6	-3.1	-5.6	-3.7
BN	0.0	0.0	0.0	0.3	0.2	0.1	0.3	0.3	0.1	0.0	0.0	0.0
AN	-0.9	-0.3	0.5	0.9	0.1	0.2	0.0	0.2	1.3	0.3	-0.1	-0.2
Wet	-0.1	-0.1	0.2	0.2	0.0	0.0	0.1	0.1	0.2	0.1	0.2	0.2

Table 1-58. Sacramento River location RSAC092 export difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.2	-1.3	-0.3	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.4	28.2	-129.4	-576.4	-479.0
1977	-190.7	-53.6	-20.7	-5.5	-2.4	0.1	0.5	7.6	30.5	-423.5	-403.7	-359.7
1978	-149.0	-38.5	-1.1	0.5	0.3	0.1	0.1	0.1	0.4	0.6	0.5	0.1
1979	0.0	0.0	-0.2	0.9	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.0
1980	1.5	4.7	5.5	0.2	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1981	0.0	0.1	-0.2	0.5	0.1	0.0	0.1	1.0	2.0	-17.2	-186.3	-100.7
1982	-44.2	-4.3	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.0
1983	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.1	0.0	0.0
1985	0.0	0.3	0.3	0.8	0.4	0.2	0.2	0.4	0.8	0.5	1.0	0.8
1986	1.0	0.8	1.5	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.2	0.7	0.2	0.0	0.5	2.1	7.1	-126.9	-505.1	-404.0
1988	-151.5	-48.5	2.4	0.9	0.2	2.3	5.8	6.2	11.7	-295.9	-430.9	-367.3
1989	-161.3	-28.8	32.1	22.1	4.7	0.7	0.8	1.5	3.4	-10.9	-89.9	-50.9
1990	-18.6	-4.6	1.3	2.0	5.7	11.1	5.7	9.5	31.7	-352.1	-412.0	-368.1
1991	-174.7	-51.3	-18.4	-1.2	10.4	1.8	2.4	18.5	46.7	-296.4	-331.9	-304.6
1992	-131.5	-36.2	-6.9	-2.1	1.1	0.8	3.9	11.1	16.0	-304.8	-425.2	-317.8
1993	-142.2	-32.0	29.8	1.9	0.6	0.6	0.1	0.3	0.0	1.8	2.5	0.6
1994	0.2	0.1	-0.1	9.6	2.5	4.0	4.1	5.8	22.4	-38.4	-419.9	-254.1
1995	-87.6	-19.5	4.6	0.5	0.2	0.0	0.0	0.0	0.0	0.2	2.2	1.0
1996	0.1	0.0	0.8	0.2	0.0	0.0	0.0	0.0	0.4	1.0	0.7	0.1
1997	0.0	-0.1	0.1	0.0	0.0	0.0	0.1	0.4	0.8	0.2	-0.1	0.1
1998	0.4	0.0	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2
1999	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.4	0.3	0.0
2000	0.0	0.0	0.1	0.9	0.0	0.0	0.1	0.1	0.3	0.1	0.0	0.0
2001	0.0	0.0	0.6	1.5	0.1	0.0	0.2	4.9	12.2	-192.2	-329.4	-327.7
2002	-130.5	12.1	3.8	0.2	0.8	0.8	1.0	1.6	5.2	1.5	4.2	2.0
2003	-0.1	0.9	1.1	0.1	0.0	0.1	0.1	0.0	4.7	-1.3	-10.3	-6.9
Average	-40.5	-8.8	1.1	1.0	0.7	0.7	0.7	2.1	6.6	-64.2	-120.9	-98.1
Critical	-95.3	-27.7	-6.1	0.5	2.5	2.9	3.2	8.3	26.8	-262.9	-428.6	-350.1
Dry	-48.7	-2.7	6.1	4.3	1.1	0.3	0.5	1.9	5.1	-57.5	-184.2	-146.7
BN	0.0	0.0	-0.1	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0
AN	-48.3	-10.8	5.9	0.6	0.2	0.1	-0.2	0.1	0.9	0.2	-1.2	-1.0
Wet	-10.0	-1.7	0.6	0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.1

Table 1-59. Sacramento River location RSAC092 (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	-9.0	-23.5	-14.3
1977	-4.8	-1.7	-0.7	-0.6	-0.4	0.0	0.1	0.5	1.2	-15.2	-13.7	-8.7
1978	-4.0	-1.1	-0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.0
1979	0.0	0.0	0.0	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.1	0.4	1.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.3	0.4	-2.2	-13.0	-4.7
1982	-1.6	-1.3	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1985	0.0	0.1	0.1	0.3	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.0
1986	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.4	1.1	-12.3	-24.6	-15.2
1988	-5.0	-1.7	0.3	0.4	0.1	0.5	1.3	1.1	1.6	-20.7	-17.1	-11.4
1989	-3.9	-1.2	1.6	2.1	0.6	0.4	0.4	0.7	0.6	-1.2	-7.7	-3.9
1990	-1.0	-0.2	0.1	0.4	2.1	3.5	1.5	1.6	2.1	-19.1	-16.2	-11.2
1991	-4.4	-1.3	-0.5	-0.1	1.3	0.8	1.0	3.0	3.0	-15.6	-13.6	-9.1
1992	-3.4	-1.0	-0.2	-0.1	0.4	0.4	1.5	1.8	2.0	-20.6	-16.1	-10.2
1993	-4.5	-1.1	2.1	0.8	0.3	0.3	0.1	0.2	0.0	0.7	0.3	0.1
1994	0.0	0.0	0.0	1.3	1.0	1.5	1.4	1.6	1.9	-3.0	-21.3	-10.2
1995	-3.8	-0.9	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.9	0.4
1996	0.1	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.2	0.3	0.1	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.0	0.0
1998	0.1	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1999	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0
2000	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
2001	0.0	0.0	0.1	0.3	0.1	0.0	0.1	1.3	2.3	-19.7	-18.1	-12.4
2002	-4.6	0.6	1.2	0.1	0.4	0.4	0.5	0.7	0.8	0.2	0.3	0.1
2003	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	1.7	-0.4	-1.4	-1.4
Average	-1.2	-0.3	0.2	0.2	0.2	0.2	0.2	0.4	0.6	-4.0	-5.4	-3.3
Critical	-2.6	-0.8	-0.2	0.2	0.6	1.0	1.0	1.4	1.9	-14.8	-17.4	-10.8
Dry	-1.4	-0.1	0.5	0.5	0.2	0.1	0.2	0.6	0.9	-5.9	-10.5	-6.0
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
AN	-1.4	-0.3	0.6	0.2	0.1	0.1	-0.1	0.0	0.3	0.1	-0.2	-0.2
Wet	-0.4	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0

Table 1-60. Sacramento River location RSAC101 (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.1	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	-10.2	-82.7	-65.0
1977	-25.6	-7.3	-3.6	-1.2	-0.5	-0.1	0.0	0.9	4.7	-67.8	-44.1	-61.5
1978	-21.2	-5.4	-0.6	0.3	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.0
1979	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.1	0.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	-1.7	-15.1	-7.2
1982	-7.3	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1986	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5	-7.3	-58.6	-44.8
1988	-18.1	-6.8	-0.2	0.2	0.0	0.5	0.4	0.6	1.0	-23.1	-53.6	-58.5
1989	-24.5	-4.8	3.1	2.5	0.6	0.2	0.3	0.2	0.2	-1.0	-7.7	-4.4
1990	-3.0	-1.8	-0.8	0.0	0.6	0.8	0.4	0.8	4.4	-30.6	-44.5	-54.1
1991	-25.2	-7.4	-3.4	-0.4	0.6	0.3	0.4	1.5	5.7	-25.8	-36.4	-47.2
1992	-18.6	-5.1	-0.5	-1.2	0.4	0.3	0.4	0.8	1.1	-24.2	-47.6	-40.3
1993	-18.3	-3.2	2.3	0.6	0.4	0.3	0.0	0.1	0.0	0.0	0.3	0.1
1994	0.0	0.0	0.0	0.8	0.3	0.4	0.2	0.3	2.5	-4.3	-47.7	-15.1
1995	-7.0	-1.6	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1
1996	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.4	0.8	-10.0	-27.4	-34.8
2002	-13.3	0.2	0.3	0.1	0.3	0.1	0.2	0.2	0.5	0.1	0.4	-0.1
2003	-0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.3	-0.8	-0.7
Average	-5.4	-1.3	-0.1	0.1	0.1	0.1	0.1	0.2	0.8	-6.0	-13.7	-12.7
Critical	-12.9	-4.1	-1.2	-0.3	0.2	0.3	0.2	0.7	3.4	-26.6	-50.9	-48.8
Dry	-6.3	-0.7	0.6	0.5	0.2	0.1	0.1	0.2	0.4	-3.3	-18.1	-15.2
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-6.6	-1.4	0.4	0.2	0.1	0.1	0.0	0.0	0.1	0.1	-0.1	-0.1
Wet	-1.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-61. Sacramento River location RSAC101 (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	-3.5	-19.5	-12.9
1977	-4.5	-1.6	-0.8	-0.5	-0.2	0.0	0.0	0.3	1.2	-15.3	-10.0	-9.5
1978	-3.9	-1.1	-0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	-0.8	-5.1	-1.9
1982	-1.7	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	-3.0	-16.6	-11.0
1988	-3.9	-1.6	-0.1	0.1	0.0	0.2	0.2	0.3	0.5	-8.2	-12.9	-11.6
1989	-3.7	-1.2	0.8	0.9	0.2	0.1	0.2	0.1	0.1	-0.4	-2.7	-1.5
1990	-0.9	-0.4	-0.2	0.0	0.3	0.4	0.2	0.4	1.5	-9.3	-10.3	-10.6
1991	-4.1	-1.2	-0.6	-0.1	0.3	0.2	0.2	0.7	2.0	-7.5	-8.8	-9.0
1992	-3.1	-0.9	-0.1	-0.4	0.2	0.2	0.2	0.4	0.5	-8.5	-11.3	-8.5
1993	-3.9	-0.7	0.8	0.3	0.2	0.2	0.0	0.1	0.0	0.0	0.1	0.0
1994	0.0	0.0	0.0	0.3	0.2	0.2	0.1	0.2	1.0	-1.6	-13.0	-3.8
1995	-1.8	-0.5	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.4	-4.3	-8.7	-8.8
2002	-3.3	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.0
2003	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	-0.4	-0.3
Average	-1.0	-0.3	0.0	0.0	0.1	0.0	0.0	0.1	0.3	-1.8	-3.5	-2.6
Critical	-2.3	-0.8	-0.3	-0.1	0.1	0.2	0.1	0.3	1.1	-7.7	-12.2	-9.4
Dry	-1.2	-0.2	0.2	0.2	0.1	0.0	0.1	0.1	0.2	-1.4	-5.5	-3.9
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.3	-0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Wet	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-62. San Joaquin River location RSAN007 (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-1.9	-3.6	-1.1	-0.2	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.3	-1.9	40.4	-214.5	-453.2	-542.8
1977	-326.9	-139.2	-73.6	-27.6	-15.6	-10.0	-6.0	6.7	44.9	-191.6	-505.3	-364.4
1978	-233.7	-102.8	-12.7	1.6	0.6	0.4	0.2	0.2	1.6	3.3	1.6	0.5
1979	0.1	0.0	-0.6	3.2	0.5	0.3	0.3	0.5	0.9	0.5	0.3	0.0
1980	0.2	13.3	24.7	2.4	-1.8	0.3	0.1	0.2	0.3	0.1	0.1	0.0
1981	-0.1	-0.3	-0.7	2.0	0.4	0.2	0.5	2.8	2.7	-48.3	-232.8	-253.0
1982	-113.4	-21.8	-1.1	0.1	-1.7	-1.2	0.1	0.0	0.0	0.5	0.5	0.0
1983	3.8	0.7	0.0	0.0	0.2	0.2	0.1	-0.1	0.0	0.1	0.3	0.2
1984	2.0	0.2	0.0	0.0	0.0	0.0	0.1	0.8	1.0	0.1	0.0	0.0
1985	-0.2	2.3	2.3	3.8	2.8	0.6	0.5	1.4	1.3	0.8	0.4	0.8
1986	-0.1	-0.2	6.3	1.7	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
1987	0.0	-0.2	-0.1	2.2	1.2	0.2	0.0	-0.9	8.8	-145.1	-454.7	-572.0
1988	-310.7	-132.5	2.9	5.5	0.9	-1.6	13.7	9.7	21.7	-308.1	-491.1	-420.0
1989	-295.9	-121.5	44.5	50.2	-4.7	1.2	2.7	5.9	1.9	-22.5	-156.7	-145.9
1990	-66.3	-36.3	-24.7	6.6	30.3	45.9	22.4	20.9	53.8	-415.1	-583.8	-443.0
1991	-304.9	-139.4	-74.0	-42.2	17.6	8.6	8.1	40.5	70.7	-326.2	-451.9	-351.4
1992	-244.6	-107.5	-65.8	-40.4	-3.5	3.0	14.1	17.7	22.3	-328.0	-526.6	-422.9
1993	-233.5	-102.4	55.8	15.3	1.2	0.9	0.4	0.5	2.1	13.5	8.3	2.7
1994	0.8	0.5	-0.6	28.4	15.4	15.2	17.1	17.6	39.9	-98.6	-414.0	-445.1
1995	-181.6	-76.9	8.6	5.0	0.6	0.2	0.1	0.0	0.0	0.3	10.6	7.0
1996	0.8	0.0	6.2	0.8	0.1	0.0	0.0	0.1	1.9	5.3	2.1	0.4
1997	0.1	-0.5	0.1	-0.2	-0.1	0.1	0.4	1.4	2.6	0.4	-0.2	0.9
1998	-0.3	-1.2	5.9	1.7	0.3	0.1	0.0	0.1	0.1	0.0	1.8	1.6
1999	1.3	2.2	0.3	0.0	0.0	0.0	0.0	0.2	2.0	2.4	1.0	0.2
2000	0.0	0.0	-0.4	3.3	0.1	0.1	0.1	0.2	1.2	0.1	0.1	0.0
2001	0.0	-0.1	0.4	4.7	0.8	0.1	0.7	12.3	25.8	-251.2	-419.0	-424.7
2002	-268.7	-4.0	18.2	0.7	4.7	5.9	5.2	6.8	8.3	4.5	1.4	2.2
2003	-0.4	-4.5	3.1	0.3	0.1	0.6	0.2	0.1	16.2	4.9	-33.3	-27.4
Average	-75.7	-28.6	-2.2	0.9	1.5	2.0	2.3	4.2	11.0	-68.0	-138.1	-129.3
Critical	-178.9	-79.2	-33.7	-10.0	6.5	8.7	9.9	15.9	42.0	-268.9	-489.4	-427.1
Dry	-94.1	-20.6	10.8	10.6	0.9	1.4	1.6	4.7	8.1	-77.0	-210.2	-232.1
BN	0.1	0.0	-0.3	1.6	0.2	0.1	0.2	0.3	0.5	0.3	0.1	0.0
AN	-77.9	-32.7	11.7	3.8	0.0	0.1	-0.4	0.0	3.5	3.7	-3.9	-4.0
Wet	-22.1	-7.5	2.0	0.7	0.0	0.0	0.1	0.2	0.6	0.7	1.2	0.8

Table 1-63. San Joaquin River location RSAN007 (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.8	-1.6	-0.4	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.0	-4.5	-8.9	-8.3
1977	-4.3	-2.0	-1.0	-0.8	-0.9	-0.6	-0.3	0.2	0.9	-3.4	-7.5	-4.8
1978	-3.4	-1.5	-0.4	0.4	0.2	0.1	0.1	0.1	0.5	0.3	0.1	0.0
1979	0.0	0.0	0.0	0.3	0.2	0.1	0.1	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.3	1.2	0.7	-0.7	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.2	0.1	0.1	0.2	0.4	0.2	-1.7	-5.6	-4.4
1982	-1.6	-1.5	-0.5	0.0	-0.8	-0.5	0.0	0.0	0.0	0.1	0.0	0.0
1983	1.1	0.3	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
1984	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1985	0.0	0.5	0.5	0.5	0.5	0.1	0.1	0.2	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.2	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.1	0.0	-0.1	0.5	-4.7	-10.2	-9.9
1988	-4.8	-2.1	0.1	1.4	0.3	-0.2	1.1	0.6	1.2	-8.1	-9.6	-6.8
1989	-3.8	-1.9	0.8	1.4	-0.2	0.3	1.2	1.5	0.1	-0.7	-4.1	-3.5
1990	-1.3	-0.6	-0.4	0.3	4.5	5.3	2.2	1.3	1.7	-8.0	-10.4	-6.7
1991	-4.2	-1.8	-1.0	-0.9	0.7	1.7	2.0	2.7	1.9	-6.2	-8.2	-5.3
1992	-3.3	-1.5	-0.9	-0.8	-0.4	1.0	2.8	1.0	1.0	-8.3	-9.1	-6.4
1993	-3.7	-1.7	1.2	2.5	0.4	0.4	0.2	0.2	1.0	1.9	0.3	0.1
1994	0.0	0.0	0.0	1.1	2.2	2.5	2.3	1.8	1.5	-2.2	-8.1	-7.1
1995	-3.8	-1.4	0.2	1.0	0.3	0.1	0.1	0.0	0.0	0.1	1.8	1.2
1996	0.2	0.0	1.4	0.4	0.0	0.0	0.0	0.0	0.6	0.5	0.1	0.0
1997	0.0	-0.1	0.0	-0.1	0.0	0.0	0.2	0.5	0.3	0.0	0.0	0.1
1998	0.0	-0.2	0.7	0.5	0.1	0.0	0.0	0.1	0.0	0.0	0.5	0.5
1999	0.2	0.5	0.2	0.0	0.0	0.0	0.0	0.1	0.5	0.2	0.0	0.0
2000	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.3	0.2	0.0	0.2	1.5	1.7	-8.4	-9.9	-7.4
2002	-4.3	-0.1	1.7	0.3	1.9	2.2	2.0	1.7	0.5	0.1	0.0	0.0
2003	0.0	-0.1	0.3	0.2	0.1	0.3	0.1	0.0	2.6	0.4	-1.3	-1.5
Average	-1.1	-0.4	0.1	0.3	0.3	0.4	0.4	0.4	0.5	-1.5	-2.6	-2.1
Critical	-2.5	-1.1	-0.5	0.1	0.9	1.4	1.4	1.1	1.3	-5.8	-8.8	-6.5
Dry	-1.3	-0.3	0.5	0.5	0.5	0.5	0.6	0.9	0.5	-2.6	-5.0	-4.2
BN	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
AN	-1.2	-0.5	0.4	0.7	0.0	0.0	-0.2	0.0	0.7	0.5	-0.2	-0.2
Wet	-0.3	-0.2	0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1

Table 1-64. San Joaquin River location RSAN018 (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.1	-2.6	-4.3	-1.0	-0.2	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	13.8	18.9	4.5	-136.5
1977	-151.4	-78.0	-56.6	-34.5	-11.4	-6.5	-4.3	0.1	17.2	70.3	-97.7	-111.4
1978	-102.5	-56.0	-19.3	0.7	0.9	0.5	0.2	0.1	0.2	0.9	0.9	0.3
1979	0.1	0.0	-0.3	1.0	0.4	0.2	0.1	0.2	0.1	0.3	0.2	0.0
1980	-2.0	4.2	12.8	1.4	-1.8	0.3	0.0	0.1	0.1	0.0	0.0	0.0
1981	0.0	-0.9	-0.6	0.6	0.2	0.1	0.0	0.3	-0.1	-22.0	55.4	-98.6
1982	-87.1	-28.6	-0.9	0.1	-2.1	-1.1	0.1	0.0	-0.1	0.0	0.2	0.0
1983	0.6	0.2	0.0	0.0	0.2	0.2	0.1	-0.1	0.0	0.0	0.0	0.0
1984	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-0.4	-0.1	0.0
1985	0.0	0.7	0.9	1.0	0.8	0.2	0.1	0.2	0.1	-0.5	-1.2	-1.5
1986	-1.5	-2.1	1.7	0.8	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.5	0.3	0.5	0.1	0.3	-1.3	-0.6	57.2	38.3	-137.5
1988	-136.7	-73.7	-16.5	1.4	0.3	-0.6	1.8	0.9	3.7	87.5	-59.3	-123.6
1989	-150.6	-86.8	6.0	15.8	-6.6	0.7	0.9	0.8	-2.4	-6.2	1.6	-64.6
1990	-50.5	-36.7	-29.8	-5.9	5.6	10.2	5.8	3.9	16.9	91.3	-102.2	-127.2
1991	-142.3	-84.7	-56.1	-30.9	-2.7	2.0	1.1	7.6	20.9	81.6	-75.1	-105.7
1992	-120.3	-66.1	-50.6	-44.5	-5.4	0.6	1.3	0.2	-0.2	81.2	-71.0	-130.0
1993	-90.6	-53.7	6.7	7.4	1.7	1.2	0.4	0.5	-0.7	2.6	4.3	1.9
1994	0.3	0.2	-0.3	7.8	6.7	2.8	2.8	2.3	9.8	-53.1	75.2	-47.4
1995	-52.6	-37.3	-6.7	3.0	0.9	0.2	0.1	0.0	0.1	0.1	2.0	2.4
1996	0.2	0.0	1.1	0.4	0.1	0.0	0.0	0.1	0.1	2.0	1.2	0.5
1997	0.0	-0.1	0.1	-0.2	-0.1	0.0	0.1	0.1	0.3	-0.9	-0.3	-0.5
1998	-0.3	-1.2	2.0	0.9	0.3	0.0	0.0	0.1	0.1	0.0	0.1	0.2
1999	0.4	0.8	0.2	0.0	0.0	0.0	0.1	0.1	0.2	0.9	0.6	0.2
2000	0.0	0.0	-0.9	0.4	0.1	0.1	0.1	0.1	0.2	-0.6	-0.1	0.0
2001	0.0	0.0	-1.3	0.6	0.3	0.1	0.1	1.4	3.2	89.6	6.1	-84.5
2002	-110.6	-15.8	9.8	0.8	0.7	0.7	0.3	0.5	0.5	0.0	-4.2	-5.5
2003	-2.6	-6.4	1.9	0.4	0.1	0.1	0.1	0.1	2.6	24.5	-12.4	-16.5
Average	-35.3	-18.3	-5.8	-2.1	-0.3	0.3	0.2	0.5	2.5	15.5	-6.9	-34.9
Critical	-85.8	-48.4	-30.0	-15.2	-1.0	1.2	1.2	2.0	11.7	54.0	-46.5	-111.7
Dry	-43.5	-17.1	2.4	3.2	-0.7	0.3	0.3	0.3	0.1	19.7	16.0	-65.4
BN	0.0	0.0	-0.2	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0
AN	-32.9	-18.7	0.2	1.7	0.2	-0.1	-0.6	0.0	0.4	4.6	-1.2	-2.4
Wet	-10.8	-5.2	-0.2	0.4	0.0	0.0	0.1	0.0	0.1	0.1	0.3	0.2

Table 1-65. San Joaquin River location RSAN018 (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-1.1	-1.8	-0.4	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.4	0.9	0.3	-6.5
1977	-6.4	-3.6	-2.1	-1.9	-1.7	-1.4	-0.9	0.0	1.4	4.3	-3.9	-4.1
1978	-5.1	-2.8	-1.2	0.2	0.3	0.2	0.1	0.1	0.1	0.3	0.1	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1980	-0.1	0.3	1.0	0.5	-0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.2	0.0	0.1	0.1	0.0	0.0	0.1	0.0	-1.7	3.1	-3.9
1982	-3.1	-2.0	-0.4	0.1	-0.9	-0.5	0.1	0.0	0.0	0.0	0.0	0.0
1983	0.3	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1985	0.0	0.2	0.3	0.3	0.3	0.1	0.1	0.1	0.0	0.0	-0.1	-0.1
1986	-0.1	-0.1	0.1	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	-0.1	0.0	0.1	0.0	0.1	-0.3	-0.1	5.8	3.0	-7.4
1988	-6.8	-3.8	-1.3	0.4	0.1	-0.2	0.5	0.2	0.9	7.5	-3.9	-6.5
1989	-5.9	-4.0	0.3	0.9	-0.8	0.2	0.4	0.4	-0.6	-0.4	0.1	-3.3
1990	-2.6	-1.8	-1.4	-0.6	1.4	3.1	1.8	1.1	2.3	4.4	-4.9	-5.6
1991	-6.1	-3.4	-2.2	-2.2	-0.4	0.6	0.4	2.0	2.1	3.7	-3.8	-4.9
1992	-5.1	-2.9	-2.1	-2.3	-1.1	0.2	0.5	0.0	0.0	6.4	-3.7	-5.7
1993	-5.1	-3.1	0.3	1.6	0.6	0.5	0.2	0.2	-0.3	0.9	0.4	0.2
1994	0.1	0.0	0.0	0.6	1.4	0.9	1.0	0.8	1.8	-2.4	3.5	-1.8
1995	-3.5	-2.4	-0.3	0.7	0.4	0.1	0.1	0.0	0.0	0.1	0.8	0.9
1996	0.1	0.0	0.4	0.2	0.1	0.0	0.0	0.1	0.1	0.4	0.1	0.0
1997	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.2	0.0	0.0
1998	-0.1	-0.4	0.5	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1
1999	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0
2000	0.0	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0
2001	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	0.5	0.9	9.5	0.5	-4.6
2002	-5.7	-0.8	1.4	0.3	0.3	0.3	0.2	0.2	0.1	0.0	-0.2	-0.2
2003	-0.1	-0.3	0.2	0.2	0.0	0.0	0.0	0.1	1.0	4.8	-1.1	-1.7
Average	-1.6	-0.9	-0.2	0.0	0.0	0.1	0.1	0.2	0.3	1.3	-0.3	-1.6
Critical	-3.8	-2.2	-1.3	-0.9	0.0	0.5	0.5	0.6	1.4	3.5	-2.4	-5.0
Dry	-1.9	-0.8	0.3	0.3	0.0	0.1	0.1	0.1	0.0	2.2	1.1	-3.2
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.7	-1.0	0.0	0.4	0.1	0.0	-0.2	0.0	0.1	1.0	-0.1	-0.2
Wet	-0.5	-0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

Table 1-66. San Joaquin River location RSAN032 (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.2	-3.1	-0.4	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	13.0	-61.8	-58.1
1977	-39.2	-17.3	-16.1	-13.2	-4.0	-0.8	-0.1	0.4	3.7	-27.0	-28.9	-53.8
1978	-33.3	-13.4	-7.5	1.1	1.0	0.5	0.2	0.2	0.1	0.1	0.1	0.1
1979	0.0	0.0	-0.1	0.5	0.5	0.1	0.1	0.2	0.0	0.0	0.0	0.0
1980	-0.2	0.7	3.8	0.3	-0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	-0.1	-0.2	0.3	0.1	0.0	0.1	0.3	0.2	-3.7	10.2	-1.4
1982	-17.8	-9.2	0.0	0.1	-0.9	-0.3	0.0	-0.1	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1985	0.0	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	-0.1	-0.2	-0.5
1986	-0.2	-0.5	0.2	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	-0.2	-0.1	0.1	0.0	0.7	1.0	0.6	7.0	-15.7	-32.3
1988	-25.2	-15.3	-7.4	0.5	0.2	1.2	1.2	1.3	1.1	12.7	-14.7	-46.2
1989	-37.0	-19.1	-2.0	6.2	0.0	1.3	1.0	0.9	0.2	-1.0	3.2	-5.6
1990	-9.4	-8.4	-7.8	-3.3	1.1	1.7	1.3	0.8	2.7	23.7	-14.5	-47.8
1991	-37.0	-19.5	-15.1	-9.6	-1.2	1.1	0.8	1.2	4.3	19.2	-12.7	-38.6
1992	-29.8	-15.2	-12.0	-13.4	-0.4	0.7	0.5	0.9	0.7	12.3	-14.2	-39.0
1993	-24.9	-10.8	-0.9	2.9	1.4	1.1	0.3	0.6	-2.1	-0.5	0.7	0.2
1994	0.1	0.0	-0.1	1.8	1.9	0.8	0.6	0.5	1.4	-10.9	-17.8	12.2
1995	-6.3	-4.5	-3.7	1.6	0.7	0.2	0.1	0.0	0.1	0.1	0.1	0.1
1996	0.0	0.0	0.2	0.3	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.1
1997	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.1	0.1	-0.1	-0.1	-0.5
1998	0.1	0.0	0.3	0.3	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1999	0.0	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1
2000	0.0	0.0	-0.2	0.2	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	0.0
2001	0.0	0.0	-0.6	-0.1	0.1	0.1	0.3	0.8	0.8	15.2	1.9	-24.5
2002	-21.4	-5.3	2.1	0.6	0.5	0.3	0.4	0.4	0.4	-0.2	-0.4	-1.5
2003	-1.0	-1.1	0.6	0.1	0.1	0.1	0.1	0.1	0.3	3.7	-0.4	-2.5
Average	-8.3	-4.1	-1.9	-0.7	0.0	0.2	0.2	0.3	0.5	1.9	-4.9	-10.0
Critical	-20.1	-10.8	-8.4	-5.3	-0.3	0.7	0.6	0.7	2.4	6.1	-23.5	-38.8
Dry	-9.7	-4.1	-0.1	1.2	0.2	0.3	0.4	0.6	0.4	2.9	-0.2	-11.0
BN	0.0	0.0	0.0	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
AN	-9.9	-4.1	-0.7	0.8	0.4	-0.1	-0.4	0.1	-0.3	0.5	0.1	-0.4
Wet	-1.9	-1.1	-0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-67. San Joaquin River location RSAN032 (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-1.1	-1.3	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.8	-11.6	-10.9
1977	-6.3	-3.1	-2.3	-1.9	-1.0	-0.3	0.0	0.1	1.0	-6.3	-5.6	-7.2
1978	-5.3	-2.4	-1.3	0.4	0.4	0.2	0.1	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.2	0.7	0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.1	-0.1	0.1	0.1	0.0	0.0	0.1	0.1	-1.1	2.4	-0.3
1982	-3.0	-2.0	0.0	0.1	-0.5	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1
1986	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	-0.1	0.0	0.0	0.0	0.3	0.4	0.3	2.6	-4.4	-7.6
1988	-5.1	-3.1	-1.5	0.2	0.1	0.5	0.5	0.5	0.5	4.5	-3.5	-9.3
1989	-5.7	-3.4	-0.3	0.9	0.0	0.6	0.5	0.4	0.1	-0.3	0.7	-1.2
1990	-2.1	-1.6	-1.3	-0.7	0.4	0.7	0.5	0.3	1.0	5.5	-2.7	-8.5
1991	-5.6	-2.8	-2.0	-1.5	-0.3	0.4	0.3	0.5	1.5	4.1	-2.4	-7.1
1992	-4.7	-2.4	-1.7	-2.0	-0.1	0.3	0.2	0.4	0.3	4.1	-3.1	-7.2
1993	-4.9	-2.2	-0.2	1.0	0.6	0.5	0.2	0.3	-1.0	-0.3	0.2	0.1
1994	0.0	0.0	0.0	0.3	0.6	0.3	0.3	0.2	0.6	-2.3	-3.2	2.2
1995	-1.3	-1.2	-0.6	0.6	0.3	0.1	0.0	0.0	0.1	0.1	0.1	0.1
1996	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1
1998	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.2	0.0	0.0	0.0	0.1	0.3	0.4	5.9	0.6	-5.8
2002	-4.4	-1.1	0.7	0.3	0.2	0.1	0.2	0.1	0.2	-0.1	-0.1	-0.3
2003	-0.2	-0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1	1.7	-0.1	-0.9
Average	-1.4	-0.7	-0.3	0.0	0.0	0.1	0.1	0.1	0.2	0.6	-1.0	-1.9
Critical	-3.4	-1.9	-1.3	-0.8	-0.1	0.3	0.3	0.3	0.8	1.8	-4.6	-6.8
Dry	-1.7	-0.7	0.0	0.2	0.1	0.1	0.2	0.2	0.2	1.2	-0.2	-2.6
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.7	-0.8	-0.1	0.3	0.2	-0.1	-0.2	0.1	-0.1	0.2	0.0	-0.1
Wet	-0.3	-0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-68. Sacramento River location RSAC081 (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.6	-79.3	-52.1	-258.5	-423.9	-357.4
1977	-186.1	-77.2	-41.7	-13.5	-8.2	-2.9	0.0	-70.1	-38.1	-323.9	-407.7	-278.6
1978	-155.8	-67.6	-27.5	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	18.2	-141.2	6.3
1982	26.5	-29.4	-0.1	0.0	-0.4	-0.3	0.0	0.0	0.0	-0.1	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	20.1	-129.8	-404.6	-363.5
1988	-172.8	-70.2	-18.9	-1.2	-0.1	0.0	0.0	7.0	29.2	-303.5	-372.1	-265.1
1989	-153.9	-59.7	-28.6	-11.9	-10.7	2.0	7.0	12.0	4.6	-18.5	-50.9	-12.1
1990	-1.4	-1.8	-1.6	-1.8	38.9	38.6	14.8	-54.0	-26.8	-402.9	-454.0	-307.3
1991	-175.4	-76.9	-39.9	-18.2	-7.0	-0.5	0.1	-45.4	-21.8	-336.5	-369.3	-251.1
1992	-143.6	-60.8	-36.0	-18.6	0.6	0.2	0.2	6.7	34.5	-365.1	-409.6	-263.6
1993	-139.0	-57.8	-33.8	1.6	0.6	0.3	0.0	0.4	6.9	18.4	7.7	1.9
1994	0.6	0.2	0.1	0.0	0.0	0.0	0.1	-11.9	-44.8	-71.3	-366.8	-263.3
1995	-93.6	-36.7	-19.4	0.2	0.1	0.0	0.0	0.0	0.1	0.2	2.1	1.1
1996	0.8	0.1	-0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	27.8	-315.8	-364.0	-265.2
2002	-149.1	-47.4	-16.4	-0.2	7.8	5.8	10.8	7.0	2.9	1.4	0.6	0.3
2003	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	-8.7	16.9	7.3
Average	-39.5	-17.2	-7.8	-1.9	0.6	1.3	1.0	-6.4	-1.7	-73.4	-109.9	-76.8
Critical	-97.0	-41.0	-19.7	-7.6	3.5	5.0	2.3	-35.3	-17.1	-294.5	-400.5	-283.8
Dry	-50.5	-17.9	-7.5	-2.0	-0.5	1.3	3.0	4.8	9.2	-74.1	-160.0	-105.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-49.1	-20.9	-10.2	0.3	0.2	0.1	0.0	0.1	1.3	1.6	4.1	1.5
Wet	-5.1	-5.1	-1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

Table 1-69. Sacramento River location RSAC081 (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.8	-0.7	-3.9	-5.5	-3.7
1977	-1.7	-0.7	-0.4	-0.3	-0.3	-0.1	0.0	-1.3	-0.5	-3.7	-4.3	-2.6
1978	-1.5	-0.6	-0.5	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	-2.3	0.1
1982	0.3	-2.2	-0.1	0.0	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	-2.6	-5.7	-4.2
1988	-1.8	-0.7	-0.5	-0.3	0.0	0.0	0.0	0.2	0.8	-5.0	-4.7	-2.8
1989	-1.4	-0.6	-0.3	-0.2	-0.3	0.5	2.7	1.4	0.2	-0.4	-0.9	-0.2
1990	0.0	0.0	0.0	-0.1	3.2	2.3	0.7	-1.7	-0.5	-5.4	-5.5	-3.2
1991	-1.6	-0.7	-0.4	-0.2	-0.2	-0.1	0.0	-1.5	-0.4	-4.5	-4.6	-2.6
1992	-1.3	-0.6	-0.3	-0.3	0.1	0.1	0.0	0.2	0.9	-5.9	-4.9	-2.8
1993	-1.4	-0.6	-0.5	0.4	0.3	0.1	0.0	0.2	2.7	1.4	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.9	-1.1	-5.0	-3.0
1995	-1.2	-0.4	-0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.1
1996	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	-6.5	-5.4	-3.1
2002	-1.6	-0.6	-1.5	-0.1	2.2	1.3	2.5	0.8	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.4	0.4	0.3
Average	-0.4	-0.2	-0.1	0.0	0.1	0.1	0.2	-0.1	0.1	-1.1	-1.4	-0.8
Critical	-0.9	-0.4	-0.2	-0.2	0.4	0.3	0.1	-0.9	-0.2	-4.2	-4.9	-3.0
Dry	-0.5	-0.2	-0.3	-0.1	0.3	0.3	0.9	0.5	0.3	-1.5	-2.4	-1.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.5	-0.2	-0.2	0.1	0.1	0.0	0.0	0.0	0.5	0.2	0.1	0.1
Wet	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-70. Sacramento River location RSAC092 (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-34.2	-19.3	-106.9	-273.6	-237.9
1977	-100.3	-33.0	-15.5	-3.0	-1.4	-0.6	0.0	-32.8	-14.5	-277.5	-242.4	-205.6
1978	-85.2	-29.7	-5.8	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	12.5	-88.3	44.5
1982	10.4	-4.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	5.9	-57.6	-252.5	-201.0
1988	-76.9	-27.5	-3.7	-0.2	0.0	0.0	0.0	1.9	9.4	-164.8	-213.5	-175.1
1989	-84.8	-21.3	-8.9	-2.6	-2.3	0.3	0.5	0.8	0.8	-4.5	-22.0	-0.8
1990	-0.8	-0.7	-0.7	-0.7	3.6	5.0	2.3	-15.6	-4.5	-216.0	-235.9	-195.3
1991	-95.3	-37.3	-17.4	-5.9	-1.4	-0.1	0.0	-13.8	-2.7	-189.3	-192.0	-166.7
1992	-76.5	-27.6	-15.4	-3.9	0.1	0.0	0.0	2.2	10.8	-192.1	-223.8	-157.6
1993	-63.5	-22.6	-9.1	0.5	0.4	0.1	0.0	0.1	-0.1	1.2	1.7	0.4
1994	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-2.3	-19.1	-17.4	-235.7	-114.0
1995	-35.4	-11.1	-5.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	7.0	-125.3	-162.8	-153.7
2002	-64.2	-14.7	-2.7	0.0	0.5	0.3	0.6	0.4	0.6	0.3	0.2	0.1
2003	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-1.3	8.7	0.5
Average	-19.8	-6.7	-2.5	-0.5	0.0	0.1	0.1	-2.7	-0.7	-39.4	-62.7	-45.9
Critical	-49.9	-18.0	-7.5	-2.0	0.1	0.6	0.4	-13.5	-5.7	-166.3	-231.0	-178.9
Dry	-24.8	-6.0	-1.9	-0.4	-0.3	0.1	0.2	0.6	2.4	-29.1	-87.6	-51.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-24.8	-8.7	-2.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	1.7	0.1
Wet	-1.9	-1.2	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-71. Sacramento River location RSAC092 (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.2	-0.9	-7.4	-11.1	-7.1
1977	-2.5	-1.0	-0.5	-0.3	-0.2	-0.1	0.0	-2.4	-0.6	-10.0	-8.2	-5.0
1978	-2.3	-0.9	-0.6	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	-6.2	2.1
1982	0.4	-1.2	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.9	-5.6	-12.3	-7.6
1988	-2.5	-1.0	-0.5	-0.1	0.0	0.0	0.0	0.3	1.3	-11.5	-8.5	-5.5
1989	-2.0	-0.9	-0.4	-0.2	-0.3	0.1	0.3	0.4	0.1	-0.5	-1.9	-0.1
1990	0.0	0.0	0.0	-0.1	1.3	1.6	0.6	-2.6	-0.3	-11.7	-9.3	-6.0
1991	-2.4	-0.9	-0.5	-0.3	-0.2	0.0	0.0	-2.2	-0.2	-10.0	-7.9	-5.0
1992	-2.0	-0.8	-0.4	-0.2	0.0	0.0	0.0	0.4	1.4	-13.0	-8.5	-5.1
1993	-2.0	-0.8	-0.6	0.2	0.2	0.1	0.0	0.1	-0.1	0.5	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-1.6	-1.4	-11.9	-4.6
1995	-1.5	-0.5	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	-12.9	-8.9	-5.8
2002	-2.3	-0.7	-0.9	0.0	0.2	0.1	0.3	0.2	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.4	1.2	0.1
Average	-0.6	-0.3	-0.1	0.0	0.0	0.1	0.0	-0.3	0.0	-2.4	-2.7	-1.4
Critical	-1.3	-0.5	-0.3	-0.2	0.1	0.2	0.1	-1.5	-0.1	-9.3	-9.3	-5.4
Dry	-0.7	-0.3	-0.2	0.0	0.0	0.0	0.1	0.2	0.4	-2.9	-4.9	-1.9
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.7	-0.3	-0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Wet	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-72. Sacramento River location RSAC101 (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.7	-2.1	-7.8	-39.6	-35.1
1977	-13.8	-4.5	-2.1	-0.4	-0.1	-0.1	0.0	-3.6	-2.0	-46.6	-26.3	-35.0
1978	-12.2	-4.5	-0.6	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-7.0	7.1
1982	-1.6	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	-3.0	-32.0	-23.1
1988	-8.9	-3.7	-0.4	0.0	0.0	0.0	0.0	0.1	0.7	-13.0	-26.3	-28.9
1989	-13.4	-2.8	-1.3	-0.3	-0.3	0.1	0.2	0.0	0.0	-0.6	-1.8	0.3
1990	-0.3	-0.1	-0.1	0.0	0.4	0.4	0.2	-1.1	0.2	-19.0	-24.4	-28.5
1991	-14.0	-6.5	-3.0	-0.8	-0.2	0.0	0.0	-1.1	0.0	-16.2	-20.4	-26.1
1992	-11.1	-4.5	-2.4	-0.5	0.0	0.0	0.0	0.2	0.8	-16.0	-24.8	-19.8
1993	-7.2	-3.0	-0.9	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.2	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-2.3	-2.7	-27.9	-4.9
1995	-2.6	-0.9	-0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	-6.7	-12.8	-16.4
2002	-5.8	-1.7	-0.4	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	-0.3
Average	-2.7	-1.0	-0.3	0.0	0.0	0.0	0.0	-0.3	-0.1	-3.9	-7.1	-6.2
Critical	-6.9	-2.7	-1.1	-0.3	0.0	0.0	0.0	-1.3	-0.7	-17.3	-27.1	-25.5
Dry	-3.2	-0.8	-0.3	0.0	0.0	0.0	0.1	0.0	0.2	-1.8	-8.9	-5.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-3.2	-1.2	-0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Wet	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-73. Sacramento River location RSAC101 (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-0.6	-2.6	-9.3	-7.0
1977	-2.4	-1.0	-0.5	-0.1	-0.1	0.0	0.0	-1.3	-0.5	-10.5	-6.0	-5.4
1978	-2.3	-0.9	-0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-2.3	1.9
1982	-0.4	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-1.3	-9.1	-5.6
1988	-1.9	-0.9	-0.2	0.0	0.0	0.0	0.0	0.1	0.3	-4.7	-6.3	-5.7
1989	-2.0	-0.7	-0.3	-0.1	-0.1	0.0	0.1	0.0	0.0	-0.2	-0.7	0.1
1990	-0.1	0.0	0.0	0.0	0.2	0.2	0.1	-0.6	0.1	-5.8	-5.6	-5.6
1991	-2.2	-1.0	-0.5	-0.2	-0.1	0.0	0.0	-0.5	0.0	-4.8	-4.9	-5.0
1992	-1.9	-0.8	-0.4	-0.2	0.0	0.0	0.0	0.1	0.4	-5.6	-5.9	-4.2
1993	-1.5	-0.7	-0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.9	-1.0	-7.6	-1.2
1995	-0.7	-0.3	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-2.9	-4.0	-4.2
2002	-1.4	-0.5	-0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-0.1
Average	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	-1.2	-1.8	-1.2
Critical	-1.2	-0.5	-0.2	-0.1	0.0	0.0	0.0	-0.6	-0.2	-5.0	-6.5	-4.9
Dry	-0.6	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	-0.8	-2.7	-1.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-74. San Joaquin River location RSAN007 (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.3	-53.9	-37.5	-168.8	-242.4	-246.4
1977	-151.8	-63.3	-34.1	-11.5	-4.9	-2.0	-0.1	-48.6	-28.5	-116.3	-288.1	-187.2
1978	-117.6	-53.3	-22.0	-0.5	0.3	0.2	0.0	0.0	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-5.2	-59.9	-21.4
1982	18.4	-12.3	-0.8	0.1	-1.8	-1.2	0.1	0.0	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.2	0.2	0.1	-0.1	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	13.8	-49.2	-191.8	-254.7
1988	-138.1	-55.2	-15.2	-1.3	-0.1	0.0	0.0	4.1	19.6	-143.5	-228.3	-170.0
1989	-126.3	-48.5	-22.9	-9.1	-6.7	0.7	1.7	4.8	2.6	-15.7	-32.2	-11.9
1990	-1.4	-1.5	-1.3	-1.3	18.2	22.4	9.1	-31.2	-14.4	-237.5	-318.8	-213.4
1991	-142.7	-63.6	-32.3	-13.1	-4.6	-0.6	0.0	-27.7	-14.2	-197.7	-248.8	-169.3
1992	-116.1	-49.2	-29.0	-14.4	-0.6	0.1	0.1	4.4	25.2	-195.8	-283.0	-182.4
1993	-103.4	-43.0	-27.3	0.2	0.7	0.4	0.1	0.2	1.0	9.4	5.8	1.9
1994	0.5	0.2	0.1	0.0	0.0	0.0	0.1	-6.1	-32.0	-67.7	-190.3	-195.8
1995	-66.5	-26.2	-15.8	-0.4	0.2	0.1	0.1	0.0	0.0	0.1	1.1	0.8
1996	0.3	0.1	-0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1999	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	18.7	-155.8	-219.4	-169.7
2002	-114.8	-37.4	-10.9	-0.5	2.6	2.5	2.9	2.3	1.6	1.1	0.5	0.3
2003	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-0.9	6.6	1.6
Average	-31.2	-13.3	-6.2	-1.5	0.1	0.7	0.4	-4.3	-1.3	-39.5	-67.3	-53.5
Critical	-78.5	-33.2	-16.0	-5.9	1.1	2.8	1.3	-22.7	-11.7	-161.1	-257.1	-194.9
Dry	-40.2	-14.3	-5.6	-1.6	-0.7	0.5	0.8	2.1	6.1	-37.5	-83.8	-76.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-36.8	-16.0	-8.2	-0.1	0.2	0.1	0.0	0.1	0.3	1.4	2.1	0.6
Wet	-3.7	-3.0	-1.3	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.1	0.0

Table 1-75. San Joaquin River location RSAN007 (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.2	-0.9	-3.6	-4.8	-3.8
1977	-2.0	-0.9	-0.5	-0.3	-0.3	-0.1	0.0	-1.5	-0.6	-2.1	-4.3	-2.5
1978	-1.7	-0.8	-0.6	-0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-1.4	-0.4
1982	0.3	-0.8	-0.3	0.0	-0.8	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	-1.6	-4.3	-4.4
1988	-2.1	-0.9	-0.6	-0.3	0.0	0.0	0.0	0.3	1.1	-3.8	-4.5	-2.7
1989	-1.6	-0.8	-0.4	-0.2	-0.3	0.2	0.8	1.2	0.2	-0.5	-0.8	-0.3
1990	0.0	0.0	0.0	-0.1	2.7	2.6	0.9	-2.0	-0.4	-4.6	-5.7	-3.2
1991	-1.9	-0.8	-0.4	-0.3	-0.2	-0.1	0.0	-1.8	-0.4	-3.7	-4.5	-2.6
1992	-1.6	-0.7	-0.4	-0.3	-0.1	0.0	0.0	0.3	1.1	-5.0	-4.9	-2.8
1993	-1.7	-0.7	-0.6	0.0	0.3	0.2	0.0	0.1	0.5	1.3	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-1.2	-1.5	-3.7	-3.1
1995	-1.4	-0.5	-0.3	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1
1996	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	-5.2	-5.2	-2.9
2002	-1.8	-0.7	-1.0	-0.2	1.0	0.9	1.1	0.6	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.3	0.1
Average	-0.5	-0.2	-0.2	-0.1	0.1	0.1	0.1	-0.2	0.0	-0.9	-1.3	-0.8
Critical	-1.1	-0.5	-0.3	-0.2	0.3	0.3	0.1	-1.1	-0.2	-3.5	-4.6	-3.0
Dry	-0.6	-0.2	-0.2	-0.1	0.1	0.2	0.3	0.4	0.4	-1.2	-2.0	-1.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.2	-0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.1	0.0
Wet	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-76. San Joaquin River location RSAN018 (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13.0	-12.4	33.3	-16.0	-61.1
1977	-62.6	-29.2	-17.0	-7.2	-1.8	-0.7	-0.2	-12.7	-11.9	43.3	-39.6	-38.7
1978	-44.9	-23.3	-11.6	-0.2	0.5	0.2	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-47.0	67.7	-30.5
1982	-14.8	-11.9	-0.8	0.1	-2.1	-1.1	0.1	0.0	-0.1	0.0	0.0	0.0
1983	0.0	0.0	-0.1	0.0	0.2	0.2	0.1	-0.1	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	3.6	40.7	31.0	-46.0
1988	-49.2	-23.5	-9.1	-1.1	-0.1	0.0	0.0	0.7	3.7	62.7	-15.5	-32.3
1989	-51.1	-23.4	-12.2	-5.3	-2.1	0.3	0.5	0.6	0.6	-10.2	5.9	-3.6
1990	-2.3	-0.8	-0.6	-0.6	3.1	5.5	2.4	-4.7	-2.1	68.0	-36.7	-40.8
1991	-54.9	-30.0	-15.8	-5.8	-1.9	-0.3	0.0	-5.1	-3.7	61.1	-25.1	-32.5
1992	-45.3	-22.6	-13.2	-6.4	-0.5	0.0	0.0	0.9	6.7	46.2	-38.7	-35.6
1993	-32.4	-15.9	-13.0	0.2	1.1	0.4	0.1	0.2	-0.9	1.4	3.0	1.3
1994	0.2	0.1	0.0	0.0	0.0	0.0	0.0	-0.7	-8.2	-63.4	55.2	-0.3
1995	-15.3	-8.3	-8.3	-0.2	0.2	0.1	0.1	0.0	0.1	0.0	0.2	0.3
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.7	51.5	0.0	-15.0
2002	-34.2	-17.0	-7.3	-0.4	0.3	0.3	0.2	0.2	0.3	0.6	0.3	0.2
2003	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	8.5	-10.0	-10.6
Average	-12.0	-6.0	-3.2	-0.8	-0.1	0.1	0.1	-0.9	-0.6	8.7	-0.6	-10.2
Critical	-30.6	-15.1	-8.0	-3.0	-0.2	0.6	0.3	-5.0	-4.0	35.9	-16.6	-34.5
Dry	-14.2	-6.7	-3.3	-1.0	-0.3	0.1	0.1	0.3	1.4	5.9	17.5	-15.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
AN	-12.9	-6.5	-4.1	0.0	0.3	0.1	0.0	0.1	-0.1	1.7	-1.2	-1.5
Wet	-2.3	-1.6	-0.7	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-77. San Joaquin River location RSAN018 (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.3	-1.3	1.5	-0.9	-2.9
1977	-2.6	-1.4	-0.6	-0.4	-0.3	-0.2	0.0	-1.7	-0.9	2.7	-1.6	-1.4
1978	-2.2	-1.1	-0.7	-0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.6	3.8	-1.2
1982	-0.5	-0.8	-0.3	0.0	-1.0	-0.5	0.0	0.0	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	4.1	2.5	-2.5
1988	-2.4	-1.2	-0.7	-0.3	0.0	0.0	0.0	0.2	0.9	5.4	-1.0	-1.7
1989	-2.0	-1.1	-0.5	-0.3	-0.3	0.1	0.2	0.3	0.1	-0.7	0.3	-0.2
1990	-0.1	0.0	0.0	-0.1	0.8	1.6	0.7	-1.3	-0.3	3.3	-1.8	-1.8
1991	-2.3	-1.2	-0.6	-0.4	-0.2	-0.1	0.0	-1.3	-0.4	2.8	-1.3	-1.5
1992	-1.9	-1.0	-0.6	-0.3	-0.1	0.0	0.0	0.2	1.2	3.6	-2.0	-1.6
1993	-1.8	-0.9	-0.7	0.1	0.4	0.2	0.0	0.1	-0.4	0.5	0.3	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-1.5	-2.8	2.5	0.0
1995	-1.0	-0.5	-0.4	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	5.4	0.0	-0.8
2002	-1.8	-0.9	-1.0	-0.2	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.7	-0.9	-1.1
Average	-0.6	-0.3	-0.2	-0.1	0.0	0.0	0.0	-0.2	0.0	0.7	0.0	-0.5
Critical	-1.3	-0.7	-0.4	-0.2	0.0	0.2	0.1	-0.9	-0.3	2.3	-0.9	-1.6
Dry	-0.6	-0.3	-0.3	-0.1	0.0	0.0	0.0	0.1	0.3	0.9	1.1	-0.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.7	-0.3	-0.2	0.0	0.1	0.0	0.0	0.0	-0.1	0.4	-0.1	-0.2
Wet	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-78. San Joaquin River location RSAN032 (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.1	-2.7	15.8	-24.8	-31.1
1977	-19.1	-8.0	-5.3	-2.8	-0.8	-0.3	-0.1	-2.4	-2.9	-20.4	-16.1	-26.5
1978	-17.1	-7.2	-3.9	0.4	0.7	0.2	0.0	0.1	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11.9	6.7	10.0
1982	-7.1	-6.1	0.0	0.0	-0.9	-0.3	0.0	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	4.6	-7.6	-15.2
1988	-10.0	-5.7	-3.1	-0.4	-0.1	0.0	0.0	0.1	0.5	7.4	-4.0	-19.7
1989	-15.4	-6.3	-3.7	-2.2	-0.8	0.4	0.6	0.2	0.1	-2.2	1.1	1.6
1990	-0.8	-0.3	-0.2	-0.2	0.7	0.9	0.6	-0.4	-0.4	14.7	-3.5	-21.5
1991	-16.7	-9.2	-5.4	-2.7	-0.9	-0.1	0.0	-0.7	-0.6	13.2	-3.2	-17.9
1992	-13.7	-6.9	-4.5	-2.5	0.0	0.0	0.0	0.1	0.7	5.2	-7.6	-16.3
1993	-8.6	-4.2	-3.5	0.9	1.0	0.2	0.0	0.2	-2.4	-0.6	0.4	0.2
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.1	-14.5	-14.3	11.3
1995	-1.2	-1.3	-2.0	0.2	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	7.5	1.8	-9.3
2002	-7.2	-3.8	-2.6	0.1	0.3	0.1	0.2	0.1	0.0	0.1	0.1	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	-2.0	-2.4
Average	-3.4	-1.7	-1.0	-0.3	0.0	0.0	0.1	-0.1	-0.2	0.6	-2.1	-4.0
Critical	-8.6	-4.3	-2.6	-1.2	-0.1	0.1	0.1	-0.8	-0.9	3.1	-10.5	-17.4
Dry	-3.8	-1.7	-1.0	-0.4	-0.1	0.1	0.1	0.1	0.1	-0.3	0.3	-2.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
AN	-4.3	-1.9	-1.2	0.2	0.3	0.1	0.0	0.1	-0.4	0.1	-0.3	-0.4
Wet	-0.6	-0.6	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-79. San Joaquin River location RSAN032 (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.8	3.4	-4.7	-5.8
1977	-3.1	-1.4	-0.7	-0.4	-0.2	-0.1	0.0	-0.8	-0.8	-4.7	-3.1	-3.5
1978	-2.7	-1.3	-0.7	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.7	1.6	1.9
1982	-1.2	-1.4	0.0	0.0	-0.5	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.7	-2.1	-3.6
1988	-2.0	-1.2	-0.6	-0.2	0.0	0.0	0.0	0.0	0.2	2.6	-0.9	-3.9
1989	-2.4	-1.1	-0.5	-0.3	-0.2	0.2	0.3	0.1	0.0	-0.6	0.2	0.4
1990	-0.2	0.0	0.0	0.0	0.3	0.4	0.2	-0.2	-0.1	3.4	-0.6	-3.8
1991	-2.5	-1.3	-0.7	-0.4	-0.2	0.0	0.0	-0.3	-0.2	2.8	-0.6	-3.3
1992	-2.2	-1.1	-0.6	-0.4	0.0	0.0	0.0	0.0	0.3	1.7	-1.6	-3.0
1993	-1.7	-0.9	-0.6	0.3	0.4	0.1	0.0	0.1	-1.1	-0.3	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-3.1	-2.6	2.1
1995	-0.3	-0.3	-0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.9	0.5	-2.2
2002	-1.5	-0.8	-0.8	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	-0.7	-0.9
Average	-0.6	-0.3	-0.2	0.0	0.0	0.0	0.0	0.0	-0.1	0.2	-0.4	-0.8
Critical	-1.4	-0.7	-0.4	-0.2	0.0	0.0	0.0	-0.3	-0.3	0.9	-2.0	-3.0
Dry	-0.6	-0.3	-0.2	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.7	-0.4	-0.2	0.1	0.1	0.0	0.0	0.0	-0.2	0.1	-0.1	-0.1
Wet	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-80. Sacramento River location RSAC081 (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.6	-2.1	-0.8	-0.2	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-1.2	41.2	-270.2	-549.6	-503.1
1977	-258.7	-97.6	-45.3	-10.5	-9.7	-2.8	-0.9	15.4	30.9	-272.4	-394.9	-297.8
1978	-168.5	-63.0	12.1	2.3	0.5	0.2	0.2	0.6	4.6	5.6	2.1	0.5
1979	0.2	0.1	-0.7	7.3	0.8	0.5	1.6	1.9	2.1	0.8	0.4	0.0
1980	1.5	18.9	35.0	1.5	-0.3	0.1	0.3	0.9	0.8	0.2	0.1	0.0
1981	-0.1	0.5	-0.8	5.1	0.9	0.6	1.9	6.3	6.9	-55.8	-381.4	-278.8
1982	-107.3	-22.2	-0.1	0.1	-0.3	-0.3	0.0	0.0	0.6	1.3	0.7	-0.1
1983	8.9	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.3	0.8
1984	4.1	0.2	0.0	0.0	0.0	0.0	0.4	2.4	2.1	0.5	0.1	0.0
1985	-0.3	5.3	4.3	7.2	5.3	1.5	1.5	3.5	3.1	1.6	1.7	1.6
1986	1.2	1.0	10.7	2.6	0.0	0.0	0.2	0.4	0.4	0.1	0.1	0.0
1987	0.0	0.0	0.3	3.7	1.8	0.4	0.8	1.6	11.7	-245.0	-621.5	-542.1
1988	-249.9	-99.9	38.0	12.0	2.8	3.0	27.9	20.2	23.4	-441.2	-534.6	-390.8
1989	-217.2	-71.7	75.4	74.0	12.8	4.8	10.0	17.5	10.3	-32.3	-239.6	-169.7
1990	-64.2	-25.7	-10.9	21.6	63.3	82.3	36.1	36.5	52.1	-434.1	-534.6	-403.0
1991	-227.6	-89.6	-38.7	-11.2	44.7	14.4	20.0	68.5	80.5	-294.3	-379.8	-290.7
1992	-160.1	-59.8	-25.3	-12.1	9.8	9.0	33.4	38.3	31.3	-419.7	-541.1	-389.4
1993	-205.3	-72.5	101.8	12.2	0.9	1.4	0.3	1.6	10.8	26.0	11.0	2.7
1994	1.2	0.7	-0.7	45.1	23.2	30.8	32.4	34.3	58.0	-63.1	-405.7	-338.4
1995	-143.9	-50.2	33.4	4.1	0.4	0.0	0.1	0.0	0.1	1.3	19.6	9.9
1996	1.8	0.0	13.7	1.1	0.0	0.0	0.0	0.1	5.4	7.8	2.7	0.3
1997	0.0	-1.3	0.1	0.0	0.0	0.5	1.7	4.9	5.3	1.9	0.1	0.6
1998	0.4	0.1	9.9	1.6	0.0	0.0	0.0	0.0	0.0	0.1	4.3	3.8
1999	2.7	4.7	0.7	0.0	0.0	0.0	0.1	0.7	4.9	3.7	1.3	0.2
2000	0.0	0.0	-0.1	9.5	0.1	0.0	0.3	1.1	2.4	1.1	0.2	0.0
2001	0.0	-0.1	1.6	10.4	1.7	0.4	2.3	23.4	38.6	-415.8	-479.6	-379.4
2002	-210.7	37.4	22.3	0.7	14.2	15.4	18.6	19.8	18.1	7.0	6.2	5.7
2003	1.1	-1.0	6.9	0.1	0.5	2.2	0.7	0.1	29.3	-14.5	-44.6	-34.1
Average	-58.6	-17.2	7.2	5.5	5.1	4.8	5.5	8.8	14.0	-85.3	-148.7	-117.4
Critical	-137.0	-53.2	-11.8	6.4	19.2	19.5	21.4	30.3	45.4	-313.6	-477.2	-373.3
Dry	-71.4	-4.8	17.2	16.9	6.1	3.8	5.9	12.0	14.8	-123.4	-285.7	-227.1
BN	0.1	0.0	-0.3	3.6	0.4	0.2	0.8	1.0	1.1	0.4	0.2	0.0
AN	-61.9	-19.6	26.0	4.3	0.3	0.6	-0.1	0.6	8.0	3.1	-5.2	-5.1
Wet	-17.9	-5.1	5.3	0.7	0.0	0.0	0.2	0.7	1.4	1.3	2.3	1.2

Table 1-81. Sacramento River location RSAC081 (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.3	-0.8	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	-4.1	-7.1	-5.3
1977	-2.3	-0.9	-0.4	-0.2	-0.3	-0.1	0.0	0.3	0.4	-3.1	-4.2	-2.8
1978	-1.6	-0.6	0.2	0.8	0.2	0.1	0.1	0.3	0.8	0.3	0.0	0.0
1979	0.0	0.0	0.0	0.5	0.3	0.2	0.5	0.5	0.2	0.0	0.0	0.0
1980	0.0	0.3	1.1	0.6	-0.2	0.0	0.1	0.3	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.4	0.3	0.2	0.4	0.4	0.2	-1.3	-6.2	-3.5
1982	-1.1	-1.7	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.2	0.1	0.0	0.0
1983	1.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2
1984	0.5	0.1	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.0	0.0	0.0
1985	0.0	0.8	0.6	0.5	0.5	0.2	0.2	0.3	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.3	0.4	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.3	-4.9	-8.8	-6.3
1988	-2.5	-1.0	1.0	2.8	0.5	0.1	1.1	0.7	0.6	-7.3	-6.7	-4.2
1989	-1.9	-0.8	0.9	1.4	0.3	1.3	3.9	2.1	0.3	-0.7	-4.3	-2.9
1990	-0.8	-0.3	-0.1	0.8	5.2	4.8	1.7	1.2	0.9	-5.8	-6.5	-4.2
1991	-2.1	-0.8	-0.4	-0.2	1.0	2.5	2.7	2.3	1.3	-3.9	-4.7	-3.0
1992	-1.5	-0.6	-0.2	-0.2	1.3	2.3	3.2	1.2	0.8	-6.8	-6.4	-4.2
1993	-2.1	-0.8	1.5	3.1	0.4	0.7	0.2	0.8	4.2	2.0	0.3	0.1
1994	0.0	0.0	0.0	1.2	2.8	2.6	2.1	1.7	1.2	-1.0	-5.6	-3.9
1995	-1.8	-0.6	0.5	1.3	0.2	0.0	0.0	0.0	0.1	0.5	1.7	0.9
1996	0.2	0.0	1.7	0.5	0.0	0.0	0.0	0.0	0.9	0.4	0.1	0.0
1997	0.0	-0.1	0.1	0.0	0.0	0.2	0.6	0.8	0.3	0.1	0.0	0.1
1998	0.0	0.0	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.7
1999	0.2	0.7	0.3	0.0	0.0	0.0	0.0	0.3	0.6	0.2	0.0	0.0
2000	0.0	0.0	0.0	0.9	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.4	0.5	0.1	0.4	1.3	1.3	-8.6	-7.1	-4.5
2002	-2.2	0.4	2.0	0.3	3.9	3.5	4.2	2.4	0.6	0.1	0.1	0.1
2003	0.0	0.0	0.7	0.1	0.2	0.8	0.3	0.1	2.4	-0.7	-1.1	-1.3
Average	-0.5	-0.2	0.3	0.5	0.5	0.6	0.6	0.5	0.5	-1.3	-1.9	-1.3
Critical	-1.3	-0.5	0.0	0.6	1.5	1.8	1.5	1.0	0.8	-4.6	-5.9	-3.9
Dry	-0.7	0.1	0.6	0.5	1.0	0.9	1.5	1.1	0.5	-2.5	-4.4	-2.8
BN	0.0	0.0	0.0	0.3	0.2	0.1	0.3	0.3	0.1	0.0	0.0	0.0
AN	-0.6	-0.2	0.6	0.9	0.1	0.2	0.0	0.2	1.3	0.3	-0.1	-0.2
Wet	-0.1	-0.1	0.3	0.2	0.0	0.0	0.1	0.1	0.2	0.1	0.2	0.2

Table 1-82. Sacramento River location RSAC092 (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.2	-1.3	-0.3	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	23.4	-113.4	-357.1	-331.2
1977	-133.3	-34.0	-10.8	-3.5	-1.7	0.4	0.6	8.3	17.7	-238.7	-237.9	-216.1
1978	-88.7	-18.1	2.1	0.5	0.3	0.1	0.1	0.1	0.4	0.6	0.5	0.1
1979	0.0	0.0	-0.2	0.9	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.0
1980	1.5	4.7	5.5	0.2	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1981	0.0	0.1	-0.2	0.5	0.1	0.0	0.1	1.0	2.0	-14.8	-182.2	-97.8
1982	-42.8	-4.2	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.0
1983	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.1	0.0	0.0
1985	0.0	0.3	0.3	0.8	0.4	0.2	0.2	0.4	0.8	0.5	1.0	0.8
1986	1.0	0.8	1.5	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.2	0.7	0.2	0.0	0.5	1.4	4.5	-102.4	-364.1	-289.0
1988	-105.2	-31.8	4.8	1.0	0.2	2.3	5.9	5.4	7.5	-227.3	-292.9	-245.0
1989	-104.3	-14.4	38.0	23.8	5.6	0.7	0.8	1.5	3.4	-10.9	-89.9	-50.9
1990	-18.6	-4.6	1.3	2.0	5.7	11.1	5.7	9.6	22.5	-234.0	-278.2	-250.7
1991	-116.1	-28.3	-6.9	2.8	11.5	1.9	2.4	18.8	38.1	-169.9	-200.9	-186.8
1992	-75.7	-16.1	3.8	0.9	1.3	0.8	3.9	10.6	11.5	-220.8	-307.2	-220.8
1993	-102.1	-17.8	33.6	1.9	0.6	0.6	0.1	0.3	0.0	1.8	2.5	0.6
1994	0.2	0.1	-0.1	9.6	2.5	4.0	4.1	5.8	22.3	-19.7	-246.9	-156.4
1995	-53.1	-7.6	8.4	0.6	0.2	0.0	0.0	0.0	0.0	0.2	2.2	1.0
1996	0.1	0.0	0.8	0.2	0.0	0.0	0.0	0.0	0.4	1.0	0.7	0.1
1997	0.0	-0.1	0.1	0.0	0.0	0.0	0.1	0.4	0.8	0.2	-0.1	0.1
1998	0.4	0.0	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2
1999	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.4	0.3	0.0
2000	0.0	0.0	0.1	0.9	0.0	0.0	0.1	0.1	0.3	0.1	0.0	0.0
2001	0.0	0.0	0.6	1.5	0.1	0.0	0.2	4.6	9.9	-160.9	-207.7	-213.6
2002	-87.2	24.1	4.4	0.3	0.8	0.8	1.0	1.6	5.2	1.5	4.2	2.0
2003	-0.1	0.9	1.1	0.1	0.0	0.1	0.1	0.0	4.7	-1.3	-10.3	-6.9
Average	-27.2	-4.3	2.6	1.4	0.8	0.7	0.7	2.1	5.2	-44.3	-81.3	-66.5
Critical	-64.1	-16.4	-1.1	1.8	2.8	2.9	3.2	8.3	20.4	-174.8	-274.4	-229.6
Dry	-31.9	1.7	7.2	4.6	1.2	0.3	0.5	1.8	4.3	-47.8	-139.8	-108.1
BN	0.0	0.0	-0.1	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0
AN	-31.6	-5.1	7.1	0.6	0.2	0.1	-0.2	0.1	0.9	0.2	-1.2	-1.0
Wet	-7.2	-0.8	0.9	0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.1

Table 1-83. Sacramento River location RSAC092 (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	-7.9	-14.5	-9.9
1977	-3.4	-1.1	-0.4	-0.4	-0.3	0.1	0.1	0.6	0.7	-8.6	-8.1	-5.2
1978	-2.4	-0.5	0.2	0.3	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.0
1979	0.0	0.0	0.0	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.1	0.4	1.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.3	0.4	-1.9	-12.8	-4.6
1982	-1.5	-1.2	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1985	0.0	0.1	0.1	0.3	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.0
1986	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.3	0.7	-9.9	-17.8	-10.9
1988	-3.4	-1.1	0.7	0.4	0.1	0.5	1.3	1.0	1.0	-15.9	-11.6	-7.6
1989	-2.5	-0.6	1.9	2.3	0.7	0.4	0.4	0.7	0.6	-1.2	-7.7	-3.9
1990	-1.0	-0.2	0.1	0.4	2.1	3.5	1.5	1.6	1.5	-12.7	-11.0	-7.7
1991	-3.0	-0.7	-0.2	0.2	1.4	0.8	1.0	3.1	2.5	-9.0	-8.2	-5.6
1992	-1.9	-0.4	0.1	0.1	0.5	0.4	1.5	1.7	1.5	-14.9	-11.6	-7.1
1993	-3.2	-0.6	2.4	0.8	0.3	0.3	0.1	0.2	0.0	0.7	0.3	0.1
1994	0.0	0.0	0.0	1.3	1.0	1.5	1.4	1.6	1.9	-1.6	-12.5	-6.3
1995	-2.3	-0.3	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.9	0.4
1996	0.1	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.2	0.3	0.1	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.0	0.0
1998	0.1	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1999	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0
2000	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
2001	0.0	0.0	0.1	0.3	0.1	0.0	0.1	1.2	1.9	-16.5	-11.4	-8.1
2002	-3.1	1.2	1.4	0.1	0.4	0.4	0.5	0.7	0.8	0.2	0.3	0.1
2003	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	1.7	-0.4	-1.4	-1.4
Average	-0.8	-0.1	0.3	0.2	0.2	0.2	0.2	0.4	0.5	-2.9	-3.7	-2.3
Critical	-1.8	-0.5	0.0	0.3	0.7	1.0	1.0	1.4	1.4	-10.1	-11.1	-7.1
Dry	-0.9	0.1	0.6	0.5	0.3	0.1	0.2	0.6	0.7	-4.9	-8.2	-4.5
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
AN	-0.9	-0.1	0.7	0.3	0.1	0.1	-0.1	0.0	0.3	0.1	-0.2	-0.2
Wet	-0.2	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0

Table 1-84. Sacramento River location RSAC101 (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.1	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	-8.3	-52.2	-49.0
1977	-18.5	-4.8	-2.3	-1.0	-0.4	-0.1	0.0	1.0	2.7	-40.5	-27.7	-37.9
1978	-12.7	-2.3	-0.3	0.3	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.0
1979	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.1	0.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	-1.5	-14.7	-6.9
1982	-7.2	-0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1986	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	-6.2	-44.5	-33.9
1988	-13.0	-4.6	0.1	0.2	0.0	0.5	0.4	0.5	0.7	-18.4	-36.0	-40.3
1989	-15.4	-2.8	3.9	2.7	0.7	0.2	0.3	0.2	0.2	-1.0	-7.7	-4.4
1990	-3.0	-1.8	-0.8	0.0	0.6	0.8	0.4	0.8	3.0	-21.0	-30.7	-38.0
1991	-16.8	-3.4	-1.6	0.1	0.7	0.3	0.4	1.5	4.6	-15.4	-23.0	-30.0
1992	-10.5	-1.8	1.2	-0.9	0.4	0.3	0.4	0.7	0.8	-18.4	-35.7	-28.6
1993	-13.9	-1.3	2.7	0.6	0.4	0.3	0.0	0.1	0.0	0.0	0.3	0.1
1994	0.0	0.0	0.0	0.8	0.3	0.4	0.2	0.3	2.5	-2.1	-28.6	-10.5
1995	-4.4	-0.6	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1
1996	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.4	0.7	-8.6	-16.0	-24.2
2002	-9.3	1.6	0.4	0.1	0.3	0.1	0.2	0.2	0.5	0.1	0.4	-0.1
2003	-0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.3	-0.8	-0.7
Average	-3.7	-0.6	0.1	0.1	0.1	0.1	0.1	0.2	0.6	-4.1	-9.3	-9.0
Critical	-8.8	-2.3	-0.5	-0.1	0.3	0.3	0.3	0.7	2.5	-17.7	-33.4	-33.5
Dry	-4.1	-0.2	0.7	0.5	0.2	0.1	0.1	0.2	0.3	-2.9	-13.7	-11.6
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-4.5	-0.5	0.5	0.2	0.1	0.1	0.0	0.0	0.1	0.1	-0.1	-0.1
Wet	-0.9	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-85. Sacramento River location RSAC101 (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	-2.8	-12.3	-9.8
1977	-3.2	-1.0	-0.5	-0.4	-0.2	0.0	0.0	0.4	0.7	-9.1	-6.3	-5.9
1978	-2.3	-0.5	-0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	-0.7	-4.9	-1.9
1982	-1.7	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	-2.6	-12.6	-8.3
1988	-2.8	-1.1	0.0	0.1	0.0	0.2	0.2	0.3	0.3	-6.6	-8.6	-8.0
1989	-2.3	-0.7	1.0	1.0	0.3	0.1	0.2	0.1	0.1	-0.4	-2.7	-1.5
1990	-0.9	-0.4	-0.2	0.0	0.3	0.4	0.2	0.4	1.0	-6.4	-7.1	-7.5
1991	-2.7	-0.5	-0.3	0.0	0.3	0.2	0.2	0.7	1.6	-4.5	-5.5	-5.7
1992	-1.7	-0.3	0.2	-0.3	0.2	0.2	0.2	0.3	0.3	-6.5	-8.4	-6.0
1993	-2.9	-0.3	0.9	0.3	0.2	0.2	0.0	0.1	0.0	0.0	0.1	0.0
1994	0.0	0.0	0.0	0.3	0.2	0.2	0.1	0.2	1.0	-0.8	-7.8	-2.7
1995	-1.1	-0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.3	-3.7	-5.0	-6.2
2002	-2.3	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.0
2003	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	-0.4	-0.3
Average	-0.7	-0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.2	-1.3	-2.4	-1.9
Critical	-1.6	-0.5	-0.1	0.0	0.1	0.2	0.1	0.3	0.8	-5.2	-8.0	-6.5
Dry	-0.8	0.0	0.2	0.2	0.1	0.0	0.1	0.1	0.2	-1.2	-4.2	-3.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.9	-0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Wet	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-86. San Joaquin River location RSAN007 (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-1.9	-3.6	-1.1	-0.2	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.3	-1.6	33.9	-174.5	-324.3	-374.0
1977	-237.7	-101.4	-52.2	-20.1	-13.4	-9.1	-5.7	7.9	26.7	-108.7	-296.1	-229.1
1978	-149.9	-66.6	-0.3	2.4	0.6	0.4	0.2	0.2	1.6	3.3	1.6	0.5
1979	0.1	0.0	-0.6	3.2	0.5	0.3	0.3	0.5	0.9	0.5	0.3	0.0
1980	0.2	13.3	24.7	2.4	-1.8	0.3	0.1	0.2	0.3	0.1	0.1	0.0
1981	-0.1	-0.3	-0.7	2.0	0.4	0.2	0.5	2.8	2.6	-41.6	-225.1	-248.5
1982	-110.4	-21.5	-1.1	0.1	-1.7	-1.2	0.1	0.0	0.0	0.5	0.5	0.0
1983	3.8	0.7	0.0	0.0	0.2	0.2	0.1	-0.1	0.0	0.1	0.3	0.2
1984	2.0	0.2	0.0	0.0	0.0	0.0	0.1	0.8	1.0	0.1	0.0	0.0
1985	-0.2	2.3	2.3	3.8	2.8	0.6	0.5	1.4	1.3	0.8	0.4	0.8
1986	-0.1	-0.2	6.3	1.7	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
1987	0.0	-0.2	-0.1	2.2	1.2	0.2	0.0	-2.3	2.5	-119.1	-334.5	-409.9
1988	-227.3	-98.8	12.6	6.3	1.0	-1.6	13.7	8.0	13.1	-230.3	-363.6	-291.7
1989	-211.1	-89.6	59.2	56.1	-1.9	1.4	2.7	5.9	1.9	-22.5	-156.7	-145.9
1990	-66.2	-36.3	-24.6	6.6	30.3	45.9	22.4	21.2	39.5	-264.1	-392.9	-311.1
1991	-216.9	-100.6	-52.5	-33.3	20.9	9.0	8.1	41.2	56.2	-177.4	-271.2	-226.6
1992	-160.4	-72.7	-46.3	-32.2	-2.4	3.1	14.1	17.1	11.3	-229.0	-378.0	-309.6
1993	-168.6	-76.0	68.0	16.2	1.2	0.9	0.4	0.5	2.1	13.5	8.3	2.7
1994	0.8	0.5	-0.5	28.4	15.4	15.2	17.1	17.7	39.7	-46.6	-230.3	-259.4
1995	-117.0	-49.8	20.8	5.7	0.6	0.2	0.1	0.0	0.0	0.3	10.6	7.0
1996	0.8	0.0	6.2	0.8	0.1	0.0	0.0	0.1	1.9	5.3	2.1	0.4
1997	0.1	-0.5	0.1	-0.2	-0.1	0.1	0.4	1.4	2.6	0.4	-0.2	0.9
1998	-0.3	-1.2	5.9	1.7	0.3	0.1	0.0	0.1	0.1	0.0	1.8	1.6
1999	1.3	2.2	0.3	0.0	0.0	0.0	0.0	0.2	2.0	2.4	1.0	0.2
2000	0.0	0.0	-0.4	3.3	0.1	0.1	0.1	0.2	1.2	0.1	0.1	0.0
2001	0.0	-0.1	0.4	4.7	0.8	0.1	0.7	11.4	20.0	-208.0	-304.9	-273.7
2002	-189.8	24.8	22.0	0.9	4.8	5.9	5.2	6.8	8.3	4.6	1.4	2.2
2003	-0.4	-4.5	3.1	0.3	0.1	0.6	0.2	0.1	16.2	4.9	-33.3	-27.4
Average	-54.3	-19.9	1.5	1.9	1.8	2.1	2.3	4.1	8.4	-46.6	-96.5	-90.9
Critical	-129.7	-58.5	-23.4	-6.3	7.4	8.9	10.0	15.9	31.5	-175.8	-322.3	-285.9
Dry	-66.9	-10.5	13.9	11.6	1.3	1.4	1.6	4.3	6.1	-64.3	-169.9	-179.2
BN	0.1	0.0	-0.3	1.6	0.2	0.1	0.2	0.3	0.5	0.3	0.1	0.0
AN	-53.1	-22.3	15.8	4.1	0.1	0.1	-0.4	0.0	3.5	3.7	-3.9	-4.0
Wet	-16.9	-5.4	3.0	0.8	0.0	0.0	0.1	0.2	0.6	0.7	1.2	0.8

Table 1-87. San Joaquin River location RSAN007 (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.8	-1.6	-0.4	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.8	-3.7	-6.4	-5.7
1977	-3.2	-1.5	-0.7	-0.6	-0.8	-0.5	-0.3	0.3	0.5	-1.9	-4.4	-3.0
1978	-2.2	-1.0	0.0	0.6	0.2	0.1	0.1	0.1	0.5	0.3	0.1	0.0
1979	0.0	0.0	0.0	0.3	0.2	0.1	0.1	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.3	1.2	0.7	-0.7	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.2	0.1	0.1	0.2	0.4	0.2	-1.4	-5.4	-4.4
1982	-1.6	-1.4	-0.4	0.0	-0.8	-0.5	0.0	0.0	0.0	0.1	0.0	0.0
1983	1.1	0.3	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
1984	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1985	0.0	0.5	0.5	0.5	0.5	0.1	0.1	0.2	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.2	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.1	0.0	-0.2	0.1	-3.9	-7.5	-7.1
1988	-3.5	-1.6	0.5	1.6	0.3	-0.2	1.1	0.5	0.7	-6.0	-7.1	-4.7
1989	-2.7	-1.4	1.0	1.5	-0.1	0.4	1.2	1.5	0.1	-0.7	-4.1	-3.5
1990	-1.3	-0.6	-0.4	0.3	4.5	5.3	2.2	1.4	1.2	-5.1	-7.0	-4.7
1991	-3.0	-1.3	-0.7	-0.7	0.8	1.8	2.0	2.7	1.5	-3.4	-4.9	-3.4
1992	-2.2	-1.0	-0.6	-0.6	-0.3	1.0	2.8	1.0	0.5	-5.8	-6.6	-4.7
1993	-2.7	-1.2	1.4	2.7	0.4	0.4	0.2	0.2	1.0	1.9	0.3	0.1
1994	0.0	0.0	0.0	1.1	2.2	2.5	2.3	1.8	1.5	-1.0	-4.5	-4.1
1995	-2.4	-0.9	0.5	1.1	0.3	0.1	0.1	0.0	0.0	0.1	1.8	1.2
1996	0.2	0.0	1.4	0.4	0.0	0.0	0.0	0.0	0.6	0.5	0.1	0.0
1997	0.0	-0.1	0.0	-0.1	0.0	0.0	0.2	0.5	0.3	0.0	0.0	0.1
1998	0.0	-0.2	0.7	0.5	0.1	0.0	0.0	0.1	0.0	0.0	0.5	0.5
1999	0.2	0.5	0.2	0.0	0.0	0.0	0.0	0.1	0.5	0.2	0.0	0.0
2000	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.3	0.2	0.0	0.2	1.3	1.3	-7.0	-7.2	-4.7
2002	-3.0	0.4	2.1	0.4	1.9	2.2	2.0	1.7	0.5	0.1	0.0	0.0
2003	0.0	-0.1	0.3	0.2	0.1	0.3	0.1	0.0	2.6	0.4	-1.3	-1.5
Average	-0.8	-0.3	0.2	0.3	0.3	0.4	0.4	0.4	0.4	-1.1	-1.9	-1.5
Critical	-1.9	-0.8	-0.3	0.2	1.0	1.4	1.4	1.1	1.0	-3.8	-5.8	-4.3
Dry	-1.0	-0.1	0.6	0.5	0.5	0.5	0.6	0.8	0.4	-2.1	-4.0	-3.3
BN	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
AN	-0.8	-0.3	0.5	0.7	0.0	0.0	-0.2	0.0	0.7	0.5	-0.2	-0.2
Wet	-0.2	-0.1	0.2	0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1

Table 1-88. San Joaquin River location RSAN018 (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.1	-2.6	-4.3	-1.0	-0.2	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	11.4	39.4	-34.8	-119.6
1977	-118.7	-61.8	-46.5	-30.1	-10.4	-6.2	-4.1	0.4	10.1	24.7	-70.5	-81.8
1978	-70.7	-40.1	-12.1	1.2	0.9	0.5	0.2	0.1	0.2	0.9	0.9	0.3
1979	0.1	0.0	-0.3	1.0	0.4	0.2	0.1	0.2	0.1	0.3	0.2	0.0
1980	-2.0	4.2	12.8	1.4	-1.8	0.3	0.0	0.1	0.1	0.0	0.0	0.0
1981	0.0	-0.9	-0.6	0.6	0.2	0.1	0.0	0.3	-0.1	-19.2	57.3	-98.1
1982	-85.9	-28.2	-0.9	0.1	-2.1	-1.1	0.1	0.0	-0.1	0.0	0.2	0.0
1983	0.6	0.2	0.0	0.0	0.2	0.2	0.1	-0.1	0.0	0.0	0.0	0.0
1984	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	-0.4	-0.1	0.0
1985	0.0	0.7	0.9	1.0	0.8	0.2	0.1	0.2	0.1	-0.5	-1.2	-1.5
1986	-1.5	-2.1	1.7	0.8	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.5	0.3	0.5	0.1	0.3	-1.6	-2.2	38.2	7.5	-113.7
1988	-108.0	-60.1	-10.9	2.0	0.4	-0.5	1.8	0.6	2.1	59.9	-63.8	-97.2
1989	-115.8	-71.2	13.9	19.2	-5.5	0.9	0.9	0.8	-2.4	-6.2	1.6	-64.6
1990	-50.5	-36.7	-29.8	-5.9	5.6	10.2	5.8	4.0	12.0	58.1	-75.3	-101.5
1991	-109.3	-66.5	-46.1	-27.1	-1.4	2.2	1.1	7.7	14.9	42.4	-52.3	-79.9
1992	-87.3	-50.1	-41.7	-40.4	-4.8	0.7	1.3	0.0	-2.7	48.7	-61.6	-109.7
1993	-70.5	-43.8	12.9	7.9	1.7	1.2	0.4	0.5	-0.7	2.6	4.3	1.9
1994	0.3	0.2	-0.3	7.8	6.7	2.8	2.8	2.3	9.8	-19.6	33.2	-33.4
1995	-37.3	-28.7	-0.2	3.5	0.9	0.2	0.1	0.0	0.1	0.1	2.0	2.4
1996	0.2	0.0	1.1	0.4	0.1	0.0	0.0	0.1	0.1	2.0	1.2	0.5
1997	0.0	-0.1	0.1	-0.2	-0.1	0.0	0.1	0.1	0.3	-0.9	-0.3	-0.5
1998	-0.3	-1.2	2.0	0.9	0.3	0.0	0.0	0.1	0.1	0.0	0.1	0.2
1999	0.4	0.8	0.2	0.0	0.0	0.0	0.1	0.1	0.2	0.9	0.6	0.2
2000	0.0	0.0	-0.9	0.4	0.1	0.1	0.1	0.1	0.2	-0.6	-0.1	0.0
2001	0.0	0.0	-1.3	0.6	0.3	0.1	0.1	1.4	2.1	67.0	-15.9	-66.4
2002	-85.6	-2.7	12.5	0.9	0.7	0.8	0.3	0.5	0.5	0.0	-4.2	-5.5
2003	-2.5	-6.4	1.9	0.4	0.1	0.1	0.1	0.1	2.6	24.5	-12.4	-16.5
Average	-27.8	-14.5	-3.9	-1.6	-0.2	0.3	0.2	0.5	1.7	10.7	-8.3	-29.0
Critical	-67.6	-39.3	-25.1	-13.4	-0.6	1.3	1.2	2.0	8.2	36.2	-46.4	-89.0
Dry	-33.6	-12.3	4.1	3.8	-0.5	0.3	0.3	0.3	-0.3	13.2	7.5	-58.3
BN	0.0	0.0	-0.1	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0
AN	-24.3	-14.4	2.4	1.9	0.2	-0.1	-0.6	0.0	0.4	4.6	-1.2	-2.4
Wet	-9.5	-4.6	0.3	0.4	0.0	0.0	0.1	0.0	0.1	0.1	0.3	0.2

Table 1-89. San Joaquin River location RSAN018 (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-1.1	-1.8	-0.4	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.2	1.8	-2.0	-5.7
1977	-5.0	-2.9	-1.8	-1.7	-1.6	-1.3	-0.9	0.1	0.8	1.5	-2.8	-3.0
1978	-3.5	-2.0	-0.7	0.3	0.3	0.2	0.1	0.1	0.1	0.3	0.1	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1980	-0.1	0.3	1.0	0.5	-0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.2	0.0	0.1	0.1	0.0	0.0	0.1	0.0	-1.5	3.2	-3.9
1982	-3.1	-2.0	-0.4	0.1	-0.9	-0.5	0.1	0.0	0.0	0.0	0.0	0.0
1983	0.3	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1985	0.0	0.2	0.3	0.3	0.3	0.1	0.1	0.1	0.0	0.0	-0.1	-0.1
1986	-0.1	-0.1	0.1	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	-0.1	0.0	0.1	0.0	0.1	-0.4	-0.5	3.9	0.6	-6.1
1988	-5.4	-3.1	-0.8	0.6	0.1	-0.2	0.5	0.2	0.5	5.1	-4.2	-5.1
1989	-4.6	-3.3	0.6	1.1	-0.7	0.3	0.4	0.4	-0.6	-0.4	0.1	-3.3
1990	-2.6	-1.8	-1.4	-0.6	1.4	3.1	1.8	1.1	1.6	2.8	-3.6	-4.5
1991	-4.7	-2.7	-1.8	-1.9	-0.2	0.7	0.4	2.0	1.5	1.9	-2.6	-3.7
1992	-3.7	-2.2	-1.8	-2.1	-0.9	0.2	0.5	0.0	-0.5	3.8	-3.2	-4.8
1993	-3.9	-2.5	0.6	1.7	0.6	0.5	0.2	0.2	-0.3	0.9	0.4	0.2
1994	0.1	0.0	0.0	0.6	1.4	0.9	1.0	0.8	1.8	-0.9	1.5	-1.3
1995	-2.5	-1.8	0.0	0.8	0.4	0.1	0.1	0.0	0.0	0.1	0.8	0.9
1996	0.1	0.0	0.4	0.2	0.1	0.0	0.0	0.1	0.1	0.4	0.1	0.0
1997	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.2	0.0	0.0
1998	-0.1	-0.4	0.5	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1
1999	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0
2000	0.0	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0
2001	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	0.5	0.6	7.1	-1.3	-3.6
2002	-4.4	-0.1	1.8	0.4	0.3	0.3	0.2	0.2	0.1	0.0	-0.2	-0.2
2003	-0.1	-0.3	0.2	0.2	0.0	0.0	0.0	0.1	1.0	4.8	-1.1	-1.7
Average	-1.3	-0.7	-0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.9	-0.4	-1.3
Critical	-3.0	-1.8	-1.1	-0.7	0.0	0.5	0.5	0.6	1.0	2.3	-2.4	-4.0
Dry	-1.5	-0.6	0.4	0.3	0.0	0.1	0.1	0.1	-0.1	1.5	0.4	-2.9
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.3	-0.8	0.2	0.5	0.1	0.0	-0.2	0.0	0.1	1.0	-0.1	-0.2
Wet	-0.4	-0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

Table 1-90. San Joaquin River location RSAN032 (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.2	-3.1	-0.4	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	17.3	-36.6	-47.2
1977	-30.6	-13.1	-13.2	-11.5	-3.5	-0.7	0.0	0.4	2.2	-18.1	-21.7	-36.0
1978	-21.5	-8.4	-5.0	1.2	1.0	0.5	0.2	0.2	0.1	0.1	0.1	0.1
1979	0.0	0.0	-0.1	0.5	0.5	0.1	0.1	0.2	0.0	0.0	0.0	0.0
1980	-0.2	0.7	3.8	0.3	-0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	-0.1	-0.2	0.3	0.1	0.0	0.1	0.3	0.2	-3.2	10.5	-1.4
1982	-17.7	-9.1	0.0	0.1	-0.9	-0.3	0.0	-0.1	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1985	0.0	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	-0.1	-0.2	-0.5
1986	-0.2	-0.5	0.2	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	-0.2	-0.1	0.1	0.0	0.7	1.0	0.4	4.1	-14.1	-27.5
1988	-19.9	-12.0	-5.5	0.7	0.3	1.3	1.2	1.2	0.9	7.3	-11.0	-33.8
1989	-26.6	-14.9	0.5	7.6	0.5	1.3	1.0	0.9	0.2	-1.0	3.2	-5.6
1990	-9.4	-8.4	-7.8	-3.3	1.1	1.7	1.3	0.8	1.9	12.8	-12.6	-35.3
1991	-27.2	-14.0	-11.7	-7.9	-0.6	1.2	0.8	1.2	3.3	8.4	-10.5	-26.5
1992	-20.1	-10.2	-8.9	-11.8	-0.2	0.7	0.5	0.9	0.4	5.6	-13.6	-30.3
1993	-19.7	-8.1	0.9	3.0	1.4	1.1	0.3	0.6	-2.1	-0.5	0.7	0.3
1994	0.1	0.0	-0.1	1.8	1.9	0.8	0.6	0.5	1.4	-3.8	-14.2	2.3
1995	-4.8	-3.1	-2.0	1.7	0.7	0.2	0.1	0.0	0.1	0.1	0.1	0.1
1996	0.0	0.0	0.2	0.3	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.1
1997	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.1	0.1	-0.1	-0.1	-0.5
1998	0.1	0.0	0.3	0.3	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1999	0.0	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1
2000	0.0	0.0	-0.2	0.2	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	0.0
2001	0.0	0.0	-0.6	-0.1	0.1	0.1	0.3	0.7	0.7	11.0	2.5	-18.8
2002	-16.3	-2.3	3.0	0.7	0.5	0.3	0.4	0.4	0.4	-0.2	-0.4	-1.5
2003	-1.0	-1.1	0.6	0.1	0.1	0.1	0.1	0.1	0.3	3.7	-0.4	-2.5
Average	-6.3	-3.1	-1.3	-0.4	0.1	0.2	0.2	0.3	0.4	1.3	-3.5	-7.8
Critical	-15.3	-8.2	-6.7	-4.6	-0.2	0.7	0.6	0.7	1.8	4.2	-17.2	-29.6
Dry	-7.2	-2.9	0.4	1.4	0.3	0.3	0.4	0.6	0.3	1.7	0.2	-9.2
BN	0.0	0.0	0.0	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
AN	-7.1	-2.8	0.0	0.8	0.4	-0.1	-0.4	0.1	-0.3	0.5	0.1	-0.4
Wet	-1.7	-1.0	-0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-91. San Joaquin River location RSAN032 (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-1.1	-1.3	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	3.7	-6.9	-8.9
1977	-4.9	-2.3	-1.8	-1.7	-0.9	-0.2	0.0	0.1	0.6	-4.2	-4.2	-4.8
1978	-3.4	-1.5	-0.9	0.5	0.4	0.2	0.1	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.2	0.7	0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.1	-0.1	0.1	0.1	0.0	0.0	0.1	0.1	-1.0	2.4	-0.3
1982	-3.0	-2.0	0.0	0.1	-0.5	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1
1986	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	-0.1	0.0	0.0	0.0	0.3	0.4	0.2	1.6	-4.0	-6.5
1988	-4.0	-2.4	-1.1	0.3	0.1	0.5	0.5	0.5	0.4	2.5	-2.6	-6.8
1989	-4.1	-2.6	0.1	1.1	0.1	0.6	0.5	0.4	0.1	-0.3	0.7	-1.2
1990	-2.1	-1.6	-1.3	-0.7	0.4	0.7	0.5	0.3	0.7	3.0	-2.3	-6.3
1991	-4.1	-2.0	-1.6	-1.2	-0.2	0.5	0.3	0.5	1.2	1.8	-2.0	-4.9
1992	-3.2	-1.6	-1.3	-1.7	-0.1	0.3	0.2	0.4	0.2	1.9	-2.9	-5.6
1993	-3.8	-1.7	0.2	1.0	0.6	0.5	0.2	0.3	-1.0	-0.3	0.2	0.1
1994	0.0	0.0	0.0	0.3	0.6	0.3	0.3	0.2	0.6	-0.8	-2.6	0.4
1995	-1.0	-0.8	-0.3	0.7	0.3	0.1	0.0	0.0	0.1	0.1	0.1	0.1
1996	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1
1998	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.2	0.0	0.0	0.0	0.1	0.3	0.3	4.3	0.7	-4.5
2002	-3.4	-0.5	0.9	0.3	0.2	0.1	0.2	0.1	0.2	-0.1	-0.1	-0.3
2003	-0.2	-0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1	1.7	-0.1	-0.9
Average	-1.1	-0.6	-0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.4	-0.7	-1.5
Critical	-2.6	-1.4	-1.0	-0.7	0.0	0.3	0.3	0.3	0.6	1.1	-3.4	-5.2
Dry	-1.2	-0.5	0.1	0.3	0.1	0.1	0.2	0.2	0.2	0.7	0.0	-2.1
BN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.2	-0.5	0.0	0.3	0.2	-0.1	-0.2	0.1	-0.1	0.2	0.0	-0.1
Wet	-0.3	-0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-92. San Joaquin River location RSAN037 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	230.6	266.4	234.5	292.1	251.3	246.9	268.4	268.9	233.4	216.3	283.6	468.2
1971	250.4	238.6	245.0	247.4	236.1	275.8	290.2	260.2	211.4	201.4	317.2	476.2
1972	249.5	254.2	251.0	335.0	287.4	255.6	319.4	297.9	238.5	261.5	371.0	528.9
1973	533.8	749.2	373.6	331.9	340.0	296.7	300.1	296.3	226.6	216.8	295.4	279.7
1974	230.6	217.4	240.1	315.1	262.6	261.7	259.0	274.0	252.6	206.7	253.9	357.8
1975	246.5	252.8	269.8	390.7	342.0	254.6	276.3	257.1	260.3	209.2	259.2	390.9
1976	236.4	236.4	247.0	432.1	377.0	302.9	317.6	331.7	346.5	496.7	524.1	490.9
1977	565.1	530.5	662.5	715.7	424.4	336.2	301.3	321.3	377.9	426.5	513.0	663.0
1978	610.9	527.6	575.6	382.2	388.9	389.6	327.5	257.0	280.3	222.0	286.9	294.7
1979	232.4	261.6	380.1	476.5	367.2	283.7	296.0	295.4	222.4	250.8	383.3	530.4
1980	516.5	420.2	530.8	324.9	313.1	238.0	261.4	297.9	292.0	243.8	266.2	272.8
1981	236.0	244.2	384.8	452.1	268.8	316.3	345.8	307.6	240.9	337.4	453.4	540.1
1982	565.9	478.4	228.2	314.7	272.9	282.1	204.1	182.1	248.9	250.4	241.5	220.8
1983	194.3	206.4	250.2	292.8	304.6	252.9	202.1	201.0	209.3	222.5	193.6	190.4
1984	201.9	187.8	227.6	274.1	229.9	235.8	285.1	281.5	231.0	217.6	274.3	391.7
1985	246.5	228.4	219.4	247.3	262.6	317.5	338.6	292.5	240.1	342.3	443.3	524.9
1986	479.5	513.8	584.4	341.1	350.7	278.4	261.9	251.1	275.6	223.7	290.6	249.9
1987	242.6	242.8	274.8	442.4	312.2	329.4	350.4	303.5	244.7	270.2	344.9	402.3
1988	471.7	463.4	504.1	315.2	318.0	329.8	320.1	301.6	265.5	286.0	402.2	462.6
1989	580.4	555.4	645.4	731.9	469.2	339.5	285.6	244.8	216.3	398.4	513.0	474.1
1990	443.5	496.9	563.1	490.0	305.4	265.4	257.5	268.7	283.5	445.3	539.9	522.0
1991	600.6	620.7	703.5	658.1	457.6	405.9	335.0	276.7	282.4	479.5	532.4	505.1
1992	580.2	577.2	662.6	678.9	452.8	323.0	277.9	260.6	243.7	298.9	451.3	516.9
1993	497.9	463.8	589.1	462.3	357.9	311.2	315.3	288.4	257.4	205.5	284.6	290.6
1994	234.8	276.9	423.8	564.8	351.5	282.0	269.1	270.8	267.1	519.3	594.3	546.1
1995	487.4	378.6	572.9	419.4	277.7	325.3	240.8	173.6	241.8	254.0	202.8	190.1
1996	221.0	246.1	222.8	300.8	326.8	265.0	283.3	276.3	247.9	215.9	315.6	429.4
1997	253.1	245.3	288.8	267.5	197.7	203.3	246.8	289.6	245.1	215.1	261.2	417.3
1998	254.9	236.1	231.8	384.2	372.0	263.9	210.8	186.1	232.1	248.3	203.6	197.2
1999	211.3	231.8	209.5	299.9	260.2	238.9	295.6	278.0	224.0	208.7	314.3	440.7
2000	260.6	245.5	272.5	368.6	377.2	258.6	274.3	293.6	232.1	217.2	279.1	289.7
2001	243.3	267.2	345.8	484.0	338.9	309.4	358.9	305.2	241.6	261.2	327.7	394.6
2002	459.9	448.3	355.5	294.2	249.7	259.8	302.6	309.4	254.6	390.4	455.3	528.1
2003	534.2	473.7	397.1	237.5	222.0	224.1	320.7	265.6	207.7	222.7	301.9	307.0
Average	364.8	361.3	387.3	399.0	321.4	287.0	288.2	272.5	252.2	284.8	352.2	405.4
Critical	447.5	457.4	538.1	550.7	383.8	320.8	296.9	290.2	295.2	421.7	508.2	529.5
Dry	334.8	331.1	370.9	442.0	316.9	312.0	330.3	293.8	239.7	333.3	422.9	477.3
BN	240.9	257.9	315.6	405.7	327.3	269.7	307.7	296.6	230.5	256.1	377.1	529.7
AN	492.3	480.0	456.4	351.2	333.2	286.4	299.9	283.1	249.3	221.3	285.7	289.1
Wet	294.4	284.6	292.7	318.5	283.4	260.4	255.7	244.6	239.5	222.3	262.4	340.1

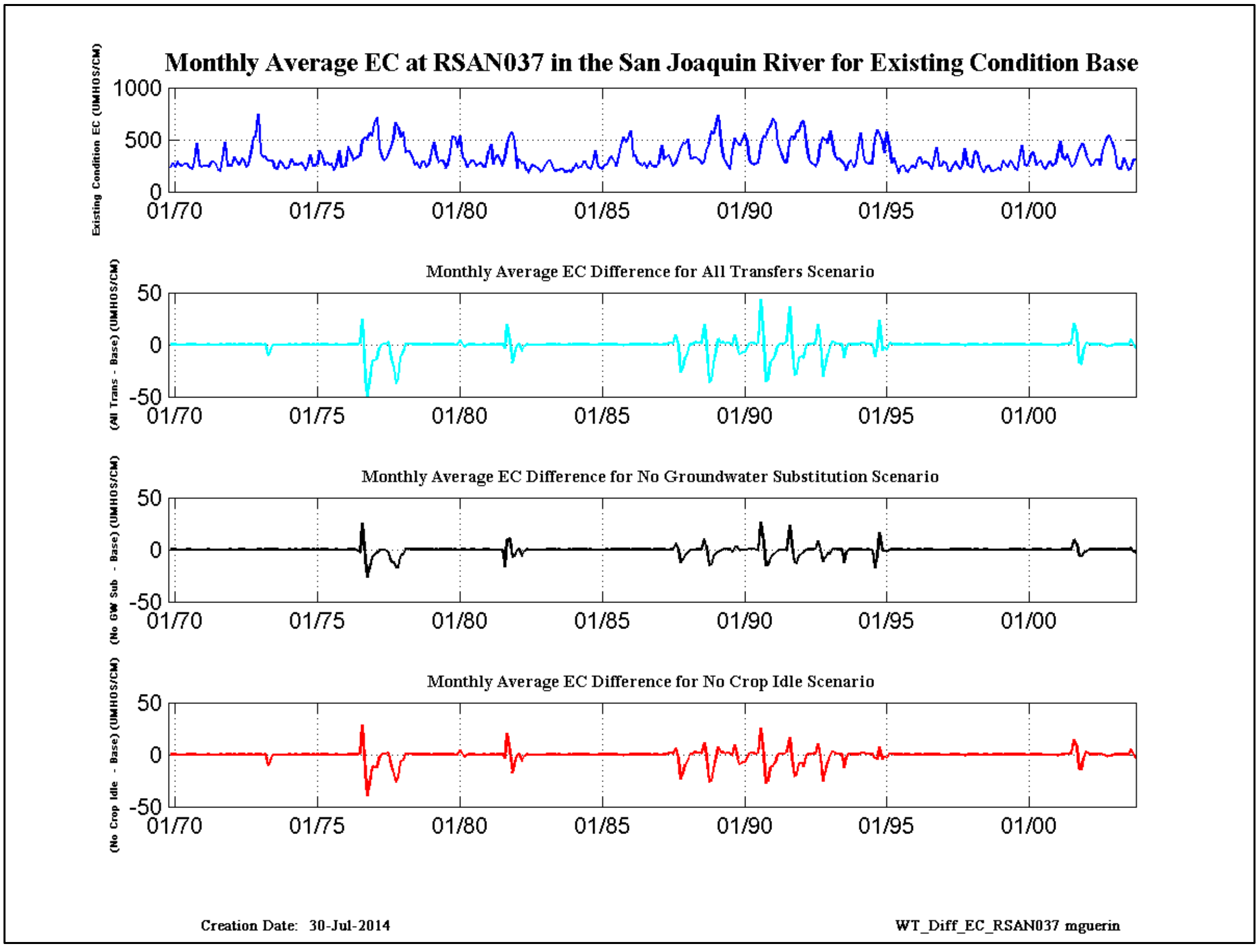


Figure 1-14. San Joaquin River location San Joaquin River location RSAN037 EC for the Base condition and change from Base for the scenarios.

Table 1-93. RSAN072 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	413.6	478.1	582.3	286.3	319.2	296.1	308.7	400.2	430.5	590.4	560.4	528.3
1971	484.6	563.5	783.3	673.3	734.0	449.2	302.9	358.0	457.7	567.5	557.3	540.1
1972	487.5	581.9	787.5	805.3	850.3	827.4	505.6	454.2	587.3	642.6	595.4	584.0
1973	524.4	576.1	776.6	811.6	649.1	351.1	339.1	348.3	478.3	590.5	478.1	489.1
1974	446.5	521.3	768.7	521.3	607.4	277.9	299.4	375.5	456.0	527.4	450.9	462.0
1975	428.3	469.2	721.0	755.4	389.2	260.8	328.3	368.6	374.0	510.1	439.1	476.9
1976	423.0	503.7	762.1	778.7	893.2	874.1	628.2	473.2	593.5	655.2	586.5	577.9
1977	532.8	655.2	816.4	825.7	1037.2	1212.6	808.2	684.9	673.5	694.9	685.7	665.5
1978	611.0	683.0	833.1	725.8	618.6	567.9	279.4	239.6	375.1	507.3	443.8	424.4
1979	512.2	493.0	741.1	666.0	386.7	284.9	335.7	302.1	440.5	603.6	476.7	509.9
1980	460.8	526.5	767.6	350.6	304.2	206.8	315.6	349.6	350.0	428.5	416.0	459.4
1981	451.3	499.6	758.2	768.7	849.3	581.5	433.3	426.4	592.6	627.3	592.3	571.9
1982	505.4	577.9	771.1	622.6	298.0	280.0	178.2	170.2	328.8	383.7	311.8	244.4
1983	190.3	194.9	267.7	265.2	282.2	227.2	176.8	198.7	200.0	217.5	170.5	223.8
1984	342.2	164.4	223.0	293.9	201.8	301.6	315.7	364.9	469.7	589.4	497.1	415.8
1985	380.6	467.8	777.0	768.2	768.7	560.5	381.1	442.6	580.2	665.1	575.2	538.3
1986	500.7	550.5	764.4	797.2	400.2	259.4	244.6	246.5	365.3	515.7	434.9	411.5
1987	393.1	423.1	710.5	741.6	865.2	723.3	585.1	463.0	600.3	652.3	614.1	589.6
1988	528.1	603.1	798.3	817.0	980.7	921.9	675.3	617.4	664.2	668.6	649.3	618.9
1989	581.8	636.8	811.6	827.2	958.1	842.3	586.0	679.0	651.2	621.0	615.8	556.2
1990	572.1	626.2	815.2	837.5	948.7	929.9	766.4	657.3	679.2	665.0	634.7	619.3
1991	581.0	624.9	820.8	847.2	1000.9	741.9	607.9	672.2	716.5	693.9	700.5	678.4
1992	591.0	637.7	829.6	855.7	837.0	799.0	802.6	738.5	740.5	691.2	757.9	733.3
1993	613.2	668.2	833.0	678.2	673.5	636.1	456.7	485.2	687.9	780.0	510.6	485.2
1994	499.1	554.2	800.1	843.9	904.1	927.1	705.1	631.8	690.7	648.5	657.0	641.0
1995	607.6	644.2	820.5	716.2	711.7	355.2	211.7	152.2	289.3	250.1	299.4	458.7
1996	450.9	508.7	766.5	744.5	337.8	284.0	309.4	327.8	454.9	563.9	472.6	474.9
1997	451.7	441.0	297.2	234.8	168.9	196.4	304.9	320.5	435.1	599.7	513.2	468.9
1998	469.9	566.1	770.8	569.4	348.7	253.3	186.3	169.3	252.7	249.3	275.0	302.6
1999	351.8	442.1	676.4	525.8	221.6	340.0	337.1	352.2	419.6	615.0	540.9	510.0
2000	483.5	554.1	796.6	751.8	360.1	255.8	329.2	363.3	566.0	630.9	557.8	475.9
2001	437.4	514.2	765.0	769.3	851.8	669.2	401.2	442.1	598.4	657.8	613.1	572.7
2002	531.1	590.1	782.7	758.4	805.1	773.8	517.8	517.3	559.4	629.0	610.5	585.6
2003	576.7	620.6	797.8	818.5	792.7	798.7	448.2	452.8	473.8	623.8	604.2	586.5
Average	482.8	534.2	729.2	678.0	628.1	537.3	423.9	419.0	506.8	575.2	526.4	514.1
Critical	532.4	600.7	806.1	829.4	943.1	915.2	713.4	639.3	679.7	673.9	667.4	647.8
Dry	462.5	521.9	767.5	772.3	849.7	691.8	484.1	495.1	597.0	642.1	603.5	569.0
BN	499.8	537.4	764.3	735.6	618.5	556.1	420.7	378.1	513.9	623.1	536.0	546.9
AN	544.9	604.8	800.8	689.4	566.4	469.4	361.4	373.2	488.5	593.5	501.8	486.8
Wet	434.1	470.9	631.8	538.9	386.2	290.9	269.5	292.7	379.5	475.4	424.8	424.4

Table 1-94. San Joaquin River location RSAN112 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	414.5	479.7	584.5	277.7	319.3	293.9	301.7	392.8	415.0	593.5	546.3	520.9
1971	481.5	562.3	782.4	664.3	736.7	439.7	293.7	353.8	446.5	563.4	545.0	533.6
1972	483.5	586.7	804.2	797.8	851.8	817.0	482.5	439.5	583.4	638.0	578.5	580.3
1973	520.7	573.0	790.3	769.3	628.2	342.1	335.1	341.4	472.3	588.6	463.6	485.5
1974	443.9	522.7	775.3	510.5	609.9	268.5	298.8	371.4	451.9	524.4	438.7	457.8
1975	425.4	470.2	737.0	753.3	374.6	257.3	327.4	359.4	368.7	508.9	429.0	474.3
1976	420.0	506.2	784.2	772.7	898.1	861.2	606.0	451.2	587.9	655.0	573.9	574.8
1977	528.8	662.0	831.5	817.4	1058.5	1236.8	720.8	675.5	651.9	691.5	677.9	659.6
1978	604.4	687.6	842.6	709.2	612.5	559.6	272.0	235.6	373.9	505.5	432.4	419.9
1979	513.6	490.5	755.8	655.8	376.0	281.0	334.6	296.2	427.0	605.7	462.2	507.0
1980	457.6	528.7	787.3	338.4	300.6	204.6	314.7	345.8	346.0	426.5	408.1	457.3
1981	448.9	501.1	781.5	761.2	853.5	570.2	422.2	415.6	590.7	617.5	580.3	565.7
1982	501.8	579.5	779.8	604.3	289.6	274.5	176.0	167.6	328.6	380.8	303.3	241.5
1983	188.2	191.7	267.8	257.3	279.7	221.7	175.4	197.6	197.7	215.6	165.2	222.9
1984	344.4	159.9	221.5	294.6	198.5	302.2	310.7	357.6	463.9	588.6	483.5	407.7
1985	378.8	468.0	798.9	762.3	767.6	551.7	367.8	434.6	575.5	667.4	560.2	532.5
1986	497.7	551.1	776.8	789.4	386.2	254.5	243.2	243.0	363.3	514.0	422.4	407.7
1987	390.3	422.6	733.1	737.2	870.9	707.9	564.1	442.1	596.9	647.3	601.9	583.0
1988	523.5	606.6	817.9	807.6	992.6	909.0	645.9	604.4	656.9	648.8	640.8	610.8
1989	576.1	639.4	824.6	820.8	968.7	830.6	554.2	681.0	623.2	616.9	612.5	549.5
1990	572.3	628.2	832.0	830.0	957.8	918.8	724.4	646.4	667.6	634.0	625.9	612.4
1991	575.4	625.8	839.0	842.9	1013.7	724.1	587.9	668.9	713.4	717.4	698.2	670.8
1992	584.2	640.4	848.9	845.0	829.7	791.2	794.3	716.5	737.9	752.0	790.3	723.5
1993	603.0	671.6	849.4	651.8	648.8	624.7	445.8	483.1	694.0	786.0	485.1	480.9
1994	498.4	555.9	824.2	836.3	905.3	924.2	667.9	623.7	686.2	711.8	651.9	634.0
1995	603.9	645.2	845.7	683.0	711.2	344.2	208.2	149.8	288.7	246.8	294.0	461.6
1996	448.1	510.9	779.0	720.7	315.4	280.1	308.5	325.5	452.4	561.5	458.8	471.2
1997	450.2	439.4	292.2	230.3	167.5	194.9	299.4	314.2	430.9	602.0	500.2	462.8
1998	468.6	568.8	792.2	542.4	329.4	250.8	184.2	168.0	251.9	246.5	269.6	300.7
1999	352.7	443.8	687.1	516.6	212.2	342.3	334.0	346.3	411.2	622.1	527.5	504.8
2000	480.6	556.6	819.3	739.3	341.1	253.2	327.0	358.4	567.4	627.3	544.1	469.5
2001	435.2	516.3	779.3	760.7	852.4	660.4	389.3	432.6	596.6	656.6	601.3	566.5
2002	527.1	591.6	785.9	749.6	805.9	769.2	491.8	492.7	541.6	651.3	596.7	579.6
2003	574.1	621.3	805.6	813.7	786.6	797.1	430.7	445.2	439.5	637.1	592.6	581.1
Average	479.9	535.5	742.8	666.6	625.0	531.2	410.0	411.1	500.0	578.0	516.5	509.2
Critical	528.9	603.6	825.4	821.7	950.8	909.3	678.2	626.7	671.7	687.2	665.6	640.8
Dry	459.4	523.2	783.9	765.3	853.2	681.7	464.9	483.1	587.4	642.8	592.1	562.8
BN	498.5	538.6	780.0	726.8	613.9	549.0	408.6	367.8	505.2	621.8	520.3	543.6
AN	540.1	606.5	815.7	670.3	552.9	463.6	354.2	368.3	482.2	595.2	487.6	482.4
Wet	432.4	471.2	640.1	526.5	379.2	286.5	266.2	288.2	374.7	474.5	414.1	420.6

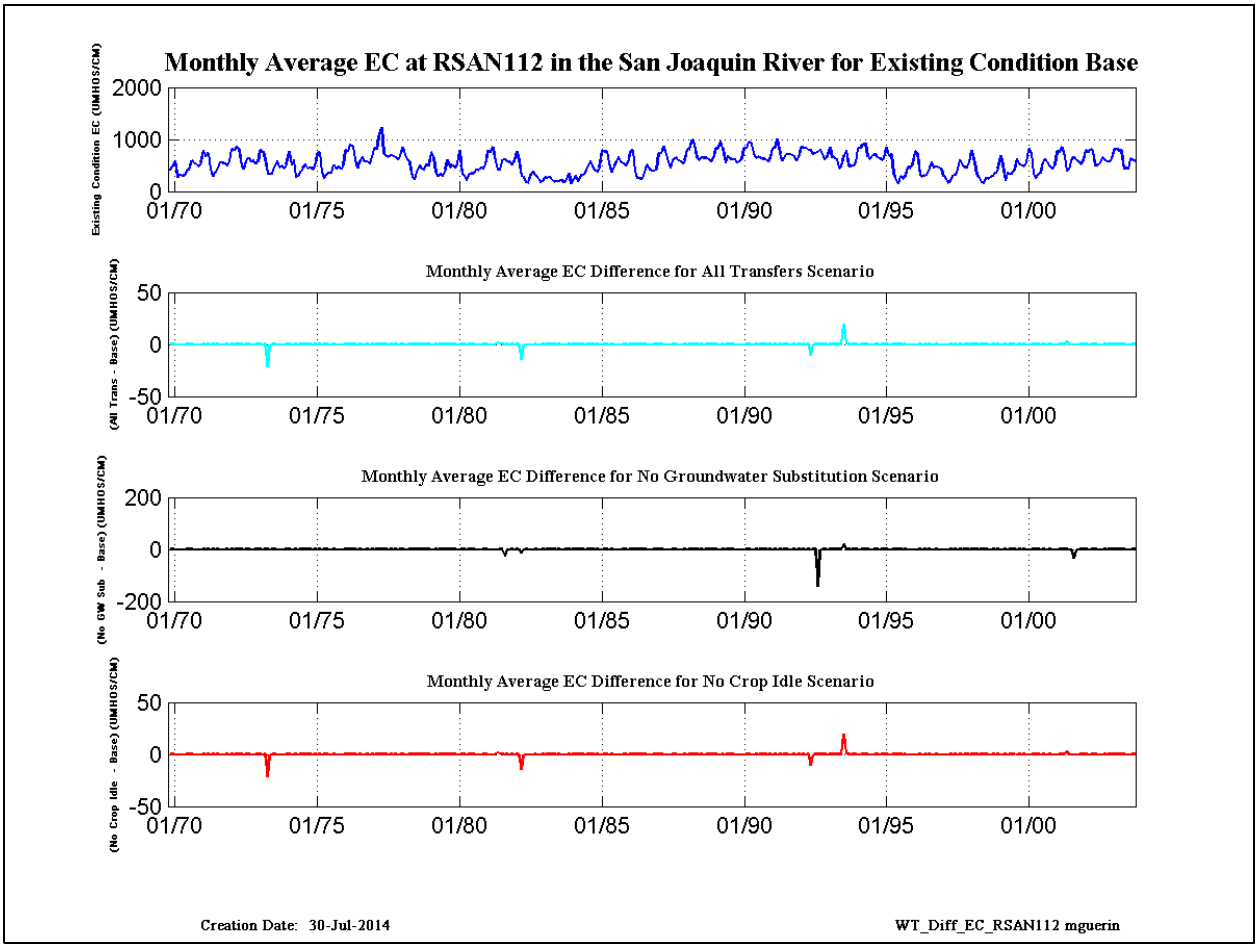


Figure 1-15. San Joaquin River location San Joaquin River location RSAN112 EC for the Base condition and change from Base for the scenarios.

Table 1-95. Mokelumne River location RSMKL008 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	182.4	187.3	186.3	203.2	185.5	181.4	196.9	191.5	187.6	183.6	182.7	182.8
1971	185.6	189.2	205.5	194.0	195.0	184.3	185.6	176.8	179.1	183.1	181.6	182.3
1972	185.4	187.6	186.6	216.1	208.3	192.4	194.9	198.0	189.8	183.6	182.4	181.9
1973	183.7	199.5	205.4	233.6	207.2	189.7	189.5	183.2	184.9	183.0	182.2	179.5
1974	182.8	179.8	190.9	192.0	191.7	193.7	177.1	174.2	179.2	181.2	180.4	181.5
1975	184.8	189.8	189.4	219.1	211.4	200.0	185.5	173.1	179.2	181.3	179.8	180.3
1976	181.7	184.7	186.3	215.6	217.2	208.9	208.8	230.4	205.4	185.3	185.7	188.7
1977	193.4	192.9	201.0	222.3	237.3	223.4	213.8	217.5	203.5	194.3	185.6	189.1
1978	193.5	195.2	208.3	246.8	222.9	223.2	194.7	184.0	185.7	184.6	183.0	180.2
1979	184.2	184.4	187.0	237.1	255.6	203.8	189.6	177.2	184.7	183.5	181.9	182.4
1980	182.9	186.5	194.5	195.1	201.4	182.9	187.2	176.4	180.1	182.7	180.4	177.8
1981	184.6	186.8	189.8	210.4	209.2	207.9	202.8	201.9	191.2	184.7	184.0	183.3
1982	183.8	185.6	192.9	215.5	179.8	201.6	167.8	168.1	176.6	182.9	180.2	175.1
1983	183.2	194.3	182.8	222.3	201.0	189.9	179.7	165.7	171.2	177.4	175.0	173.2
1984	184.8	174.7	192.2	185.1	184.9	182.8	189.6	187.0	185.3	182.5	181.7	183.1
1985	182.4	195.9	210.0	225.2	212.5	225.0	205.1	200.6	191.4	184.7	184.3	181.6
1986	186.0	187.5	189.5	237.3	209.5	190.9	198.0	179.3	184.3	182.7	181.9	177.5
1987	185.2	186.2	188.2	226.0	227.8	231.7	220.9	209.4	191.3	186.5	188.2	187.3
1988	188.8	191.6	208.4	249.7	237.9	234.4	214.7	210.9	193.6	189.2	190.1	191.4
1989	194.2	191.2	196.9	222.7	237.7	199.6	195.4	192.4	187.9	184.1	182.1	181.1
1990	184.8	190.6	201.1	217.1	242.3	223.6	205.7	204.4	196.9	187.3	186.8	189.0
1991	192.9	196.8	204.4	248.9	241.9	229.9	212.9	202.4	189.1	186.7	186.0	189.8
1992	190.8	196.7	208.6	236.7	250.8	236.3	212.6	203.0	189.0	187.4	187.0	187.4
1993	190.4	196.7	204.6	263.6	230.7	202.5	182.2	177.0	180.6	182.4	181.8	179.4
1994	184.9	186.4	190.0	228.2	260.3	231.6	206.1	201.8	197.7	184.6	185.0	184.6
1995	188.7	190.5	192.0	245.9	197.8	196.0	173.9	165.4	172.4	179.4	176.9	175.4
1996	183.7	189.7	198.1	225.8	200.3	189.3	185.6	171.5	179.1	182.7	182.1	181.7
1997	184.5	184.9	192.9	192.0	182.2	195.3	198.6	198.6	188.9	183.4	182.4	182.8
1998	185.3	186.0	192.1	251.4	238.6	186.5	175.2	170.3	172.6	179.3	177.4	175.7
1999	185.3	188.3	187.3	209.2	194.6	183.6	182.9	176.6	180.3	181.5	180.2	181.0
2000	185.2	188.5	188.6	214.5	225.4	185.7	190.3	183.9	184.3	183.3	182.3	180.3
2001	184.3	190.4	191.6	241.0	242.7	206.9	208.9	205.1	190.1	186.6	187.3	187.1
2002	191.0	192.1	199.4	208.7	212.5	199.4	196.5	211.3	191.3	184.6	184.1	184.2
2003	188.3	188.3	188.8	195.8	205.3	201.7	192.6	178.2	184.6	184.0	181.2	180.9
Average	186.3	189.3	195.0	222.0	216.4	203.4	194.8	189.6	186.1	183.9	182.8	182.3
Critical	188.2	191.4	200.0	231.2	241.1	226.9	210.7	210.1	196.5	187.8	186.6	188.6
Dry	186.9	190.4	196.0	222.3	223.7	211.7	205.0	203.4	190.5	185.2	185.0	184.1
BN	184.8	186.0	186.8	226.6	231.9	198.1	192.2	187.6	187.2	183.6	182.1	182.1
AN	187.3	192.4	198.4	224.9	215.5	197.6	189.4	180.5	183.4	183.3	181.8	179.7
Wet	184.7	186.7	191.7	214.8	197.9	190.4	184.3	176.8	179.7	181.6	180.2	179.4

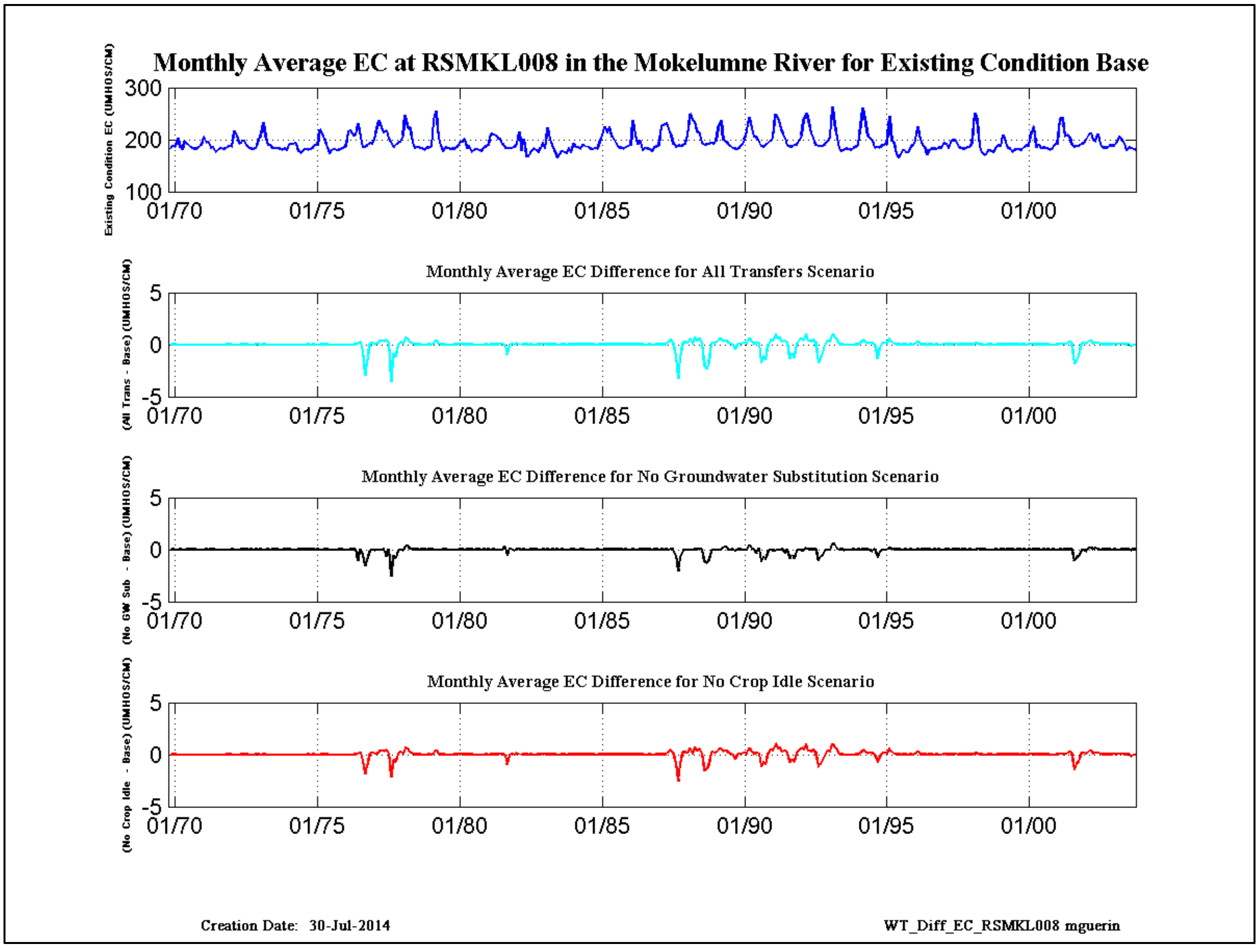


Figure 1-16. Mokelumne River location San Joaquin River location RSMKL008 EC for the Base condition and change from Base for the scenarios.

Table 1-96. Barker Slough location SLBAR002 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	186.1	186.4	193.8	220.8	220.1	199.7	201.4	196.4	191.9	189.4	189.1	189.4
1971	189.3	198.3	208.5	204.7	200.6	200.9	197.7	190.3	188.1	188.9	189.4	189.4
1972	190.1	192.0	195.9	201.2	204.8	206.4	206.4	198.5	192.7	189.4	187.5	187.7
1973	186.6	199.8	205.0	230.3	245.7	211.4	203.1	197.2	193.2	189.4	188.9	189.8
1974	188.1	195.8	198.4	203.6	201.0	197.7	193.2	191.0	190.1	188.7	187.7	188.7
1975	188.7	189.3	189.4	197.5	218.2	212.1	198.1	192.6	189.1	188.7	189.6	189.2
1976	183.8	187.2	188.0	195.9	204.2	204.9	206.4	204.6	200.5	194.6	189.2	193.6
1977	197.9	196.1	190.9	196.7	210.0	216.5	223.8	221.2	204.1	203.9	196.6	193.9
1978	202.5	203.5	211.5	244.7	255.0	222.3	206.9	195.5	192.6	190.3	189.8	189.5
1979	191.1	190.9	187.7	233.9	277.2	246.4	209.4	197.2	193.3	190.7	187.7	189.8
1980	187.5	185.6	197.0	219.7	227.2	212.5	200.1	195.2	191.6	188.9	188.2	189.0
1981	189.5	191.5	187.7	205.1	221.1	204.4	206.5	201.0	195.1	191.6	187.9	188.8
1982	187.8	193.2	195.7	223.8	223.5	212.2	210.3	193.1	190.7	188.9	189.3	188.2
1983	186.4	198.2	195.2	210.8	228.5	233.7	218.3	191.3	188.1	185.9	187.1	188.0
1984	188.2	187.7	193.8	197.6	194.7	199.6	199.0	194.6	192.9	189.4	188.9	190.1
1985	188.3	203.4	201.7	203.0	209.5	204.5	210.0	199.0	194.5	191.2	189.5	189.0
1986	190.1	193.0	193.5	208.8	249.5	233.5	204.9	199.6	193.6	190.6	189.2	188.9
1987	189.4	191.4	186.9	198.1	212.5	212.7	214.1	220.3	205.2	199.5	195.7	198.4
1988	202.4	202.4	199.9	211.5	227.4	233.5	228.7	211.1	205.0	198.4	195.5	198.5
1989	204.1	201.2	191.7	197.1	203.5	209.0	206.9	207.0	195.7	189.9	186.9	185.6
1990	187.2	190.1	194.1	204.6	213.7	221.8	220.0	206.8	197.9	203.9	197.7	198.1
1991	200.4	202.4	203.1	204.2	211.3	209.0	218.5	205.5	195.8	195.5	195.0	197.4
1992	198.3	197.8	197.0	202.6	216.5	225.1	226.5	220.6	210.7	198.5	195.0	197.3
1993	194.7	195.0	213.2	257.2	276.0	226.4	200.4	192.0	188.1	188.3	189.4	190.4
1994	190.9	190.9	189.5	203.7	223.7	228.5	216.5	200.2	195.1	196.1	191.0	193.3
1995	194.6	198.6	204.4	247.3	249.2	214.7	211.5	188.7	186.4	186.3	187.6	188.7
1996	189.2	190.4	202.0	209.8	215.8	206.7	194.9	189.0	189.9	190.6	190.3	189.3
1997	187.4	190.2	199.9	226.8	232.2	206.6	204.8	195.8	191.8	189.1	188.5	189.0
1998	188.6	192.6	191.3	211.2	252.2	242.4	193.3	186.5	185.8	185.5	187.4	187.4
1999	187.1	186.6	184.2	195.4	209.0	200.9	196.0	192.0	190.0	189.4	189.6	189.6
2000	190.3	191.6	188.5	201.8	217.7	208.7	197.7	194.1	193.7	190.0	189.4	189.5
2001	186.4	188.3	188.6	197.2	216.6	227.2	208.9	207.9	204.6	196.9	193.6	196.4
2002	199.9	195.2	210.7	226.5	215.9	210.0	207.7	208.9	201.3	190.7	187.9	190.3
2003	192.7	194.6	207.3	213.6	205.7	204.1	200.8	193.5	190.0	189.0	187.0	189.1
Average	191.3	193.9	196.6	212.0	223.2	214.9	207.1	199.4	194.4	191.7	190.1	190.9
Critical	194.4	195.3	194.6	202.7	215.3	219.9	220.1	210.0	201.3	198.7	194.3	196.0
Dry	192.9	195.2	194.5	204.5	213.2	211.3	209.0	207.3	199.4	193.3	190.2	191.4
BN	190.6	191.5	191.8	217.5	241.0	226.4	207.9	197.8	193.0	190.1	187.6	188.7
AN	192.4	195.0	203.7	227.9	237.9	214.2	201.5	194.6	191.6	189.3	188.8	189.5
Wet	188.6	192.3	196.2	212.2	222.7	212.4	201.8	192.4	189.9	188.6	188.7	188.9

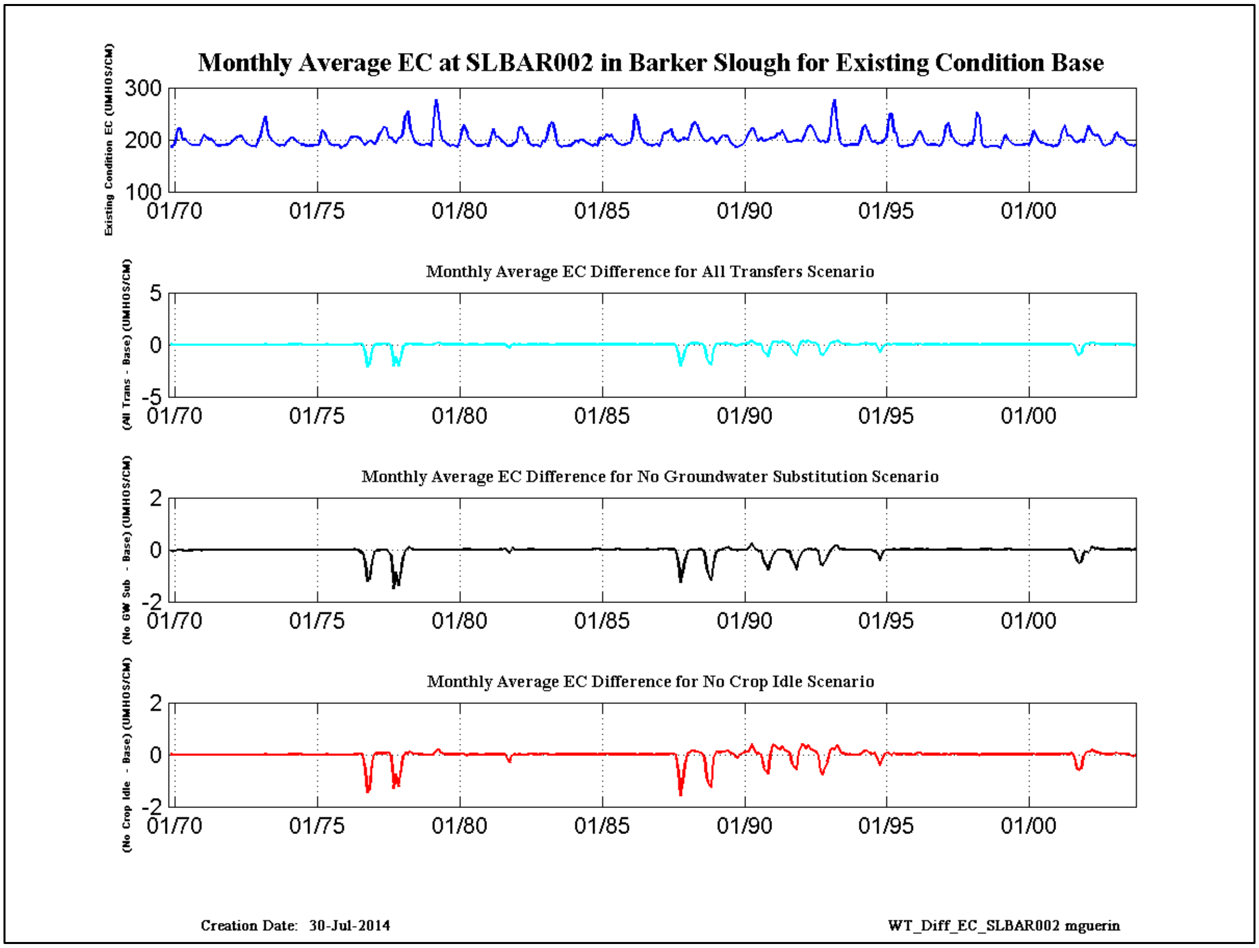


Figure 1-17. Barker Slough location SLBAR002 EC for the Base condition and change from Base for the scenarios.

Table 1-97. Suisun Marsh location SLCBN002 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	5164.7	5471.1	2604.9	1186.2	1026.0	980.1	2124.4	4396.3	6318.3	7702.3	8852.0	8158.9
1971	5559.2	5438.9	2726.5	1632.7	1749.0	1569.3	1460.2	1515.8	2331.3	4922.9	8645.7	8254.4
1972	5448.9	5516.6	5840.5	6460.9	4748.5	3010.1	3218.1	5456.9	7813.4	9169.2	10397.8	12605.9
1973	11957.5	9649.8	5994.5	2594.0	1493.8	1868.5	2118.3	2729.3	4217.8	7107.7	9531.3	10048.1
1974	7939.1	4016.2	1760.9	1246.5	1340.3	894.5	947.4	1320.3	2635.4	5166.1	8581.6	7946.6
1975	5529.2	5440.0	5773.9	7181.5	4271.9	1602.3	1530.3	1606.1	1755.0	4225.2	8300.0	8169.8
1976	5347.7	5344.0	5622.7	7633.6	7456.7	7327.7	7709.0	9573.8	12422.4	13948.0	14373.6	15455.4
1977	14250.0	13441.7	13000.9	11013.6	8488.3	9908.9	10827.8	12054.2	14260.8	15539.0	16383.7	17056.3
1978	14922.9	13701.1	11544.7	4713.3	2513.9	2492.8	2177.6	2403.4	3742.1	6414.9	9709.6	10724.6
1979	8221.9	7808.8	7928.5	6928.1	3486.9	2531.8	2924.2	3241.6	4773.7	8332.0	10900.9	13314.6
1980	12155.2	10830.5	8647.9	3850.7	2019.1	2054.8	2280.5	2808.9	4026.0	6382.9	9579.6	10399.5
1981	8022.4	7450.6	7570.5	6442.8	3958.1	3198.4	3849.6	5543.4	7990.6	10485.6	12319.0	13973.0
1982	12997.2	7981.9	3123.9	2002.3	1602.3	1244.8	1198.2	1144.3	1679.9	4214.4	8708.6	8418.9
1983	5123.5	2914.0	1504.6	1021.4	962.8	856.5	1007.2	827.7	698.3	848.9	1953.7	2718.8
1984	3238.8	1932.1	853.4	776.3	781.6	807.6	1510.9	3213.2	5652.5	7536.9	8817.3	8293.3
1985	5620.4	4882.8	4180.6	5098.6	4975.3	5054.7	5234.6	5586.5	7869.1	10298.4	12257.7	13929.9
1986	12086.7	11711.6	10005.9	5996.4	2121.9	1860.2	1953.3	2517.2	4296.2	7114.4	9688.7	8892.8
1987	5961.6	6154.2	6802.0	7919.9	5968.5	3802.1	4590.3	7638.4	9353.8	11104.6	12947.0	14324.0
1988	13270.5	12622.1	10462.4	5498.5	4064.4	6556.5	8960.0	9379.9	10470.8	12170.0	14050.1	15400.9
1989	14365.3	13408.1	12512.0	11128.9	9314.7	4878.1	3116.4	4606.4	7782.0	10892.9	12686.4	13316.9
1990	11874.9	11915.8	12307.5	9583.8	6810.7	7439.8	8519.0	9411.1	11563.5	13937.5	15051.1	15853.3
1991	14447.5	14087.2	14072.1	12633.1	10244.5	6543.8	5597.8	8311.5	11767.1	14106.6	15130.5	16043.7
1992	14739.3	14081.0	14027.1	12784.4	7166.1	4496.8	6075.0	8784.3	10865.7	12460.5	14689.9	15819.8
1993	14067.8	13095.0	12193.9	5234.5	2779.7	2693.3	2522.8	1964.4	2408.6	4613.3	8946.0	10008.3
1994	7828.4	7585.2	7809.9	8375.5	6134.9	5597.6	7282.9	7799.1	10052.5	12860.7	14112.7	15260.2
1995	13143.3	11658.3	11552.0	4366.9	3016.8	1717.9	2284.1	1538.3	1453.1	1868.6	4264.9	6077.1
1996	5202.7	5096.3	4783.9	2722.3	1171.3	1250.4	1274.2	978.6	2193.4	6076.1	9273.5	8190.9
1997	5513.3	5449.9	2118.3	1032.1	1306.7	1547.9	2340.0	3381.4	5542.8	7479.5	8783.2	8126.3
1998	5826.0	5705.8	5293.4	3405.6	1291.8	1401.4	1203.4	891.8	745.7	1065.6	2693.2	3988.7
1999	4090.6	4064.2	2425.0	1296.8	873.6	705.4	926.9	1580.7	3393.4	6049.9	8965.4	8293.7
2000	5352.4	5291.7	5851.0	5416.3	1826.4	1381.5	1501.2	2355.9	4996.8	7569.0	8961.1	9863.2
2001	7734.4	7186.9	7316.9	7525.3	4109.7	2666.2	3425.4	5925.1	8138.7	10429.3	12337.5	14113.0
2002	12795.0	11869.3	7306.8	2939.7	2894.3	3896.9	3898.4	4598.7	7419.6	10996.6	12510.6	14264.8
2003	12796.0	12175.8	6864.3	3103.8	2388.4	3218.9	2702.8	1805.0	3379.6	7003.7	9046.5	9991.9
Average	9193.9	8381.7	7128.9	5316.1	3657.6	3148.7	3479.2	4320.3	6000.3	8238.0	10395.6	11097.0
Critical	11679.8	11296.7	11043.2	9646.1	7195.1	6838.7	7853.1	9330.6	11629.0	13574.6	14827.4	15841.4
Dry	9083.2	8492.0	7614.8	6842.5	5203.4	3916.0	4019.1	5649.8	8092.3	10701.2	12509.7	13986.9
BN	6835.4	6662.7	6884.5	6694.5	4117.7	2771.0	3071.1	4349.3	6293.5	8750.6	10649.3	12960.3
AN	11875.3	10790.6	8516.1	4152.1	2170.2	2285.0	2217.2	2344.5	3795.2	6515.3	9295.7	10172.6
Wet	7031.9	5913.9	4194.4	2605.1	1655.1	1264.5	1520.0	1916.3	2976.6	4943.9	7502.1	7348.5

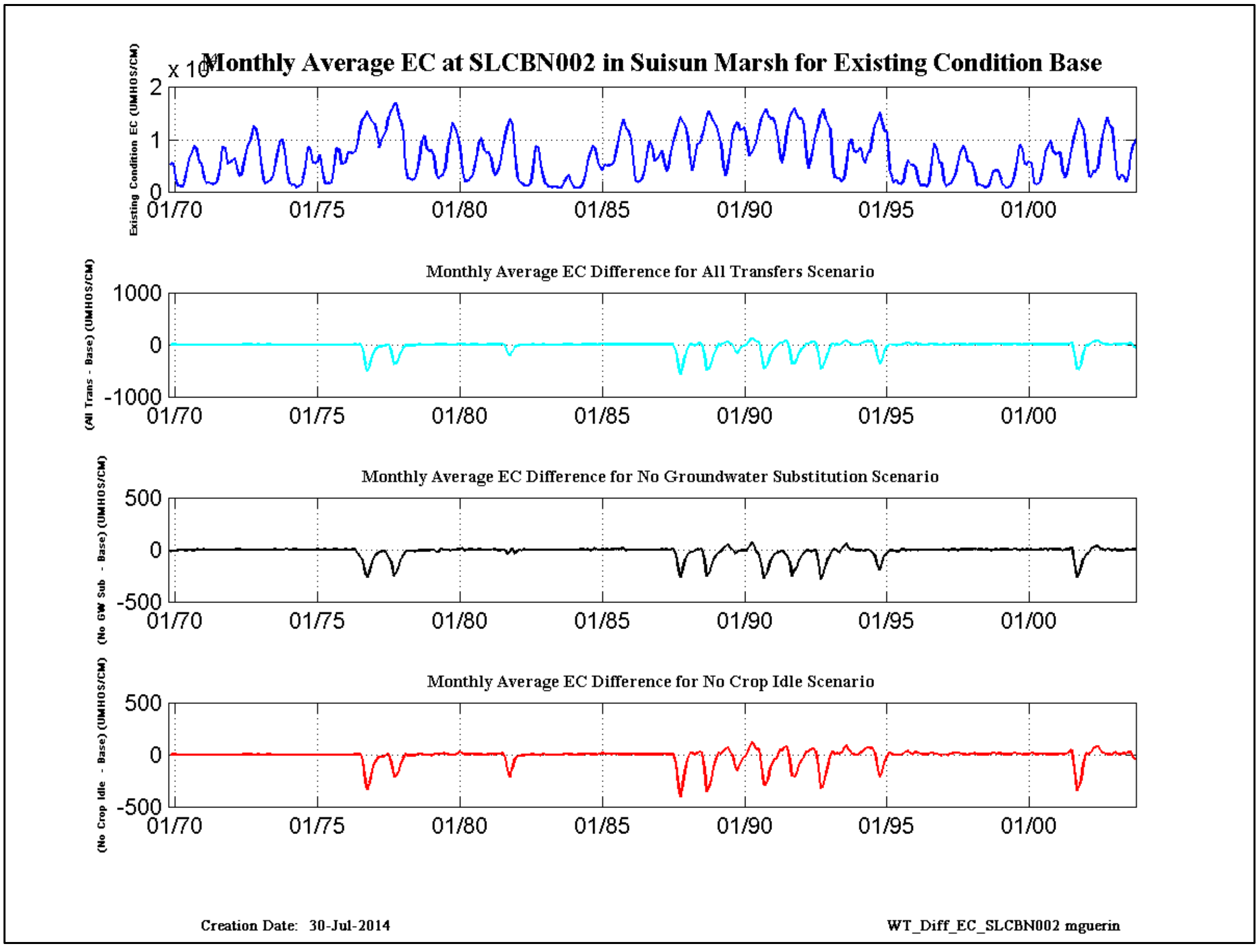


Figure 1-18. Suisun Marsh location SLCBN002 EC for the Base condition and change from Base for the scenarios.

Table 1-98. San Joaquin River location RSAN037 salinity (EC, UMHOS/CM) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.2	-10.2	-6.2	-0.6	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.7	24.1	-32.5	-49.2
1977	-35.3	-15.6	-15.2	-13.9	-3.7	0.0	0.7	0.7	2.9	-13.7	-22.4	-37.0
1978	-32.4	-11.8	-8.0	0.5	0.9	0.5	0.1	0.2	0.2	0.1	0.1	0.1
1979	0.0	0.0	-0.1	0.3	0.4	0.1	0.2	0.2	0.1	0.0	0.0	0.0
1980	-0.2	0.5	3.7	0.4	-2.0	-0.1	0.0	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	-0.2	0.2	0.1	0.0	0.2	0.5	0.4	-3.6	19.9	3.9
1982	-17.5	-9.8	-0.4	0.3	-6.9	-1.8	0.2	-0.2	-0.2	-0.1	0.0	0.0
1983	-0.1	0.0	-0.2	0.0	0.4	0.2	0.1	-0.2	0.2	0.0	-0.1	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1985	0.0	0.1	0.2	0.2	0.1	0.3	0.2	0.1	0.1	-0.2	-0.3	-0.5
1986	-0.2	-0.5	0.1	0.3	0.1	0.3	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.1	-0.1	-0.2	0.1	0.0	1.1	1.7	1.0	9.9	-0.1	-26.4
1988	-22.8	-12.4	-8.1	0.2	0.3	2.2	1.8	1.9	1.5	19.1	0.5	-36.1
1989	-34.4	-18.1	-5.3	5.9	1.6	2.2	1.0	1.8	0.6	-0.7	9.9	-3.7
1990	-9.6	-7.8	-7.3	-4.0	0.7	1.5	1.3	0.8	2.0	43.6	2.9	-35.6
1991	-33.7	-16.7	-14.1	-8.9	-1.1	0.8	0.9	1.0	3.6	36.3	1.4	-29.1
1992	-27.7	-13.0	-11.3	-12.7	-1.5	0.8	0.5	1.4	1.1	19.9	2.2	-30.5
1993	-23.9	-9.5	-2.7	2.8	1.5	1.0	0.6	0.8	-12.2	-2.1	0.7	0.3
1994	0.1	0.0	-0.1	1.3	1.8	0.8	0.6	0.4	1.0	-11.5	-1.6	23.1
1995	-5.5	-3.2	-4.6	1.2	0.7	0.3	0.2	0.1	0.2	-0.1	0.1	0.1
1996	0.0	-0.1	0.1	0.3	0.2	-0.1	0.1	0.1	0.1	0.2	0.3	0.2
1997	0.0	0.0	0.0	-0.3	-0.2	0.0	0.0	0.2	0.1	-0.1	-0.1	-0.7
1998	0.2	0.3	0.3	0.3	0.3	-0.1	0.0	0.3	0.2	-0.1	0.0	0.0
1999	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.1
2000	0.0	0.0	-0.3	0.0	0.2	0.2	0.2	0.1	0.0	0.0	-0.1	0.0
2001	0.0	0.0	-0.6	-0.3	0.1	0.1	0.7	1.0	1.2	20.2	10.7	-17.2
2002	-18.8	-5.8	1.9	0.6	0.5	0.3	0.2	0.4	0.6	-0.3	-0.7	-1.8
2003	-1.0	-0.9	0.4	0.2	0.1	0.1	0.2	0.2	0.2	4.8	0.5	-3.1
Average	-7.7	-3.7	-2.1	-0.7	-0.2	0.0	0.2	0.4	0.2	4.3	-0.3	-7.2
Critical	-18.5	-9.4	-8.0	-5.4	-0.5	0.9	0.8	0.9	2.0	16.8	-7.1	-27.8
Dry	-8.9	-4.0	-0.7	1.1	0.4	0.5	0.6	0.9	0.6	4.2	6.6	-7.6
BN	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
AN	-9.6	-3.6	-1.1	0.7	0.1	-1.4	-0.8	0.1	-2.0	0.5	0.2	-0.5
Wet	-1.8	-1.0	-0.4	0.2	-0.4	-0.1	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-99. San Joaquin River location RSAN037 salinity (EC, UMHOS/CM) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.1	-3.4	-2.1	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	4.8	-6.2	-10.0
1977	-6.3	-2.9	-2.3	-1.9	-0.9	0.0	0.2	0.2	0.8	-3.2	-4.4	-5.6
1978	-5.3	-2.2	-1.4	0.1	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.1	0.7	0.1	-0.6	-0.1	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.2	0.1	-1.1	4.4	0.7
1982	-3.1	-2.1	-0.2	0.1	-2.5	-0.6	0.1	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	-0.1	0.0	0.1	0.1	0.1	-0.1	0.1	0.0	-0.1	0.0
1984	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1
1986	0.0	-0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	-0.1	0.0	0.0	0.0	0.3	0.5	0.4	3.7	0.0	-6.6
1988	-4.8	-2.7	-1.6	0.1	0.1	0.7	0.6	0.6	0.6	6.7	0.1	-7.8
1989	-5.9	-3.3	-0.8	0.8	0.3	0.6	0.4	0.7	0.3	-0.2	1.9	-0.8
1990	-2.2	-1.6	-1.3	-0.8	0.2	0.6	0.5	0.3	0.7	9.8	0.5	-6.8
1991	-5.6	-2.7	-2.0	-1.4	-0.2	0.2	0.3	0.3	1.3	7.6	0.3	-5.8
1992	-4.8	-2.3	-1.7	-1.9	-0.3	0.2	0.2	0.5	0.4	6.7	0.5	-5.9
1993	-4.8	-2.0	-0.5	0.6	0.4	0.3	0.2	0.3	-4.7	-1.0	0.3	0.1
1994	0.0	0.0	0.0	0.2	0.5	0.3	0.2	0.2	0.4	-2.2	-0.3	4.2
1995	-1.1	-0.8	-0.8	0.3	0.3	0.1	0.1	0.0	0.1	0.0	0.0	0.1
1996	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	-0.2
1998	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.2	-0.1	0.0	0.0	0.2	0.3	0.5	7.7	3.3	-4.4
2002	-4.1	-1.3	0.5	0.2	0.2	0.1	0.1	0.1	0.2	-0.1	-0.2	-0.3
2003	-0.2	-0.2	0.1	0.1	0.0	0.0	0.1	0.1	0.1	2.2	0.2	-1.0
Average	-1.4	-0.7	-0.3	-0.1	-0.1	0.0	0.1	0.1	0.1	1.2	0.0	-1.5
Critical	-3.4	-1.7	-1.3	-0.8	-0.1	0.3	0.3	0.3	0.7	4.3	-1.4	-5.4
Dry	-1.7	-0.7	-0.1	0.2	0.1	0.1	0.2	0.3	0.3	1.7	1.6	-1.9
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.7	-0.7	-0.2	0.2	0.0	-0.5	-0.3	0.1	-0.8	0.2	0.1	-0.1
Wet	-0.3	-0.2	-0.1	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-100. RSAN072 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.3	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.2	0.2	0.2	0.3	-0.3	0.3	0.3	-0.2	-0.4
1973	0.3	0.1	0.2	-0.2	0.1	-20.9	-1.5	0.3	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.2	-0.2	0.1	0.3	0.3	0.3	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.1	0.2	0.3	0.0	-0.2	0.0	-3.2	0.3	0.1
1977	-0.2	0.1	-0.1	0.2	0.2	0.4	0.0	0.4	0.0	-0.2	0.2	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	1.6	0.5	0.0	-0.2	0.3	-0.2
1982	0.3	-0.3	0.3	0.0	-13.9	-1.1	0.4	-0.4	-0.3	-0.3	0.4	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.3	0.3	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.4	-0.4	-0.4	0.3
1986	0.5	0.0	0.4	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.3	-0.4	0.5	-0.3
1988	-0.4	0.3	0.0	0.0	0.4	0.1	0.4	-0.2	0.1	-0.5	0.1	0.3
1989	0.1	0.3	0.1	-0.4	-0.4	0.3	-0.4	0.3	0.0	0.5	-0.6	-0.2
1990	-0.2	-0.2	0.0	0.2	0.3	-0.2	-0.4	0.0	-0.3	-22.6	-5.0	0.1
1991	-0.1	0.3	-0.3	0.1	-0.3	0.0	-0.3	0.1	0.1	-31.4	-6.4	0.1
1992	-0.2	0.4	0.1	0.1	-0.1	0.1	-8.7	-1.6	0.2	-84.0	-34.3	0.1
1993	0.1	-0.2	0.3	0.2	0.1	0.1	0.5	0.4	17.7	1.7	0.4	-0.1
1994	0.0	0.0	-0.3	-0.4	0.0	0.2	0.3	-0.4	-0.4	0.3	-1.9	-0.3
1995	0.1	0.2	0.3	-0.1	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.4
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.3	0.4	-0.1	0.1	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.4	0.3
1998	0.2	-0.3	0.1	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	0.0	0.4	0.3	0.5	-0.3	0.0	-0.1
2000	0.2	-0.3	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.2	0.0	0.3	2.9	-0.2	-0.4	-0.8	0.0	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	0.0	-0.4	0.0	0.2	0.0
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-1.4	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.3	-0.6	-0.1	0.0	0.6	-4.2	-1.4	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	-1.2	-0.3	0.0	-20.2	-6.7	0.1
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.7	0.1	-0.1	-0.2	0.0	-0.1
BN	0.2	0.0	0.1	-0.1	0.3	0.1	0.3	-0.1	0.3	0.3	-0.1	-0.1
AN	0.1	-0.1	0.0	0.0	0.2	-3.4	0.0	0.1	3.0	0.0	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.0	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-101. RSAN072 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	-0.1
1973	0.1	0.0	0.0	0.0	0.0	-5.9	-0.4	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.4	0.1	0.0	0.0	0.0	0.0
1982	0.1	-0.1	0.0	0.0	-4.7	-0.4	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	-0.1
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-3.4	-0.8	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.5	-0.9	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	-1.1	-0.2	0.0	-12.2	-4.5	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	2.6	0.2	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.3	0.0
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-0.1	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	-0.2	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.1	-0.6	-0.2	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-2.9	-0.9	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	0.0	0.4	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-102. San Joaquin River location RSAN112 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.4	-0.4	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.4	0.1	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.3	0.2	0.2	0.3	-0.4	0.4	0.3	-0.3	-0.4
1973	0.4	0.0	0.2	-0.3	0.2	-21.8	-0.9	0.4	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.3	-0.3	0.1	0.3	0.3	0.4	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.0	0.2	0.3	0.0	-0.2	0.0	-0.2	-0.1	0.1
1977	-0.2	0.1	-0.2	0.3	0.1	0.3	0.2	0.4	-0.1	0.0	-0.4	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.3	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	1.6	0.5	0.0	-0.2	0.0	-0.2
1982	0.4	-0.4	0.4	0.0	-14.5	-0.9	0.4	-0.4	-0.3	-0.3	0.4	-0.4
1983	-0.4	0.1	-0.3	0.1	0.5	0.2	0.1	-0.4	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.4	0.3	0.3	-0.2
1985	0.0	-0.2	-0.2	0.4	0.2	-0.2	0.4	0.0	-0.5	-0.4	-0.4	0.4
1986	0.5	0.0	0.5	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.4	0.1	-0.2	-0.4
1988	-0.4	0.3	-0.1	0.0	0.4	0.1	0.4	-0.3	0.1	-0.5	0.4	0.3
1989	0.1	0.3	0.0	-0.4	-0.4	0.3	-0.4	0.3	0.1	0.3	-0.3	-0.2
1990	-0.2	-0.2	0.0	0.3	0.3	-0.2	-0.4	0.1	-0.4	0.2	0.4	0.1
1991	-0.2	0.3	-0.4	0.2	-0.3	0.0	-0.3	0.1	0.1	-0.4	-0.5	0.2
1992	-0.2	0.5	-0.1	0.4	-0.2	0.1	-10.1	-0.1	0.2	0.5	0.3	0.1
1993	0.1	-0.2	0.4	0.2	0.1	0.1	0.5	0.4	19.8	0.7	0.4	-0.1
1994	0.0	0.0	-0.4	-0.4	0.1	0.2	0.3	-0.5	-0.5	0.3	0.3	-0.4
1995	0.1	0.2	0.3	-0.1	-0.5	0.3	0.1	0.1	0.3	-0.2	0.3	-0.5
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.4	0.4	-0.1	0.2	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.5	-0.1	0.1	-0.5	0.4
1998	0.2	-0.3	0.2	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	-0.1	0.5	0.3	0.5	-0.3	0.1	-0.1
2000	0.2	-0.4	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.3	0.0	0.3	3.0	-0.3	-0.4	-0.5	-0.3	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	-0.1	-0.4	-0.1	0.3	-0.1
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-0.1	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.4	-0.6	-0.1	0.0	0.7	0.0	0.0	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	-1.4	-0.1	-0.1	0.0	0.1	0.0
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.8	0.0	-0.1	-0.1	-0.1	-0.1
BN	0.2	0.0	0.2	-0.2	0.3	0.1	0.4	-0.1	0.3	0.3	-0.2	-0.1
AN	0.1	-0.1	0.0	-0.1	0.2	-3.5	0.1	0.1	3.4	0.0	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.1	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-103. San Joaquin River location RSAN112 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	-0.1	-0.1
1973	0.1	0.0	0.0	0.0	0.0	-6.4	-0.3	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	-0.1	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	-0.1	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.4	0.1	0.0	0.0	0.0	0.0
1982	0.1	-0.1	0.0	0.0	-5.0	-0.3	0.2	-0.3	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1988	-0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.1	0.0
1989	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	0.1	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	-0.1	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	-1.3	0.0	0.0	0.1	0.0	0.0
1993	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	2.9	0.1	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.3	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.8	-0.1	-0.1	-0.1	0.0	-0.1
2002	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.1	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.1	0.0	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.4	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-104. Mokelumne River location RSMKL008 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	-0.6	-2.9	-1.8
1977	0.0	0.2	0.0	0.1	0.3	0.4	0.3	0.4	0.2	-3.6	-0.9	-1.2
1978	0.0	0.2	0.1	0.6	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.9	0.0
1982	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.1	-1.1	-3.3	-1.2
1988	0.2	0.2	0.2	0.6	0.1	0.7	0.3	0.6	0.2	-2.1	-2.4	-1.8
1989	0.2	0.1	0.2	0.4	0.6	0.3	0.4	0.2	0.1	0.0	-0.4	0.0
1990	0.1	0.1	0.2	0.1	0.6	0.3	0.0	0.2	0.2	-1.8	-1.1	-1.4
1991	0.0	0.4	0.4	1.0	0.6	0.7	0.3	0.3	0.2	-1.4	-0.9	-1.3
1992	0.1	0.3	0.6	0.4	1.0	0.4	0.3	0.5	0.2	-1.7	-1.3	-0.8
1993	-0.1	0.4	0.3	1.0	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.2	0.4	0.2	0.1	0.2	0.1	-0.1	-1.4	-0.4
1995	0.1	0.2	0.1	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.3	0.1	-1.8	-1.6	-1.1
2002	0.1	0.2	0.1	0.3	0.4	0.1	0.2	0.2	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.1	-0.2	0.0	0.0
Average	0.0	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	-0.4	-0.5	-0.3
Critical	0.1	0.2	0.2	0.3	0.4	0.4	0.2	0.3	0.2	-1.6	-1.6	-1.2
Dry	0.0	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	-0.5	-1.0	-0.4
BN	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.1	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-105. Mokelumne River location RSMKL008 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	-1.6	-1.0
1977	0.0	0.1	0.0	0.0	0.1	0.2	0.1	0.2	0.1	-1.9	-0.5	-0.6
1978	0.0	0.1	0.0	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	0.0
1982	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	-0.6	-1.7	-0.6
1988	0.1	0.1	0.1	0.2	0.0	0.3	0.2	0.3	0.1	-1.1	-1.3	-0.9
1989	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.1	0.0	0.0	-0.2	0.0
1990	0.0	0.1	0.1	0.1	0.3	0.1	0.0	0.1	0.1	-1.0	-0.6	-0.7
1991	0.0	0.2	0.2	0.4	0.2	0.3	0.1	0.2	0.1	-0.7	-0.5	-0.7
1992	0.0	0.2	0.3	0.2	0.4	0.2	0.1	0.3	0.1	-0.9	-0.7	-0.4
1993	-0.1	0.2	0.1	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.0	-0.8	-0.2
1995	0.1	0.1	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-1.0	-0.9	-0.6
2002	0.0	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	-0.2	-0.3	-0.2
Critical	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.1	-0.8	-0.8	-0.6
Dry	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	-0.3	-0.6	-0.2
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-106. Barker Slough location SLBAR002 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.8	-2.1
1977	-1.8	-0.5	0.0	0.0	0.0	0.0	0.1	0.0	0.1	-0.1	-2.0	-1.2
1978	-2.0	-1.4	-0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-2.1
1988	-1.4	-0.6	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.1	-1.1	-1.8
1989	-1.9	-0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1
1990	0.0	0.0	0.1	0.1	0.1	0.4	0.2	0.0	0.0	0.0	-0.7	-0.9
1991	-1.1	-0.3	0.3	0.3	0.2	0.2	0.3	0.1	0.1	0.0	-0.6	-0.8
1992	-1.1	-0.1	0.3	0.3	0.2	0.4	0.2	0.2	0.1	-0.1	-0.9	-1.0
1993	-0.8	-0.4	0.1	0.2	0.2	0.4	0.2	0.1	0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	-0.3	-0.7
1995	-0.3	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	-0.7	-1.0
2002	-0.8	-0.1	0.0	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Average	-0.3	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.2	-0.4
Critical	-0.8	-0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.0	-0.9	-1.2
Dry	-0.5	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.3	-0.6
BN	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.5	-0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-107. Barker Slough location SLBAR002 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.1
1977	-0.9	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.0	-0.6
1978	-1.0	-0.7	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.0
1988	-0.7	-0.3	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1	-0.6	-0.9
1989	-0.9	-0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
1990	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.0	0.0	-0.3	-0.5
1991	-0.6	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.3	-0.4
1992	-0.5	-0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.0	-0.5	-0.5
1993	-0.4	-0.2	0.1	0.1	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.4
1995	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.5
2002	-0.4	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
Critical	-0.4	-0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.5	-0.6
Dry	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-108. Suisun Marsh location SLCBN002 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	1.5	1.0	-1.1	-0.4	-0.2	-0.1	-0.1
1974	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
1975	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.6	-0.9	4.4	-79.7	-377.5	-509.9
1977	-392.4	-213.5	-122.2	-69.8	-37.2	-35.0	-23.6	-11.7	7.8	-134.3	-378.0	-363.8
1978	-296.1	-166.4	-68.8	-14.7	-14.9	-19.5	-16.9	-14.5	-4.5	5.2	-4.7	-8.6
1979	-9.2	-8.9	-9.7	-0.6	3.0	1.3	3.4	7.2	5.0	-1.3	-2.9	-3.4
1980	-2.9	5.2	23.0	7.3	1.3	-1.4	-0.2	4.0	3.5	0.4	-0.5	-0.9
1981	-1.1	-1.0	0.4	5.0	3.3	2.9	6.6	9.4	12.0	-30.2	-152.5	-216.8
1982	-140.5	-55.6	-22.4	-15.5	-6.1	-5.5	-5.3	-4.9	-0.3	0.6	-2.3	-2.6
1983	-6.5	5.9	-0.5	-1.8	-1.5	-1.6	-2.6	-1.5	-1.3	-0.6	2.4	6.1
1984	3.7	2.1	-0.2	-0.5	-0.1	0.0	1.4	5.4	6.1	2.3	0.8	0.2
1985	-0.3	7.8	13.5	9.4	7.2	6.5	4.8	7.0	6.8	2.5	2.4	1.6
1986	1.4	1.1	3.4	9.3	1.6	1.3	1.4	2.6	2.4	1.1	0.7	0.5
1987	0.4	0.4	0.5	2.6	6.4	4.4	3.0	2.4	11.6	-107.8	-418.3	-575.1
1988	-402.1	-211.1	-73.2	0.9	4.3	-11.8	9.5	22.3	18.5	-185.4	-485.6	-462.8
1989	-344.2	-191.4	-68.4	2.3	-11.1	22.8	39.6	65.3	17.5	-9.9	-115.7	-160.4
1990	-98.4	-47.8	-25.6	0.5	54.4	117.7	96.3	50.5	53.5	-164.1	-455.5	-438.2
1991	-352.1	-185.3	-108.9	-63.8	-17.5	38.4	29.6	62.0	74.8	-110.8	-369.4	-362.1
1992	-287.4	-161.7	-88.9	-52.7	16.2	16.1	41.0	52.9	34.0	-178.5	-455.3	-436.5
1993	-320.0	-177.0	-43.5	16.3	-11.1	2.5	-2.3	10.7	57.8	82.6	36.4	5.8
1994	-4.1	-5.9	-6.2	13.0	35.2	51.0	64.0	59.8	61.7	-20.1	-257.4	-376.9
1995	-283.3	-121.4	-46.5	9.8	-7.0	-7.5	-10.5	-9.8	-5.0	4.2	25.4	30.7
1996	3.6	-1.3	21.1	15.2	3.4	-0.1	-1.9	-0.6	7.3	19.8	8.3	4.2
1997	-2.0	-6.9	3.6	-5.4	-6.7	7.5	11.3	16.7	16.5	8.1	3.5	2.9
1998	-0.7	0.1	7.0	12.4	1.6	2.2	1.2	0.8	0.7	2.0	8.8	17.2
1999	5.6	14.0	12.9	4.4	2.1	1.3	2.2	5.3	15.8	8.1	6.9	-1.4
2000	2.2	1.3	0.7	17.3	9.4	3.4	4.0	7.8	7.6	4.8	1.7	1.2
2001	1.0	0.9	0.9	5.6	2.2	4.5	7.3	28.2	47.6	-172.1	-466.3	-475.3
2002	-352.1	-141.6	-12.4	-13.3	14.7	58.8	68.0	73.2	41.2	15.8	4.3	1.3
2003	-1.1	-3.7	21.5	3.8	1.3	7.5	10.5	4.3	23.5	27.3	-32.6	-51.3
Average	-96.4	-48.9	-17.3	-3.0	1.6	7.9	10.1	13.3	15.5	-29.7	-113.9	-128.7
Critical	-219.5	-117.9	-60.7	-24.5	7.9	25.2	31.1	33.6	36.4	-124.7	-397.0	-421.4
Dry	-116.0	-54.1	-10.9	1.9	3.8	16.6	21.5	30.9	22.8	-50.3	-191.0	-237.5
BN	-4.6	-4.5	-4.9	-0.3	1.5	0.6	1.7	3.6	2.5	-0.6	-1.4	-1.7
AN	-103.0	-56.8	-11.2	5.0	-2.3	-1.0	-0.6	1.9	14.6	20.0	0.0	-9.0
Wet	-32.2	-12.5	-1.7	2.1	-1.0	-0.2	-0.2	1.1	3.2	3.5	4.2	4.4

Table 1-109. Suisun Marsh location SLCBN002 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-2.6	-3.3
1977	-2.8	-1.6	-0.9	-0.6	-0.4	-0.4	-0.2	-0.1	0.1	-0.9	-2.3	-2.1
1978	-2.0	-1.2	-0.6	-0.3	-0.6	-0.8	-0.8	-0.6	-0.1	0.1	0.0	-0.1
1979	-0.1	-0.1	-0.1	0.0	0.1	0.1	0.1	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.3	0.2	0.1	-0.1	0.0	0.1	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.1	-0.3	-1.2	-1.6
1982	-1.1	-0.7	-0.7	-0.8	-0.4	-0.4	-0.4	-0.4	0.0	0.0	0.0	0.0
1983	-0.1	0.2	0.0	-0.2	-0.2	-0.2	-0.3	-0.2	-0.2	-0.1	0.1	0.2
1984	0.1	0.1	0.0	-0.1	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0
1985	0.0	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	-1.0	-3.2	-4.0
1988	-3.0	-1.7	-0.7	0.0	0.1	-0.2	0.1	0.2	0.2	-1.5	-3.5	-3.0
1989	-2.4	-1.4	-0.5	0.0	-0.1	0.5	1.3	1.4	0.2	-0.1	-0.9	-1.2
1990	-0.8	-0.4	-0.2	0.0	0.8	1.6	1.1	0.5	0.5	-1.2	-3.0	-2.8
1991	-2.4	-1.3	-0.8	-0.5	-0.2	0.6	0.5	0.7	0.6	-0.8	-2.4	-2.3
1992	-1.9	-1.1	-0.6	-0.4	0.2	0.4	0.7	0.6	0.3	-1.4	-3.1	-2.8
1993	-2.3	-1.4	-0.4	0.3	-0.4	0.1	-0.1	0.5	2.4	1.8	0.4	0.1
1994	-0.1	-0.1	-0.1	0.2	0.6	0.9	0.9	0.8	0.6	-0.2	-1.8	-2.5
1995	-2.2	-1.0	-0.4	0.2	-0.2	-0.4	-0.5	-0.6	-0.3	0.2	0.6	0.5
1996	0.1	0.0	0.4	0.6	0.3	0.0	-0.1	-0.1	0.3	0.3	0.1	0.1
1997	0.0	-0.1	0.2	-0.5	-0.5	0.5	0.5	0.5	0.3	0.1	0.0	0.0
1998	0.0	0.0	0.1	0.4	0.1	0.2	0.1	0.1	0.1	0.2	0.3	0.4
1999	0.1	0.3	0.5	0.3	0.2	0.2	0.2	0.3	0.5	0.1	0.1	0.0
2000	0.0	0.0	0.0	0.3	0.5	0.2	0.3	0.3	0.2	0.1	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.5	0.6	-1.7	-3.8	-3.4
2002	-2.8	-1.2	-0.2	-0.5	0.5	1.5	1.7	1.6	0.6	0.1	0.0	0.0
2003	0.0	0.0	0.3	0.1	0.1	0.2	0.4	0.2	0.7	0.4	-0.4	-0.5
Average	-0.7	-0.4	-0.1	0.0	0.0	0.1	0.2	0.2	0.2	-0.2	-0.8	-0.8
Critical	-1.6	-0.9	-0.5	-0.2	0.2	0.4	0.4	0.4	0.3	-0.9	-2.7	-2.7
Dry	-0.9	-0.4	-0.1	0.0	0.1	0.4	0.6	0.6	0.3	-0.5	-1.5	-1.7
BN	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
AN	-0.7	-0.4	-0.1	0.1	-0.1	0.0	0.0	0.1	0.5	0.4	0.0	-0.1
Wet	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1

Table 1-110. San Joaquin River location RSAN037 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-2.8	25.4	-9.8	-26.2
1977	-17.1	-7.3	-5.0	-3.1	-0.9	-0.3	-0.1	-1.4	-3.1	-11.8	-12.2	-16.8
1978	-16.7	-6.5	-4.0	0.1	0.6	0.3	0.0	0.2	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.0	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-16.0	9.5	10.2
1982	-7.2	-6.0	-0.5	0.3	-7.0	-1.8	0.2	-0.2	-0.2	-0.1	0.0	0.0
1983	-0.1	0.0	-0.2	0.0	0.4	0.2	0.1	-0.2	0.2	-0.1	-0.1	0.0
1984	0.0	-0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	6.0	0.6	-12.5
1988	-9.1	-4.8	-3.3	-0.6	-0.1	0.0	0.0	0.1	0.4	10.3	3.4	-14.6
1989	-14.0	-6.2	-3.7	-2.4	-0.9	0.3	0.5	0.3	0.1	-2.5	2.6	2.3
1990	-0.8	-0.2	-0.2	-0.2	0.5	0.9	0.6	-0.2	-0.5	26.3	6.8	-15.1
1991	-14.9	-7.8	-5.1	-2.9	-1.0	-0.2	0.0	-0.4	-0.8	23.0	5.4	-12.4
1992	-12.5	-6.0	-4.1	-2.6	-0.3	0.1	0.0	0.1	0.6	8.8	0.1	-11.6
1993	-8.4	-3.7	-3.5	0.5	1.0	0.3	0.1	0.5	-12.4	-2.2	0.5	0.2
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-17.6	-5.8	16.1
1995	-0.9	-1.0	-2.0	0.0	0.2	0.2	0.1	0.1	0.2	-0.1	0.0	0.0
1996	0.0	-0.1	0.0	0.0	0.1	-0.1	0.1	0.1	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	-0.3	-0.2	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.1	0.2	-0.1	0.0	0.3	0.2	-0.1	-0.1	0.0
1999	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	9.5	5.7	-5.8
2002	-6.5	-3.2	-2.4	-0.2	0.2	0.1	0.1	0.2	0.0	0.1	0.1	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	1.7	-2.5	-3.5
Average	-3.2	-1.6	-1.0	-0.3	-0.2	0.0	0.1	0.0	-0.5	1.8	0.1	-2.6
Critical	-7.8	-3.7	-2.5	-1.3	-0.3	0.1	0.1	-0.5	-1.0	9.2	-1.7	-11.5
Dry	-3.4	-1.6	-1.0	-0.4	-0.1	0.1	0.1	0.1	0.1	-0.5	3.1	-1.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
AN	-4.2	-1.7	-1.3	0.1	0.3	0.1	0.1	0.2	-2.0	-0.1	-0.3	-0.5
Wet	-0.6	-0.6	-0.2	0.0	-0.5	-0.1	0.1	0.0	0.0	0.0	0.0	0.0

Table 1-111. San Joaquin River location RSAN037 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.8	5.1	-1.9	-5.3
1977	-3.0	-1.4	-0.8	-0.4	-0.2	-0.1	0.0	-0.4	-0.8	-2.8	-2.4	-2.5
1978	-2.7	-1.2	-0.7	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.8	2.1	1.9
1982	-1.3	-1.3	-0.2	0.1	-2.5	-0.6	0.1	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	-0.1	0.0	0.1	0.1	0.1	-0.1	0.1	0.0	-0.1	0.0
1984	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.2	0.2	-3.1
1988	-1.9	-1.0	-0.6	-0.2	0.0	0.0	0.0	0.0	0.1	3.6	0.9	-3.2
1989	-2.4	-1.1	-0.6	-0.3	-0.2	0.1	0.2	0.1	0.0	-0.6	0.5	0.5
1990	-0.2	0.0	0.0	0.0	0.2	0.3	0.2	-0.1	-0.2	5.9	1.3	-2.9
1991	-2.5	-1.3	-0.7	-0.4	-0.2	-0.1	0.0	-0.2	-0.3	4.8	1.0	-2.5
1992	-2.2	-1.0	-0.6	-0.4	-0.1	0.0	0.0	0.0	0.2	2.9	0.0	-2.2
1993	-1.7	-0.8	-0.6	0.1	0.3	0.1	0.0	0.2	-4.8	-1.1	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-3.4	-1.0	2.9
1995	-0.2	-0.3	-0.3	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	-0.1	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.6	1.7	-1.5
2002	-1.4	-0.7	-0.7	-0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	-0.8	-1.1
Average	-0.6	-0.3	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.2	0.5	0.0	-0.6
Critical	-1.4	-0.7	-0.4	-0.2	-0.1	0.0	0.0	-0.1	-0.3	2.3	-0.3	-2.2
Dry	-0.6	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.8	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.7	-0.3	-0.2	0.0	0.1	0.0	0.0	0.1	-0.8	-0.1	-0.1	-0.2
Wet	-0.1	-0.1	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-112. RSAN072 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.3	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.2	0.2	0.2	0.3	-0.3	0.3	0.3	-0.2	-0.4
1973	0.3	0.1	0.2	-0.2	0.2	0.4	-0.1	0.3	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.2	-0.2	0.1	0.3	0.3	0.3	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.1	0.2	0.3	0.0	-0.2	0.0	-2.9	0.0	0.1
1977	-0.2	0.1	-0.1	0.3	0.1	0.2	0.2	0.4	0.0	-0.1	0.0	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	-0.3	0.4	0.0	-25.2	-3.1	-0.2
1982	0.3	-0.3	0.3	0.0	-13.9	-1.1	0.4	-0.4	-0.3	-0.3	0.4	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.3	0.3	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.4	-0.4	-0.4	0.3
1986	0.5	0.0	0.4	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.3	-0.1	0.1	-0.4
1988	-0.4	0.3	0.0	0.0	0.4	0.1	0.4	-0.2	0.1	0.8	0.4	0.3
1989	0.1	0.3	0.1	-0.4	-0.4	0.3	-0.4	0.2	0.1	0.4	-0.2	-0.2
1990	-0.2	-0.2	0.0	0.2	0.3	-0.2	-0.4	0.0	-0.3	-12.4	-2.7	0.1
1991	-0.1	0.3	-0.3	0.2	-0.3	0.0	-0.3	0.1	0.1	-19.7	-3.9	0.1
1992	-0.2	0.4	0.0	0.3	-0.1	0.1	-0.4	0.1	0.1	-43.0	-29.1	0.1
1993	0.1	-0.2	0.3	0.2	0.1	0.1	0.5	0.4	17.7	1.7	0.4	-0.1
1994	0.0	0.0	-0.3	-0.4	0.0	0.2	0.3	-0.4	-0.4	1.9	-0.1	-0.3
1995	0.1	0.2	0.3	-0.1	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.4
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.3	0.4	-0.1	0.1	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.4	0.3
1998	0.2	-0.3	0.1	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	0.0	0.4	0.3	0.5	-0.3	0.0	-0.1
2000	0.2	-0.3	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.2	0.0	0.3	0.1	-0.4	-0.4	-29.7	-4.5	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	0.0	-0.3	-0.2	0.2	0.0
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-0.6	0.1	0.2
Average	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.6	-3.8	-1.3	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	0.0	0.0	-0.1	-10.8	-5.1	0.1
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-9.2	-1.3	-0.1
BN	0.2	0.0	0.1	-0.1	0.3	0.1	0.3	-0.1	0.3	0.3	-0.1	-0.1
AN	0.1	-0.1	0.0	0.0	0.2	0.2	0.2	0.1	3.0	0.1	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.0	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-113. RSAN072 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	-0.1
1973	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	0.0	-4.0	-0.5	0.0
1982	0.1	-0.1	0.0	0.0	-4.7	-0.4	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-1.9	-0.4	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.8	-0.6	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.2	-3.8	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	2.6	0.2	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.3	0.0	0.0
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-4.5	-0.7	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	-0.6	-0.2	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.6	-0.7	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.2	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-114. San Joaquin River location RSAN112 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.4	-0.4	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.4	0.1	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.3	0.2	0.2	0.3	-0.4	0.4	0.3	-0.3	-0.4
1973	0.4	0.0	0.2	-0.3	0.2	0.4	-0.2	0.4	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.3	-0.3	0.1	0.3	0.3	0.4	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.0	0.2	0.3	0.0	-0.2	0.0	-0.2	-0.1	0.1
1977	-0.2	0.1	-0.2	0.3	0.1	0.3	0.2	0.4	-0.1	0.0	-0.4	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.3	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	-0.3	0.4	0.0	-25.3	-0.9	-0.2
1982	0.4	-0.4	0.4	0.0	-14.5	-0.9	0.4	-0.4	-0.3	-0.3	0.4	-0.4
1983	-0.4	0.1	-0.3	0.1	0.5	0.2	0.1	-0.4	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.4	0.3	0.3	-0.2
1985	0.0	-0.2	-0.2	0.4	0.2	-0.2	0.4	0.0	-0.5	-0.4	-0.4	0.4
1986	0.5	0.0	0.5	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.4	0.1	-0.2	-0.4
1988	-0.4	0.3	-0.1	0.0	0.4	0.1	0.4	-0.3	0.1	-0.5	0.4	0.3
1989	0.1	0.3	0.0	-0.4	-0.4	0.3	-0.4	0.3	0.1	0.3	-0.3	-0.2
1990	-0.2	-0.2	0.0	0.3	0.3	-0.2	-0.4	0.1	-0.4	0.2	0.4	0.1
1991	-0.2	0.3	-0.4	0.2	-0.3	0.0	-0.3	0.1	0.1	-0.4	-0.5	0.2
1992	-0.2	0.5	-0.1	0.4	-0.2	0.1	-0.4	0.2	0.2	-143.5	-4.8	0.1
1993	0.1	-0.2	0.4	0.2	0.1	0.1	0.5	0.4	19.8	0.7	0.4	-0.1
1994	0.0	0.0	-0.4	-0.4	0.1	0.2	0.3	-0.5	-0.5	0.3	0.3	-0.4
1995	0.1	0.2	0.3	-0.1	-0.5	0.3	0.1	0.1	0.3	-0.2	0.3	-0.5
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.4	0.4	-0.1	0.2	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.5	-0.1	0.1	-0.5	0.4
1998	0.2	-0.3	0.2	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	-0.1	0.5	0.3	0.5	-0.3	0.1	-0.1
2000	0.2	-0.4	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.3	0.0	0.3	0.1	-0.4	-0.4	-34.3	-1.4	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	-0.1	-0.4	-0.1	0.3	-0.1
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-0.1	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.4	0.0	0.1	0.0	0.7	-6.0	-0.2	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	0.0	0.0	-0.1	-20.6	-0.7	0.0
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-10.0	-0.5	-0.1
BN	0.2	0.0	0.2	-0.2	0.3	0.1	0.4	-0.1	0.3	0.3	-0.2	-0.1
AN	0.1	-0.1	0.0	-0.1	0.2	0.2	0.2	0.1	3.4	0.0	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.1	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-115. San Joaquin River location RSAN112 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	-0.1	-0.1
1973	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	-0.1	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	-0.1	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.1	0.0	-4.1	-0.1	0.0
1982	0.1	-0.1	0.0	0.0	-5.0	-0.3	0.2	-0.3	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1988	-0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.1	0.0
1989	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	0.1	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	-0.1	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-19.1	-0.6	0.0
1993	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	2.9	0.1	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.3	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-5.2	-0.2	-0.1
2002	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	-0.8	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.7	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.6	-0.1	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.4	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-116. Mokelumne River location RSMKL008 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	0.0	-0.5	-1.5	-1.0
1977	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	-0.7	0.1	-2.5	-0.6	-0.8
1978	-0.1	0.0	-0.1	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	-0.5	0.1
1982	0.0	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-2.1	-0.7
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-1.2	-1.3	-1.1
1989	-0.1	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.4	0.1	0.0	-0.4	0.1	-1.1	-0.7	-0.9
1991	-0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.3	0.0	-0.9	-0.6	-0.8
1992	-0.1	0.0	-0.1	-0.1	0.1	0.0	0.0	0.0	0.0	-1.0	-0.7	-0.5
1993	-0.1	0.0	0.0	0.5	0.5	0.1	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	-0.8	-0.2
1995	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-0.8	-0.6
2002	-0.1	0.0	-0.2	0.1	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.3	-0.3	-0.2
Critical	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	-0.3	0.0	-1.0	-0.9	-0.8
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.2	-0.6	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-117. Mokelumne River location RSMKL008 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	0.0	-0.3	-0.8	-0.5
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	-1.3	-0.3	-0.4
1978	-0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	0.1
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-1.1	-0.4
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.7	-0.6
1989	-0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.2	0.0	0.0	-0.2	0.1	-0.6	-0.4	-0.5
1991	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	-0.5	-0.3	-0.4
1992	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.5	-0.4	-0.3
1993	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.4	-0.1
1995	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.4	-0.3
2002	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.5	-0.5	-0.4
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-118. Barker Slough location SLBAR002 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.5	-1.2
1977	-1.1	-0.4	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-1.5	-0.8
1978	-1.4	-1.0	-0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1982	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-1.3
1988	-0.9	-0.4	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	-1.0
1989	-1.2	-0.5	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	-0.1	0.0	-0.4	-0.6
1991	-0.8	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.4	-0.5
1992	-0.8	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.6	-0.6
1993	-0.5	-0.2	-0.1	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.4
1995	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.5
2002	-0.5	-0.1	-0.1	-0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2
Critical	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.6	-0.7
Dry	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-119. Barker Slough location SLBAR002 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.3	-0.6
1977	-0.6	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.8	-0.4
1978	-0.7	-0.5	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.6
1988	-0.4	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.5
1989	-0.6	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.2	-0.3
1991	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
1992	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3
1993	-0.2	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
2002	-0.2	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Critical	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.4
Dry	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-120. Suisun Marsh location SLCBN002 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-18.8	-10.9	-11.2	-7.7	-0.8	-1.8	-5.4	-5.1	-3.6	-6.8	-5.7	0.2
1971	-1.5	-2.8	0.1	-4.2	-4.4	-2.1	-1.3	-4.7	-1.3	-1.2	-1.3	-1.7
1972	-1.5	-1.5	-3.5	-1.7	2.3	2.3	-3.4	-1.7	-1.6	-1.3	-1.2	-1.1
1973	-0.8	-0.6	-0.5	-0.5	-0.5	-0.9	-0.8	-1.5	0.2	-0.5	-0.3	-0.6
1974	-0.3	5.4	-1.3	-1.3	1.3	2.5	-0.1	-1.1	-0.3	-0.3	-0.4	-0.4
1975	-0.2	-0.2	0.2	-0.2	-0.5	0.2	-0.2	-0.2	0.0	0.1	0.0	-0.4
1976	-0.1	-0.2	0.4	-0.9	-1.8	2.1	3.2	-38.2	-75.7	-101.2	-236.3	-265.8
1977	-203.4	-114.1	-68.1	-42.3	-20.7	-19.0	-14.8	-39.5	-77.9	-117.0	-251.7	-224.2
1978	-172.5	-99.1	-56.6	-19.6	-11.8	-13.8	-11.6	-15.1	-11.1	-7.3	-7.8	-8.4
1979	-7.2	-6.8	-3.1	-1.1	-21.7	-23.8	10.8	-0.2	-3.0	-2.6	-11.8	-1.9
1980	-3.4	1.2	-1.8	11.7	-8.1	-3.5	0.7	0.3	-2.8	-0.8	3.0	4.2
1981	-4.6	-1.8	-2.0	-2.4	4.8	2.8	-5.5	-5.3	-2.8	-8.6	-41.8	-23.0
1982	6.2	-38.6	-16.4	-3.6	-13.4	0.6	-4.5	-1.7	-0.2	-1.2	-1.8	-1.6
1983	-1.2	-0.9	-0.8	-0.7	-0.7	-0.7	-1.4	-0.5	-0.7	-0.5	-0.5	-0.4
1984	-0.4	-0.6	-0.4	-0.4	-1.0	0.3	0.1	-0.3	1.1	-7.1	-1.6	11.8
1985	-4.4	-0.9	1.4	-1.2	0.9	-2.0	0.6	0.7	8.2	4.6	14.4	12.1
1986	-12.1	-2.1	-3.0	-1.8	-0.8	-1.1	-1.3	-0.9	-0.5	-0.7	-0.6	-1.0
1987	-0.5	-0.7	-0.2	0.5	-1.0	2.5	-0.3	-0.4	11.2	-42.1	-190.3	-265.6
1988	-187.3	-98.5	-49.4	-25.8	-20.1	-13.0	0.2	-4.5	5.4	-96.4	-255.4	-228.3
1989	-159.9	-91.6	-56.9	-28.8	-16.4	3.2	28.7	49.8	13.6	-5.1	-39.4	-18.2
1990	-12.0	-9.9	-6.2	-7.1	24.5	66.4	41.3	-21.1	-54.7	-133.6	-273.2	-247.0
1991	-194.5	-104.8	-67.4	-41.9	-25.9	-16.7	-6.0	-41.5	-63.5	-117.1	-250.8	-201.6
1992	-175.0	-100.6	-58.2	-37.3	-9.2	-6.8	-15.7	-11.2	-0.3	-116.4	-284.6	-242.9
1993	-173.0	-93.0	-57.9	-6.5	5.0	-9.6	-29.5	0.7	28.7	57.2	13.3	-0.6
1994	3.0	-5.4	-6.2	-5.1	-11.5	-9.3	-3.4	-14.8	-27.1	-60.7	-162.9	-195.2
1995	-122.1	-59.8	-39.5	-6.2	-10.0	-10.9	-18.0	-19.7	0.4	1.8	-5.7	2.5
1996	-5.7	-3.1	-1.2	-6.8	-0.9	-2.2	-3.8	-2.5	-1.5	-1.5	-1.6	-2.2
1997	-1.7	-1.3	0.1	-4.4	-6.9	3.4	0.8	0.4	-8.1	1.6	1.2	2.9
1998	1.0	0.9	0.5	6.7	-3.2	1.9	3.2	-2.1	0.7	-0.7	-5.4	-0.3
1999	2.5	-0.4	1.7	0.9	2.7	1.4	-2.9	-1.2	8.3	-4.8	-8.1	3.9
2000	-2.3	0.4	-2.7	4.2	-3.1	-4.1	-2.7	3.9	-3.0	7.8	-7.5	6.6
2001	4.4	1.8	1.9	1.7	-13.3	-0.9	3.1	4.4	20.1	-121.7	-260.3	-243.9
2002	-158.2	-89.9	-46.2	-39.4	3.6	19.6	32.3	33.1	8.8	2.8	-8.1	11.1
2003	-1.5	-7.6	1.2	-5.9	-7.1	-5.5	-11.1	8.0	-0.6	-1.3	4.6	4.2
Average	-47.3	-27.6	-16.3	-8.2	-5.0	-1.1	-0.6	-3.9	-6.9	-26.0	-67.0	-62.3
Critical	-109.9	-61.9	-36.4	-22.9	-9.3	0.5	0.7	-24.4	-42.0	-106.1	-245.0	-229.3
Dry	-53.9	-30.5	-17.0	-11.6	-3.5	4.2	9.8	13.7	9.9	-28.4	-87.6	-87.9
BN	-4.4	-4.2	-3.3	-1.4	-9.7	-10.7	3.7	-1.0	-2.3	-1.9	-6.5	-1.5
AN	-58.9	-33.1	-19.7	-2.8	-4.3	-6.2	-9.1	-0.6	1.9	9.2	0.9	0.9
Wet	-11.9	-8.8	-5.5	-2.3	-3.0	-0.7	-2.7	-3.0	-0.4	-1.6	-2.4	1.0

Table 1-121. Suisun Marsh location SLCBN002 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.4	-0.2	-0.4	-0.6	-0.1	-0.2	-0.3	-0.1	-0.1	-0.1	-0.1	0.0
1971	0.0	-0.1	0.0	-0.3	-0.2	-0.1	-0.1	-0.3	-0.1	0.0	0.0	0.0
1972	0.0	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1974	0.0	0.1	-0.1	-0.1	0.1	0.3	0.0	-0.1	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.6	-0.7	-1.6	-1.7
1977	-1.4	-0.8	-0.5	-0.4	-0.2	-0.2	-0.1	-0.3	-0.5	-0.8	-1.5	-1.3
1978	-1.2	-0.7	-0.5	-0.4	-0.5	-0.6	-0.5	-0.6	-0.3	-0.1	-0.1	-0.1
1979	-0.1	-0.1	0.0	0.0	-0.6	-0.9	0.4	0.0	-0.1	0.0	-0.1	0.0
1980	0.0	0.0	0.0	0.3	-0.4	-0.2	0.0	0.0	-0.1	0.0	0.0	0.0
1981	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	-0.1	0.0	-0.1	-0.3	-0.2
1982	0.0	-0.5	-0.5	-0.2	-0.8	0.0	-0.4	-0.1	0.0	0.0	0.0	0.0
1983	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0
1984	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.1
1985	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1
1986	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	-0.4	-1.5	-1.9
1988	-1.4	-0.8	-0.5	-0.5	-0.5	-0.2	0.0	0.0	0.1	-0.8	-1.8	-1.5
1989	-1.1	-0.7	-0.5	-0.3	-0.2	0.1	0.9	1.1	0.2	0.0	-0.3	-0.1
1990	-0.1	-0.1	-0.1	-0.1	0.4	0.9	0.5	-0.2	-0.5	-1.0	-1.8	-1.6
1991	-1.3	-0.7	-0.5	-0.3	-0.3	-0.3	-0.1	-0.5	-0.5	-0.8	-1.7	-1.3
1992	-1.2	-0.7	-0.4	-0.3	-0.1	-0.2	-0.3	-0.1	0.0	-0.9	-1.9	-1.5
1993	-1.2	-0.7	-0.5	-0.1	0.2	-0.4	-1.2	0.0	1.2	1.2	0.1	0.0
1994	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	0.0	-0.2	-0.3	-0.5	-1.2	-1.3
1995	-0.9	-0.5	-0.3	-0.1	-0.3	-0.6	-0.8	-1.3	0.0	0.1	-0.1	0.0
1996	-0.1	-0.1	0.0	-0.2	-0.1	-0.2	-0.3	-0.3	-0.1	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.4	-0.5	0.2	0.0	0.0	-0.1	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.2	-0.3	0.1	0.3	-0.2	0.1	-0.1	-0.2	0.0
1999	0.1	0.0	0.1	0.1	0.3	0.2	-0.3	-0.1	0.2	-0.1	-0.1	0.0
2000	0.0	0.0	0.0	0.1	-0.2	-0.3	-0.2	0.2	-0.1	0.1	-0.1	0.1
2001	0.1	0.0	0.0	0.0	-0.3	0.0	0.1	0.1	0.2	-1.2	-2.1	-1.7
2002	-1.2	-0.8	-0.6	-1.3	0.1	0.5	0.8	0.7	0.1	0.0	-0.1	0.1
2003	0.0	-0.1	0.0	-0.2	-0.3	-0.2	-0.4	0.4	0.0	0.0	0.1	0.0
Average	-0.4	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	-0.2	-0.5	-0.4
Critical	-0.8	-0.5	-0.3	-0.2	-0.1	0.0	0.0	-0.3	-0.3	-0.8	-1.7	-1.4
Dry	-0.4	-0.2	-0.2	-0.3	0.0	0.1	0.3	0.3	0.1	-0.3	-0.7	-0.6
BN	-0.1	-0.1	0.0	0.0	-0.3	-0.4	0.1	0.0	0.0	0.0	-0.1	0.0
AN	-0.4	-0.2	-0.2	-0.1	-0.2	-0.3	-0.4	0.0	0.1	0.2	0.0	0.0
Wet	-0.1	-0.1	-0.1	-0.1	-0.2	0.0	-0.2	-0.2	0.0	0.0	0.0	0.0

Table 1-122. San Joaquin River location RSAN037 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.2	-10.2	-6.2	-0.6	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.4	28.3	-17.7	-39.6
1977	-27.8	-11.9	-12.4	-12.1	-3.2	0.2	0.8	0.7	1.9	-10.1	-18.2	-26.5
1978	-21.1	-7.3	-5.3	0.8	0.9	0.5	0.1	0.2	0.2	0.1	0.2	0.1
1979	0.0	0.0	-0.1	0.3	0.4	0.1	0.2	0.2	0.1	0.0	0.0	0.0
1980	-0.2	0.5	3.7	0.4	-2.0	-0.1	0.0	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	-0.2	0.2	0.1	0.0	0.2	0.5	0.4	-3.2	20.1	3.6
1982	-17.3	-9.7	-0.3	0.3	-6.9	-1.8	0.2	-0.2	-0.2	-0.1	0.0	0.0
1983	-0.1	0.0	-0.2	0.0	0.4	0.2	0.1	-0.2	0.2	0.0	-0.1	0.0
1984	0.1	-0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1985	0.0	0.1	0.2	0.2	0.1	0.3	0.2	0.1	0.1	-0.2	-0.3	-0.5
1986	-0.2	-0.5	0.1	0.3	0.1	0.3	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.1	-0.1	-0.2	0.1	0.0	1.1	1.6	0.8	6.3	-3.0	-23.3
1988	-18.2	-9.7	-6.2	0.5	0.4	2.2	1.8	1.9	1.3	11.5	-1.6	-26.6
1989	-25.1	-13.9	-2.9	7.5	2.1	2.2	1.0	1.8	0.6	-0.7	9.9	-3.7
1990	-9.6	-7.8	-7.3	-4.0	0.7	1.5	1.3	0.8	1.5	25.0	-1.5	-27.2
1991	-25.1	-12.1	-11.0	-7.1	-0.5	0.9	0.9	1.0	3.0	17.0	-2.6	-20.8
1992	-18.9	-8.7	-8.5	-11.0	-1.2	0.8	0.5	1.4	0.8	10.6	-2.4	-25.1
1993	-18.8	-7.1	-0.8	3.0	1.5	1.0	0.6	0.8	-12.2	-2.1	0.7	0.3
1994	0.1	0.0	-0.1	1.3	1.8	0.8	0.6	0.4	1.0	-3.5	-4.5	7.8
1995	-4.3	-2.1	-2.9	1.4	0.7	0.3	0.2	0.1	0.2	-0.1	0.1	0.1
1996	0.0	-0.1	0.1	0.3	0.2	-0.1	0.1	0.1	0.1	0.2	0.3	0.2
1997	0.0	0.0	0.0	-0.3	-0.2	0.0	0.0	0.2	0.1	-0.1	-0.1	-0.7
1998	0.2	0.3	0.3	0.3	0.3	-0.1	0.0	0.3	0.2	-0.1	0.0	0.0
1999	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.1
2000	0.0	0.0	-0.3	0.0	0.2	0.2	0.2	0.1	0.0	0.0	-0.1	0.0
2001	0.0	0.0	-0.6	-0.3	0.1	0.1	0.7	1.0	1.1	14.4	7.4	-13.6
2002	-14.3	-3.3	2.8	0.6	0.5	0.3	0.2	0.4	0.6	-0.3	-0.7	-1.8
2003	-1.0	-0.9	0.4	0.2	0.1	0.1	0.2	0.2	0.2	4.8	0.5	-3.1
Average	-5.9	-2.8	-1.5	-0.5	-0.1	0.0	0.2	0.4	0.1	2.9	-0.4	-5.9
Critical	-14.2	-7.2	-6.5	-4.6	-0.3	0.9	0.8	0.9	1.5	11.3	-6.9	-22.6
Dry	-6.6	-2.8	-0.1	1.3	0.5	0.5	0.6	0.9	0.6	2.7	5.5	-6.5
BN	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
AN	-6.9	-2.5	-0.4	0.7	0.1	-1.4	-0.8	0.1	-2.0	0.5	0.2	-0.5
Wet	-1.7	-0.9	-0.2	0.2	-0.4	-0.1	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-123. San Joaquin River location RSAN037 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.1	-3.4	-2.1	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.7	-3.4	-8.1
1977	-4.9	-2.2	-1.9	-1.7	-0.7	0.1	0.3	0.2	0.5	-2.4	-3.5	-4.0
1978	-3.4	-1.4	-0.9	0.2	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.1	0.7	0.1	-0.6	-0.1	0.0	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.2	0.1	-0.9	4.4	0.7
1982	-3.1	-2.0	-0.2	0.1	-2.5	-0.6	0.1	-0.1	-0.1	0.0	0.0	0.0
1983	0.0	0.0	-0.1	0.0	0.1	0.1	0.1	-0.1	0.1	0.0	-0.1	0.0
1984	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1
1986	0.0	-0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	-0.1	0.0	0.0	0.0	0.3	0.5	0.3	2.3	-0.9	-5.8
1988	-3.9	-2.1	-1.2	0.2	0.1	0.7	0.6	0.6	0.5	4.0	-0.4	-5.7
1989	-4.3	-2.5	-0.4	1.0	0.5	0.7	0.4	0.7	0.3	-0.2	1.9	-0.8
1990	-2.2	-1.6	-1.3	-0.8	0.2	0.6	0.5	0.3	0.5	5.6	-0.3	-5.2
1991	-4.2	-1.9	-1.6	-1.1	-0.1	0.2	0.3	0.4	1.0	3.5	-0.5	-4.1
1992	-3.3	-1.5	-1.3	-1.6	-0.3	0.2	0.2	0.5	0.3	3.5	-0.5	-4.9
1993	-3.8	-1.5	-0.1	0.7	0.4	0.3	0.2	0.3	-4.7	-1.0	0.3	0.1
1994	0.0	0.0	0.0	0.2	0.5	0.3	0.2	0.2	0.4	-0.7	-0.8	1.4
1995	-0.9	-0.5	-0.5	0.3	0.3	0.1	0.1	0.0	0.1	0.0	0.0	0.1
1996	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	-0.2
1998	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.0
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.2	-0.1	0.0	0.0	0.2	0.3	0.4	5.5	2.2	-3.5
2002	-3.1	-0.7	0.8	0.2	0.2	0.1	0.1	0.1	0.2	-0.1	-0.2	-0.3
2003	-0.2	-0.2	0.1	0.1	0.0	0.0	0.1	0.1	0.1	2.2	0.2	-1.0
Average	-1.1	-0.5	-0.2	-0.1	0.0	0.0	0.1	0.1	0.0	0.8	0.0	-1.2
Critical	-2.6	-1.3	-1.0	-0.7	0.0	0.3	0.3	0.3	0.5	2.8	-1.3	-4.4
Dry	-1.2	-0.5	0.0	0.2	0.1	0.2	0.2	0.3	0.2	1.1	1.2	-1.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-1.2	-0.5	-0.1	0.2	0.0	-0.5	-0.3	0.1	-0.8	0.2	0.1	-0.1
Wet	-0.3	-0.2	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-124. RSAN072 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.3	-0.3	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.3	0.0	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.2	0.2	0.2	0.3	-0.3	0.3	0.3	-0.2	-0.4
1973	0.3	0.1	0.2	-0.2	0.1	-20.9	-1.5	0.3	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.2	-0.2	0.1	0.3	0.3	0.3	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.1	0.2	0.3	0.0	-0.2	0.0	-3.2	0.0	0.1
1977	-0.2	0.1	-0.1	0.2	0.2	0.4	0.0	0.4	0.0	0.0	-0.1	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.2	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	1.6	0.5	0.0	-0.2	0.3	-0.2
1982	0.3	-0.3	0.3	0.0	-13.9	-1.1	0.4	-0.4	-0.3	-0.3	0.4	-0.3
1983	-0.4	0.0	-0.3	0.1	0.5	0.3	0.1	-0.3	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.3	0.3	0.3	-0.1
1985	0.0	-0.2	-0.2	0.3	0.2	-0.2	0.4	0.0	-0.4	-0.4	-0.4	0.3
1986	0.5	0.0	0.4	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.3	-0.2	0.2	-0.4
1988	-0.4	0.3	0.0	0.0	0.4	0.1	0.4	-0.2	0.1	0.8	0.3	0.3
1989	0.1	0.3	0.1	-0.4	-0.4	0.3	-0.4	0.3	0.0	0.5	-0.6	-0.2
1990	-0.2	-0.2	0.0	0.2	0.3	-0.2	-0.4	0.0	-0.3	-12.6	-2.8	0.1
1991	-0.1	0.3	-0.3	0.1	-0.3	0.0	-0.3	0.1	0.1	-15.4	-3.1	0.1
1992	-0.2	0.4	0.1	0.1	-0.1	0.1	-8.7	-1.6	0.2	-58.0	-20.7	0.1
1993	0.1	-0.2	0.3	0.2	0.1	0.1	0.5	0.4	17.7	1.7	0.4	-0.1
1994	0.0	0.0	-0.3	-0.4	0.0	0.2	0.3	-0.4	-0.4	-0.3	-0.5	-0.3
1995	0.1	0.2	0.3	-0.1	-0.4	0.3	0.2	0.1	0.3	-0.2	0.3	-0.4
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.3	0.4	-0.1	0.1	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.4	0.0	0.1	-0.4	0.3
1998	0.2	-0.3	0.1	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	0.0	0.4	0.3	0.5	-0.3	0.0	-0.1
2000	0.2	-0.3	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.2	0.0	0.3	2.9	-0.2	-0.4	-0.7	-0.1	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	0.0	-0.4	0.0	0.2	0.0
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-1.4	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.3	-0.6	-0.1	0.0	0.6	-2.6	-0.8	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	-1.2	-0.3	0.0	-12.7	-3.8	0.1
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.7	0.1	-0.1	-0.2	-0.1	-0.1
BN	0.2	0.0	0.1	-0.1	0.3	0.1	0.3	-0.1	0.3	0.3	-0.1	-0.1
AN	0.1	-0.1	0.0	0.0	0.2	-3.4	0.0	0.1	3.0	0.0	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.0	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-125. RSAN072 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	-0.1
1973	0.1	0.0	0.0	0.0	0.0	-5.9	-0.4	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.4	0.1	0.0	0.0	0.0	0.0
1982	0.1	-0.1	0.0	0.0	-4.7	-0.4	0.2	-0.2	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
1989	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-1.9	-0.4	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.2	-0.4	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	-1.1	-0.2	0.0	-8.4	-2.7	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	2.6	0.2	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.2	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-0.1	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	-0.2	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.1	-0.4	-0.1	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-1.8	-0.5	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	0.0	0.4	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-126. San Joaquin River location RSAN112 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.3	0.4	-0.4	-0.1
1971	-0.2	-0.2	0.0	0.0	0.3	-0.4	0.1	-0.1	0.2	-0.3	-0.2	-0.2
1972	0.2	-0.4	0.3	-0.3	0.2	0.2	0.3	-0.4	0.4	0.3	-0.3	-0.4
1973	0.4	0.0	0.2	-0.3	0.2	-21.8	-0.9	0.4	0.1	-0.4	-0.2	-0.4
1974	-0.5	0.4	0.1	-0.2	0.0	0.3	-0.3	0.1	0.3	0.3	0.4	0.4
1975	-0.2	0.2	-0.2	0.4	-0.1	0.2	0.1	-0.4	0.0	0.3	-0.1	0.0
1976	-0.1	-0.3	0.2	0.0	0.2	0.3	0.0	-0.2	0.0	-0.2	-0.1	0.1
1977	-0.2	0.1	-0.2	0.3	0.1	0.3	0.2	0.4	-0.1	0.0	-0.4	0.0
1978	-0.4	0.3	0.1	-0.4	0.0	0.1	0.0	0.3	0.3	0.2	0.3	0.4
1979	0.2	0.4	0.0	-0.1	0.4	-0.1	0.4	0.2	0.3	0.3	0.0	0.2
1980	0.2	-0.3	-0.2	0.1	0.2	-0.4	0.3	0.2	0.1	-0.3	-0.3	-0.1
1981	0.4	0.0	-0.1	-0.2	-0.1	-0.4	1.6	0.5	0.0	-0.2	0.0	-0.2
1982	0.4	-0.4	0.4	0.0	-14.5	-0.9	0.4	-0.4	-0.3	-0.3	0.4	-0.4
1983	-0.4	0.1	-0.3	0.1	0.5	0.2	0.1	-0.4	0.3	-0.1	-0.5	0.0
1984	0.4	-0.3	0.2	0.0	0.1	0.1	0.2	-0.2	0.4	0.3	0.3	-0.2
1985	0.0	-0.2	-0.2	0.4	0.2	-0.2	0.4	0.0	-0.5	-0.4	-0.4	0.4
1986	0.5	0.0	0.5	0.5	0.1	0.4	0.1	0.0	0.4	0.0	0.0	-0.3
1987	0.3	0.3	0.1	0.1	0.0	-0.1	-0.2	-0.1	0.4	0.1	-0.2	-0.4
1988	-0.4	0.3	-0.1	0.0	0.4	0.1	0.4	-0.3	0.1	-0.5	0.4	0.3
1989	0.1	0.3	0.0	-0.4	-0.4	0.3	-0.4	0.3	0.1	0.3	-0.3	-0.2
1990	-0.2	-0.2	0.0	0.3	0.3	-0.2	-0.4	0.1	-0.4	0.2	0.4	0.1
1991	-0.2	0.3	-0.4	0.2	-0.3	0.0	-0.3	0.1	0.1	-0.4	-0.5	0.2
1992	-0.2	0.5	-0.1	0.4	-0.2	0.1	-10.1	-0.1	0.2	0.5	0.3	0.1
1993	0.1	-0.2	0.4	0.2	0.1	0.1	0.5	0.4	19.8	0.7	0.4	-0.1
1994	0.0	0.0	-0.4	-0.4	0.1	0.2	0.3	-0.5	-0.5	0.3	0.3	-0.4
1995	0.1	0.2	0.3	-0.1	-0.5	0.3	0.1	0.1	0.3	-0.2	0.3	-0.5
1996	-0.4	-0.2	-0.2	-0.3	0.2	-0.4	0.4	-0.1	0.2	-0.1	-0.1	0.2
1997	-0.4	-0.1	-0.2	-0.4	-0.2	0.1	-0.1	0.5	-0.1	0.1	-0.5	0.4
1998	0.2	-0.3	0.2	0.4	0.3	-0.3	0.0	0.4	0.1	-0.2	-0.4	0.2
1999	-0.4	0.0	-0.3	-0.4	0.1	-0.1	0.5	0.3	0.5	-0.3	0.1	-0.1
2000	0.2	-0.4	-0.3	-0.2	0.3	0.3	0.4	-0.4	0.2	-0.1	-0.1	0.1
2001	-0.1	-0.2	-0.3	0.3	0.0	0.3	3.0	-0.3	-0.4	-0.5	-0.3	-0.3
2002	0.2	0.1	0.4	-0.1	-0.1	0.2	0.1	-0.1	-0.4	-0.1	0.3	-0.1
2003	0.1	0.0	0.0	0.3	0.5	0.5	0.3	-0.1	-0.2	-0.1	0.2	0.2
Average	0.0	0.0	0.0	0.0	-0.4	-0.6	-0.1	0.0	0.7	0.0	0.0	0.0
Critical	-0.2	0.1	-0.1	0.1	0.1	0.1	-1.4	-0.1	-0.1	0.0	0.1	0.0
Dry	0.1	0.0	0.0	0.0	-0.1	0.0	0.8	0.0	-0.1	-0.1	-0.1	-0.1
BN	0.2	0.0	0.2	-0.2	0.3	0.1	0.4	-0.1	0.3	0.3	-0.2	-0.1
AN	0.1	-0.1	0.0	-0.1	0.2	-3.5	0.1	0.1	3.4	0.0	0.0	0.0
Wet	-0.1	0.0	0.0	0.0	-1.1	0.0	0.1	0.0	0.2	0.0	-0.1	0.0

Table 1-127. San Joaquin River location RSAN112 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.1	-0.1	0.0
1971	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0	0.0
1972	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	-0.1	-0.1
1973	0.1	0.0	0.0	0.0	0.0	-6.4	-0.3	0.1	0.0	-0.1	0.0	-0.1
1974	-0.1	0.1	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	0.1	0.1
1975	0.0	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.0
1976	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.0
1978	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1
1979	0.0	0.1	0.0	0.0	0.1	-0.1	0.1	0.1	0.1	0.0	0.0	0.0
1980	0.0	-0.1	0.0	0.0	0.1	-0.2	0.1	0.1	0.0	-0.1	-0.1	0.0
1981	0.1	0.0	0.0	0.0	0.0	-0.1	0.4	0.1	0.0	0.0	0.0	0.0
1982	0.1	-0.1	0.0	0.0	-5.0	-0.3	0.2	-0.3	-0.1	-0.1	0.1	-0.1
1983	-0.2	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.2	-0.1	-0.3	0.0
1984	0.1	-0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.1	0.1
1986	0.1	0.0	0.1	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	-0.1
1987	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1988	-0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1	0.1	0.0
1989	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	0.1	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	-0.1	0.0
1992	0.0	0.1	0.0	0.0	0.0	0.0	-1.3	0.0	0.0	0.1	0.0	0.0
1993	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.1	2.9	0.1	0.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1
1995	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.1	-0.1	0.1	-0.1
1996	-0.1	0.0	0.0	0.0	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0
1997	-0.1	0.0	-0.1	-0.2	-0.1	0.1	0.0	0.1	0.0	0.0	-0.1	0.1
1998	0.0	-0.1	0.0	0.1	0.1	-0.1	0.0	0.3	0.1	-0.1	-0.2	0.1
1999	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0
2000	0.0	-0.1	0.0	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.8	-0.1	-0.1	-0.1	0.0	-0.1
2002	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.1	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.1	0.0	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.4	0.0	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-128. Mokelumne River location RSMKL008 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	-0.6	-1.9	-1.2
1977	0.1	0.2	0.1	0.1	0.3	0.4	0.3	0.4	0.1	-2.2	-0.5	-0.7
1978	0.1	0.2	0.1	0.6	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.9	0.0
1982	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.1	-0.9	-2.5	-0.8
1988	0.2	0.2	0.2	0.6	0.1	0.7	0.3	0.5	0.1	-1.5	-1.4	-1.1
1989	0.3	0.2	0.2	0.4	0.6	0.3	0.4	0.2	0.1	0.0	-0.4	0.0
1990	0.1	0.1	0.2	0.1	0.6	0.3	0.0	0.2	0.1	-1.2	-0.7	-0.9
1991	0.1	0.5	0.4	1.1	0.6	0.7	0.3	0.4	0.2	-0.7	-0.5	-0.7
1992	0.2	0.3	0.6	0.4	1.0	0.4	0.3	0.5	0.2	-1.2	-1.0	-0.5
1993	-0.1	0.4	0.3	1.0	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.2	0.4	0.2	0.1	0.2	0.1	0.0	-0.7	-0.2
1995	0.1	0.2	0.1	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.3	0.1	-1.5	-0.9	-0.7
2002	0.1	0.2	0.1	0.3	0.4	0.1	0.2	0.2	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.1	-0.2	0.0	0.0
Average	0.0	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.0	-0.3	-0.3	-0.2
Critical	0.1	0.2	0.2	0.3	0.4	0.4	0.2	0.3	0.2	-1.1	-1.0	-0.7
Dry	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	-0.4	-0.8	-0.3
BN	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.1	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-129. Mokelumne River location RSMKL008 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	-1.0	-0.6
1977	0.0	0.1	0.0	0.0	0.1	0.2	0.1	0.2	0.1	-1.1	-0.3	-0.3
1978	0.0	0.1	0.0	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	0.0
1982	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	-0.5	-1.3	-0.4
1988	0.1	0.1	0.1	0.2	0.0	0.3	0.2	0.3	0.1	-0.8	-0.8	-0.6
1989	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.1	0.0	0.0	-0.2	0.0
1990	0.0	0.1	0.1	0.1	0.3	0.1	0.0	0.1	0.1	-0.6	-0.4	-0.5
1991	0.1	0.2	0.2	0.4	0.2	0.3	0.1	0.2	0.1	-0.4	-0.3	-0.4
1992	0.1	0.2	0.3	0.2	0.4	0.2	0.1	0.3	0.1	-0.6	-0.5	-0.3
1993	0.0	0.2	0.1	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.0	-0.4	-0.1
1995	0.1	0.1	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.8	-0.5	-0.4
2002	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	-0.2	-0.2	-0.1
Critical	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.1	-0.6	-0.5	-0.4
Dry	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	-0.2	-0.4	-0.1
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-130. Barker Slough location SLBAR002 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-1.5
1977	-1.3	-0.3	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.1	-1.3	-0.8
1978	-1.2	-0.8	-0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-1.6
1988	-1.0	-0.4	0.0	0.1	0.2	0.1	0.1	0.1	0.1	-0.1	-0.9	-1.2
1989	-1.3	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1
1990	0.0	0.0	0.1	0.1	0.1	0.4	0.2	0.0	0.0	0.0	-0.5	-0.6
1991	-0.7	0.0	0.4	0.3	0.2	0.2	0.3	0.2	0.1	0.1	-0.3	-0.5
1992	-0.6	0.1	0.4	0.4	0.2	0.4	0.2	0.2	0.1	0.0	-0.7	-0.8
1993	-0.5	-0.3	0.2	0.2	0.2	0.4	0.2	0.1	0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	-0.2	-0.4
1995	-0.2	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.6
2002	-0.5	-0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Average	-0.2	-0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	-0.2	-0.2
Critical	-0.5	-0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.0	-0.6	-0.8
Dry	-0.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.2	-0.4
BN	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.3	-0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-131. Barker Slough location SLBAR002 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.8
1977	-0.7	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.4
1978	-0.6	-0.4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.8
1988	-0.5	-0.2	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1	-0.4	-0.6
1989	-0.6	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
1990	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.0	0.0	-0.2	-0.3
1991	-0.4	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	-0.2	-0.3
1992	-0.3	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.0	-0.3	-0.4
1993	-0.3	-0.1	0.1	0.1	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.2
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3
2002	-0.3	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Critical	-0.3	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.3	-0.4
Dry	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-132. Suisun Marsh location SLCBN002 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	1.5	1.0	-1.1	-0.4	-0.2	-0.1	-0.1
1974	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
1975	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1	4.5	-55.3	-258.6	-335.2
1977	-266.5	-144.6	-82.1	-46.1	-21.7	-22.7	-15.7	-5.2	9.6	-72.0	-208.6	-207.5
1978	-173.6	-96.6	-31.4	1.2	-5.3	-9.6	-8.3	-6.5	2.9	10.2	0.5	-3.4
1979	-4.6	-4.7	-5.5	2.4	6.4	4.6	6.8	10.1	7.5	1.1	-0.6	-1.3
1980	-1.0	7.0	24.5	8.5	2.5	0.3	1.4	5.2	4.5	1.3	0.4	0.0
1981	-0.2	-0.1	1.1	5.6	4.0	3.5	7.2	9.9	12.4	-25.2	-142.9	-210.5
1982	-135.9	-53.4	-21.3	-14.7	-5.4	-5.0	-4.9	-4.5	0.1	1.0	-2.0	-2.3
1983	-6.2	6.1	-0.3	-1.6	-1.3	-1.4	-2.3	-1.3	-1.2	-0.5	2.6	6.2
1984	3.9	2.2	-0.1	-0.4	0.0	0.1	1.5	5.5	6.2	2.4	0.9	0.3
1985	-0.2	7.9	13.6	9.4	7.2	6.6	4.9	7.0	6.8	2.5	2.4	1.6
1986	1.5	1.1	3.4	9.3	1.7	1.3	1.5	2.6	2.4	1.1	0.7	0.5
1987	0.5	0.4	0.5	2.6	6.4	4.4	3.0	1.4	7.0	-86.6	-308.3	-403.9
1988	-281.4	-150.7	-43.5	16.0	12.7	-5.2	14.5	25.7	16.8	-137.9	-350.0	-313.2
1989	-234.2	-128.6	-30.6	24.8	0.0	31.0	46.1	71.1	22.0	-5.6	-111.7	-156.4
1990	-94.1	-44.2	-22.5	3.6	57.5	120.8	98.5	53.6	52.3	-95.5	-289.0	-287.7
1991	-235.1	-121.0	-72.9	-42.0	-2.8	48.3	39.0	69.7	76.6	-45.2	-202.8	-213.1
1992	-172.8	-95.3	-50.3	-27.8	29.0	25.5	51.2	59.2	34.2	-117.7	-324.8	-309.6
1993	-226.4	-123.5	-12.8	29.9	-1.5	12.1	6.9	16.8	63.5	87.7	41.6	10.9
1994	0.4	-1.5	-2.1	16.6	38.4	54.6	67.3	62.5	63.9	11.0	-136.7	-215.8
1995	-166.5	-73.2	-18.1	20.0	2.6	-1.9	-2.4	-4.5	-0.3	8.2	29.2	34.5
1996	7.5	2.3	23.9	18.1	5.4	2.5	0.9	1.4	9.2	21.4	9.9	5.7
1997	-0.4	-5.4	4.7	-4.6	-5.3	8.7	12.4	17.5	17.2	8.8	4.1	3.6
1998	-0.1	0.6	7.5	12.8	2.0	2.8	1.7	1.2	1.0	2.3	9.1	17.5
1999	5.9	14.3	13.2	4.6	2.3	1.5	2.4	5.5	15.9	8.2	7.1	-1.3
2000	2.4	1.4	0.8	17.4	9.5	3.4	4.1	7.9	7.6	4.8	1.7	1.2
2001	1.1	1.0	1.0	5.6	2.3	4.5	7.3	27.0	43.1	-138.0	-344.7	-312.9
2002	-236.8	-80.6	12.5	-1.7	22.9	64.8	72.9	77.2	44.4	18.7	7.3	4.0
2003	1.6	-1.3	23.3	6.0	3.3	9.9	12.3	5.9	24.9	28.6	-31.4	-50.0
Average	-65.0	-31.8	-7.8	2.2	5.1	10.8	12.7	15.3	16.3	-16.5	-76.3	-86.4
Critical	-149.9	-79.6	-39.1	-11.4	16.2	31.6	36.5	37.9	36.9	-73.3	-252.9	-268.9
Dry	-78.3	-33.3	-0.3	7.7	7.1	19.2	23.6	32.3	22.6	-39.0	-149.7	-179.7
BN	-2.3	-2.3	-2.7	1.2	3.2	2.3	3.4	5.0	3.8	0.5	-0.3	-0.7
AN	-66.2	-35.5	0.7	10.5	1.4	2.9	2.9	4.7	17.2	22.1	2.1	-6.9
Wet	-22.3	-8.1	1.0	3.3	0.1	0.7	0.8	1.8	3.9	4.1	4.7	5.0

Table 1-133. Suisun Marsh location SLCBN002 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.8	-2.2
1977	-1.9	-1.1	-0.6	-0.4	-0.3	-0.2	-0.1	0.0	0.1	-0.5	-1.3	-1.2
1978	-1.2	-0.7	-0.3	0.0	-0.2	-0.4	-0.4	-0.3	0.1	0.2	0.0	0.0
1979	-0.1	-0.1	-0.1	0.0	0.2	0.2	0.2	0.3	0.2	0.0	0.0	0.0
1980	0.0	0.1	0.3	0.2	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	-0.2	-1.2	-1.5
1982	-1.0	-0.7	-0.7	-0.7	-0.3	-0.4	-0.4	-0.4	0.0	0.0	0.0	0.0
1983	-0.1	0.2	0.0	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	0.1	0.2
1984	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0
1985	0.0	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	-0.8	-2.4	-2.8
1988	-2.1	-1.2	-0.4	0.3	0.3	-0.1	0.2	0.3	0.2	-1.1	-2.5	-2.0
1989	-1.6	-1.0	-0.2	0.2	0.0	0.6	1.5	1.5	0.3	-0.1	-0.9	-1.2
1990	-0.8	-0.4	-0.2	0.0	0.8	1.6	1.2	0.6	0.5	-0.7	-1.9	-1.8
1991	-1.6	-0.9	-0.5	-0.3	0.0	0.7	0.7	0.8	0.7	-0.3	-1.3	-1.3
1992	-1.2	-0.7	-0.4	-0.2	0.4	0.6	0.8	0.7	0.3	-0.9	-2.2	-2.0
1993	-1.6	-0.9	-0.1	0.6	-0.1	0.4	0.3	0.9	2.6	1.9	0.5	0.1
1994	0.0	0.0	0.0	0.2	0.6	1.0	0.9	0.8	0.6	0.1	-1.0	-1.4
1995	-1.3	-0.6	-0.2	0.5	0.1	-0.1	-0.1	-0.3	0.0	0.4	0.7	0.6
1996	0.1	0.0	0.5	0.7	0.5	0.2	0.1	0.1	0.4	0.4	0.1	0.1
1997	0.0	-0.1	0.2	-0.4	-0.4	0.6	0.5	0.5	0.3	0.1	0.0	0.0
1998	0.0	0.0	0.1	0.4	0.2	0.2	0.1	0.1	0.1	0.2	0.3	0.4
1999	0.1	0.4	0.5	0.4	0.3	0.2	0.3	0.3	0.5	0.1	0.1	0.0
2000	0.0	0.0	0.0	0.3	0.5	0.2	0.3	0.3	0.2	0.1	0.0	0.0
2001	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.5	0.5	-1.3	-2.8	-2.2
2002	-1.9	-0.7	0.2	-0.1	0.8	1.7	1.9	1.7	0.6	0.2	0.1	0.0
2003	0.0	0.0	0.3	0.2	0.1	0.3	0.5	0.3	0.7	0.4	-0.3	-0.5
Average	-0.5	-0.2	0.0	0.1	0.1	0.2	0.3	0.3	0.3	-0.1	-0.5	-0.6
Critical	-1.1	-0.6	-0.3	-0.1	0.3	0.5	0.5	0.4	0.3	-0.6	-1.7	-1.7
Dry	-0.6	-0.2	0.0	0.1	0.2	0.5	0.7	0.7	0.3	-0.4	-1.2	-1.3
BN	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.0	0.0	0.0
AN	-0.5	-0.3	0.0	0.2	0.1	0.1	0.1	0.2	0.6	0.4	0.0	-0.1
Wet	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1

Table 1-134. Upper Cache Slough location SLCCH016 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	188.1	188.5	244.3	763.2	711.4	419.3	242.3	202.5	194.1	191.5	188.9	188.5
1971	188.4	190.9	428.5	390.7	289.1	234.3	204.4	193.7	188.8	188.9	188.6	188.3
1972	188.3	189.7	189.9	195.9	205.9	205.1	199.9	194.8	192.0	190.7	188.4	188.0
1973	187.7	204.2	214.5	759.9	806.3	623.4	309.0	210.0	194.7	191.5	189.2	189.2
1974	189.0	190.8	326.2	472.8	397.9	290.2	249.1	205.2	192.7	190.1	189.1	189.0
1975	188.5	189.1	189.7	195.5	410.2	376.5	273.7	207.4	191.5	189.8	188.9	188.9
1976	187.5	187.1	188.5	193.6	202.8	204.6	202.0	197.1	197.1	194.5	189.0	190.3
1977	194.3	197.5	196.1	198.6	207.9	210.2	204.1	197.2	194.7	195.4	193.5	191.4
1978	195.9	198.8	224.7	754.5	762.7	718.2	499.2	246.7	198.3	192.0	189.8	189.4
1979	189.9	191.3	190.2	563.3	762.9	573.3	297.3	212.7	194.6	191.6	189.3	189.6
1980	190.3	189.9	222.9	577.6	782.5	635.5	314.1	214.0	195.9	191.8	189.8	189.4
1981	190.0	191.9	191.2	222.0	227.3	217.1	207.5	198.4	193.7	191.9	189.5	189.3
1982	189.5	190.3	278.0	745.6	675.3	700.4	572.8	288.1	201.5	191.9	190.7	189.7
1983	188.2	190.5	200.7	685.0	807.8	790.2	661.3	310.4	201.8	189.5	188.9	188.7
1984	188.8	189.6	324.6	305.3	253.5	225.4	206.0	197.2	192.8	191.1	188.9	188.9
1985	188.2	191.5	202.7	211.3	218.1	217.1	216.8	200.3	193.2	191.7	189.2	189.1
1986	189.5	191.9	193.4	299.3	783.9	767.2	455.2	230.1	198.1	192.8	189.9	189.6
1987	189.6	191.5	190.6	195.6	209.1	214.6	209.0	198.2	192.6	190.6	190.0	192.1
1988	193.3	194.5	195.0	383.6	351.5	258.6	218.5	200.6	193.4	192.0	191.5	193.9
1989	197.0	200.3	197.3	198.9	206.7	208.1	203.3	195.6	191.4	190.0	188.2	187.3
1990	187.2	189.6	192.7	198.9	210.8	223.4	212.6	199.3	193.9	194.6	190.6	191.9
1991	195.2	199.7	202.4	204.7	212.3	213.7	218.7	205.3	192.3	189.6	189.8	191.9
1992	195.0	197.4	198.7	202.9	270.2	272.3	251.3	210.5	195.5	191.3	190.7	192.1
1993	193.3	195.0	270.4	786.5	812.0	561.7	262.9	203.7	190.9	188.8	189.1	189.4
1994	189.7	190.3	190.2	219.9	372.1	306.3	220.0	197.6	192.8	193.2	189.5	190.3
1995	191.6	193.9	197.5	784.5	701.3	732.7	550.8	251.6	198.1	189.6	189.4	189.2
1996	189.8	191.1	245.8	397.9	682.9	520.0	261.8	204.9	192.6	191.4	189.8	189.1
1997	188.1	189.4	298.4	769.9	699.9	368.8	227.0	201.2	193.8	191.9	189.0	188.7
1998	188.5	190.0	190.7	503.3	811.0	676.9	326.1	220.0	195.3	188.5	189.0	188.6
1999	188.6	189.4	189.4	231.2	408.3	342.1	236.4	199.0	191.2	190.0	188.7	188.3
2000	188.7	190.6	190.1	196.4	370.2	336.8	238.0	204.6	194.6	192.1	189.3	189.1
2001	188.4	189.3	190.9	195.5	301.0	283.2	225.3	201.7	194.8	191.9	190.4	191.9
2002	193.7	195.0	330.4	332.3	289.2	246.0	213.8	205.0	201.9	193.0	189.6	190.1
2003	191.7	193.8	367.1	376.0	304.6	249.0	220.0	200.9	190.7	190.8	188.6	188.5
Average	190.3	192.5	230.7	403.3	462.3	394.8	282.6	211.9	194.4	191.4	189.6	189.7
Critical	191.7	193.7	194.8	228.9	261.1	241.3	218.2	201.1	194.2	192.9	190.7	191.7
Dry	191.2	193.2	217.2	225.9	241.9	231.0	212.6	199.9	194.6	191.5	189.5	190.0
BN	189.1	190.5	190.1	379.6	484.4	389.2	248.6	203.8	193.3	191.2	188.8	188.8
AN	191.2	195.4	248.3	575.1	639.7	520.8	307.2	213.3	194.2	191.2	189.3	189.2
Wet	189.0	190.4	254.4	503.4	587.1	495.7	343.6	223.9	194.8	190.5	189.2	188.9

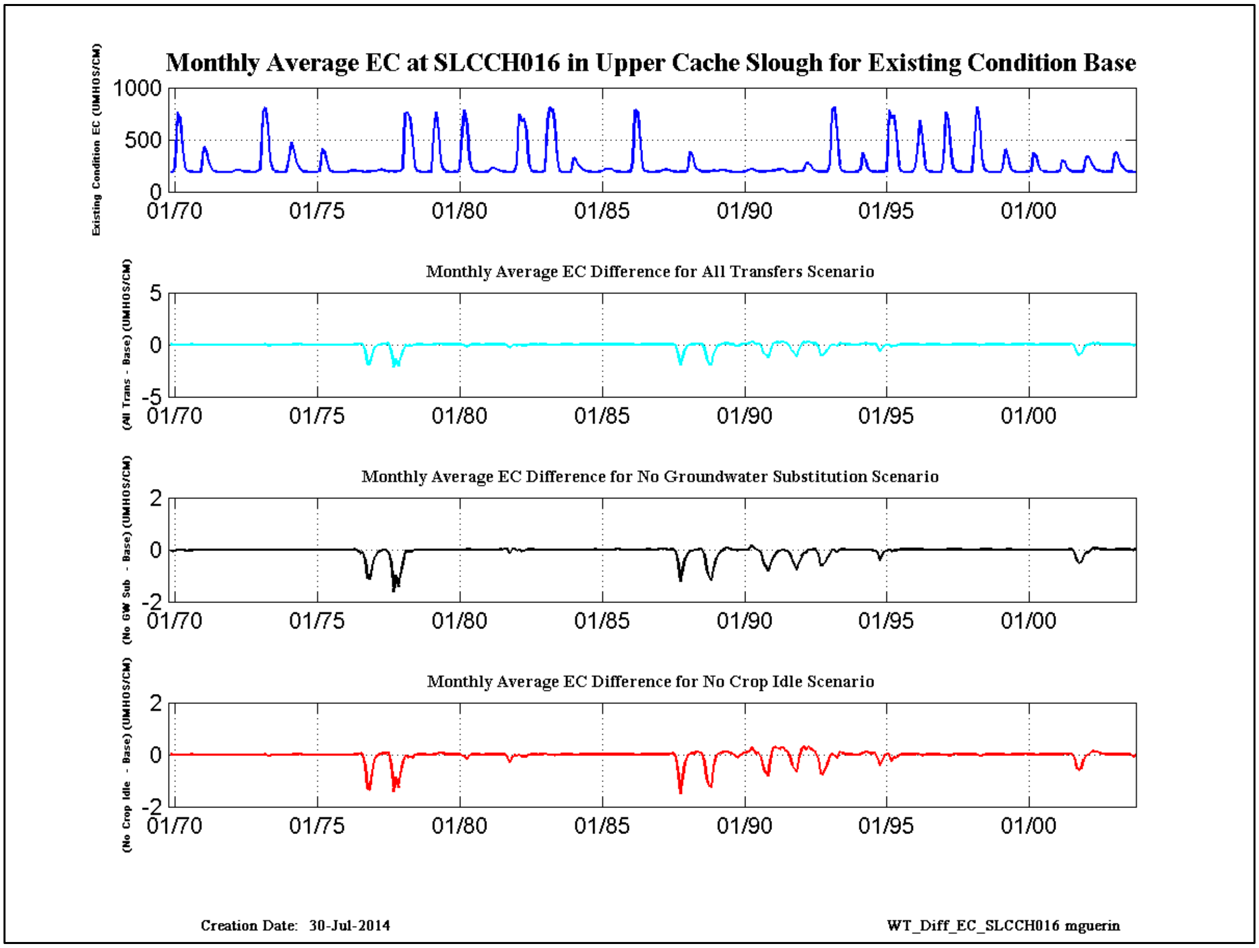


Figure 1-19. Cache Slough location SLCCH016 EC for the Base condition and change from Base for the scenarios.

Table 1-135. Montezuma Slough location SLMZU011 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	2620.5	2489.3	849.7	192.4	200.7	254.1	1205.4	3358.9	5314.3	6641.3	7975.5	7087.5
1971	2564.7	2273.7	755.8	268.2	473.2	539.7	595.0	714.8	1373.3	3939.2	8056.0	7221.5
1972	2477.3	2362.0	2682.4	2851.0	1759.8	1197.5	1852.1	4196.4	6780.4	8260.3	9521.5	12164.0
1973	8639.2	4659.2	1924.0	459.0	227.8	234.5	682.2	1455.4	2939.2	5948.6	8831.1	9512.2
1974	4048.4	1611.1	266.2	189.6	247.5	197.3	197.5	477.3	1648.7	4141.7	8073.2	6936.9
1975	2610.6	2239.7	2683.9	3555.8	1431.4	241.6	395.3	587.1	831.3	3019.6	7955.0	7041.7
1976	2367.7	2290.7	2606.4	4299.8	3551.7	5340.8	6252.7	8537.8	11890.2	13237.7	13857.8	15356.8
1977	10863.7	9951.1	9330.3	5365.7	3224.1	7286.5	9259.0	10783.5	13336.1	14958.6	15780.2	16567.5
1978	10564.9	9757.1	5732.4	984.4	307.4	252.4	290.4	550.0	1815.8	4793.5	8794.0	9712.1
1979	4012.1	3365.1	3783.1	2816.5	954.1	652.0	1177.0	1653.3	3281.9	7115.3	10244.5	13053.9
1980	8471.9	6163.9	3523.5	686.5	212.6	241.1	610.3	1418.6	2631.7	4963.8	8738.6	9607.4
1981	3866.0	3222.1	3765.1	2555.6	1369.3	1368.1	2202.0	4201.2	6826.6	9468.6	11784.8	13888.1
1982	9495.1	3135.4	417.0	230.2	207.2	209.5	190.0	222.5	668.5	3114.0	7804.3	7219.5
1983	2309.3	969.1	249.0	219.2	204.4	194.0	198.1	192.1	194.7	312.5	1232.3	1842.7
1984	1610.5	626.1	187.9	206.1	248.1	310.2	866.9	2353.5	4759.0	6503.1	7974.1	7337.1
1985	2595.1	2219.7	1783.3	2227.5	1926.2	3385.5	3912.8	4244.2	6683.6	9434.7	11806.3	13778.4
1986	8306.1	8117.1	4768.3	1816.1	257.0	200.0	412.8	1149.1	2915.5	5934.6	9013.9	7683.4
1987	2595.2	2489.8	3507.4	3947.5	2179.3	1519.8	2709.2	6274.7	8331.4	10174.3	12531.6	14283.7
1988	9715.9	9067.0	4666.6	1484.0	1340.6	4620.6	7699.1	7988.1	9122.5	10925.3	13509.2	15165.7
1989	11041.8	9205.3	7799.7	5421.5	4021.1	1746.4	873.8	2622.7	6081.1	9735.4	11715.5	12045.2
1990	7594.2	8175.6	8533.8	3817.7	1885.0	4613.4	6586.0	7692.9	10270.6	13106.5	14459.2	15222.0
1991	10753.4	10599.3	10047.0	7330.2	4576.4	2804.0	2100.0	6154.9	10433.0	13285.0	14507.5	15441.0
1992	10876.1	10230.3	10040.2	7371.0	2362.3	1535.1	3427.3	6853.8	9385.5	11107.6	14052.9	15444.4
1993	9739.2	9098.3	6915.8	1432.6	337.8	413.4	374.2	459.5	872.2	3006.8	7863.3	8947.9
1994	3783.3	3325.5	3793.7	4157.5	2172.0	3206.8	5613.8	6174.5	8841.2	12227.8	13638.4	14811.2
1995	8321.5	7568.4	6351.5	848.5	323.5	195.4	232.2	198.8	260.8	718.1	3017.3	4849.1
1996	2157.6	1944.6	1858.6	787.3	209.8	206.6	237.1	240.0	1317.6	5112.3	8846.6	7167.0
1997	2637.0	2249.3	511.5	195.8	209.6	559.7	1334.0	2311.5	4576.0	6550.7	7868.5	7181.7
1998	2908.6	2519.8	2236.7	1197.0	213.0	215.1	209.2	205.3	192.5	390.2	1867.3	2979.4
1999	1948.2	1788.2	933.9	411.5	211.5	197.9	335.2	891.9	2528.0	5225.7	8601.8	7149.8
2000	2388.6	2217.1	2884.0	2367.7	401.4	220.7	527.6	1350.1	3980.1	6805.0	8216.0	9205.6
2001	3981.3	3314.7	3704.7	3415.6	1465.9	1020.9	1921.4	4579.0	7135.6	9561.1	12046.2	14069.3
2002	9409.9	7976.9	2638.1	505.2	843.2	2024.7	2263.7	3016.9	6045.5	10184.6	12019.8	13958.0
2003	9044.5	8603.6	2576.3	389.3	507.5	1229.8	1157.6	457.3	2089.0	5655.8	7891.0	8985.0
Average	5774.1	4877.2	3656.1	2176.6	1178.3	1424.6	1997.1	3046.1	4863.3	7222.3	9708.7	10379.9
Critical	7993.5	7662.8	7002.6	4832.3	2730.3	4201.0	5848.3	7740.8	10468.4	12692.6	14257.9	15429.8
Dry	5581.6	4738.1	3866.4	3012.2	1967.5	1844.3	2313.8	4156.4	6850.6	9759.8	11984.0	13670.4
BN	3244.7	2863.5	3232.8	2833.7	1357.0	924.7	1514.6	2924.8	5031.1	7687.8	9883.0	12609.0
AN	8141.4	6749.9	3926.0	1053.2	332.4	432.0	607.0	948.5	2388.0	5195.6	8389.0	9328.3
Wet	3964.5	2887.1	1697.7	778.3	341.3	270.9	493.0	992.5	2044.6	3969.5	6791.2	6284.4

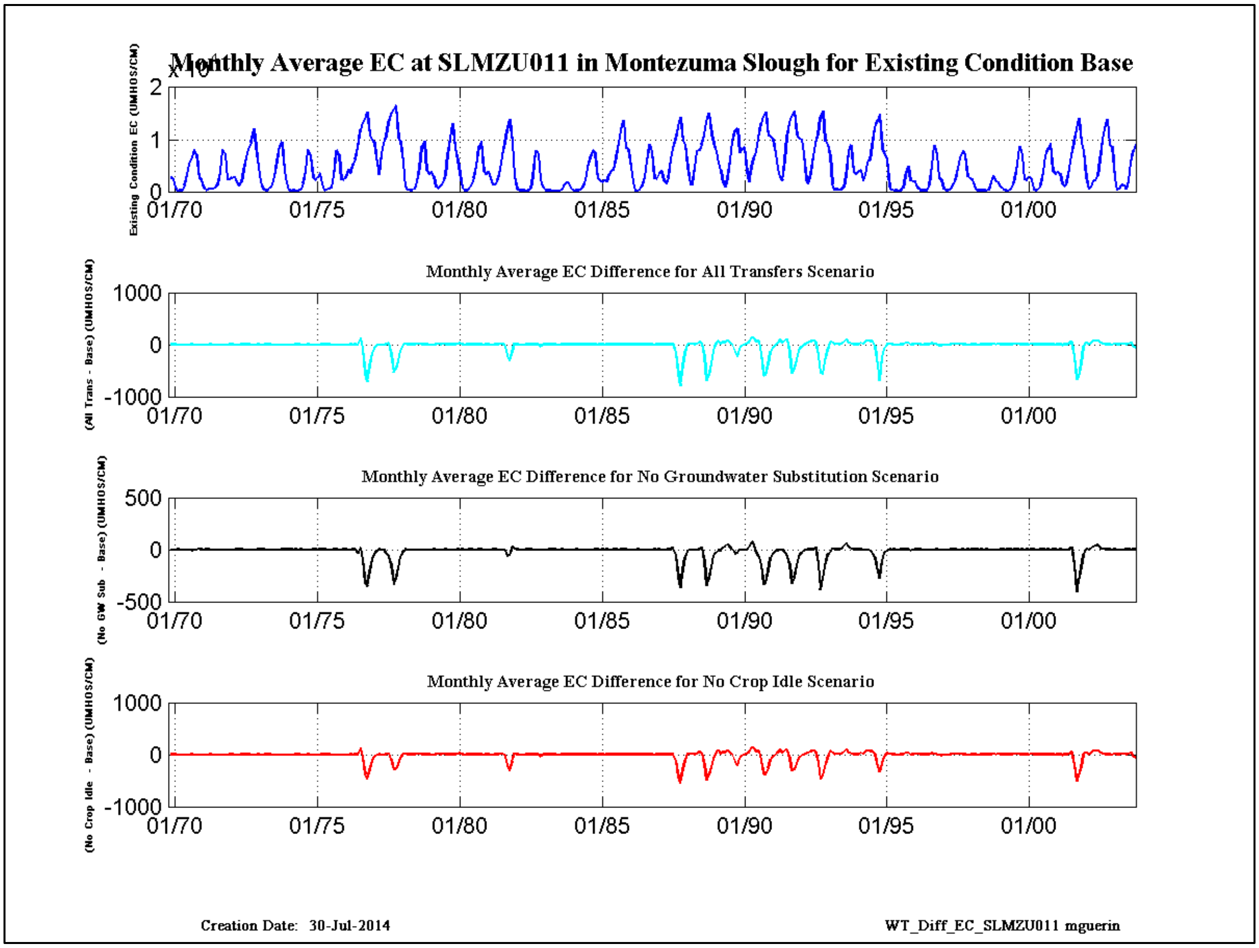


Figure 1-20. Montezuma Slough location SLMZU011 EC for the Base condition and change from Base for the scenarios.

Table 1-136. Montezuma Slough location SLMZU025 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	1718.1	1507.9	262.7	186.4	186.2	189.8	516.8	1477.7	3032.9	3334.2	5153.3	2807.3
1971	1478.4	1272.2	271.1	189.7	221.1	216.5	260.0	266.5	563.6	2028.1	5386.2	2928.2
1972	1492.1	1296.6	2329.3	2101.7	735.9	337.9	765.8	2116.3	4192.1	4551.9	6304.9	8670.5
1973	8123.4	3795.7	814.0	218.8	201.0	193.3	285.6	511.6	1472.9	3223.1	5832.5	4992.7
1974	3242.5	509.4	186.4	182.7	189.9	183.9	186.4	243.1	662.7	2227.2	5180.9	2740.5
1975	1537.5	1200.5	2495.9	3086.5	512.5	189.9	220.7	243.5	317.1	1617.3	5251.2	2793.6
1976	1417.9	1098.0	2321.3	4076.0	2936.6	2608.7	3217.9	5673.6	8756.2	9253.6	10078.5	11872.0
1977	10330.1	9664.6	9358.6	4558.0	2908.8	4124.5	5286.3	7315.9	9956.1	11347.6	12009.4	13015.5
1978	9835.3	9692.8	4860.4	352.6	211.6	203.3	219.1	258.5	753.2	2554.4	5800.4	5072.3
1979	3183.2	2669.9	3746.9	1468.5	316.8	272.0	415.0	554.8	1668.8	4225.0	6832.9	9399.6
1980	7853.6	5567.2	2988.9	304.0	201.0	202.3	266.4	500.7	1127.8	2676.5	5806.3	5080.8
1981	3056.4	2501.9	3534.2	1453.7	375.3	428.1	821.8	2088.1	4069.2	6160.0	8190.2	10187.3
1982	8947.6	1555.0	197.1	200.4	188.6	198.4	183.6	182.8	296.8	1716.8	5489.7	3027.3
1983	787.2	291.2	189.9	210.8	201.5	193.4	188.3	182.0	185.0	207.4	498.9	616.6
1984	873.5	246.8	183.5	193.3	196.1	195.0	355.8	1000.5	2680.0	3350.8	5295.4	3064.8
1985	1574.9	874.7	884.8	1551.5	1041.2	1398.0	1544.2	1990.6	4134.1	6213.7	8445.6	9935.0
1986	7806.3	8101.7	3924.9	792.0	198.0	193.5	239.6	439.3	1481.1	3329.2	6079.3	3300.1
1987	1700.0	1580.8	3457.6	3437.2	1033.7	453.4	1315.6	3737.7	5138.7	6874.7	9191.9	10907.1
1988	9219.9	8944.4	3636.9	518.5	614.7	2634.3	4257.3	4681.6	5588.5	7777.1	10125.1	11726.8
1989	10671.5	8694.3	7682.3	4983.0	3686.8	599.0	331.9	1169.5	3817.9	6552.3	7892.7	8358.1
1990	7092.3	8201.2	8501.1	2720.1	1182.8	2290.7	3450.2	4612.1	7329.2	9696.6	10810.4	11894.4
1991	10242.6	10524.2	10013.7	6885.2	4206.4	985.2	945.4	3764.4	7523.4	9816.7	10747.1	11962.5
1992	10317.5	10102.8	10059.4	6904.7	945.1	578.0	1576.5	4250.4	5916.3	7930.0	10699.7	11937.8
1993	9143.8	8977.4	6425.3	531.5	223.4	218.0	205.3	223.0	322.3	1595.4	5263.4	4542.5
1994	2942.5	2655.8	3655.6	3675.1	949.6	1480.6	2626.4	3230.4	6036.0	8581.0	9685.1	11032.5
1995	7387.6	7621.6	5837.0	374.4	203.9	185.9	195.1	178.9	184.5	300.2	1477.0	2013.7
1996	1024.0	1085.9	862.5	250.8	192.9	189.1	194.2	196.1	635.3	2776.1	5887.5	2748.5
1997	1591.5	1180.6	220.6	195.2	191.6	245.0	446.9	894.4	2615.7	3240.3	5136.3	2873.6
1998	1850.9	1440.4	1511.9	449.4	202.7	195.9	187.3	181.9	181.3	222.1	816.5	1029.0
1999	1208.5	674.5	281.2	203.2	189.7	184.4	209.7	353.6	1176.1	2782.1	5655.6	2780.1
2000	1576.9	1152.4	2628.5	1196.0	211.0	191.3	240.9	486.6	2374.4	3596.4	5311.1	4777.7
2001	3268.4	2595.0	3602.5	2501.6	451.6	336.4	732.8	2460.7	4223.3	6408.5	8626.9	10631.5
2002	8786.6	7723.3	1243.9	217.0	363.4	687.1	776.4	1270.1	3875.7	6808.0	8267.9	10385.6
2003	8485.3	8456.2	1125.7	199.3	231.4	400.4	337.8	213.3	1249.4	2948.1	5096.4	4652.3
Average	4993.2	4219.3	3214.6	1657.9	761.8	681.9	970.7	1675.0	3045.2	4585.9	6715.5	6581.1
Critical	7366.1	7313.0	6792.4	4191.1	1963.4	2100.3	3051.5	4789.8	7300.8	9200.4	10593.6	11920.2
Dry	4843.0	3995.0	3400.9	2357.3	1158.7	650.3	920.5	2119.5	4209.8	6502.8	8435.9	10067.4
BN	2337.6	1983.2	3038.1	1785.1	526.3	305.0	590.4	1335.6	2930.4	4388.5	6568.9	9035.1
AN	7503.0	6273.6	3140.4	467.0	213.2	234.7	259.2	365.6	1216.7	2765.7	5518.3	4853.0
Wet	3034.9	2052.9	1263.4	501.1	221.1	197.0	260.4	449.3	1077.9	2087.1	4408.3	2517.2

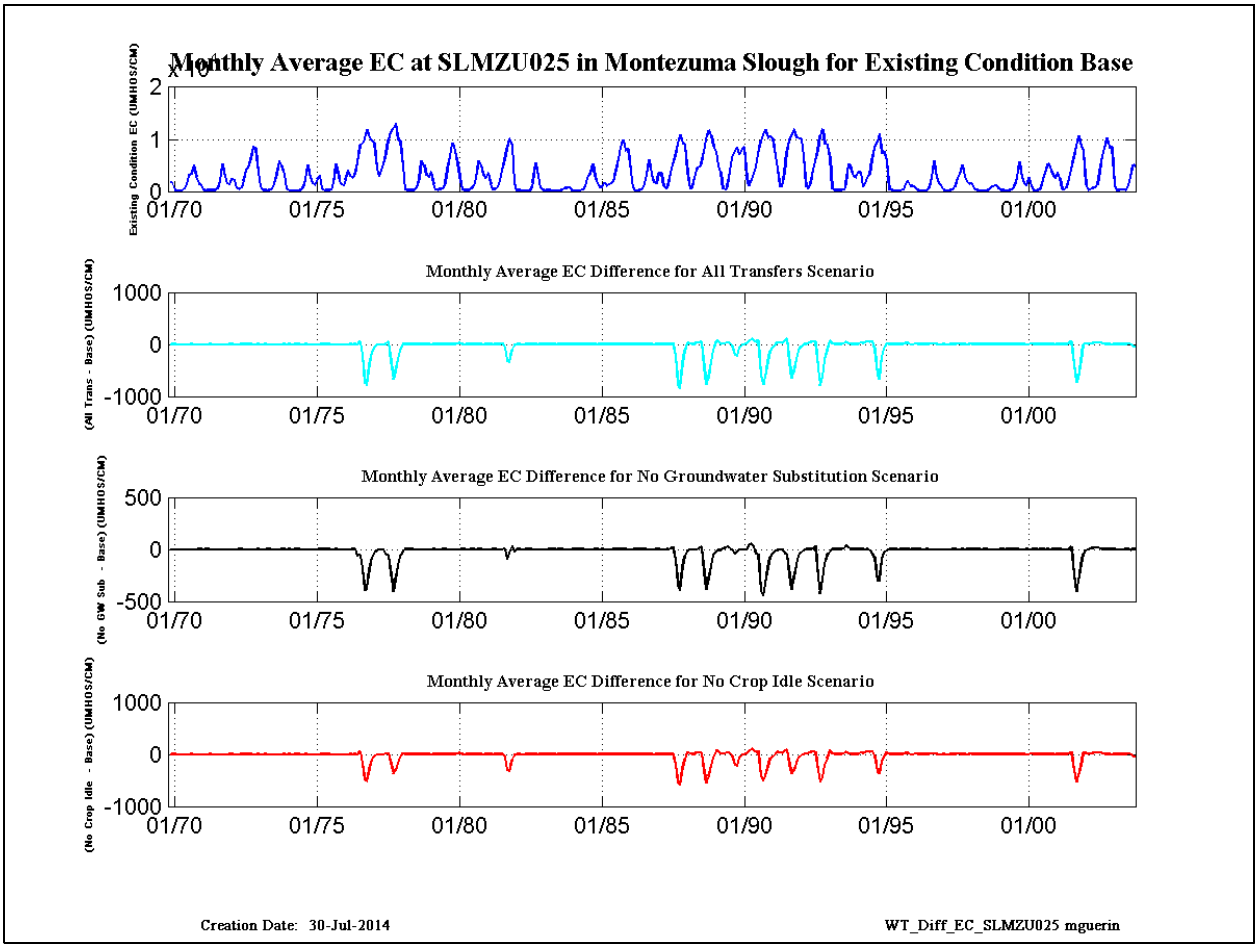


Figure 1-21. Montezuma Slough location SLMZU025 EC for the Base condition and change from Base for the scenarios.

Table 1-137. Suisun Slough location SLSUS012 Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	4798.7	5011.1	2301.3	727.3	535.3	545.8	1721.0	4292.2	6359.5	7971.0	9145.3	8814.9
1971	5195.7	4868.6	2281.5	938.6	1053.6	1105.5	1040.0	1227.4	1985.6	4847.5	8999.3	8880.6
1972	5119.4	4978.1	5062.5	5829.3	4255.9	2535.1	2732.1	5222.7	7834.4	9547.6	10724.2	13295.6
1973	11794.0	8980.5	5107.1	1892.7	862.6	821.2	1281.3	2249.4	3867.0	7085.9	9873.5	10856.5
1974	7593.3	3703.8	1063.6	613.5	629.0	484.0	454.2	829.7	2315.3	5064.2	8970.1	8565.3
1975	5160.0	4890.0	5053.5	6541.0	3755.2	1023.4	888.5	1106.0	1373.6	3960.4	8766.7	8739.5
1976	4998.5	4814.5	4909.9	6971.2	6837.0	7266.1	7808.4	9732.3	12954.2	14429.7	15042.4	16241.4
1977	14201.4	12946.8	12262.5	9916.4	6983.1	9340.6	10790.7	12121.2	14486.2	15962.1	16884.2	17609.2
1978	14647.2	12752.8	10384.3	3718.9	1381.7	1145.4	995.4	1264.3	2770.5	5925.8	9792.3	11184.9
1979	7647.4	6827.2	6685.5	6086.4	2592.7	1573.1	2026.9	2609.7	4296.5	8282.4	11345.0	14016.7
1980	11996.8	10053.3	7459.5	3066.5	1093.7	898.4	1271.8	2207.7	3583.3	6154.4	9789.9	11052.0
1981	7544.6	6650.2	6630.6	5722.2	3160.6	2529.2	3266.5	5263.2	8026.4	10657.7	12910.1	14863.1
1982	13057.9	7468.2	2120.8	985.3	744.0	591.3	541.0	547.5	1130.7	3864.1	8914.0	8999.3
1983	4786.9	2561.0	935.7	578.7	494.9	420.1	504.6	439.8	394.5	549.8	1702.9	2637.6
1984	3036.4	1794.6	554.6	438.0	460.3	547.9	1288.1	3126.9	5673.2	7765.2	9115.5	8983.3
1985	5215.8	4527.3	3634.0	4506.2	4481.8	4886.9	5193.8	5486.8	7831.2	10589.3	12948.8	14760.7
1986	12112.2	11124.5	9009.8	5031.8	1532.7	876.0	998.2	1856.5	3812.4	7028.3	9998.2	9439.5
1987	5418.2	5319.0	5861.1	7082.0	5295.3	3095.2	3820.4	7383.1	9511.7	11360.7	13465.1	15105.1
1988	13127.5	11969.5	9296.0	4371.9	2992.4	5938.3	8944.4	9360.4	10555.0	12246.5	14534.1	16065.5
1989	14251.2	12733.8	11359.5	9814.9	7906.8	4014.2	1976.4	3725.3	7253.2	10892.7	12992.8	13751.2
1990	11446.8	11008.6	11355.0	8440.4	5334.6	6529.4	8142.5	9125.9	11489.5	14161.3	15532.0	16389.6
1991	14165.6	13367.1	13159.7	11414.7	8789.7	5526.6	3741.9	7476.6	11581.2	14339.5	15627.0	16485.9
1992	14304.0	13195.0	13036.3	11508.5	6151.3	3238.3	4878.0	8175.4	10714.9	12420.2	15014.6	16414.8
1993	13682.0	12052.6	10954.3	4331.0	1574.4	1364.1	1190.8	1092.5	1612.0	3985.7	8881.8	10517.0
1994	7242.3	6602.5	6669.6	7397.4	5275.9	4775.8	7029.3	7583.4	10018.3	13249.3	14806.3	16010.4
1995	12748.7	10635.6	10369.8	3681.6	1601.5	846.5	934.6	676.4	693.7	1243.7	3824.4	6105.8
1996	4753.2	4424.7	4155.8	2126.9	699.9	588.4	593.2	517.3	1799.2	6021.4	9739.5	8935.7
1997	5047.0	4919.3	1818.9	573.3	584.3	994.9	2005.0	3167.8	5506.2	7800.2	9016.3	8854.7
1998	5443.3	5161.9	4642.9	2950.5	834.2	702.4	577.7	476.0	401.2	689.5	2480.3	4010.7
1999	3899.1	3832.9	2040.6	962.4	511.0	383.5	573.8	1325.7	3247.2	6227.1	9577.9	9022.3
2000	5002.2	4840.1	5167.6	5097.5	1535.0	714.6	991.9	2042.3	4785.6	7929.8	9370.8	10622.4
2001	7423.5	6603.7	6509.2	6760.9	3647.7	2058.1	2862.3	5642.8	8296.8	10736.2	13048.4	14957.3
2002	12963.4	11286.5	6404.1	1949.8	1822.1	3248.5	3400.3	4138.8	7153.6	11273.1	13145.9	14947.0
2003	12648.7	11495.8	6244.7	1883.3	1362.5	2209.6	2112.0	1124.3	2778.0	6905.4	9144.1	10529.7
Average	8896.3	7747.1	6308.9	4526.8	2846.3	2435.8	2840.5	3900.5	5767.4	8269.6	10738.9	11696.0
Critical	11355.2	10557.7	10098.4	8574.4	6052.0	6087.8	7333.6	9082.2	11685.6	13829.8	15348.7	16459.5
Dry	8802.8	7853.4	6733.1	5972.7	4385.7	3305.4	3419.9	5273.3	8012.2	10918.3	13085.2	14730.7
BN	6383.4	5902.6	5874.0	5957.9	3424.3	2054.1	2379.5	3916.2	6065.5	8915.0	11034.6	13656.1
AN	11628.5	10029.2	7552.9	3331.7	1301.7	1192.2	1307.2	1663.4	3232.7	6331.2	9475.4	10793.8
Wet	6741.0	5415.1	3565.3	2011.5	1033.5	700.7	932.3	1506.9	2668.6	4848.6	7711.6	7845.3

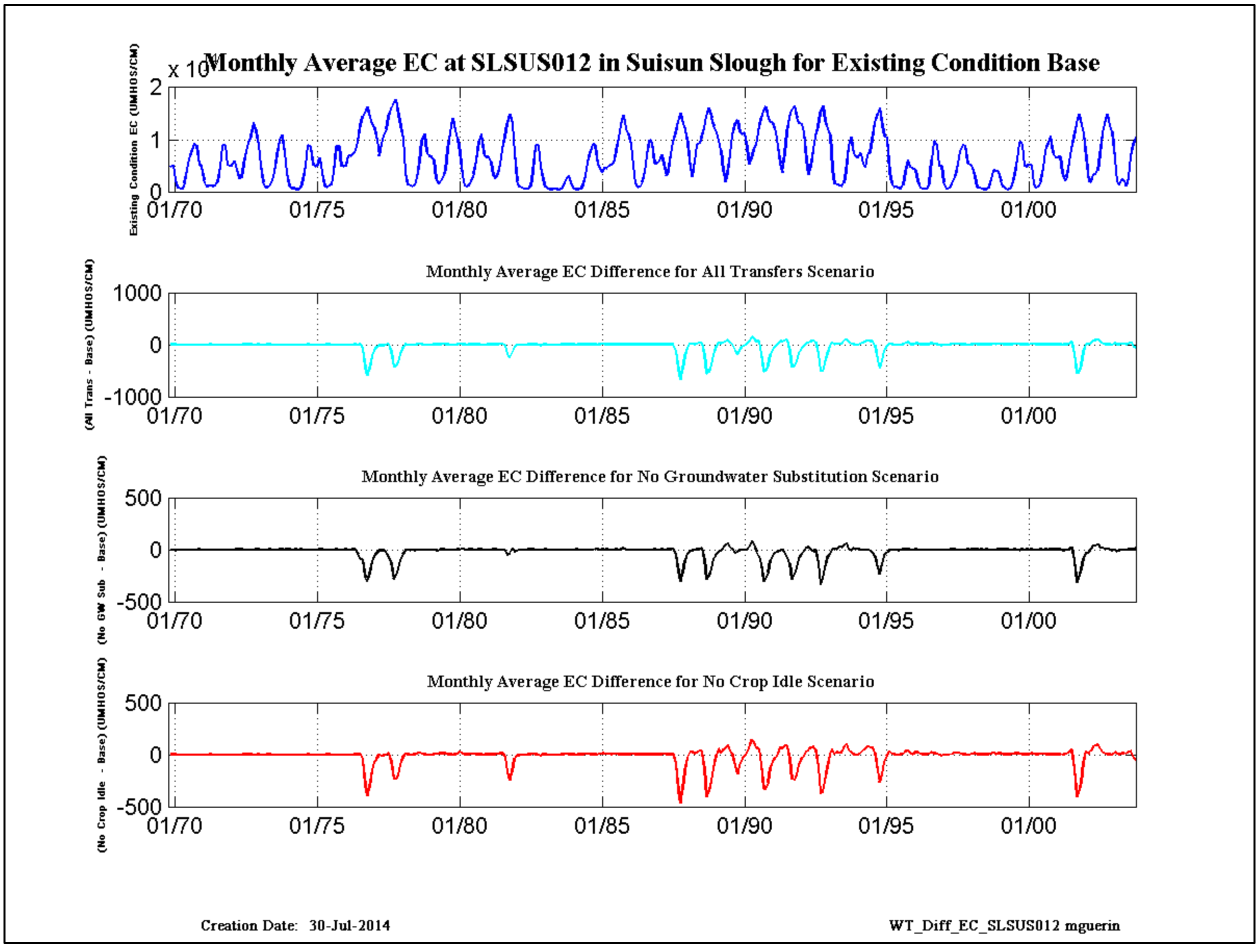


Figure 1-22. Suisun Slough location SLMZU012EC for the Base condition and change from Base for the scenarios.

Table 1-138. CCWD Intake location in Victoria Canal Base salinity (EC).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	310.0	341.7	340.9	387.2	334.2	307.6	329.5	382.1	340.3	259.8	268.5	431.3
1971	356.2	337.5	354.3	399.1	392.9	414.5	366.3	381.8	309.3	238.1	280.2	443.7
1972	352.3	359.9	305.4	399.5	455.7	451.8	458.6	451.2	358.4	273.3	316.2	452.8
1973	506.7	630.9	516.9	562.1	531.6	401.7	351.5	378.3	337.2	259.4	294.7	335.2
1974	315.0	305.9	352.6	467.9	421.4	346.0	302.0	379.7	367.2	300.0	283.4	356.4
1975	333.1	334.9	300.3	471.9	486.3	322.4	327.9	383.6	352.0	298.1	286.6	377.6
1976	324.1	328.3	282.4	456.2	503.1	466.5	467.3	462.1	449.9	431.3	564.2	517.9
1977	570.4	587.8	611.3	791.3	650.8	541.2	466.5	428.2	460.1	485.1	475.4	593.2
1978	709.7	611.8	626.5	653.4	585.1	548.4	308.2	247.9	343.5	320.0	302.4	334.5
1979	308.9	332.8	331.9	610.3	487.9	353.5	339.7	317.9	310.0	261.5	350.0	449.1
1980	483.2	436.8	479.5	465.0	363.0	225.0	311.0	357.9	366.7	347.9	299.6	317.4
1981	321.2	336.0	351.7	562.5	462.1	473.5	494.8	459.5	359.8	309.1	413.3	467.2
1982	526.6	481.1	335.7	483.2	371.2	376.7	192.1	175.3	288.9	338.7	290.4	259.0
1983	214.4	224.5	287.3	397.6	297.3	248.0	181.6	200.1	207.4	236.9	215.4	210.6
1984	254.5	203.8	233.2	338.6	295.6	282.4	327.2	391.9	336.9	264.2	277.9	384.6
1985	330.1	309.6	280.6	354.5	431.5	472.9	474.4	436.5	355.6	314.6	420.1	456.1
1986	497.1	460.0	586.7	541.7	500.8	347.9	252.4	253.1	337.8	295.6	299.9	327.4
1987	321.3	335.3	293.4	501.7	491.4	509.5	550.7	456.0	357.7	295.9	360.8	419.9
1988	504.5	511.1	551.1	507.5	576.7	521.2	503.6	462.6	416.0	321.9	404.4	478.6
1989	567.4	591.1	585.5	759.4	680.9	644.8	528.2	403.9	296.6	333.2	452.4	432.5
1990	444.9	508.4	580.7	607.1	470.5	425.1	400.9	388.9	397.0	399.8	531.9	515.6
1991	610.7	640.2	717.0	836.2	735.0	667.9	577.2	437.5	356.6	412.3	540.4	506.6
1992	596.4	620.4	685.1	765.7	774.5	594.0	465.4	391.9	335.7	294.7	416.2	487.7
1993	573.9	544.9	580.7	720.2	621.1	519.1	516.2	503.7	420.6	319.5	296.5	331.0
1994	311.6	357.2	362.8	618.8	547.6	467.5	434.0	413.0	396.3	424.7	565.3	484.1
1995	594.7	476.2	523.0	709.5	501.0	437.6	231.2	157.7	267.3	286.9	251.9	245.4
1996	304.6	323.1	307.4	483.3	480.3	346.6	318.0	333.3	357.6	286.8	304.6	411.8
1997	353.1	324.3	352.9	256.0	199.9	232.6	315.3	343.2	343.0	269.6	270.6	395.4
1998	359.0	344.5	299.4	549.4	558.5	349.3	196.9	174.1	257.8	279.9	251.4	246.3
1999	269.7	292.0	306.3	453.3	354.9	303.0	344.4	385.7	329.4	250.5	291.8	422.2
2000	367.5	345.2	285.7	520.8	588.3	343.1	331.0	385.5	342.2	274.9	273.6	337.1
2001	326.9	351.3	340.0	574.4	513.2	466.2	494.7	476.2	362.9	288.3	350.9	410.7
2002	494.5	469.6	511.3	541.7	442.9	435.6	489.9	507.4	391.5	343.1	432.6	447.4
2003	572.2	493.4	541.8	438.0	376.8	367.1	458.0	441.2	305.1	241.0	270.1	339.6
Average	420.2	416.2	423.6	534.9	484.8	417.9	385.5	375.0	347.5	310.5	350.1	400.8
Critical	480.4	507.6	541.5	654.7	608.3	526.2	473.6	426.3	401.7	395.7	499.7	512.0
Dry	393.6	398.8	393.8	549.0	503.7	500.4	505.5	456.6	354.0	314.0	405.0	439.0
BN	330.6	346.3	318.7	504.9	471.8	402.6	399.2	384.5	334.2	267.4	333.1	450.9
AN	535.5	510.5	505.2	559.9	511.0	400.7	379.3	385.7	352.6	293.8	289.5	332.4
Wet	360.6	342.3	352.3	456.8	399.6	331.9	283.5	303.2	315.0	277.3	274.8	347.1

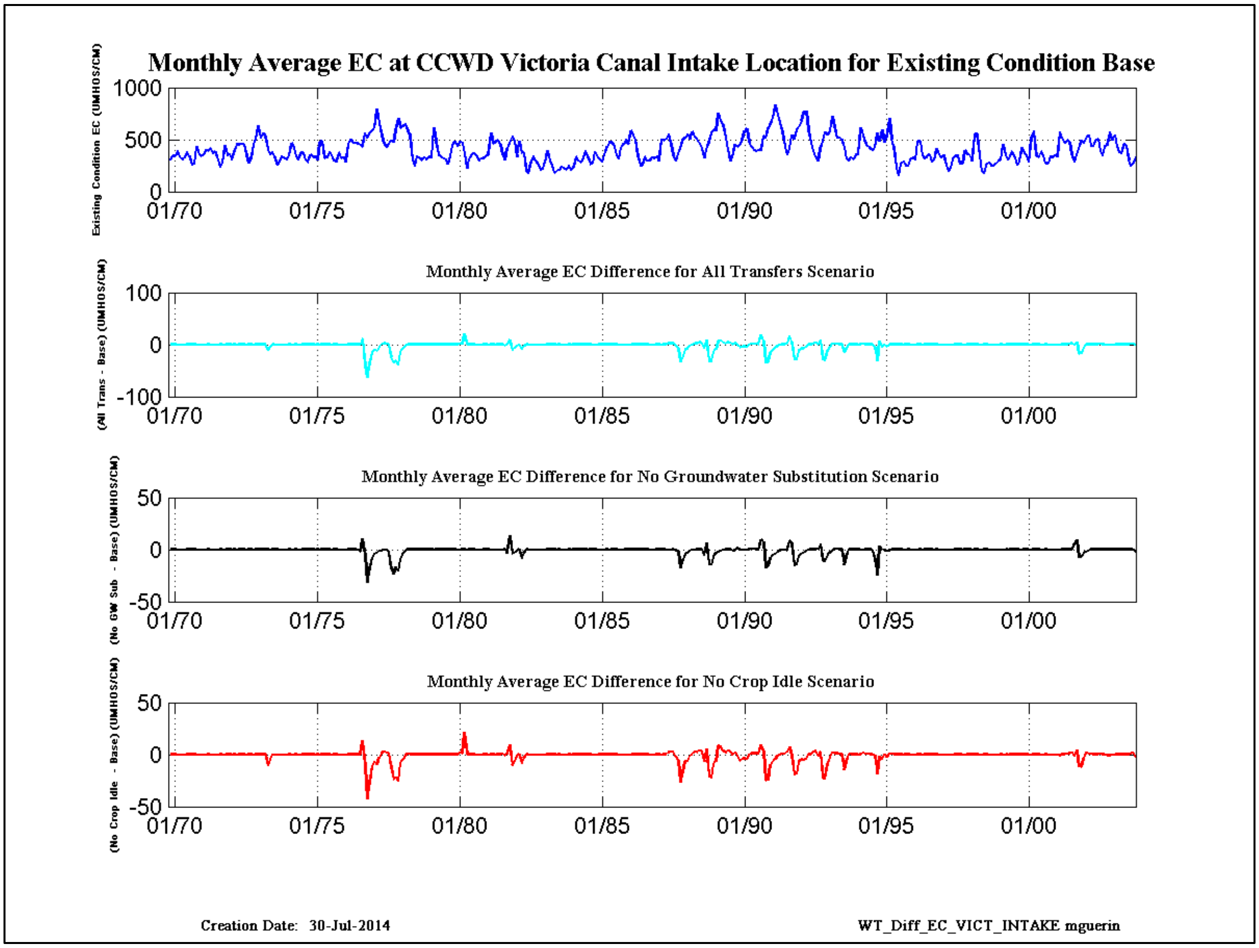


Figure 1-23. CCWD Intake location in Victoria Canal EC for the Base condition and change from Base for the scenarios.

Table 1-139. Upper Cache Slough location SLCCH016 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.5	-1.9
1977	-1.9	-1.0	-0.3	-0.1	0.0	0.0	0.1	0.0	0.1	-0.6	-2.2	-1.4
1978	-2.1	-1.3	-0.5	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3
1982	-0.1	0.0	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.0	-2.0
1988	-1.2	-0.4	-0.1	0.0	0.0	0.0	0.1	0.1	0.1	-0.3	-1.2	-1.9
1989	-1.9	-0.9	-0.2	-0.1	0.0	0.1	0.1	0.1	0.0	0.0	-0.1	-0.1
1990	-0.1	0.0	0.1	0.1	0.1	0.3	0.2	0.0	0.1	-0.2	-0.8	-1.0
1991	-1.2	-0.5	0.0	0.2	0.2	0.2	0.3	0.2	0.1	-0.1	-0.6	-0.9
1992	-1.1	-0.5	0.0	0.2	0.2	0.3	0.2	0.1	0.1	-0.2	-1.0	-1.0
1993	-0.8	-0.5	-0.1	0.0	0.0	-0.2	0.1	0.1	0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	-0.2	-0.7
1995	-0.4	-0.1	0.0	0.0	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	-0.7	-1.0
2002	-0.8	-0.3	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Average	-0.3	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.4
Critical	-0.8	-0.3	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.2	-0.9	-1.2
Dry	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.5	-0.3	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-140. Upper Cache Slough location SLCCH016 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-1.0
1977	-1.0	-0.5	-0.2	-0.1	0.0	0.0	0.0	0.0	0.1	-0.3	-1.1	-0.7
1978	-1.1	-0.7	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1982	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-1.0
1988	-0.6	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.6	-1.0
1989	-1.0	-0.4	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
1990	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	-0.1	-0.4	-0.5
1991	-0.6	-0.3	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.1	-0.3	-0.5
1992	-0.6	-0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.1	-0.5	-0.5
1993	-0.4	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4
1995	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.5
2002	-0.4	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
Critical	-0.4	-0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	-0.1	-0.5	-0.7
Dry	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-141. Montezuma Slough location SLMZU011 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.3	0.9	-1.3	-0.3	-0.1	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-0.8	122.0	-78.7	-548.8	-710.7
1977	-414.0	-156.6	-69.9	-15.5	-3.1	-7.5	-6.3	2.9	39.6	-172.3	-530.7	-474.6
1978	-307.4	-113.8	-5.6	11.5	0.9	0.5	0.1	2.4	11.6	15.9	5.7	1.5
1979	0.2	0.0	-0.8	-6.4	6.3	10.2	8.9	11.7	8.5	2.9	0.8	0.1
1980	1.3	16.1	22.0	0.4	-0.2	0.0	1.4	4.9	4.4	1.2	0.3	0.1
1981	-0.1	0.3	2.1	-0.4	-6.2	2.2	6.4	11.1	13.1	-36.1	-219.5	-312.2
1982	-127.2	20.8	4.0	-0.1	-0.1	-0.4	0.0	0.5	3.0	4.7	1.8	0.0
1983	-32.6	1.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	3.3	6.9
1984	1.2	1.9	0.0	0.0	0.2	0.4	1.8	8.6	6.8	2.3	0.7	0.1
1985	-0.3	1.0	9.7	-0.1	1.6	6.3	4.6	7.2	7.2	2.9	1.6	1.1
1986	1.2	1.0	2.3	6.2	0.3	0.0	0.4	1.7	1.8	0.6	0.2	0.1
1987	0.0	0.1	0.5	3.2	5.3	3.0	2.5	2.7	16.5	-141.1	-577.4	-792.1
1988	-392.5	-145.2	9.6	17.1	16.4	3.8	26.8	43.1	39.8	-239.9	-685.8	-591.5
1989	-347.2	-116.5	37.3	66.1	10.4	46.9	46.9	75.5	26.8	-8.9	-136.7	-220.3
1990	-71.9	-21.9	-6.2	17.1	47.5	140.4	112.0	56.3	68.8	-174.0	-592.0	-580.5
1991	-370.3	-138.3	-62.0	-20.4	26.6	97.1	32.0	71.9	100.2	-152.8	-541.5	-473.7
1992	-290.4	-109.7	-47.6	-15.6	16.1	40.3	66.4	75.5	54.8	-208.1	-539.8	-565.0
1993	-317.5	-109.0	60.0	33.4	5.2	12.4	9.8	16.6	57.3	91.2	35.6	12.8
1994	0.2	0.5	-0.7	29.5	9.9	51.0	77.5	67.1	69.3	-30.4	-410.6	-685.7
1995	-255.5	-76.4	9.5	17.7	1.8	0.0	-0.7	-0.2	1.6	7.9	32.1	39.8
1996	-2.8	0.2	19.7	14.9	0.4	0.0	0.3	0.4	8.8	28.0	17.1	7.4
1997	-10.2	-19.4	-0.2	-0.1	-0.2	3.3	11.3	16.9	19.1	12.9	3.5	5.0
1998	-6.7	-0.5	5.5	8.6	-0.4	-0.4	0.0	0.1	0.1	1.1	9.7	20.2
1999	-1.9	10.8	5.4	1.3	0.1	0.1	0.8	3.7	10.1	11.8	4.3	1.4
2000	0.1	0.0	-0.2	9.9	3.1	0.2	1.8	5.6	6.5	2.9	1.1	0.3
2001	0.0	-0.1	1.3	2.7	-10.7	3.0	6.4	28.7	54.7	-227.8	-676.0	-630.5
2002	-344.9	-21.0	36.5	4.3	20.5	73.4	75.6	70.5	45.6	18.8	6.7	4.5
2003	1.5	-1.3	13.9	3.2	2.5	11.5	11.6	3.7	19.9	32.0	-43.0	-63.8
Average	-96.7	-28.7	1.4	5.5	4.5	14.6	14.7	17.3	24.0	-36.2	-158.2	-176.5
Critical	-219.8	-81.6	-25.3	1.7	16.2	46.4	44.2	45.2	70.6	-150.9	-549.9	-583.1
Dry	-115.4	-22.7	14.6	12.6	3.5	22.4	23.7	32.6	27.3	-65.4	-266.9	-324.9
BN	0.1	0.0	-0.4	-3.2	3.2	5.1	4.4	5.9	4.3	1.5	0.4	0.0
AN	-103.7	-34.7	15.0	9.7	1.9	4.2	4.3	5.3	16.6	23.9	0.0	-8.2
Wet	-33.4	-4.7	3.6	3.7	0.2	0.2	1.1	2.4	3.9	5.4	5.6	6.2

Table 1-142. Montezuma Slough location SLMZU011 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	-0.6	-4.0	-4.6
1977	-3.8	-1.6	-0.7	-0.3	-0.1	-0.1	-0.1	0.0	0.3	-1.2	-3.4	-2.9
1978	-2.9	-1.2	-0.1	1.2	0.3	0.2	0.0	0.4	0.6	0.3	0.1	0.0
1979	0.0	0.0	0.0	-0.2	0.7	1.6	0.8	0.7	0.3	0.0	0.0	0.0
1980	0.0	0.3	0.6	0.1	-0.1	0.0	0.2	0.3	0.2	0.0	0.0	0.0
1981	0.0	0.0	0.1	0.0	-0.5	0.2	0.3	0.3	0.2	-0.4	-1.9	-2.2
1982	-1.3	0.7	1.0	0.0	0.0	-0.2	0.0	0.2	0.4	0.2	0.0	0.0
1983	-1.4	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4
1984	0.1	0.3	0.0	0.0	0.1	0.1	0.2	0.4	0.1	0.0	0.0	0.0
1985	0.0	0.0	0.5	0.0	0.1	0.2	0.1	0.2	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.0	0.2	-1.4	-4.6	-5.5
1988	-4.0	-1.6	0.2	1.2	1.2	0.1	0.3	0.5	0.4	-2.2	-5.1	-3.9
1989	-3.1	-1.3	0.5	1.2	0.3	2.7	5.4	2.9	0.4	-0.1	-1.2	-1.8
1990	-0.9	-0.3	-0.1	0.4	2.5	3.0	1.7	0.7	0.7	-1.3	-4.1	-3.8
1991	-3.4	-1.3	-0.6	-0.3	0.6	3.5	1.5	1.2	1.0	-1.2	-3.7	-3.1
1992	-2.7	-1.1	-0.5	-0.2	0.7	2.6	1.9	1.1	0.6	-1.9	-3.8	-3.7
1993	-3.3	-1.2	0.9	2.3	1.5	3.0	2.6	3.6	6.6	3.0	0.5	0.1
1994	0.0	0.0	0.0	0.7	0.5	1.6	1.4	1.1	0.8	-0.2	-3.0	-4.6
1995	-3.1	-1.0	0.1	2.1	0.5	0.0	-0.3	-0.1	0.6	1.1	1.1	0.8
1996	-0.1	0.0	1.1	1.9	0.2	0.0	0.1	0.2	0.7	0.5	0.2	0.1
1997	-0.4	-0.9	0.0	-0.1	-0.1	0.6	0.8	0.7	0.4	0.2	0.0	0.1
1998	-0.2	0.0	0.2	0.7	-0.2	-0.2	0.0	0.1	0.0	0.3	0.5	0.7
1999	-0.1	0.6	0.6	0.3	0.1	0.0	0.2	0.4	0.4	0.2	0.1	0.0
2000	0.0	0.0	0.0	0.4	0.8	0.1	0.3	0.4	0.2	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	-0.7	0.3	0.3	0.6	0.8	-2.4	-5.6	-4.5
2002	-3.7	-0.3	1.4	0.8	2.4	3.6	3.3	2.3	0.8	0.2	0.1	0.0
2003	0.0	0.0	0.5	0.8	0.5	0.9	1.0	0.8	1.0	0.6	-0.5	-0.7
Average	-1.0	-0.3	0.2	0.4	0.3	0.7	0.7	0.6	0.6	-0.2	-1.1	-1.2
Critical	-2.1	-0.8	-0.2	0.2	0.8	1.5	1.0	0.7	0.7	-1.2	-3.9	-3.8
Dry	-1.1	-0.2	0.4	0.4	0.3	1.2	1.6	1.1	0.4	-0.7	-2.2	-2.3
BN	0.0	0.0	0.0	-0.1	0.3	0.8	0.4	0.4	0.1	0.0	0.0	0.0
AN	-1.0	-0.4	0.3	0.8	0.5	0.7	0.7	0.9	1.4	0.7	0.0	-0.1
Wet	-0.5	0.0	0.2	0.4	0.1	0.0	0.1	0.2	0.2	0.2	0.2	0.2

Table 1-143. Montezuma Slough location SLMZU025 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.5	-1.5	-1.1	-0.2	-0.1	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-1.2	56.2	-216.8	-744.1	-788.5
1977	-375.3	-142.8	-64.7	-14.7	-10.0	-5.1	-3.3	9.5	46.4	-339.5	-666.4	-517.3
1978	-282.7	-104.4	0.6	3.7	0.6	0.3	0.2	0.8	6.2	9.6	4.1	1.1
1979	0.2	0.1	-0.7	5.8	2.1	1.4	3.0	4.2	4.3	1.8	0.6	0.1
1980	1.5	17.9	27.1	1.8	-0.5	0.1	0.4	1.7	1.9	0.6	0.2	0.1
1981	-0.1	0.5	2.0	2.9	-1.2	0.9	3.1	8.0	10.1	-53.0	-319.0	-335.7
1982	-110.2	-14.8	0.0	0.1	-0.4	-0.3	0.0	0.1	0.9	2.5	1.3	0.0
1983	2.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	1.8
1984	4.2	0.5	0.0	0.0	0.0	0.1	0.7	4.0	4.0	1.3	0.4	0.0
1985	-0.3	5.1	4.9	4.8	4.5	3.0	2.5	4.7	5.1	2.3	1.6	1.5
1986	1.2	1.1	7.4	3.1	0.0	0.0	0.2	0.6	0.9	0.3	0.1	0.0
1987	0.0	0.7	0.3	3.6	2.5	0.9	1.3	3.7	21.6	-235.6	-762.9	-842.9
1988	-349.7	-135.3	26.3	12.6	4.9	3.1	30.1	33.4	41.9	-426.6	-775.2	-625.0
1989	-320.0	-102.3	55.0	62.5	9.1	15.0	16.6	35.1	17.9	-21.4	-204.9	-215.4
1990	-59.8	-16.3	-6.7	21.2	58.8	104.4	69.3	46.7	73.5	-583.5	-768.8	-620.8
1991	-339.5	-123.9	-58.8	-19.8	36.5	30.1	24.9	67.0	104.8	-353.4	-652.2	-503.1
1992	-267.1	-100.2	-44.1	-15.5	9.7	16.2	44.3	56.4	55.6	-444.9	-785.1	-600.9
1993	-282.4	-100.4	78.3	16.0	1.3	3.1	1.2	3.1	18.4	46.6	22.8	6.8
1994	0.6	0.7	-0.7	41.4	12.0	34.8	52.0	48.8	64.2	-83.4	-590.2	-672.2
1995	-221.9	-74.8	18.4	5.5	0.5	0.0	0.1	0.0	0.2	2.2	22.1	20.9
1996	-0.5	0.0	14.4	2.2	0.0	0.0	0.0	0.1	5.4	16.3	10.7	2.8
1997	-1.7	-0.6	0.2	0.0	0.0	0.9	3.7	8.4	11.1	6.6	1.8	2.0
1998	-0.1	0.1	9.9	3.1	0.0	0.0	0.0	0.0	0.0	0.2	5.4	9.0
1999	2.9	5.4	1.2	0.1	0.0	0.0	0.1	1.3	6.2	7.0	2.7	0.5
2000	0.1	0.0	-0.1	9.8	0.3	0.0	0.4	2.0	3.8	1.8	0.6	0.1
2001	0.0	-0.1	1.7	7.2	2.0	0.8	3.1	25.7	52.9	-390.6	-729.9	-654.2
2002	-308.2	-1.0	21.3	1.1	11.9	29.0	34.7	37.4	30.4	13.1	6.6	5.3
2003	1.1	-1.1	7.0	0.3	0.5	3.7	2.7	0.5	21.3	1.6	-45.6	-49.5
Average	-85.4	-26.0	2.9	4.7	4.3	7.1	8.5	11.8	19.6	-89.3	-204.8	-187.5
Critical	-198.7	-74.0	-21.2	3.6	16.0	26.2	31.1	37.2	63.2	-349.7	-711.7	-618.3
Dry	-104.8	-16.2	14.2	13.7	4.8	8.3	10.2	19.1	23.0	-114.2	-334.8	-340.2
BN	0.1	0.0	-0.4	2.9	1.0	0.7	1.5	2.1	2.1	0.9	0.3	0.0
AN	-93.7	-31.3	18.8	5.3	0.4	1.1	0.6	1.2	8.6	10.0	-3.0	-6.9
Wet	-24.9	-6.3	4.0	1.1	0.0	0.1	0.4	1.1	2.2	2.8	3.5	2.8

Table 1-144. Montezuma Slough location SLMZU025 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.3	-0.5	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	-2.3	-7.4	-6.6
1977	-3.6	-1.5	-0.7	-0.3	-0.3	-0.1	-0.1	0.1	0.5	-3.0	-5.5	-4.0
1978	-2.9	-1.1	0.0	1.0	0.3	0.1	0.1	0.3	0.8	0.4	0.1	0.0
1979	0.0	0.0	0.0	0.4	0.7	0.5	0.7	0.8	0.3	0.0	0.0	0.0
1980	0.0	0.3	0.9	0.6	-0.2	0.0	0.2	0.3	0.2	0.0	0.0	0.0
1981	0.0	0.0	0.1	0.2	-0.3	0.2	0.4	0.4	0.2	-0.9	-3.9	-3.3
1982	-1.2	-1.0	0.0	0.0	-0.2	-0.2	0.0	0.0	0.3	0.1	0.0	0.0
1983	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3
1984	0.5	0.2	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.0	0.0	0.0
1985	0.0	0.6	0.6	0.3	0.4	0.2	0.2	0.2	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.4	-3.4	-8.3	-7.7
1988	-3.8	-1.5	0.7	2.4	0.8	0.1	0.7	0.7	0.8	-5.5	-7.7	-5.3
1989	-3.0	-1.2	0.7	1.3	0.2	2.5	5.0	3.0	0.5	-0.3	-2.6	-2.6
1990	-0.8	-0.2	-0.1	0.8	5.0	4.6	2.0	1.0	1.0	-6.0	-7.1	-5.2
1991	-3.3	-1.2	-0.6	-0.3	0.9	3.1	2.6	1.8	1.4	-3.6	-6.1	-4.2
1992	-2.6	-1.0	-0.4	-0.2	1.0	2.8	2.8	1.3	0.9	-5.6	-7.3	-5.0
1993	-3.1	-1.1	1.2	3.0	0.6	1.4	0.6	1.4	5.7	2.9	0.4	0.1
1994	0.0	0.0	0.0	1.1	1.3	2.4	2.0	1.5	1.1	-1.0	-6.1	-6.1
1995	-3.0	-1.0	0.3	1.5	0.2	0.0	0.0	0.0	0.1	0.7	1.5	1.0
1996	0.0	0.0	1.7	0.9	0.0	0.0	0.0	0.0	0.9	0.6	0.2	0.1
1997	-0.1	0.0	0.1	0.0	0.0	0.4	0.8	0.9	0.4	0.2	0.0	0.1
1998	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.9
1999	0.2	0.8	0.4	0.1	0.0	0.0	0.1	0.4	0.5	0.3	0.0	0.0
2000	0.0	0.0	0.0	0.8	0.1	0.0	0.2	0.4	0.2	0.1	0.0	0.0
2001	0.0	0.0	0.0	0.3	0.5	0.2	0.4	1.0	1.3	-6.1	-8.5	-6.2
2002	-3.5	0.0	1.7	0.5	3.3	4.2	4.5	2.9	0.8	0.2	0.1	0.1
2003	0.0	0.0	0.6	0.2	0.2	0.9	0.8	0.2	1.7	0.1	-0.9	-1.1
Average	-0.9	-0.2	0.2	0.5	0.4	0.7	0.7	0.6	0.6	-0.9	-2.0	-1.6
Critical	-2.0	-0.8	-0.2	0.5	1.2	1.8	1.4	0.9	0.9	-3.9	-6.7	-5.2
Dry	-1.1	-0.1	0.5	0.4	0.7	1.3	1.8	1.3	0.5	-1.7	-3.9	-3.3
BN	0.0	0.0	0.0	0.2	0.3	0.2	0.4	0.4	0.1	0.0	0.0	0.0
AN	-1.0	-0.3	0.5	0.9	0.2	0.4	0.2	0.4	1.4	0.6	-0.1	-0.1
Wet	-0.3	0.0	0.3	0.3	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2

Table 1-145. Suisun Slough location SLSUS012 salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	1.6	2.3	-0.9	-0.3	-0.1	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-0.7	2.7	-68.5	-424.4	-595.7
1977	-449.7	-219.4	-109.7	-49.2	-12.6	-16.9	-11.5	-2.3	17.6	-130.8	-422.7	-411.4
1978	-328.3	-162.2	-50.8	2.4	-2.7	-6.4	-5.9	-2.2	8.4	14.0	3.5	-1.2
1979	-2.6	-2.5	-3.3	0.1	8.6	7.4	9.3	12.8	9.4	2.4	0.0	-0.9
1980	-0.3	9.2	25.0	5.5	1.4	-0.1	1.2	5.4	5.0	1.3	0.2	-0.2
1981	-0.4	-0.2	1.6	3.8	1.9	3.2	7.2	11.4	12.9	-29.6	-170.9	-256.9
1982	-158.5	-38.0	-9.5	-7.0	-3.1	-2.2	-1.7	1.3	2.7	5.1	0.8	-0.7
1983	-12.5	3.1	0.8	-0.7	-0.5	-0.5	-1.2	-0.6	-0.5	0.1	3.3	7.2
1984	4.2	2.7	0.2	-0.1	0.1	0.5	2.1	6.3	7.0	2.8	1.0	0.3
1985	-0.2	5.7	14.6	8.0	5.5	6.4	5.0	7.4	7.3	2.8	1.8	1.2
1986	1.1	0.9	1.6	9.4	2.5	0.7	0.9	2.3	2.3	0.9	0.5	0.3
1987	0.2	0.1	0.3	2.5	6.7	4.5	3.1	2.3	12.1	-109.8	-464.8	-667.9
1988	-453.1	-212.6	-51.1	19.0	19.3	1.5	19.5	37.3	30.3	-181.2	-554.0	-525.9
1989	-382.7	-182.0	-37.0	41.3	8.3	39.4	54.7	85.4	29.0	-4.7	-111.1	-187.5
1990	-102.3	-34.9	-17.4	10.9	59.3	143.8	115.9	58.5	61.1	-161.8	-511.6	-503.3
1991	-396.3	-185.6	-94.7	-43.4	0.4	63.8	53.1	79.2	90.2	-104.1	-423.6	-412.7
1992	-317.1	-157.0	-74.8	-35.2	23.1	35.6	61.8	71.3	47.3	-177.6	-506.2	-500.3
1993	-352.2	-165.6	-14.6	43.4	4.1	17.5	13.1	18.0	68.3	102.9	40.5	14.7
1994	1.7	-2.0	-1.9	16.5	36.6	59.1	77.4	68.7	69.2	-16.7	-292.7	-447.1
1995	-316.7	-110.1	-31.8	19.5	2.3	-0.6	-2.8	-3.2	-0.5	8.6	31.5	40.9
1996	6.4	0.6	22.3	21.1	4.4	0.6	0.1	0.4	8.6	23.3	10.9	5.7
1997	-2.8	-10.4	-1.9	-2.3	-3.7	4.4	12.6	17.8	18.2	9.3	3.4	2.9
1998	-2.0	-0.4	5.8	13.0	1.5	0.6	0.5	0.4	0.4	1.6	9.2	19.0
1999	4.0	13.6	13.2	4.0	1.3	0.6	1.5	5.0	13.3	11.8	6.9	1.2
2000	0.7	0.5	0.0	14.8	10.0	2.2	2.8	7.3	7.7	4.1	1.6	0.7
2001	0.4	0.2	0.5	4.7	-2.7	4.0	7.5	28.3	53.3	-173.3	-542.8	-550.0
2002	-397.8	-134.2	15.9	2.2	27.1	76.9	84.8	90.1	50.3	20.3	6.9	3.6
2003	1.3	-1.6	21.7	7.8	3.1	11.4	14.2	6.2	24.4	34.7	-34.1	-58.9
Average	-107.5	-46.5	-11.0	3.3	5.9	13.5	15.5	18.0	19.3	-26.8	-127.6	-147.7
Critical	-245.3	-115.9	-49.9	-11.6	18.0	41.0	45.2	44.5	45.5	-120.1	-447.9	-485.2
Dry	-130.1	-51.7	-0.7	10.4	7.8	22.4	27.0	37.5	27.5	-49.1	-213.5	-276.2
BN	-1.3	-1.3	-1.7	0.1	4.3	3.7	4.6	6.4	4.7	1.2	0.0	-0.5
AN	-113.1	-53.3	-3.1	12.3	2.7	4.4	4.6	5.6	18.9	26.1	1.9	-7.5
Wet	-36.7	-10.6	0.0	4.4	0.4	0.3	0.9	2.3	4.0	4.9	5.2	5.9

Table 1-146. Suisun Slough location SLSUS012 salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-2.8	-3.7
1977	-3.2	-1.7	-0.9	-0.5	-0.2	-0.2	-0.1	0.0	0.1	-0.8	-2.5	-2.3
1978	-2.2	-1.3	-0.5	0.1	-0.2	-0.6	-0.6	-0.2	0.3	0.2	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.3	0.5	0.5	0.5	0.2	0.0	0.0	0.0
1980	0.0	0.1	0.3	0.2	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	-0.3	-1.3	-1.7
1982	-1.2	-0.5	-0.4	-0.7	-0.4	-0.4	-0.3	0.2	0.2	0.1	0.0	0.0
1983	-0.3	0.1	0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	0.0	0.2	0.3
1984	0.1	0.2	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.0	0.0	0.0
1985	0.0	0.1	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	-1.0	-3.5	-4.4
1988	-3.5	-1.8	-0.5	0.4	0.6	0.0	0.2	0.4	0.3	-1.5	-3.8	-3.3
1989	-2.7	-1.4	-0.3	0.4	0.1	1.0	2.8	2.3	0.4	0.0	-0.9	-1.4
1990	-0.9	-0.3	-0.2	0.1	1.1	2.2	1.4	0.6	0.5	-1.1	-3.3	-3.1
1991	-2.8	-1.4	-0.7	-0.4	0.0	1.2	1.4	1.1	0.8	-0.7	-2.7	-2.5
1992	-2.2	-1.2	-0.6	-0.3	0.4	1.1	1.3	0.9	0.4	-1.4	-3.4	-3.0
1993	-2.6	-1.4	-0.1	1.0	0.3	1.3	1.1	1.7	4.2	2.6	0.5	0.1
1994	0.0	0.0	0.0	0.2	0.7	1.2	1.1	0.9	0.7	-0.1	-2.0	-2.8
1995	-2.5	-1.0	-0.3	0.5	0.1	-0.1	-0.3	-0.5	-0.1	0.7	0.8	0.7
1996	0.1	0.0	0.5	1.0	0.6	0.1	0.0	0.1	0.5	0.4	0.1	0.1
1997	-0.1	-0.2	-0.1	-0.4	-0.6	0.4	0.6	0.6	0.3	0.1	0.0	0.0
1998	0.0	0.0	0.1	0.4	0.2	0.1	0.1	0.1	0.1	0.2	0.4	0.5
1999	0.1	0.4	0.6	0.4	0.2	0.2	0.3	0.4	0.4	0.2	0.1	0.0
2000	0.0	0.0	0.0	0.3	0.7	0.3	0.3	0.4	0.2	0.1	0.0	0.0
2001	0.0	0.0	0.0	0.1	-0.1	0.2	0.3	0.5	0.6	-1.6	-4.2	-3.7
2002	-3.1	-1.2	0.2	0.1	1.5	2.4	2.5	2.2	0.7	0.2	0.1	0.0
2003	0.0	0.0	0.3	0.4	0.2	0.5	0.7	0.5	0.9	0.5	-0.4	-0.6
Average	-0.8	-0.4	-0.1	0.1	0.2	0.4	0.4	0.4	0.4	-0.1	-0.8	-0.9
Critical	-1.8	-0.9	-0.4	-0.1	0.4	0.8	0.8	0.5	0.4	-0.9	-2.9	-3.0
Dry	-1.0	-0.4	0.1	0.1	0.3	0.7	1.0	0.9	0.4	-0.4	-1.6	-1.9
BN	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0
AN	-0.8	-0.4	0.0	0.3	0.2	0.3	0.3	0.4	1.0	0.6	0.0	-0.1
Wet	-0.3	-0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1

Table 1-147. CCWD Intake location in Victoria Canal salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.1	0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.1	0.0	0.0	0.2	-10.6	-4.4	0.0	-0.4	0.0	0.0	-0.1
1974	-0.2	0.0	0.1	0.0	-0.1	0.1	-0.2	0.0	0.1	0.1	0.0	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-0.1	0.0	0.0	0.0
1976	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.2	0.2	11.9	-40.5	-63.2
1977	-34.5	-14.5	-9.7	-11.5	-3.7	1.0	2.8	1.7	1.2	-23.6	-35.1	-31.4
1978	-38.5	-13.8	-7.4	-1.6	0.7	0.4	0.0	0.3	0.2	0.1	0.1	0.1
1979	0.1	0.1	0.0	0.1	0.3	0.1	0.3	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.1	2.0	1.0	21.8	0.4	0.2	0.3	0.1	-0.1	-0.1	0.0
1981	0.1	0.2	-0.1	0.0	0.1	0.0	0.2	0.5	0.9	-1.3	0.4	9.6
1982	-10.1	-6.7	-1.2	0.4	-8.0	-3.4	0.4	-0.4	-0.3	-0.2	0.0	-0.1
1983	-0.2	-0.1	-0.3	0.0	0.5	0.3	0.1	-0.3	0.2	-0.1	-0.2	-0.1
1984	0.1	-0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0
1985	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	-0.1	-0.2	-0.3
1986	0.0	0.0	-0.2	0.4	0.1	0.3	0.1	0.0	0.2	0.1	0.0	-0.1
1987	0.0	0.2	0.1	-0.2	0.1	0.0	2.5	2.9	2.5	-2.2	-6.7	-32.9
1988	-21.0	-8.7	-7.8	-1.3	0.2	2.6	2.4	4.1	3.0	-7.5	8.9	-31.2
1989	-31.5	-13.0	-8.2	6.4	7.2	3.5	1.5	4.2	3.0	-0.4	2.5	-0.9
1990	-5.9	-4.5	-3.9	-4.2	-0.3	1.2	1.4	1.1	0.8	18.6	7.2	-34.1
1991	-33.3	-14.4	-9.9	-6.5	-2.3	-0.5	0.6	0.6	2.9	16.1	5.1	-28.9
1992	-27.5	-11.3	-7.7	-7.1	-4.7	0.1	0.5	2.9	3.3	0.6	8.5	-28.7
1993	-30.3	-11.1	-4.4	1.6	1.3	1.0	0.7	0.7	-14.5	-6.9	0.6	0.3
1994	0.0	0.0	0.0	0.4	1.5	0.8	0.6	0.5	0.4	-4.8	-30.5	6.0
1995	-4.9	-0.4	-4.1	0.0	0.7	0.3	0.2	0.1	0.2	-0.1	0.0	0.1
1996	-0.1	-0.1	0.0	0.1	0.2	-0.1	0.3	0.0	0.1	0.1	0.2	0.1
1997	0.0	-0.1	-0.1	-0.4	-0.2	0.0	0.0	0.3	0.2	0.1	-0.1	-0.3
1998	0.3	0.4	0.2	0.4	0.3	-0.1	0.0	0.4	0.2	-0.1	-0.2	0.0
1999	-0.1	0.0	0.1	-0.1	0.0	0.0	0.4	0.3	0.2	0.1	0.1	0.1
2000	0.0	0.0	-0.1	-0.3	0.1	0.3	0.3	-0.1	-0.1	0.1	0.0	0.0
2001	0.0	-0.1	-0.1	-0.6	0.1	0.1	0.9	1.0	2.1	-0.9	4.3	-17.7
2002	-16.5	-5.8	0.8	0.7	0.6	0.3	0.2	0.1	1.2	0.1	-0.1	-0.8
2003	-0.9	-0.1	-0.1	0.5	0.1	0.1	0.2	0.2	0.1	1.1	1.5	-2.6
Average	-7.5	-3.1	-1.8	-0.6	0.5	0.0	0.4	0.7	0.3	0.0	-2.2	-7.6
Critical	-17.5	-7.6	-5.6	-4.3	-1.3	0.7	1.2	1.6	1.7	1.6	-10.9	-30.2
Dry	-8.0	-3.1	-1.2	1.1	1.4	0.7	0.9	1.5	1.7	-0.8	0.0	-7.2
BN	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.0	0.0	0.0	0.0
AN	-11.6	-4.2	-1.7	0.2	4.0	-1.4	-0.5	0.2	-2.4	-0.9	0.3	-0.4
Wet	-1.2	-0.6	-0.4	0.1	-0.5	-0.2	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-148. CCWD Intake location in Victoria Canal salinity (EC) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.6	-1.3	0.0	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	-7.2	-12.2
1977	-6.0	-2.5	-1.6	-1.5	-0.6	0.2	0.6	0.4	0.3	-4.9	-7.4	-5.3
1978	-5.4	-2.3	-1.2	-0.2	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.4	0.2	6.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	-0.4	0.1	2.1
1982	-1.9	-1.4	-0.4	0.1	-2.2	-0.9	0.2	-0.2	-0.1	-0.1	0.0	0.0
1983	-0.1	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	0.0	-0.1	-0.1
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1986	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.6	0.7	-0.7	-1.8	-7.8
1988	-4.2	-1.7	-1.4	-0.3	0.0	0.5	0.5	0.9	0.7	-2.3	2.2	-6.5
1989	-5.6	-2.2	-1.4	0.8	1.1	0.5	0.3	1.0	1.0	-0.1	0.6	-0.2
1990	-1.3	-0.9	-0.7	-0.7	-0.1	0.3	0.3	0.3	0.2	4.6	1.3	-6.6
1991	-5.4	-2.2	-1.4	-0.8	-0.3	-0.1	0.1	0.1	0.8	3.9	0.9	-5.7
1992	-4.6	-1.8	-1.1	-0.9	-0.6	0.0	0.1	0.7	1.0	0.2	2.0	-5.9
1993	-5.3	-2.0	-0.7	0.2	0.2	0.2	0.1	0.1	-3.4	-2.2	0.2	0.1
1994	0.0	0.0	0.0	0.1	0.3	0.2	0.1	0.1	0.1	-1.1	-5.4	1.2
1995	-0.8	-0.1	-0.8	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	-0.1
1998	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2	0.1	0.0	-0.1	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	-0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	-0.1	0.0	0.0	0.2	0.2	0.6	-0.3	1.2	-4.3
2002	-3.3	-1.2	0.2	0.1	0.1	0.1	0.0	0.0	0.3	0.0	0.0	-0.2
2003	-0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.6	-0.8
Average	-1.3	-0.5	-0.3	-0.1	0.1	0.0	0.1	0.2	0.1	0.0	-0.4	-1.5
Critical	-3.1	-1.3	-0.9	-0.6	-0.2	0.2	0.3	0.4	0.4	0.5	-1.9	-5.9
Dry	-1.5	-0.6	-0.2	0.1	0.2	0.1	0.2	0.3	0.5	-0.3	0.0	-1.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.8	-0.7	-0.3	0.0	1.1	-0.3	-0.1	0.1	-0.6	-0.3	0.1	-0.1
Wet	-0.2	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-149. Upper Cache Slough location SLCCH016 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.4	-1.1
1977	-1.1	-0.7	-0.3	-0.1	-0.1	0.0	0.0	0.0	-0.1	-0.5	-1.6	-1.0
1978	-1.4	-1.0	-0.5	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1982	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.6	-1.2
1988	-0.7	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	-0.7	-1.1
1989	-1.2	-0.7	-0.3	-0.2	-0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	-0.1	-0.5	-0.7
1991	-0.8	-0.6	-0.3	-0.2	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.4	-0.6
1992	-0.8	-0.5	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.2	-0.6	-0.6
1993	-0.5	-0.3	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.4
1995	-0.2	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.5
2002	-0.5	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2
Critical	-0.5	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	-0.6	-0.8
Dry	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-150. Upper Cache Slough location SLCCH016 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.2	-0.6
1977	-0.6	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.8	-0.5
1978	-0.7	-0.5	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.6
1988	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	-0.6
1989	-0.6	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.3	-0.3
1991	-0.4	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.3
1992	-0.4	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3
1993	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.3
2002	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Critical	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.4
Dry	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-151. Montezuma Slough location SLMZU011 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.6	0.0	-0.5	0.0	-0.1	-0.1	-0.3	-4.1	-4.9	-5.3	-2.5	-3.2
1971	7.9	0.2	-0.1	0.3	4.1	-1.0	0.0	-0.2	-0.2	-0.1	-0.1	-0.1
1972	0.0	0.0	-0.1	0.0	0.1	0.2	0.1	-0.2	-0.2	-0.2	-0.1	-0.2
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0
1974	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.1	0.8	-35.5	18.6	-98.6	-324.2	-351.6
1977	-206.0	-82.4	-40.3	-12.7	1.3	-2.7	-2.9	-40.6	-60.9	-145.4	-337.7	-281.6
1978	-170.8	-67.9	-21.8	2.5	-0.1	0.0	-0.3	-0.7	-1.0	-0.7	-0.7	-0.7
1979	-0.1	-0.1	-0.4	0.4	-1.1	-1.9	-0.1	0.0	0.1	-0.4	-1.0	-0.9
1980	-0.1	0.0	0.0	0.2	0.0	-0.2	0.1	0.0	-0.1	-0.1	0.2	0.5
1981	0.0	0.0	0.0	-0.1	0.6	0.2	-0.4	-0.2	-0.6	-5.2	-64.0	-52.1
1982	27.8	10.1	2.8	0.0	-0.1	-0.5	0.0	0.4	0.7	0.0	-0.1	-0.1
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.2	-0.2	-0.3	-0.3	0.4
1985	0.1	-0.1	0.1	0.0	0.0	-0.1	-0.1	0.0	0.1	-0.2	0.7	2.7
1986	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.2
1987	0.0	0.0	0.0	0.0	0.0	-0.3	0.4	3.4	16.5	-51.7	-260.1	-369.1
1988	-182.8	-71.0	-14.2	-4.0	-1.1	-1.1	-0.1	3.4	21.1	-116.8	-346.3	-278.9
1989	-169.7	-58.9	-28.1	-8.8	-7.5	22.6	31.7	54.9	17.7	-7.2	-37.4	-28.3
1990	-2.3	-2.0	-1.7	-2.1	20.1	75.7	47.6	-32.8	-71.4	-145.7	-330.0	-316.6
1991	-194.2	-78.9	-41.4	-17.8	-5.5	-3.2	-0.8	-33.2	-61.4	-142.7	-329.9	-269.1
1992	-158.7	-64.1	-33.2	-12.6	0.0	4.0	0.6	0.9	20.4	-139.8	-387.5	-274.8
1993	-153.2	-54.7	-27.3	10.4	3.4	3.1	1.8	5.2	32.4	63.8	22.4	5.7
1994	0.9	0.4	0.0	0.0	0.0	-0.5	-0.2	-11.2	-39.1	-76.9	-213.0	-279.5
1995	-107.2	-34.1	-15.6	0.2	-1.7	0.0	0.0	-0.2	0.7	2.1	3.1	4.1
1996	-7.5	0.0	3.1	0.8	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	0.0
1997	-0.1	0.0	-0.1	0.0	-0.2	0.1	0.1	0.0	-0.4	-0.8	0.2	-0.4
1998	0.0	0.0	0.0	0.2	0.0	-0.1	0.1	0.0	0.1	-0.1	-0.5	-0.4
1999	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	0.3	0.2	-1.1	0.1
2000	-0.2	0.0	0.0	0.1	0.0	0.0	-0.5	0.2	0.2	-0.3	0.0	-0.1
2001	0.1	0.0	0.0	0.4	-0.9	-0.9	-0.4	3.4	21.1	-143.5	-403.8	-307.4
2002	-163.1	-42.3	5.6	-3.2	11.1	29.9	36.4	42.7	12.7	5.7	2.0	1.0
2003	0.4	0.0	0.0	-0.8	-0.7	-0.4	-0.2	0.2	1.9	-2.6	2.6	9.1
Average	-43.5	-16.1	-6.3	-1.4	0.6	3.6	3.3	-1.3	-2.2	-29.8	-88.5	-82.1
Critical	-106.2	-42.6	-18.7	-7.0	2.1	10.3	6.4	-21.3	-24.7	-123.7	-324.1	-293.2
Dry	-55.4	-16.9	-3.7	-2.0	0.5	8.6	11.3	17.4	11.3	-33.7	-127.1	-125.5
BN	-0.1	-0.1	-0.3	0.2	-0.5	-0.8	0.0	-0.1	0.0	-0.3	-0.6	-0.5
AN	-54.0	-20.4	-8.2	2.1	0.4	0.4	0.1	0.8	5.5	10.0	4.1	2.4
Wet	-6.1	-1.8	-0.8	0.1	0.2	-0.1	0.0	-0.4	-0.3	-0.4	-0.1	0.0

Table 1-152. Montezuma Slough location SLMZU011 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0
1971	0.3	0.0	0.0	0.1	0.9	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	0.2	-0.7	-2.3	-2.3
1977	-1.9	-0.8	-0.4	-0.2	0.0	0.0	0.0	-0.4	-0.5	-1.0	-2.1	-1.7
1978	-1.6	-0.7	-0.4	0.3	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	-0.3	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.4
1982	0.3	0.3	0.7	0.0	0.0	-0.2	0.0	0.2	0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	-0.5	-2.1	-2.6
1988	-1.9	-0.8	-0.3	-0.3	-0.1	0.0	0.0	0.0	0.2	-1.1	-2.6	-1.8
1989	-1.5	-0.6	-0.4	-0.2	-0.2	1.3	3.6	2.1	0.3	-0.1	-0.3	-0.2
1990	0.0	0.0	0.0	-0.1	1.1	1.6	0.7	-0.4	-0.7	-1.1	-2.3	-2.1
1991	-1.8	-0.7	-0.4	-0.2	-0.1	-0.1	0.0	-0.5	-0.6	-1.1	-2.3	-1.7
1992	-1.5	-0.6	-0.3	-0.2	0.0	0.3	0.0	0.0	0.2	-1.3	-2.8	-1.8
1993	-1.6	-0.6	-0.4	0.7	1.0	0.7	0.5	1.1	3.7	2.1	0.3	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.4	-0.6	-1.6	-1.9
1995	-1.3	-0.5	-0.2	0.0	-0.5	0.0	0.0	-0.1	0.3	0.3	0.1	0.1
1996	-0.3	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.1	0.3	-1.5	-3.4	-2.2
2002	-1.7	-0.5	0.2	-0.6	1.3	1.5	1.6	1.4	0.2	0.1	0.0	0.0
2003	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1
Average	-0.4	-0.2	-0.1	0.0	0.1	0.1	0.2	0.1	0.1	-0.2	-0.6	-0.5
Critical	-1.0	-0.4	-0.2	-0.1	0.1	0.2	0.1	-0.3	-0.2	-1.0	-2.3	-1.9
Dry	-0.5	-0.2	0.0	-0.1	0.2	0.4	0.9	0.6	0.2	-0.3	-1.0	-0.9
BN	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.5	-0.2	-0.1	0.1	0.1	0.1	0.0	0.2	0.6	0.3	0.1	0.0
Wet	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-153. Montezuma Slough location SLMZU025 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.6	0.0	0.0	0.0	0.0	0.0	-0.1	-1.6	-2.2	-2.2	-1.3	-1.1
1971	0.6	0.0	0.0	0.0	1.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-60.5	-51.5	-188.5	-395.9	-376.4
1977	-187.3	-75.8	-38.2	-11.4	-4.2	-2.6	-1.1	-54.8	-53.8	-234.8	-405.4	-297.4
1978	-155.7	-63.2	-20.6	0.2	0.4	0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.2
1979	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.1	-0.1	-0.2	-0.3
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1981	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.4	8.0	-99.7	-38.5
1982	28.8	-25.0	0.1	0.0	-0.4	-0.4	0.0	0.0	0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.0	21.2	-92.9	-348.2	-391.8
1988	-165.2	-66.4	-17.6	-1.6	-0.2	-0.3	-0.1	6.1	29.9	-213.3	-383.3	-286.8
1989	-155.3	-52.6	-27.6	-8.1	-9.2	7.3	11.3	24.9	10.5	-13.6	-46.0	-22.3
1990	-1.2	-1.8	-1.5	-1.9	35.1	52.9	29.3	-44.0	-49.9	-398.8	-444.4	-328.2
1991	-177.5	-70.8	-39.1	-16.7	-6.2	-1.1	-0.1	-37.3	-43.1	-241.0	-387.3	-274.8
1992	-144.5	-59.6	-32.0	-12.4	0.1	0.9	0.6	5.0	32.8	-265.9	-423.4	-289.9
1993	-134.7	-53.2	-26.0	2.8	0.9	0.8	0.1	0.9	10.9	32.8	15.4	3.9
1994	0.7	0.2	0.1	0.0	0.0	-0.1	0.0	-12.1	-42.9	-80.2	-302.4	-300.1
1995	-90.9	-32.5	-15.5	0.1	0.1	0.0	0.0	0.0	0.1	0.5	2.2	2.2
1996	-1.7	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	0.1	-0.1
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1999	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.3	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	-0.1	0.1	0.0
2001	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	4.0	28.1	-240.5	-401.9	-301.8
2002	-147.0	-40.9	-15.0	-0.3	6.9	12.0	17.7	18.5	7.3	3.2	1.3	0.5
2003	0.2	0.0	0.0	0.0	-0.1	-0.1	0.0	0.1	1.3	-7.5	9.8	9.2
Average	-39.2	-15.9	-6.8	-1.4	0.7	2.0	1.7	-4.3	-3.0	-56.9	-106.2	-85.1
Critical	-96.4	-39.2	-18.3	-6.3	3.5	7.1	4.2	-28.2	-25.5	-231.8	-391.7	-307.6
Dry	-50.4	-15.6	-7.1	-1.4	-0.4	3.2	4.8	8.7	11.1	-56.0	-149.1	-125.5
BN	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.2
AN	-48.4	-19.4	-7.8	0.5	0.2	0.1	0.0	0.2	2.0	4.2	4.2	2.2
Wet	-4.9	-4.4	-1.2	0.0	0.1	0.0	0.0	-0.1	-0.2	-0.2	0.0	0.0

Table 1-154. Montezuma Slough location SLMZU025 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.5	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-0.6	-2.0	-3.9	-3.2
1977	-1.8	-0.8	-0.4	-0.3	-0.1	-0.1	0.0	-0.7	-0.5	-2.1	-3.4	-2.3
1978	-1.6	-0.7	-0.4	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-1.2	-0.4
1982	0.3	-1.6	0.0	0.0	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	-1.4	-3.8	-3.6
1988	-1.8	-0.7	-0.5	-0.3	0.0	0.0	0.0	0.1	0.5	-2.7	-3.8	-2.4
1989	-1.5	-0.6	-0.4	-0.2	-0.2	1.2	3.4	2.1	0.3	-0.2	-0.6	-0.3
1990	0.0	0.0	0.0	-0.1	3.0	2.3	0.8	-1.0	-0.7	-4.1	-4.1	-2.8
1991	-1.7	-0.7	-0.4	-0.2	-0.1	-0.1	0.0	-1.0	-0.6	-2.5	-3.6	-2.3
1992	-1.4	-0.6	-0.3	-0.2	0.0	0.2	0.0	0.1	0.6	-3.4	-4.0	-2.4
1993	-1.5	-0.6	-0.4	0.5	0.4	0.4	0.1	0.4	3.4	2.1	0.3	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.7	-0.9	-3.1	-2.7
1995	-1.2	-0.4	-0.3	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.1	0.1
1996	-0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	-3.8	-4.7	-2.8
2002	-1.7	-0.5	-1.2	-0.1	1.9	1.7	2.3	1.5	0.2	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	0.2	0.2
Average	-0.4	-0.2	-0.1	0.0	0.2	0.2	0.2	0.0	0.1	-0.6	-1.0	-0.7
Critical	-1.0	-0.4	-0.2	-0.1	0.4	0.3	0.1	-0.6	-0.3	-2.5	-3.7	-2.6
Dry	-0.5	-0.2	-0.3	0.0	0.3	0.5	0.9	0.6	0.3	-0.9	-1.7	-1.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.5	-0.2	-0.1	0.1	0.1	0.1	0.0	0.1	0.6	0.3	0.1	0.0
Wet	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-155. Suisun Slough location SLSUS01 salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-2.6	-3.0	-5.1	-3.6	-2.3	-1.5	-1.4	-2.6	-4.0	-3.0	-2.1	-3.4
1971	2.6	-0.4	-0.9	-1.7	-1.1	-0.5	0.0	-1.4	-0.9	-0.6	-0.5	-0.4
1972	-0.4	-0.6	-1.3	-0.9	1.6	1.6	0.7	-0.8	-0.8	-0.5	-0.5	-0.6
1973	0.1	0.1	0.0	-0.1	-0.4	-0.6	0.2	-0.4	-0.3	-0.3	0.5	0.1
1974	-0.3	0.2	1.1	-0.4	-2.6	0.8	-1.3	0.2	-0.2	-0.3	-0.4	-0.1
1975	0.0	-0.1	-0.1	0.0	1.2	0.0	-1.1	-0.3	0.0	0.0	0.0	-0.1
1976	-0.1	0.0	0.2	-0.2	-0.5	0.7	1.6	-37.5	-93.8	-98.9	-265.7	-305.8
1977	-227.8	-114.4	-60.3	-30.2	-5.5	-8.8	-7.2	-39.1	-73.9	-122.7	-280.7	-249.4
1978	-189.1	-95.0	-44.0	-8.5	-4.3	-5.4	-4.7	-5.5	-4.9	-3.0	-2.9	-2.9
1979	-2.2	-2.3	-1.6	-0.5	-7.0	-14.3	1.2	0.0	-0.2	-1.2	-4.2	-2.8
1980	-0.1	0.7	-0.5	8.7	-4.0	-3.8	2.1	0.2	-0.7	-0.2	0.5	2.4
1981	-0.8	-1.3	-1.5	-1.5	4.2	1.7	-2.3	-0.9	-2.1	-7.3	-47.1	-36.8
1982	11.8	-18.4	-12.2	-1.7	-3.5	-3.1	-0.3	0.7	0.8	0.4	-0.7	0.0
1983	-0.2	-0.5	0.5	-0.1	-0.2	-0.2	-0.8	-0.5	-1.1	-0.3	-0.2	-0.2
1984	-0.2	-0.2	-0.4	0.1	-0.5	-0.4	-0.2	-0.9	-1.1	-2.3	-3.7	4.9
1985	0.1	-0.7	0.7	-1.2	0.1	-0.8	-0.1	-0.2	1.6	-2.5	4.6	12.0
1986	-1.3	-1.7	-1.1	-0.5	0.0	-0.7	-0.7	-0.4	-0.4	-0.4	-0.2	-0.1
1987	0.1	-0.4	-0.2	0.1	-0.5	-2.7	2.1	1.8	13.0	-41.5	-209.5	-307.5
1988	-210.1	-101.4	-37.6	-16.6	-7.1	-4.6	2.3	0.4	15.1	-91.6	-281.7	-258.3
1989	-188.1	-87.8	-45.1	-20.4	-9.1	11.9	35.5	62.4	20.4	-3.3	-35.1	-24.5
1990	-8.0	-4.7	-4.4	-3.9	23.0	78.7	50.2	-19.5	-65.6	-138.7	-303.8	-281.0
1991	-214.7	-103.8	-59.7	-31.5	-17.1	-5.8	-4.5	-35.6	-78.8	-134.2	-281.9	-239.2
1992	-174.7	-84.3	-45.6	-18.1	16.3	21.7	-4.4	-17.1	-4.0	-124.6	-334.2	-276.2
1993	-177.6	-73.1	-41.1	3.5	7.7	3.7	31.4	22.2	36.8	63.9	2.6	-9.4
1994	12.8	5.0	0.8	-1.6	-0.4	-1.4	-1.0	-11.0	-33.4	-67.1	-171.4	-233.8
1995	-139.6	-53.2	-28.0	-7.3	-3.3	-4.3	-2.7	-5.2	-2.3	4.4	3.4	3.4
1996	-4.4	-1.2	1.7	-2.7	-0.1	-0.7	-1.2	-1.1	-0.5	-0.6	-0.6	-0.7
1997	-0.6	-0.7	-1.2	-1.9	-3.7	0.9	0.3	0.0	-4.5	-2.4	-1.1	-1.7
1998	0.0	0.0	0.1	2.5	0.7	-0.8	1.5	-0.7	1.3	-0.4	-3.4	-1.6
1999	-0.3	0.4	0.7	0.2	0.4	0.7	-0.2	-1.2	2.9	-1.1	-5.7	0.7
2000	-1.6	0.1	-0.7	1.0	-1.0	-1.1	-3.8	1.4	-0.2	0.2	-0.7	0.2
2001	0.9	1.2	2.0	3.1	-8.0	-7.2	-1.5	4.7	20.9	-108.2	-314.0	-273.9
2002	-181.8	-83.7	-33.0	-31.1	4.9	35.1	40.0	48.5	19.8	15.5	3.5	5.3
2003	1.4	-7.2	-4.6	-18.6	-6.9	-1.3	-2.5	-3.1	1.7	6.3	6.1	10.7
Average	-49.9	-24.5	-12.4	-5.5	-0.9	2.6	3.7	-1.3	-7.0	-25.5	-74.4	-72.7
Critical	-117.5	-57.6	-29.5	-14.6	1.2	11.5	5.3	-22.8	-47.8	-111.1	-274.2	-263.4
Dry	-61.6	-28.8	-12.8	-8.5	-1.4	6.3	12.3	19.4	12.3	-24.5	-99.6	-104.2
BN	-1.3	-1.4	-1.4	-0.7	-2.7	-6.4	1.0	-0.4	-0.5	-0.9	-2.3	-1.7
AN	-61.2	-29.1	-15.2	-2.3	-1.5	-1.4	3.8	2.5	5.4	11.1	1.0	0.2
Wet	-10.4	-6.1	-3.5	-1.3	-1.2	-0.8	-0.6	-1.0	-0.8	-0.5	-1.2	0.0

Table 1-156. Suisun Slough location SLSUS012 salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.1	-0.1	-0.2	-0.5	-0.4	-0.3	-0.1	-0.1	-0.1	0.0	0.0	0.0
1971	0.1	0.0	0.0	-0.2	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.1	-0.1	-0.4	0.2	-0.3	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.7	-0.7	-1.8	-1.9
1977	-1.6	-0.9	-0.5	-0.3	-0.1	-0.1	-0.1	-0.3	-0.5	-0.8	-1.7	-1.4
1978	-1.3	-0.7	-0.4	-0.2	-0.3	-0.5	-0.5	-0.4	-0.2	-0.1	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.3	-0.9	0.1	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.3	-0.4	-0.4	0.2	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.0	-0.1	-0.4	-0.2
1982	0.1	-0.2	-0.6	-0.2	-0.5	-0.5	0.0	0.1	0.1	0.0	0.0	0.0
1983	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.3	-0.1	0.0	0.0
1984	0.0	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.1
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1986	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.1	-0.4	-1.6	-2.0
1988	-1.6	-0.8	-0.4	-0.4	-0.2	-0.1	0.0	0.0	0.1	-0.7	-1.9	-1.6
1989	-1.3	-0.7	-0.4	-0.2	-0.1	0.3	1.8	1.7	0.3	0.0	-0.3	-0.2
1990	-0.1	0.0	0.0	0.0	0.4	1.2	0.6	-0.2	-0.6	-1.0	-2.0	-1.7
1991	-1.5	-0.8	-0.5	-0.3	-0.2	-0.1	-0.1	-0.5	-0.7	-0.9	-1.8	-1.5
1992	-1.2	-0.6	-0.3	-0.2	0.3	0.7	-0.1	-0.2	0.0	-1.0	-2.2	-1.7
1993	-1.3	-0.6	-0.4	0.1	0.5	0.3	2.6	2.0	2.3	1.6	0.0	-0.1
1994	0.2	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.5	-1.2	-1.5
1995	-1.1	-0.5	-0.3	-0.2	-0.2	-0.5	-0.3	-0.8	-0.3	0.4	0.1	0.1
1996	-0.1	0.0	0.0	-0.1	0.0	-0.1	-0.2	-0.2	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	-0.3	-0.6	0.1	0.0	0.0	-0.1	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.1	0.1	-0.1	0.3	-0.1	0.3	-0.1	-0.1	0.0
1999	0.0	0.0	0.0	0.0	0.1	0.2	0.0	-0.1	0.1	0.0	-0.1	0.0
2000	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.4	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.1	0.1	0.3	-1.0	-2.4	-1.8
2002	-1.4	-0.7	-0.5	-1.6	0.3	1.1	1.2	1.2	0.3	0.1	0.0	0.0
2003	0.0	-0.1	-0.1	-1.0	-0.5	-0.1	-0.1	-0.3	0.1	0.1	0.1	0.1
Average	-0.4	-0.2	-0.1	-0.2	-0.1	0.0	0.1	0.0	0.0	-0.2	-0.5	-0.5
Critical	-0.8	-0.4	-0.2	-0.2	0.0	0.2	0.1	-0.2	-0.4	-0.8	-1.8	-1.6
Dry	-0.5	-0.2	-0.1	-0.3	0.0	0.2	0.5	0.5	0.2	-0.2	-0.8	-0.7
BN	0.0	0.0	0.0	0.0	-0.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.4	-0.2	-0.1	-0.1	-0.1	-0.2	0.3	0.2	0.4	0.3	0.0	0.0
Wet	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0

Table 1-157. CCWD Intake location in Victoria Canal salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.1	0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.1	0.0	0.0	0.0	0.2	-0.1	0.2	0.1	0.0	0.0	-0.1
1974	-0.2	0.0	0.1	0.0	-0.1	0.1	-0.2	0.0	0.1	0.1	0.0	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-0.1	0.0	0.0	0.0
1976	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-1.9	10.9	-5.1	-31.3
1977	-18.0	-7.8	-4.3	-3.4	-1.5	-0.6	-0.3	-0.2	-2.4	-18.7	-23.9	-16.6
1978	-20.6	-8.5	-4.0	-1.1	0.3	0.3	0.0	0.3	0.2	0.1	0.0	0.1
1979	0.1	0.1	0.1	0.0	0.1	0.0	0.3	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.2	-0.3	0.2	0.3	0.1	-0.1	-0.1	0.0
1981	0.1	0.1	0.0	0.0	0.0	-0.1	-0.2	-0.1	-0.2	0.4	-3.6	13.8
1982	-3.7	-3.5	-1.2	0.3	-8.1	-3.4	0.4	-0.4	-0.3	-0.2	0.0	-0.1
1983	-0.2	-0.1	-0.3	0.0	0.5	0.2	0.2	-0.3	0.2	-0.1	-0.2	-0.1
1984	0.1	-0.2	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1986	0.1	0.1	0.0	0.1	0.1	0.3	0.1	0.0	0.2	0.1	0.0	-0.1
1987	0.0	0.2	0.1	0.0	0.0	0.0	0.0	-0.1	0.1	-0.9	-1.6	-17.7
1988	-9.7	-4.3	-3.0	-1.1	-0.2	-0.1	0.0	0.0	0.1	-5.4	6.9	-13.6
1989	-14.3	-6.3	-3.1	-2.4	-1.2	-0.5	0.3	0.4	0.2	-1.2	-0.8	2.3
1990	-0.5	-0.3	-0.2	-0.2	0.1	0.7	0.7	0.5	-0.4	9.5	7.1	-17.2
1991	-15.9	-7.7	-5.0	-3.8	-2.1	-0.6	-0.2	-0.1	-0.8	8.5	5.6	-15.1
1992	-13.8	-6.5	-4.1	-2.9	-1.2	-0.1	0.0	0.0	0.1	0.9	5.3	-10.9
1993	-11.1	-4.4	-2.8	-0.9	0.7	0.5	0.3	0.4	-14.7	-7.0	0.4	0.2
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-9.8	-24.1	3.5
1995	0.5	-0.8	-1.4	-0.7	0.1	0.2	0.2	0.1	0.2	-0.1	0.0	0.0
1996	-0.1	-0.1	0.0	0.0	0.1	-0.1	0.3	0.0	0.0	0.0	0.0	0.0
1997	-0.1	-0.1	-0.1	-0.4	-0.2	0.0	0.0	0.3	0.2	0.0	0.0	0.0
1998	0.1	0.0	0.0	0.1	0.3	-0.1	0.0	0.4	0.2	-0.1	-0.2	0.0
1999	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.4	0.3	0.2	0.1	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.1	0.2	0.3	-0.1	-0.1	0.0	0.0	0.0
2001	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	5.5	9.3	-7.5
2002	-6.8	-2.5	-1.6	-0.6	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.2	-0.1	-2.7
Average	-3.4	-1.6	-0.9	-0.5	-0.3	-0.1	0.1	0.1	-0.5	-0.2	-0.7	-3.3
Critical	-8.3	-3.8	-2.4	-1.6	-0.7	-0.1	0.1	0.0	-0.8	-0.6	-4.0	-14.4
Dry	-3.5	-1.4	-0.8	-0.5	-0.2	-0.1	0.0	0.1	0.0	0.6	0.6	-1.5
BN	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
AN	-5.3	-2.1	-1.1	-0.3	0.2	0.2	0.2	0.2	-2.4	-1.1	0.0	-0.4
Wet	-0.3	-0.4	-0.2	-0.1	-0.6	-0.2	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-158. CCWD Intake location in Victoria Canal salinity (EC) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	2.5	-0.9	-6.0
1977	-3.1	-1.3	-0.7	-0.4	-0.2	-0.1	-0.1	0.0	-0.5	-3.9	-5.0	-2.8
1978	-2.9	-1.4	-0.6	-0.2	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.9	3.0
1982	-0.7	-0.7	-0.4	0.1	-2.2	-0.9	0.2	-0.2	-0.1	-0.1	0.0	0.0
1983	-0.1	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	0.0	-0.1	-0.1
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.4	-4.2
1988	-1.9	-0.8	-0.5	-0.2	0.0	0.0	0.0	0.0	0.0	-1.7	1.7	-2.8
1989	-2.5	-1.1	-0.5	-0.3	-0.2	-0.1	0.1	0.1	0.1	-0.4	-0.2	0.5
1990	-0.1	-0.1	0.0	0.0	0.0	0.2	0.2	0.1	-0.1	2.4	1.3	-3.3
1991	-2.6	-1.2	-0.7	-0.5	-0.3	-0.1	0.0	0.0	-0.2	2.1	1.0	-3.0
1992	-2.3	-1.0	-0.6	-0.4	-0.2	0.0	0.0	0.0	0.0	0.3	1.3	-2.2
1993	-1.9	-0.8	-0.5	-0.1	0.1	0.1	0.0	0.1	-3.5	-2.2	0.2	0.1
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.3	-4.3	0.7
1995	0.1	-0.2	-0.3	-0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	-0.1	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	2.7	-1.8
2002	-1.4	-0.5	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.8
Average	-0.6	-0.3	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.7
Critical	-1.4	-0.6	-0.4	-0.2	-0.1	0.0	0.0	0.0	-0.2	-0.1	-0.7	-2.8
Dry	-0.6	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.8	-0.4	-0.2	0.0	0.0	0.0	0.0	0.1	-0.6	-0.3	0.0	-0.1
Wet	-0.1	-0.1	-0.1	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-159. Upper Cache Slough location SLCCH016 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.3
1977	-1.3	-0.6	-0.2	0.0	0.0	0.0	0.1	0.0	0.1	-0.4	-1.4	-0.9
1978	-1.3	-0.7	-0.2	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3
1982	-0.1	0.0	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.8	-1.5
1988	-0.9	-0.3	-0.1	0.0	0.1	0.0	0.1	0.1	0.1	-0.2	-0.9	-1.2
1989	-1.3	-0.4	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	-0.1	-0.1
1990	-0.1	0.0	0.1	0.1	0.1	0.3	0.2	0.0	0.1	-0.1	-0.6	-0.7
1991	-0.8	-0.2	0.2	0.3	0.3	0.2	0.3	0.2	0.1	0.0	-0.4	-0.5
1992	-0.7	-0.2	0.2	0.3	0.2	0.3	0.2	0.1	0.1	-0.1	-0.7	-0.8
1993	-0.6	-0.3	0.0	0.0	0.0	-0.2	0.1	0.1	0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	-0.1	-0.4
1995	-0.2	-0.1	0.0	0.0	-0.3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	-0.5	-0.6
2002	-0.5	-0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
Average	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2
Critical	-0.5	-0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.1	-0.6	-0.8
Dry	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.3	-0.2	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-160. Upper Cache Slough location SLCCH016 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.7
1977	-0.7	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.7	-0.4
1978	-0.6	-0.4	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1982	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.8
1988	-0.4	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.6
1989	-0.6	-0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.1
1990	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	-0.1	-0.3	-0.4
1991	-0.4	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.2	-0.3
1992	-0.3	-0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	-0.1	-0.4	-0.4
1993	-0.3	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.3
2002	-0.3	-0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Critical	-0.3	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	-0.1	-0.3	-0.4
Dry	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1-161. Montezuma Slough location SLMZU011 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.3	0.9	-1.3	-0.3	-0.1	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.1	121.3	-51.1	-376.0	-463.0
1977	-287.7	-106.3	-45.1	-9.7	0.4	-3.8	-4.1	5.3	22.3	-89.9	-290.5	-273.1
1978	-185.4	-65.8	8.6	13.7	1.3	0.7	0.4	2.9	12.1	16.4	6.2	1.9
1979	0.3	0.0	-0.7	-6.4	6.5	10.3	9.1	11.9	8.7	3.2	1.0	0.2
1980	1.3	16.1	22.1	0.4	-0.2	0.0	1.5	5.0	4.5	1.3	0.4	0.1
1981	-0.1	0.3	2.1	-0.4	-6.2	2.3	6.4	11.2	13.0	-30.5	-207.3	-304.8
1982	-123.2	21.5	4.1	-0.1	-0.1	-0.4	0.0	0.5	3.0	4.7	1.8	0.1
1983	-32.6	1.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	3.4	7.0
1984	1.2	1.9	0.0	0.0	0.2	0.4	1.8	8.6	6.8	2.3	0.7	0.2
1985	-0.3	1.0	9.7	-0.1	1.6	6.3	4.6	7.2	7.3	2.9	1.6	1.1
1986	1.2	1.0	2.3	6.2	0.3	0.0	0.4	1.7	1.8	0.6	0.2	0.1
1987	0.0	0.1	0.5	3.2	5.3	3.0	2.5	1.3	9.6	-114.2	-424.6	-555.8
1988	-273.9	-103.2	18.1	19.6	17.3	4.4	27.3	42.0	29.0	-181.3	-496.9	-398.4
1989	-235.9	-75.2	56.3	70.3	13.4	48.0	47.3	76.0	27.2	-8.5	-136.3	-220.0
1990	-71.9	-21.9	-6.2	17.1	47.5	140.6	112.2	57.3	63.0	-111.5	-370.5	-385.1
1991	-252.2	-91.9	-40.2	-11.2	30.6	99.2	32.9	73.7	95.7	-67.6	-304.1	-284.9
1992	-179.4	-65.2	-24.1	-5.3	19.1	41.4	67.2	75.2	45.6	-154.8	-470.0	-410.7
1993	-225.5	-74.6	71.9	35.5	5.6	12.8	10.2	16.9	57.6	91.6	36.1	13.3
1994	0.3	0.6	-0.6	29.6	9.9	51.2	77.8	67.3	69.5	6.8	-224.0	-328.3
1995	-160.7	-44.6	21.2	19.0	2.1	0.0	-0.5	-0.2	1.7	8.2	32.4	40.1
1996	-2.6	0.3	19.8	15.0	0.4	0.0	0.3	0.5	8.9	28.2	17.2	7.5
1997	-10.1	-19.4	-0.1	-0.1	-0.2	3.3	11.3	17.0	19.1	13.0	3.6	5.1
1998	-6.7	-0.5	5.5	8.6	-0.4	-0.4	0.0	0.1	0.1	1.2	9.7	20.2
1999	-1.9	10.8	5.5	1.3	0.1	0.1	0.8	3.7	10.1	11.8	4.3	1.4
2000	0.1	0.0	-0.2	9.9	3.1	0.2	1.8	5.6	6.5	2.9	1.1	0.3
2001	0.0	-0.1	1.3	2.7	-10.7	3.0	6.4	27.3	52.6	-183.4	-508.8	-412.0
2002	-234.4	9.1	39.7	5.0	21.0	73.7	75.9	70.8	45.8	19.0	7.0	4.7
2003	1.5	-1.3	13.9	3.2	2.6	11.7	11.7	3.8	20.0	32.1	-42.9	-63.7
Average	-67.0	-17.8	5.5	6.7	5.0	15.0	14.9	17.4	22.4	-21.9	-109.6	-117.6
Critical	-152.1	-55.4	-14.0	5.7	17.8	47.6	44.8	45.8	63.8	-92.8	-361.7	-363.4
Dry	-78.4	-10.8	18.3	13.5	4.1	22.7	23.9	32.3	25.9	-52.5	-211.4	-247.8
BN	0.1	0.0	-0.3	-3.2	3.2	5.2	4.5	6.0	4.3	1.6	0.5	0.1
AN	-68.0	-20.9	19.4	10.5	2.1	4.3	4.4	5.5	16.7	24.0	0.1	-8.0
Wet	-25.8	-2.2	4.5	3.8	0.2	0.2	1.1	2.5	4.0	5.4	5.6	6.3

Table 1-162. Montezuma Slough location SLMZU011 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	-0.4	-2.7	-3.0
1977	-2.6	-1.1	-0.5	-0.2	0.0	-0.1	0.0	0.0	0.2	-0.6	-1.8	-1.6
1978	-1.8	-0.7	0.2	1.4	0.4	0.3	0.1	0.5	0.7	0.3	0.1	0.0
1979	0.0	0.0	0.0	-0.2	0.7	1.6	0.8	0.7	0.3	0.0	0.0	0.0
1980	0.0	0.3	0.6	0.1	-0.1	0.0	0.2	0.4	0.2	0.0	0.0	0.0
1981	0.0	0.0	0.1	0.0	-0.5	0.2	0.3	0.3	0.2	-0.3	-1.8	-2.2
1982	-1.3	0.7	1.0	0.0	0.0	-0.2	0.0	0.2	0.5	0.2	0.0	0.0
1983	-1.4	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4
1984	0.1	0.3	0.0	0.0	0.1	0.1	0.2	0.4	0.1	0.0	0.0	0.0
1985	0.0	0.0	0.5	0.0	0.1	0.2	0.1	0.2	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.2	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.0	0.1	-1.1	-3.4	-3.9
1988	-2.8	-1.1	0.4	1.3	1.3	0.1	0.4	0.5	0.3	-1.7	-3.7	-2.6
1989	-2.1	-0.8	0.7	1.3	0.3	2.8	5.4	2.9	0.4	-0.1	-1.2	-1.8
1990	-0.9	-0.3	-0.1	0.4	2.5	3.0	1.7	0.7	0.6	-0.9	-2.6	-2.5
1991	-2.3	-0.9	-0.4	-0.2	0.7	3.5	1.6	1.2	0.9	-0.5	-2.1	-1.8
1992	-1.6	-0.6	-0.2	-0.1	0.8	2.7	2.0	1.1	0.5	-1.4	-3.3	-2.7
1993	-2.3	-0.8	1.0	2.5	1.6	3.1	2.7	3.7	6.6	3.0	0.5	0.1
1994	0.0	0.0	0.0	0.7	0.5	1.6	1.4	1.1	0.8	0.1	-1.6	-2.2
1995	-1.9	-0.6	0.3	2.2	0.6	0.0	-0.2	-0.1	0.7	1.1	1.1	0.8
1996	-0.1	0.0	1.1	1.9	0.2	0.0	0.1	0.2	0.7	0.6	0.2	0.1
1997	-0.4	-0.9	0.0	-0.1	-0.1	0.6	0.8	0.7	0.4	0.2	0.0	0.1
1998	-0.2	0.0	0.2	0.7	-0.2	-0.2	0.0	0.1	0.0	0.3	0.5	0.7
1999	-0.1	0.6	0.6	0.3	0.1	0.0	0.2	0.4	0.4	0.2	0.1	0.0
2000	0.0	0.0	0.0	0.4	0.8	0.1	0.3	0.4	0.2	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.1	-0.7	0.3	0.3	0.6	0.7	-1.9	-4.2	-2.9
2002	-2.5	0.1	1.5	1.0	2.5	3.6	3.4	2.3	0.8	0.2	0.1	0.0
2003	0.0	0.0	0.5	0.8	0.5	0.9	1.0	0.8	1.0	0.6	-0.5	-0.7
Average	-0.7	-0.2	0.2	0.4	0.4	0.7	0.7	0.6	0.5	-0.1	-0.8	-0.8
Critical	-1.5	-0.6	-0.1	0.3	0.8	1.6	1.0	0.7	0.6	-0.8	-2.6	-2.4
Dry	-0.8	-0.1	0.5	0.4	0.3	1.2	1.6	1.0	0.4	-0.5	-1.7	-1.8
BN	0.0	0.0	0.0	-0.1	0.3	0.8	0.4	0.4	0.1	0.0	0.0	0.0
AN	-0.7	-0.2	0.4	0.9	0.5	0.8	0.8	1.0	1.4	0.7	0.0	-0.1
Wet	-0.4	0.0	0.3	0.4	0.1	0.0	0.1	0.2	0.2	0.2	0.2	0.2

Table 1-163. Montezuma Slough location SLMZU025 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.5	-1.5	-1.1	-0.2	-0.1	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.7	-0.6	51.5	-173.3	-492.8	-516.3
1977	-262.4	-96.6	-41.7	-8.5	-6.7	-2.9	-2.1	11.4	29.1	-179.3	-373.8	-305.6
1978	-171.7	-59.6	14.3	4.1	0.6	0.3	0.2	0.9	6.3	9.7	4.3	1.2
1979	0.2	0.1	-0.7	5.8	2.1	1.4	3.0	4.3	4.3	1.8	0.7	0.2
1980	1.5	17.9	27.1	1.8	-0.5	0.1	0.4	1.7	1.9	0.6	0.3	0.1
1981	-0.1	0.5	2.0	2.9	-1.2	0.9	3.1	8.0	9.9	-45.3	-307.1	-328.6
1982	-106.6	-14.5	0.0	0.1	-0.4	-0.3	0.0	0.1	0.9	2.5	1.3	0.0
1983	2.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	1.8
1984	4.2	0.5	0.0	0.0	0.0	0.1	0.7	4.0	4.0	1.3	0.4	0.0
1985	-0.3	5.1	4.9	4.8	4.5	3.0	2.5	4.7	5.1	2.3	1.6	1.5
1986	1.2	1.1	7.4	3.1	0.0	0.0	0.2	0.6	0.9	0.3	0.1	0.0
1987	0.0	0.7	0.3	3.6	2.5	0.9	1.4	1.6	12.4	-188.8	-552.8	-589.9
1988	-245.1	-95.9	36.4	13.5	5.1	3.3	30.3	31.1	28.8	-320.3	-552.6	-419.0
1989	-217.1	-65.3	72.7	67.9	13.2	15.3	16.7	35.2	18.0	-21.3	-204.8	-215.3
1990	-59.8	-16.3	-6.7	21.2	58.8	104.4	69.3	47.4	60.8	-401.4	-513.2	-417.6
1991	-231.1	-79.9	-37.1	-10.5	40.8	30.8	25.1	68.3	93.1	-182.9	-379.6	-306.7
1992	-163.7	-59.4	-21.8	-6.1	10.8	16.4	44.4	55.8	41.0	-303.9	-529.8	-433.6
1993	-201.7	-67.1	89.2	16.7	1.3	3.1	1.2	3.1	18.5	46.7	23.0	6.9
1994	0.6	0.7	-0.7	41.4	12.0	34.9	52.1	48.9	64.2	-30.3	-332.8	-366.5
1995	-141.2	-42.3	30.9	5.9	0.5	0.0	0.1	0.0	0.2	2.2	22.1	21.0
1996	-0.5	0.0	14.4	2.2	0.0	0.0	0.0	0.1	5.5	16.3	10.7	2.8
1997	-1.7	-0.6	0.2	0.0	0.0	0.9	3.7	8.5	11.2	6.6	1.9	2.0
1998	-0.1	0.1	9.9	3.1	0.0	0.0	0.0	0.0	0.0	0.2	5.4	9.0
1999	2.9	5.4	1.2	0.1	0.0	0.0	0.1	1.3	6.2	7.0	2.7	0.5
2000	0.1	0.0	-0.1	9.8	0.3	0.0	0.4	2.0	3.9	1.8	0.6	0.1
2001	0.0	-0.1	1.7	7.2	2.0	0.8	3.1	24.1	47.7	-318.2	-522.2	-419.6
2002	-210.5	31.2	22.3	1.2	12.0	29.1	34.7	37.5	30.5	13.2	6.6	5.4
2003	1.1	-1.1	7.0	0.3	0.5	3.7	2.7	0.5	21.3	1.6	-45.6	-49.5
Average	-58.8	-15.7	6.9	5.6	4.7	7.2	8.6	11.7	17.0	-60.3	-138.9	-126.9
Critical	-137.4	-49.6	-10.2	7.3	17.3	26.7	31.4	37.5	52.6	-227.3	-453.5	-395.1
Dry	-71.3	-4.7	17.3	14.6	5.5	8.3	10.2	18.5	20.6	-93.0	-263.1	-257.7
BN	0.1	0.0	-0.4	2.9	1.0	0.7	1.5	2.1	2.2	0.9	0.3	0.1
AN	-61.8	-18.3	22.9	5.5	0.4	1.1	0.6	1.2	8.6	10.1	-2.9	-6.9
Wet	-18.4	-3.7	4.9	1.1	0.0	0.1	0.4	1.1	2.2	2.8	3.6	2.8

Table 1-164. Montezuma Slough location SLMZU025 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.3	-0.5	-0.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	-1.9	-4.9	-4.3
1977	-2.5	-1.0	-0.4	-0.2	-0.2	-0.1	0.0	0.2	0.3	-1.6	-3.1	-2.3
1978	-1.7	-0.6	0.3	1.2	0.3	0.1	0.1	0.3	0.8	0.4	0.1	0.0
1979	0.0	0.0	0.0	0.4	0.7	0.5	0.7	0.8	0.3	0.0	0.0	0.0
1980	0.0	0.3	0.9	0.6	-0.2	0.0	0.2	0.3	0.2	0.0	0.0	0.0
1981	0.0	0.0	0.1	0.2	-0.3	0.2	0.4	0.4	0.2	-0.7	-3.7	-3.2
1982	-1.2	-0.9	0.0	0.0	-0.2	-0.2	0.0	0.0	0.3	0.1	0.0	0.0
1983	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3
1984	0.5	0.2	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.0	0.0	0.0
1985	0.0	0.6	0.6	0.3	0.4	0.2	0.2	0.2	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.0	0.2	-2.7	-6.0	-5.4
1988	-2.7	-1.1	1.0	2.6	0.8	0.1	0.7	0.7	0.5	-4.1	-5.5	-3.6
1989	-2.0	-0.8	0.9	1.4	0.4	2.6	5.0	3.0	0.5	-0.3	-2.6	-2.6
1990	-0.8	-0.2	-0.1	0.8	5.0	4.6	2.0	1.0	0.8	-4.1	-4.7	-3.5
1991	-2.3	-0.8	-0.4	-0.2	1.0	3.1	2.7	1.8	1.2	-1.9	-3.5	-2.6
1992	-1.6	-0.6	-0.2	-0.1	1.1	2.8	2.8	1.3	0.7	-3.8	-5.0	-3.6
1993	-2.2	-0.7	1.4	3.1	0.6	1.4	0.6	1.4	5.7	2.9	0.4	0.2
1994	0.0	0.0	0.0	1.1	1.3	2.4	2.0	1.5	1.1	-0.4	-3.4	-3.3
1995	-1.9	-0.6	0.5	1.6	0.2	0.0	0.0	0.0	0.1	0.7	1.5	1.0
1996	0.0	0.0	1.7	0.9	0.0	0.0	0.0	0.0	0.9	0.6	0.2	0.1
1997	-0.1	0.0	0.1	0.0	0.0	0.4	0.8	0.9	0.4	0.2	0.0	0.1
1998	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.9
1999	0.2	0.8	0.4	0.1	0.0	0.0	0.1	0.4	0.5	0.3	0.0	0.0
2000	0.0	0.0	0.0	0.8	0.1	0.0	0.2	0.4	0.2	0.1	0.0	0.0
2001	0.0	0.0	0.0	0.3	0.5	0.2	0.4	1.0	1.1	-5.0	-6.1	-3.9
2002	-2.4	0.4	1.8	0.5	3.3	4.2	4.5	2.9	0.8	0.2	0.1	0.1
2003	0.0	0.0	0.6	0.2	0.2	0.9	0.8	0.2	1.7	0.1	-0.9	-1.1
Average	-0.6	-0.1	0.3	0.5	0.4	0.7	0.7	0.6	0.6	-0.6	-1.4	-1.1
Critical	-1.4	-0.5	0.0	0.6	1.3	1.8	1.5	0.9	0.7	-2.5	-4.3	-3.3
Dry	-0.7	0.0	0.6	0.5	0.7	1.3	1.8	1.3	0.5	-1.4	-3.1	-2.5
BN	0.0	0.0	0.0	0.2	0.3	0.3	0.4	0.4	0.1	0.0	0.0	0.0
AN	-0.7	-0.2	0.5	1.0	0.2	0.4	0.2	0.4	1.4	0.6	-0.1	-0.1
Wet	-0.2	0.0	0.3	0.3	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2

Table 1-165. Suisun Slough location SLSUS012 salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	1.6	2.3	-0.9	-0.3	-0.1	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2	3.1	-45.5	-293.0	-390.6
1977	-306.2	-149.1	-73.6	-32.3	-4.2	-10.2	-7.6	1.2	16.3	-68.2	-232.1	-234.5
1978	-192.9	-94.5	-20.6	12.6	1.7	-2.5	-2.6	0.7	11.1	16.0	5.4	0.7
1979	-1.0	-1.2	-2.0	1.1	9.8	8.6	10.4	13.9	10.3	3.3	0.8	-0.1
1980	0.3	9.8	25.5	5.9	1.9	0.5	1.8	5.9	5.4	1.7	0.5	0.1
1981	-0.1	0.1	1.8	4.0	2.1	3.4	7.4	11.6	13.0	-24.8	-160.0	-249.9
1982	-153.8	-36.2	-8.9	-6.7	-2.9	-2.0	-1.5	1.4	2.8	5.2	1.0	-0.6
1983	-12.3	3.1	0.9	-0.7	-0.4	-0.4	-1.1	-0.5	-0.4	0.2	3.4	7.3
1984	4.2	2.8	0.2	-0.1	0.1	0.6	2.1	6.4	7.1	2.8	1.0	0.3
1985	-0.2	5.8	14.6	8.0	5.5	6.5	5.0	7.4	7.3	2.8	1.8	1.2
1986	1.2	0.9	1.6	9.4	2.5	0.7	0.9	2.3	2.3	0.9	0.5	0.3
1987	0.2	0.1	0.3	2.5	6.7	4.5	3.1	1.3	7.0	-88.7	-343.2	-468.8
1988	-316.2	-150.7	-28.1	27.9	23.8	4.2	21.4	37.7	25.3	-134.9	-401.0	-356.3
1989	-259.6	-120.9	-5.6	56.2	13.4	43.5	57.2	87.4	30.8	-3.1	-109.6	-186.0
1990	-100.9	-33.8	-16.4	11.9	60.3	144.8	116.7	60.1	58.8	-94.5	-325.2	-331.6
1991	-267.0	-122.7	-64.2	-29.0	9.0	69.2	56.6	82.7	89.3	-40.3	-233.0	-244.3
1992	-193.3	-93.9	-42.1	-17.0	30.9	40.2	65.6	73.2	42.5	-119.4	-368.7	-359.2
1993	-251.1	-117.4	8.8	50.9	8.4	21.4	16.4	20.4	70.5	104.8	42.6	16.7
1994	3.4	-0.6	-0.5	17.6	37.6	60.3	78.5	69.6	69.9	14.3	-159.4	-260.3
1995	-188.5	-68.8	-9.8	25.9	6.3	1.6	0.0	-1.3	1.3	10.1	32.9	42.3
1996	7.7	1.7	23.2	22.1	5.1	1.5	1.0	1.1	9.3	23.9	11.5	6.3
1997	-2.2	-9.9	-1.5	-2.0	-3.2	4.8	13.0	18.1	18.4	9.5	3.6	3.2
1998	-1.8	-0.2	6.0	13.2	1.6	0.8	0.7	0.6	0.5	1.8	9.3	19.1
1999	4.1	13.7	13.3	4.1	1.3	0.7	1.6	5.1	13.4	11.8	6.9	1.3
2000	0.8	0.6	0.0	14.8	10.0	2.2	2.9	7.3	7.7	4.1	1.6	0.7
2001	0.4	0.3	0.5	4.8	-2.7	4.0	7.6	27.2	48.6	-138.9	-405.9	-362.2
2002	-267.2	-73.9	34.6	8.2	30.4	79.2	86.5	91.6	51.4	21.3	8.0	4.6
2003	2.2	-0.9	22.3	8.6	3.8	12.2	14.8	6.7	24.8	35.2	-33.6	-58.4
Average	-73.2	-30.5	-3.5	6.5	7.6	14.8	16.5	18.8	19.0	-14.4	-86.3	-100.0
Critical	-168.6	-78.7	-32.1	-3.0	22.5	44.1	47.4	46.4	43.6	-69.8	-287.5	-311.0
Dry	-87.7	-31.4	7.7	14.0	9.2	23.5	27.8	37.7	26.4	-38.6	-168.2	-210.2
BN	-0.5	-0.6	-1.0	0.6	4.9	4.3	5.2	6.9	5.2	1.6	0.4	-0.1
AN	-73.5	-33.7	6.0	15.5	4.3	5.9	5.9	6.7	19.9	26.9	2.7	-6.7
Wet	-26.3	-7.1	1.9	5.0	0.8	0.6	1.3	2.5	4.2	5.1	5.4	6.1

Table 1-166. Suisun Slough location SLSUS012 salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-1.9	-2.4
1977	-2.2	-1.2	-0.6	-0.3	-0.1	-0.1	-0.1	0.0	0.1	-0.4	-1.4	-1.3
1978	-1.3	-0.7	-0.2	0.3	0.1	-0.2	-0.3	0.1	0.4	0.3	0.1	0.0
1979	0.0	0.0	0.0	0.0	0.4	0.5	0.5	0.5	0.2	0.0	0.0	0.0
1980	0.0	0.1	0.3	0.2	0.2	0.1	0.1	0.3	0.2	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	-0.2	-1.2	-1.7
1982	-1.2	-0.5	-0.4	-0.7	-0.4	-0.3	-0.3	0.3	0.2	0.1	0.0	0.0
1983	-0.3	0.1	0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	0.0	0.2	0.3
1984	0.1	0.2	0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.0	0.0	0.0
1985	0.0	0.1	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	-0.8	-2.5	-3.1
1988	-2.4	-1.3	-0.3	0.6	0.8	0.1	0.2	0.4	0.2	-1.1	-2.8	-2.2
1989	-1.8	-0.9	0.0	0.6	0.2	1.1	2.9	2.3	0.4	0.0	-0.8	-1.4
1990	-0.9	-0.3	-0.1	0.1	1.1	2.2	1.4	0.7	0.5	-0.7	-2.1	-2.0
1991	-1.9	-0.9	-0.5	-0.3	0.1	1.3	1.5	1.1	0.8	-0.3	-1.5	-1.5
1992	-1.4	-0.7	-0.3	-0.1	0.5	1.2	1.3	0.9	0.4	-1.0	-2.5	-2.2
1993	-1.8	-1.0	0.1	1.2	0.5	1.6	1.4	1.9	4.4	2.6	0.5	0.2
1994	0.0	0.0	0.0	0.2	0.7	1.3	1.1	0.9	0.7	0.1	-1.1	-1.6
1995	-1.5	-0.6	-0.1	0.7	0.4	0.2	0.0	-0.2	0.2	0.8	0.9	0.7
1996	0.2	0.0	0.6	1.0	0.7	0.3	0.2	0.2	0.5	0.4	0.1	0.1
1997	0.0	-0.2	-0.1	-0.4	-0.6	0.5	0.6	0.6	0.3	0.1	0.0	0.0
1998	0.0	0.0	0.1	0.4	0.2	0.1	0.1	0.1	0.1	0.3	0.4	0.5
1999	0.1	0.4	0.7	0.4	0.3	0.2	0.3	0.4	0.4	0.2	0.1	0.0
2000	0.0	0.0	0.0	0.3	0.7	0.3	0.3	0.4	0.2	0.1	0.0	0.0
2001	0.0	0.0	0.0	0.1	-0.1	0.2	0.3	0.5	0.6	-1.3	-3.1	-2.4
2002	-2.1	-0.7	0.5	0.4	1.7	2.4	2.5	2.2	0.7	0.2	0.1	0.0
2003	0.0	0.0	0.4	0.5	0.3	0.6	0.7	0.6	0.9	0.5	-0.4	-0.6
Average	-0.5	-0.2	0.0	0.2	0.2	0.4	0.5	0.4	0.4	0.0	-0.6	-0.6
Critical	-1.2	-0.6	-0.3	0.0	0.5	0.8	0.8	0.6	0.4	-0.5	-1.9	-1.9
Dry	-0.6	-0.2	0.2	0.2	0.3	0.7	1.0	0.9	0.3	-0.4	-1.3	-1.4
BN	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.1	0.0	0.0	0.0
AN	-0.5	-0.3	0.1	0.4	0.3	0.4	0.4	0.5	1.0	0.6	0.0	-0.1
Wet	-0.2	-0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1

Table 1-167. CCWD Intake location in Victoria Canal salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.1	0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1973	0.0	0.1	0.0	0.0	0.2	-10.6	-4.4	0.0	-0.4	0.0	0.0	-0.1
1974	-0.2	0.0	0.1	0.0	-0.1	0.1	-0.2	0.0	0.1	0.1	0.0	0.1
1975	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-0.1	0.0	0.0	0.0
1976	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.2	0.2	13.6	-11.8	-42.5
1977	-26.6	-10.6	-7.3	-9.5	-2.8	1.4	3.0	1.8	1.1	-12.6	-23.9	-22.4
1978	-25.0	-7.9	-4.7	-0.8	0.7	0.4	0.0	0.3	0.2	0.1	0.1	0.1
1979	0.1	0.1	0.0	0.1	0.3	0.1	0.3	0.2	0.1	0.0	0.0	0.0
1980	0.0	0.1	2.0	1.0	21.8	0.4	0.2	0.3	0.1	-0.1	-0.1	0.0
1981	0.1	0.2	-0.1	0.0	0.1	0.0	0.2	0.5	0.9	-1.2	0.9	9.5
1982	-10.1	-6.6	-1.2	0.4	-8.0	-3.4	0.4	-0.4	-0.3	-0.2	0.0	-0.1
1983	-0.2	-0.1	-0.3	0.0	0.5	0.3	0.1	-0.3	0.2	-0.1	-0.2	-0.1
1984	0.1	-0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0
1985	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	-0.1	-0.2	-0.3
1986	0.0	0.0	-0.2	0.4	0.1	0.3	0.1	0.0	0.2	0.1	0.0	-0.1
1987	0.0	0.2	0.1	-0.2	0.1	0.0	2.5	2.9	2.4	-2.2	-5.2	-26.0
1988	-16.4	-6.3	-6.0	-0.6	0.4	2.6	2.4	4.1	3.0	-6.7	5.9	-20.9
1989	-22.1	-8.7	-6.1	8.0	8.0	3.8	1.6	4.2	3.0	-0.4	2.5	-0.9
1990	-5.9	-4.5	-3.9	-4.2	-0.3	1.2	1.4	1.1	0.8	9.7	2.2	-24.6
1991	-24.2	-9.8	-6.7	-4.1	-0.9	-0.1	0.7	0.6	2.7	7.2	-0.4	-19.0
1992	-18.1	-6.6	-4.7	-5.1	-3.9	0.2	0.5	2.9	3.2	-1.1	2.5	-22.6
1993	-23.2	-8.1	-2.7	2.2	1.3	1.0	0.7	0.7	-14.5	-6.9	0.6	0.3
1994	0.0	0.0	0.0	0.4	1.5	0.8	0.6	0.5	0.4	-0.8	-18.7	-1.7
1995	-4.6	0.5	-2.8	0.6	0.7	0.3	0.2	0.1	0.2	-0.1	0.0	0.1
1996	-0.1	-0.1	0.0	0.1	0.2	-0.1	0.3	0.0	0.1	0.1	0.2	0.1
1997	0.0	-0.1	-0.1	-0.4	-0.2	0.0	0.0	0.3	0.2	0.1	-0.1	-0.3
1998	0.3	0.4	0.2	0.4	0.3	-0.1	0.0	0.4	0.2	-0.1	-0.2	0.0
1999	-0.1	0.0	0.1	-0.1	0.0	0.0	0.4	0.3	0.2	0.1	0.1	0.1
2000	0.0	0.0	-0.1	-0.3	0.1	0.3	0.3	-0.1	-0.1	0.1	0.0	0.0
2001	0.0	-0.1	-0.1	-0.6	0.1	0.1	0.9	1.0	2.1	-1.8	4.5	-11.5
2002	-12.0	-4.0	1.7	0.8	0.6	0.3	0.2	0.1	1.2	0.1	-0.1	-0.8
2003	-0.9	-0.1	-0.1	0.5	0.1	0.1	0.2	0.2	0.1	1.1	1.5	-2.6
Average	-5.6	-2.1	-1.3	-0.3	0.6	0.0	0.4	0.7	0.2	0.0	-1.2	-5.5
Critical	-13.0	-5.4	-4.1	-3.3	-0.9	0.9	1.2	1.6	1.6	1.3	-6.3	-22.0
Dry	-5.7	-2.1	-0.7	1.4	1.5	0.7	0.9	1.5	1.6	-0.9	0.4	-5.0
BN	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.0	0.0	0.0	0.0
AN	-8.2	-2.7	-0.9	0.4	4.0	-1.4	-0.5	0.2	-2.4	-0.9	0.3	-0.4
Wet	-1.1	-0.5	-0.3	0.1	-0.5	-0.2	0.1	0.0	0.1	0.0	0.0	0.0

Table 1-168. CCWD Intake location in Victoria Canal salinity (EC) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-2.6	-1.3	0.0	-0.1	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	-2.1	-8.2
1977	-4.7	-1.8	-1.2	-1.2	-0.4	0.3	0.6	0.4	0.2	-2.6	-5.0	-3.8
1978	-3.5	-1.3	-0.7	-0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.4	0.2	6.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	-0.4	0.2	2.0
1982	-1.9	-1.4	-0.4	0.1	-2.2	-0.9	0.2	-0.2	-0.1	-0.1	0.0	0.0
1983	-0.1	0.0	-0.1	0.0	0.2	0.1	0.1	-0.2	0.1	0.0	-0.1	-0.1
1984	0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.1
1986	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
1987	0.0	0.1	0.0	0.0	0.0	0.0	0.5	0.6	0.7	-0.7	-1.4	-6.2
1988	-3.3	-1.2	-1.1	-0.1	0.1	0.5	0.5	0.9	0.7	-2.1	1.5	-4.4
1989	-3.9	-1.5	-1.0	1.1	1.2	0.6	0.3	1.0	1.0	-0.1	0.6	-0.2
1990	-1.3	-0.9	-0.7	-0.7	-0.1	0.3	0.3	0.3	0.2	2.4	0.4	-4.8
1991	-4.0	-1.5	-0.9	-0.5	-0.1	0.0	0.1	0.1	0.8	1.8	-0.1	-3.8
1992	-3.0	-1.1	-0.7	-0.7	-0.5	0.0	0.1	0.7	1.0	-0.4	0.6	-4.6
1993	-4.0	-1.5	-0.5	0.3	0.2	0.2	0.1	0.1	-3.4	-2.2	0.2	0.1
1994	0.0	0.0	0.0	0.1	0.3	0.2	0.1	0.1	0.1	-0.2	-3.3	-0.4
1995	-0.8	0.1	-0.5	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0
1997	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.1	0.1	0.1	0.0	-0.1
1998	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2	0.1	0.0	-0.1	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
2000	0.0	0.0	0.0	-0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	-0.1	0.0	0.0	0.2	0.2	0.6	-0.6	1.3	-2.8
2002	-2.4	-0.8	0.3	0.1	0.1	0.1	0.0	0.0	0.3	0.0	0.0	-0.2
2003	-0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.6	-0.8
Average	-1.0	-0.4	-0.2	0.0	0.2	0.0	0.1	0.2	0.1	0.0	-0.2	-1.1
Critical	-2.3	-0.9	-0.7	-0.4	-0.1	0.2	0.3	0.4	0.4	0.3	-1.1	-4.3
Dry	-1.1	-0.4	-0.1	0.2	0.2	0.1	0.2	0.3	0.5	-0.3	0.1	-1.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-1.3	-0.5	-0.1	0.1	1.1	-0.3	-0.1	0.1	-0.6	-0.3	0.1	-0.1
Wet	-0.2	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

C.1.2 Stage Model Output

Model output for each location is presented here in two basic forms – as Tables and as Figures showing monthly average of daily minimum stage for the Base scenario and change from Base for monthly average of daily minimum stage, (Scenario – Base). The Tables have several subtypes, although all of them show results for water years 1970 – 2003, including average monthly results for the average over all water year types and results split by water year type. For each location, the Tables show Base monthly average of daily minimum stage, change from Base of Monthly Average of daily minimum stage and percent change from Base of monthly average of daily minimum stage for each of the three alternative scenarios (i.e., seven tables per location).

Results were calculated upstream and downstream of agricultural barrier locations in Old River, Middle River and Grant Line Canal, as well as at three additional locations: Old River near Middle River, Old River near Tracy, and RMID040 in Middle River.

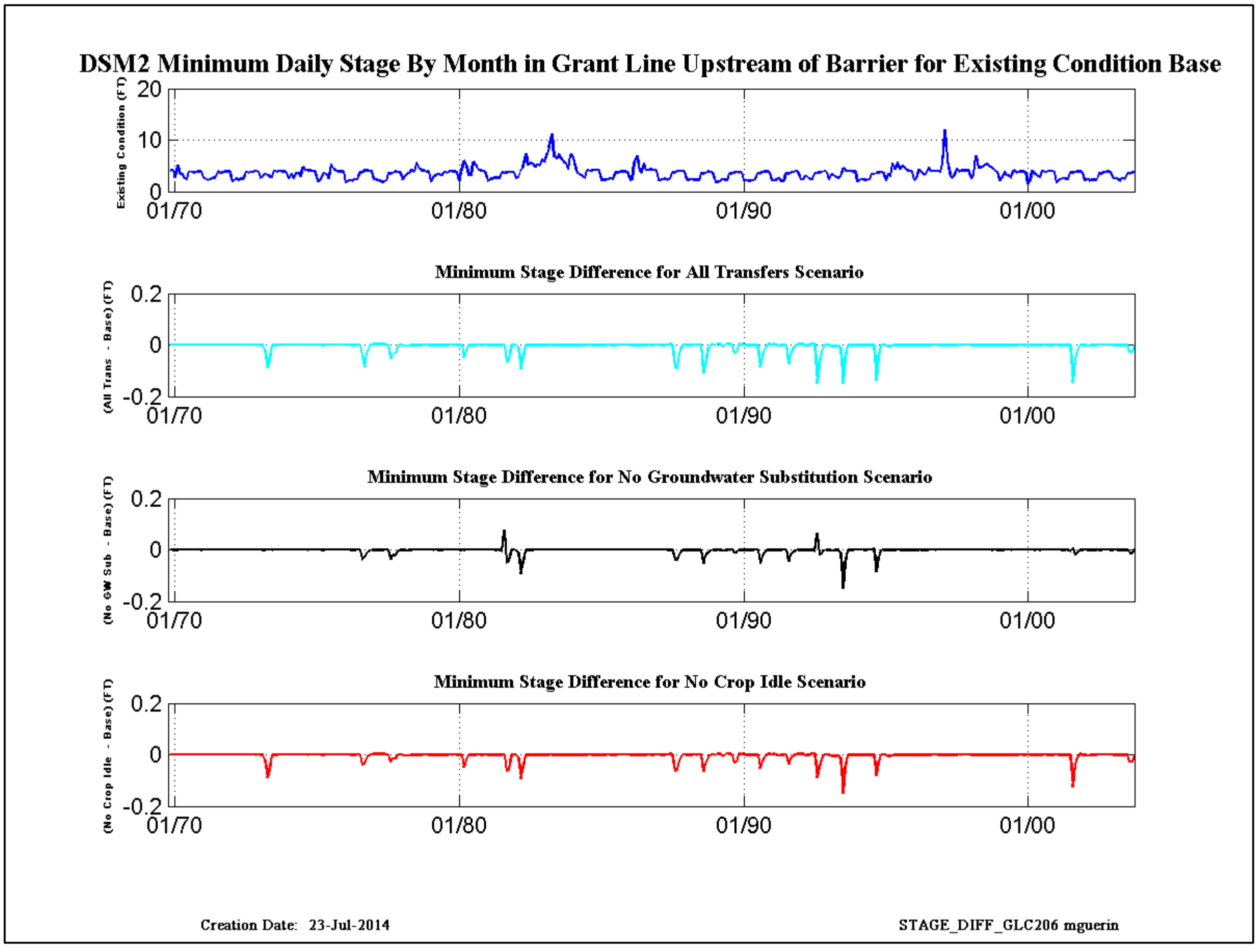


Figure 2-1. Minimum stage at Grant Line barrier and minimum stage differences Scenario – Base.

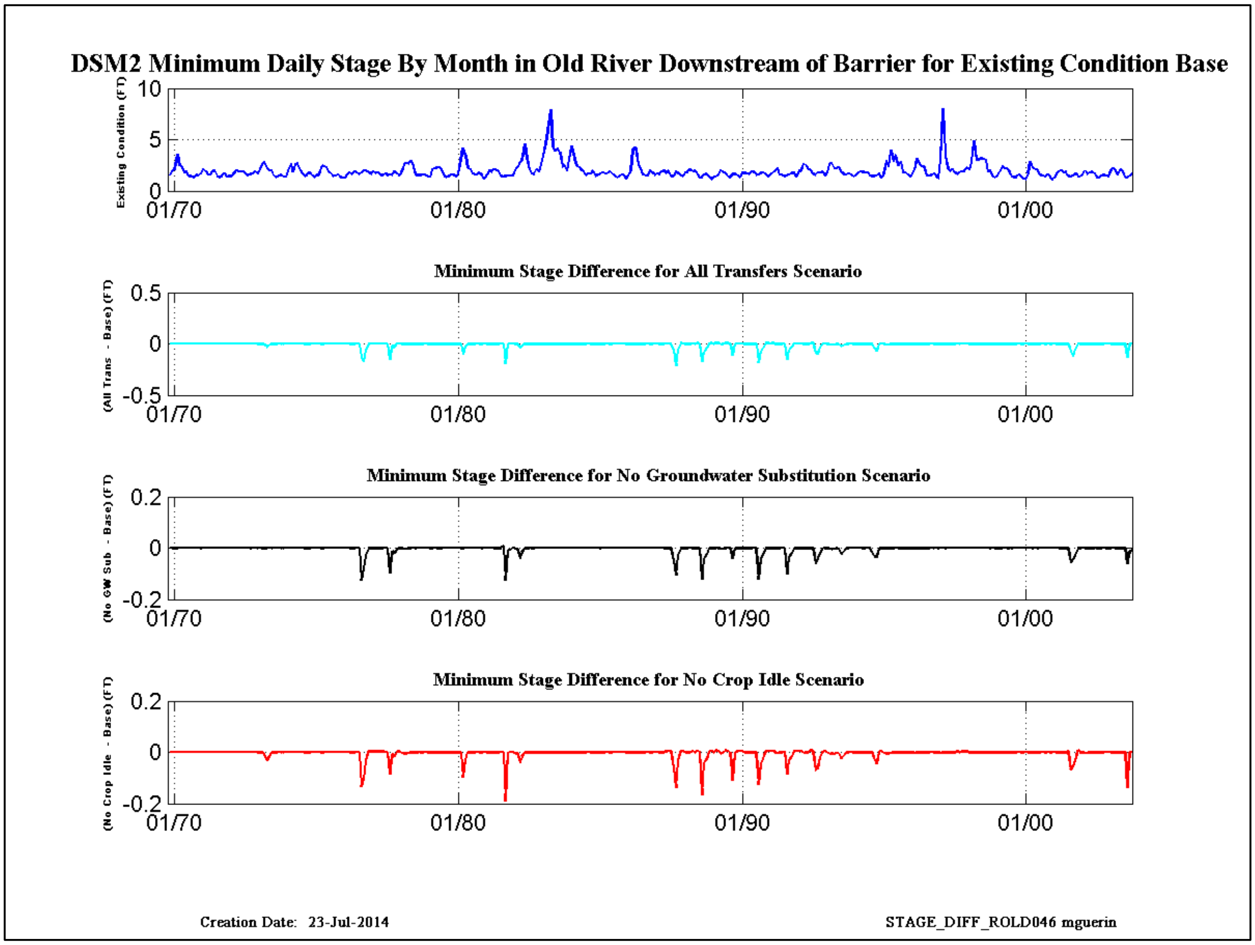


Figure 2-2. Minimum stage at Old River Downstream barrier and minimum stage differences Scenario – Base.

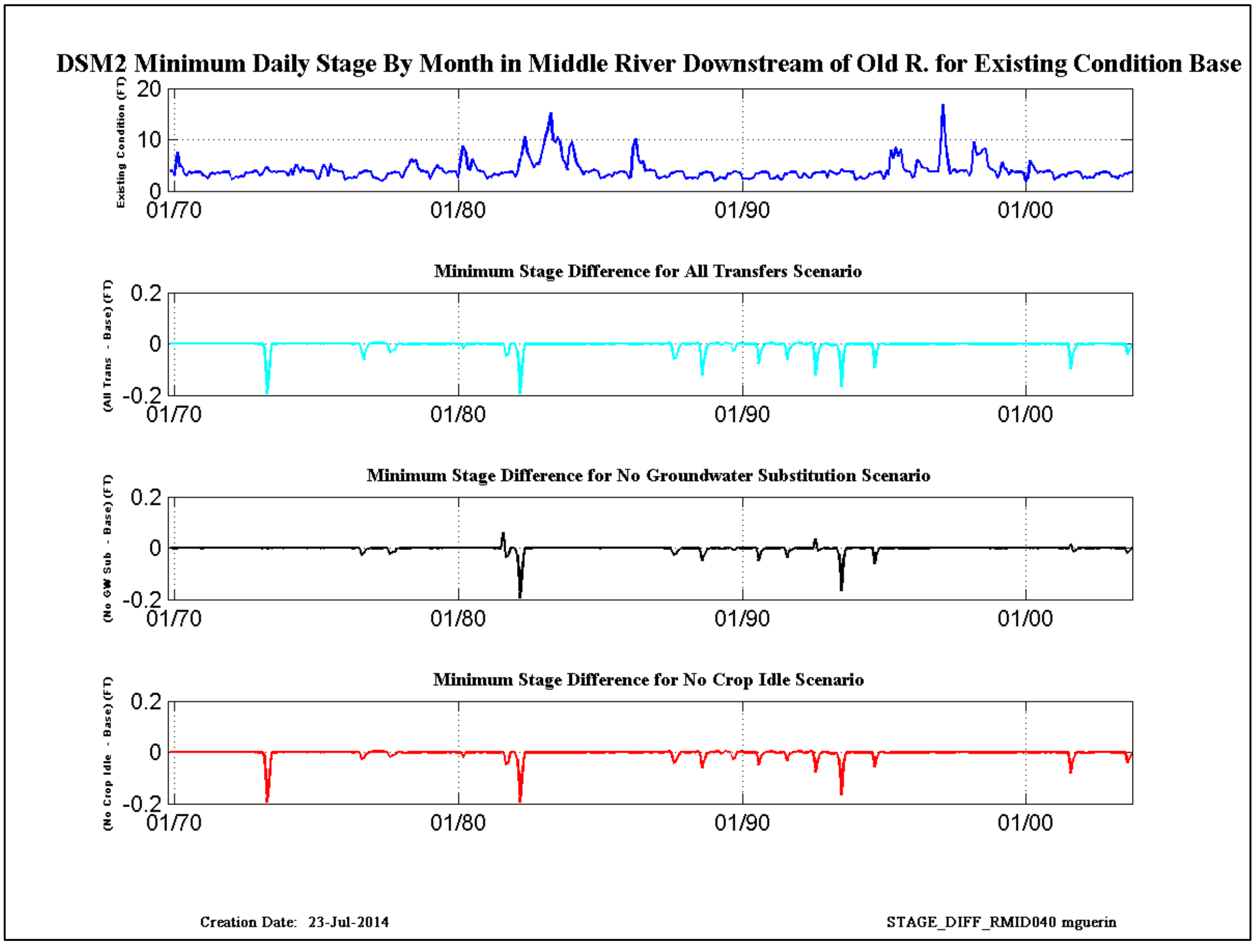


Figure 2-3. Minimum stage at Middle River Downstream of Old R. barrier and minimum stage differences Scenario – Base.

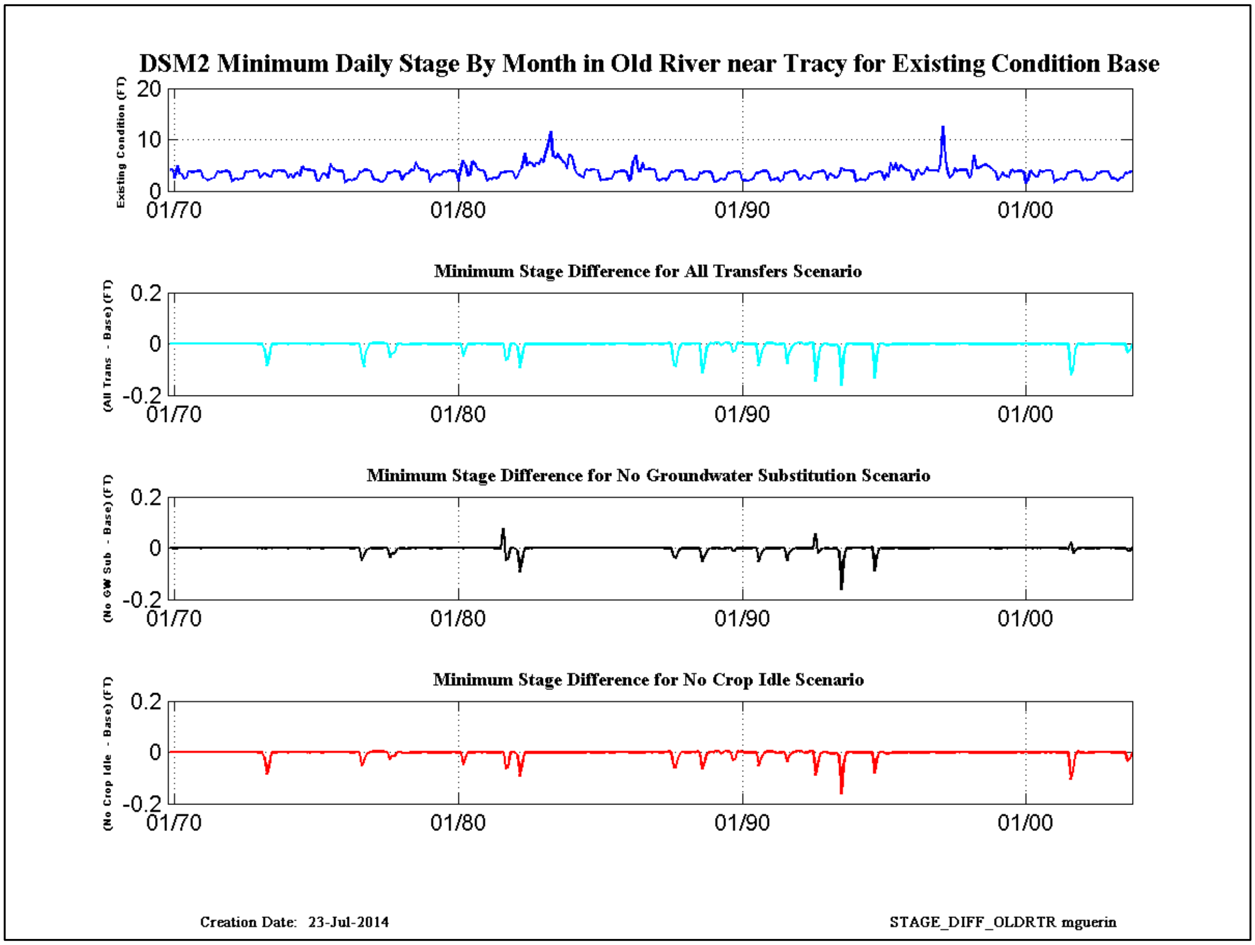


Figure 2-4. Minimum stage at Old River near Tracy barrier and minimum stage differences Scenario – Base.

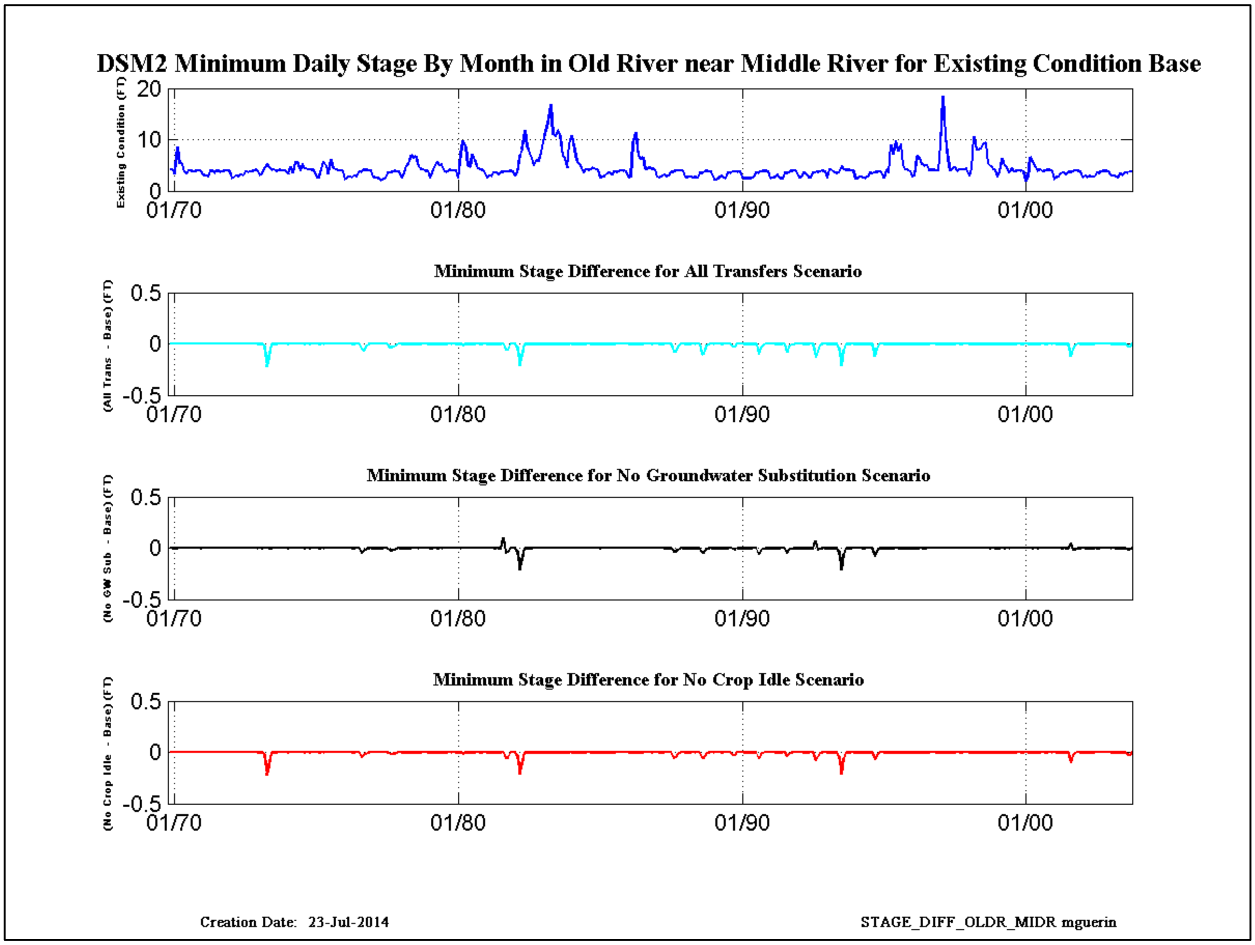


Figure 2-5. Minimum stage at Old River near Middle River barrier and minimum stage differences Scenario – Base.

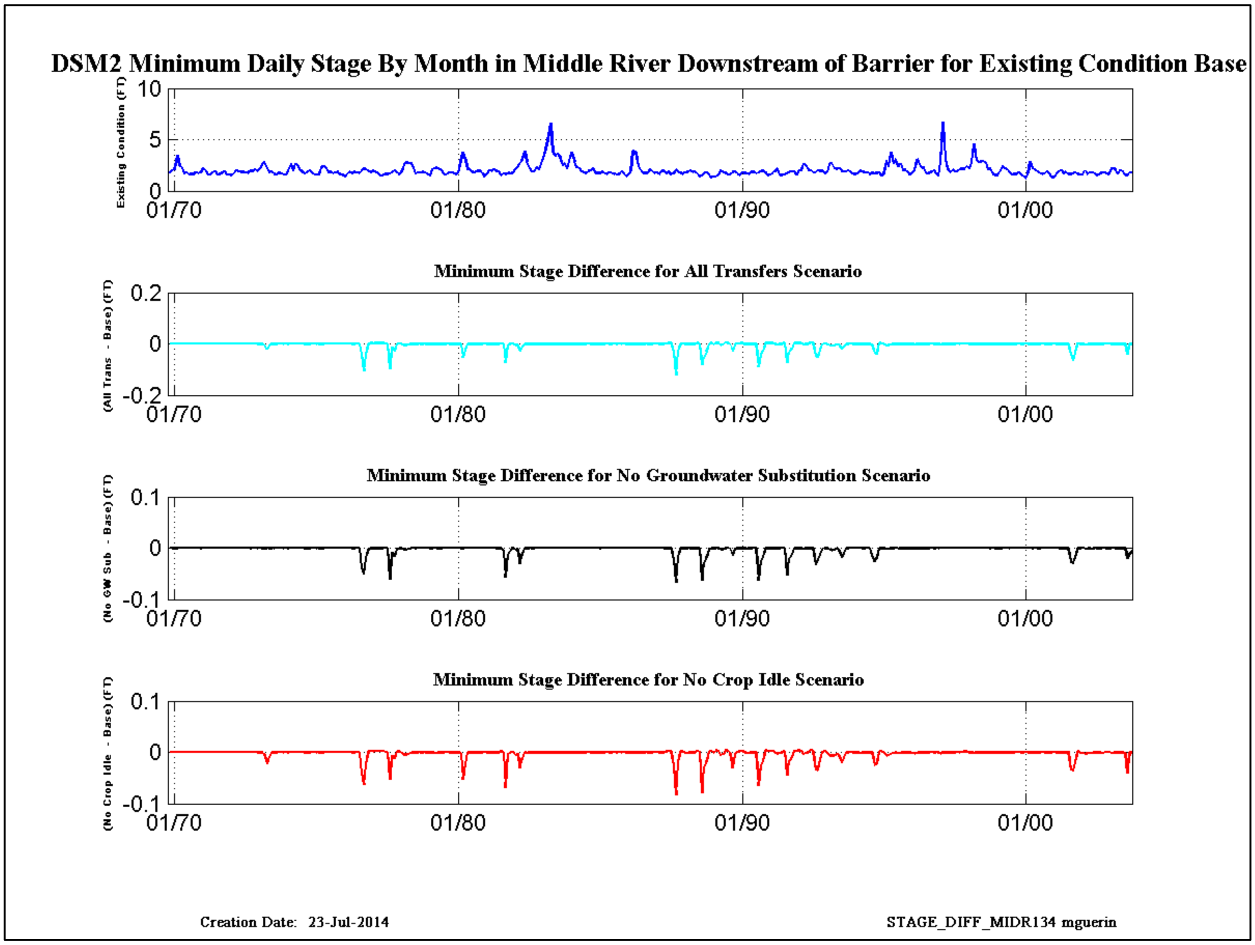


Figure 2-6. Minimum stage at Middle River barrier and minimum stage differences Scenario – Base.

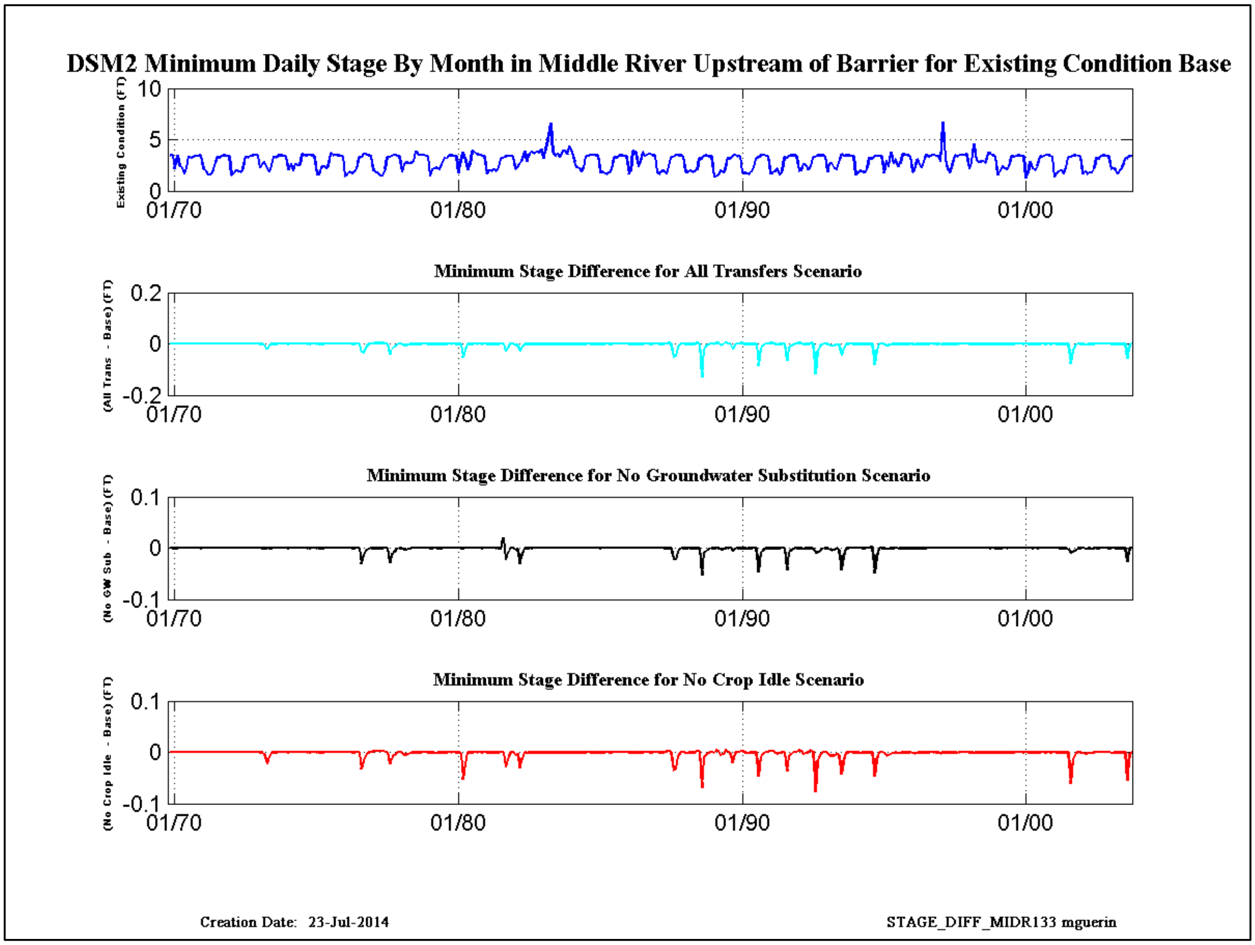


Figure 2-7. Minimum stage at Middle River Upstream barrier and minimum stage differences Scenario – Base.

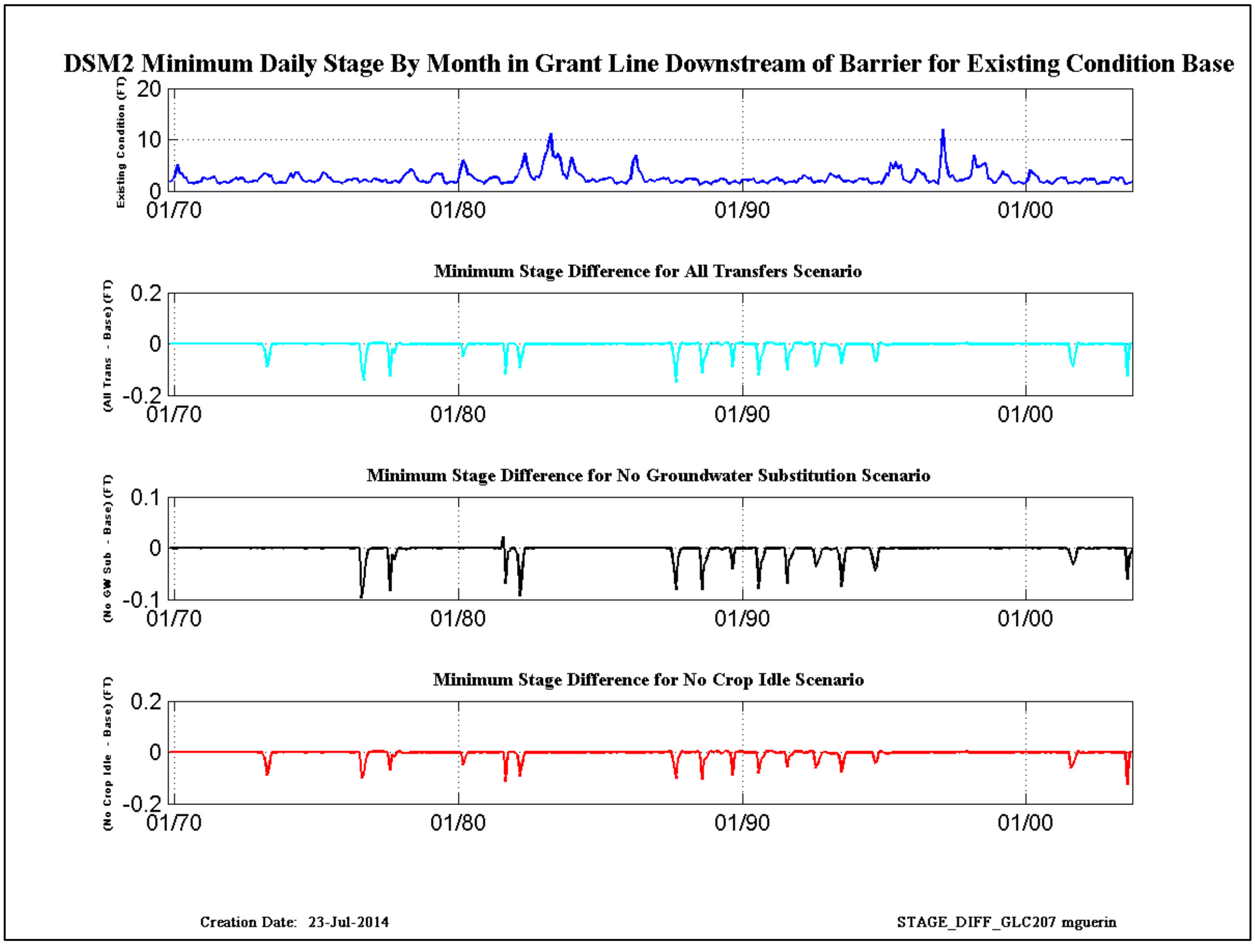


Figure 2-8. Minimum stage downstream of Grant Line barrier and minimum stage differences Scenario – Base.

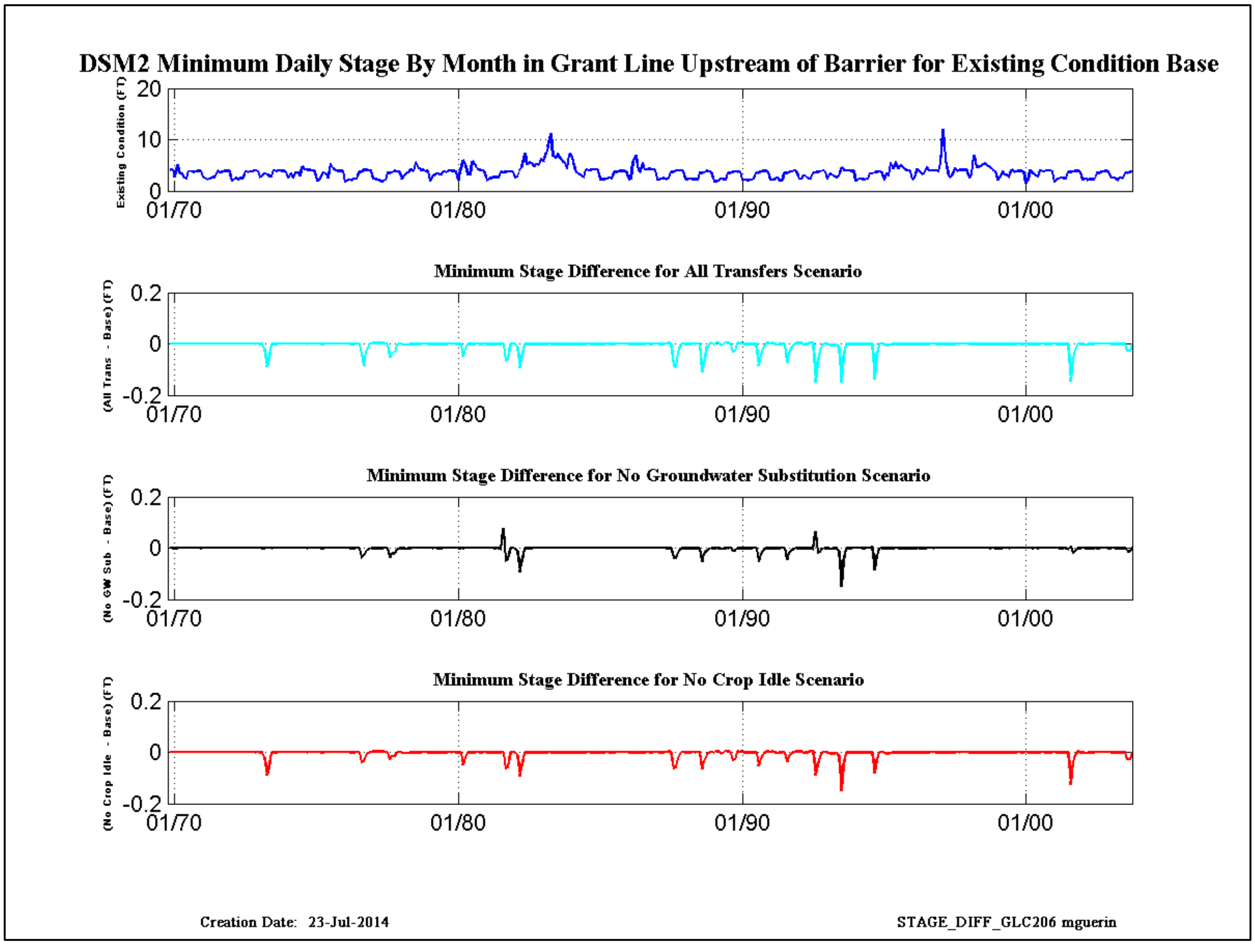


Figure 2-9. Minimum stage at Grant Line Upstream barrier and minimum stage differences Scenario – Base.

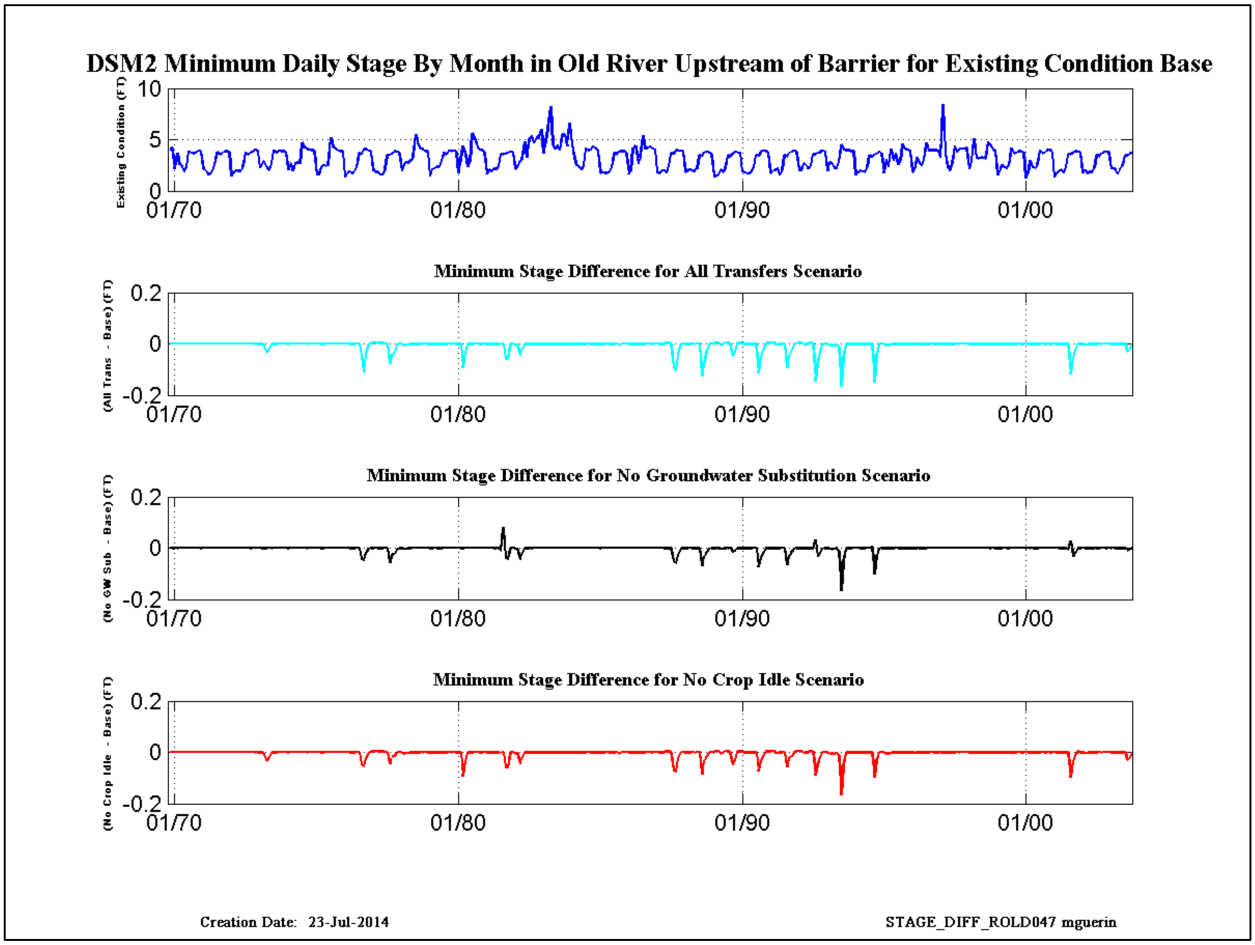


Figure 2-10. Minimum stage at Old River Upstream barrier and minimum stage differences Scenario – Base.

Table 2-1. Grant Line upstream of barrier Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	4.1	4.2	2.7	5.1	3.5	3.3	2.6	2.5	3.9	3.8	3.7	3.8
1971	3.9	3.9	2.6	2.4	2.1	2.5	2.7	2.7	3.9	3.6	3.7	3.8
1972	3.9	3.9	2.0	2.1	2.5	2.3	2.5	2.5	3.8	3.6	3.8	3.8
1973	4.0	3.9	2.6	3.0	3.4	3.2	2.9	2.9	4.0	3.8	4.0	3.9
1974	3.9	3.8	2.5	3.4	2.5	3.6	3.6	2.9	4.8	4.2	4.1	4.1
1975	4.0	3.9	2.1	2.1	3.0	3.6	3.2	2.6	5.3	4.3	4.1	3.9
1976	3.9	3.9	1.8	2.1	2.3	2.1	2.4	2.4	3.7	3.7	4.1	4.1
1977	4.0	3.9	2.4	2.2	2.2	1.9	1.9	2.2	3.5	3.5	3.6	3.9
1978	3.8	3.7	2.3	3.0	3.5	3.6	4.2	3.8	5.6	4.5	4.1	4.1
1979	3.8	3.9	1.9	2.7	3.1	3.5	3.2	3.2	3.8	3.6	4.0	3.9
1980	3.9	3.8	2.1	4.3	6.0	5.0	3.2	3.1	5.8	5.1	4.3	4.1
1981	4.0	3.8	2.1	2.5	2.3	2.7	2.6	2.6	3.7	3.6	3.7	3.8
1982	3.8	3.8	2.5	2.9	4.1	4.7	7.3	5.1	5.5	5.4	4.6	5.3
1983	5.1	6.2	5.7	7.4	8.6	11.2	6.8	6.3	7.2	6.5	5.7	5.6
1984	4.4	7.2	6.6	4.6	3.6	3.2	2.9	2.6	4.2	4.0	4.1	4.3
1985	4.1	4.0	2.2	2.3	2.3	2.4	2.6	2.4	3.8	3.6	3.9	3.9
1986	3.9	3.7	2.1	2.4	5.8	6.9	4.0	3.7	5.5	4.2	4.2	4.3
1987	4.2	4.1	2.3	2.1	2.4	2.5	2.2	2.5	3.7	3.7	4.0	3.9
1988	4.0	3.9	2.3	2.3	2.5	2.3	2.3	2.2	3.5	3.4	3.7	3.9
1989	3.8	3.6	1.9	1.8	2.1	2.4	2.2	2.2	3.5	3.4	3.7	3.9
1990	3.7	3.8	2.3	2.2	2.1	2.1	2.2	2.4	3.5	3.5	3.8	3.9
1991	3.9	3.8	2.1	2.2	2.3	2.7	2.0	2.0	3.5	3.4	3.7	3.8
1992	3.9	3.8	2.4	2.3	3.1	2.8	2.4	2.4	3.6	3.6	3.7	3.8
1993	3.9	3.8	2.3	3.3	3.2	2.8	2.7	2.9	4.6	4.1	4.0	4.0
1994	3.9	3.9	2.0	2.1	2.4	2.2	2.2	2.3	3.5	3.3	3.6	3.6
1995	3.9	3.7	2.1	3.5	2.8	5.5	4.3	5.7	4.3	5.1	4.6	4.1
1996	4.0	3.9	2.3	2.5	4.3	3.9	3.3	3.4	4.7	4.0	4.0	4.0
1997	4.0	3.9	5.3	12.1	6.2	3.6	2.7	3.1	4.5	3.8	4.1	4.1
1998	4.1	4.2	2.5	3.4	6.9	4.7	4.7	4.8	5.2	5.3	4.8	4.6
1999	4.1	3.9	2.1	2.6	3.8	3.2	3.0	2.7	4.2	3.7	3.8	3.9
2000	3.9	3.8	1.6	2.2	4.1	3.4	3.0	2.8	4.0	3.7	3.8	4.0
2001	4.0	3.8	1.8	2.2	2.3	2.6	2.5	2.5	3.7	3.6	3.8	3.9
2002	3.8	3.8	2.2	2.4	2.1	2.3	2.3	2.3	3.6	3.4	3.7	3.8
2003	3.8	3.8	2.6	2.6	2.4	2.1	2.6	2.5	3.5	3.5	3.7	3.8
Average	4.0	4.0	2.5	3.1	3.4	3.4	3.1	3.0	4.3	4.0	4.0	4.0
Critical	3.9	3.8	2.2	2.2	2.4	2.3	2.2	2.3	3.5	3.5	3.7	3.9
Dry	4.0	3.8	2.0	2.2	2.2	2.5	2.4	2.4	3.7	3.6	3.8	3.9
BN	3.9	3.9	1.9	2.4	2.8	2.9	2.8	2.9	3.8	3.6	3.9	3.9
AN	3.9	3.8	2.2	3.1	3.8	3.4	3.1	3.0	4.6	4.1	4.0	4.0
Wet	4.1	4.3	3.2	4.2	4.4	4.6	3.9	3.7	4.9	4.5	4.3	4.3

Table 2-2. Grant Line downstream of barrier Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	1.8	2.0	2.6	5.1	3.5	3.3	2.6	2.5	1.6	1.6	1.5	1.7
1971	1.7	1.8	2.6	2.4	2.1	2.5	2.7	2.7	1.6	1.4	1.6	1.8
1972	1.6	1.5	1.9	2.1	2.5	2.3	2.5	2.5	1.7	1.6	1.8	1.8
1973	2.1	1.9	2.6	3.0	3.4	3.2	2.9	2.9	1.7	1.5	1.7	1.7
1974	1.6	1.5	2.5	3.4	2.5	3.6	3.6	2.9	2.2	1.8	1.8	2.0
1975	1.8	1.6	2.0	2.1	3.0	3.6	3.2	2.6	2.5	1.8	1.8	1.8
1976	1.5	1.5	1.7	2.1	2.3	2.1	2.4	2.4	1.6	1.8	2.1	2.1
1977	1.9	1.7	2.3	2.2	2.2	1.9	1.9	2.2	1.5	1.6	1.6	2.0
1978	1.7	1.5	2.2	3.0	3.5	3.6	4.2	3.8	2.6	2.0	1.8	1.9
1979	1.7	1.6	1.8	2.7	3.1	3.5	3.2	3.2	1.5	1.4	1.7	1.7
1980	1.7	1.6	2.1	4.3	6.0	5.0	3.2	3.1	2.9	2.3	2.0	2.0
1981	1.7	1.3	2.0	2.5	2.3	2.7	2.6	2.6	1.5	1.5	1.5	1.6
1982	1.6	1.7	2.5	2.9	4.1	4.7	7.3	5.1	3.4	2.6	2.1	2.8
1983	2.6	3.6	5.6	7.4	8.6	11.2	6.8	6.3	7.2	6.5	3.2	3.2
1984	2.3	4.4	6.6	4.6	3.6	3.2	2.9	2.6	1.8	1.9	1.9	2.3
1985	1.7	1.7	2.1	2.3	2.3	2.4	2.6	2.4	1.6	1.4	1.6	1.8
1986	1.6	1.4	2.1	2.4	5.8	6.9	4.0	3.7	2.6	1.8	1.8	2.2
1987	2.0	1.7	2.2	2.1	2.4	2.5	2.2	2.5	1.5	1.6	2.0	1.8
1988	1.7	1.6	2.2	2.3	2.5	2.3	2.3	2.2	1.3	1.4	1.6	1.7
1989	1.5	1.2	1.8	1.8	2.1	2.4	2.2	2.2	1.5	1.4	1.7	1.8
1990	1.6	1.5	2.2	2.2	2.1	2.1	2.2	2.4	1.6	1.6	1.8	1.9
1991	1.7	1.5	2.1	2.2	2.3	2.7	2.0	2.0	1.5	1.5	1.7	1.8
1992	1.9	1.5	2.3	2.3	3.1	2.8	2.4	2.4	1.7	1.7	1.9	1.8
1993	1.9	1.6	2.2	3.3	3.2	2.8	2.7	2.9	2.1	1.9	1.8	1.9
1994	1.8	1.6	1.9	2.1	2.4	2.2	2.2	2.3	1.6	1.5	1.5	1.6
1995	1.8	1.4	2.1	3.5	2.8	5.5	4.3	5.7	4.3	5.1	2.3	2.0
1996	1.8	1.5	2.2	2.5	4.3	3.9	3.3	3.4	2.0	1.7	1.8	1.9
1997	1.6	1.5	5.3	12.1	6.2	3.6	2.7	3.1	2.1	1.8	2.0	2.1
1998	2.1	2.4	2.5	3.4	6.9	4.7	4.7	4.8	5.2	5.3	2.4	2.3
1999	1.7	1.5	2.1	2.6	3.8	3.2	3.0	2.7	1.7	1.5	1.5	1.8
2000	1.6	1.3	1.6	2.2	4.1	3.4	3.0	2.8	1.7	1.6	1.6	1.8
2001	1.7	1.2	1.7	2.2	2.3	2.6	2.5	2.5	1.5	1.5	1.6	1.8
2002	1.6	1.5	2.1	2.4	2.1	2.3	2.3	2.3	1.4	1.4	1.6	1.7
2003	1.6	1.5	2.5	2.6	2.4	2.1	2.6	2.5	1.4	1.4	1.6	1.8
Average	1.8	1.7	2.5	3.1	3.4	3.4	3.1	3.0	2.2	2.0	1.8	1.9
Critical	1.7	1.6	2.1	2.2	2.4	2.3	2.2	2.3	1.5	1.6	1.8	1.8
Dry	1.7	1.5	2.0	2.2	2.2	2.5	2.4	2.4	1.5	1.5	1.7	1.8
BN	1.6	1.6	1.9	2.4	2.8	2.9	2.8	2.9	1.6	1.5	1.7	1.8
AN	1.8	1.6	2.2	3.1	3.8	3.4	3.1	3.0	2.1	1.8	1.8	1.8
Wet	1.8	2.0	3.1	4.2	4.4	4.6	3.9	3.7	2.9	2.7	2.0	2.2

Table 2-3. Middle River upstream of barrier Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	3.5	3.5	2.1	3.5	2.5	2.2	1.7	2.3	3.4	3.3	3.4	3.4
1971	3.4	3.4	2.2	1.9	1.6	1.6	1.8	2.4	3.3	3.2	3.4	3.5
1972	3.4	3.4	1.5	1.7	2.0	1.9	1.8	2.3	3.3	3.2	3.4	3.5
1973	3.5	3.5	2.2	2.6	2.9	2.2	1.8	2.5	3.4	3.3	3.5	3.4
1974	3.4	3.4	2.0	2.7	1.9	2.6	2.5	2.5	3.6	3.4	3.5	3.5
1975	3.4	3.4	1.6	1.6	2.3	2.4	2.2	2.4	3.7	3.4	3.5	3.5
1976	3.4	3.4	1.4	1.6	1.9	1.7	1.8	2.2	3.3	3.3	3.6	3.6
1977	3.5	3.4	2.0	1.8	1.8	1.5	1.5	2.1	3.3	3.3	3.4	3.5
1978	3.4	3.4	1.9	2.6	2.8	2.7	2.7	2.9	3.8	3.5	3.5	3.5
1979	3.4	3.4	1.5	2.1	2.2	2.2	2.1	2.6	3.3	3.2	3.5	3.4
1980	3.4	3.4	1.8	2.9	3.8	3.0	2.1	2.7	3.9	3.7	3.5	3.5
1981	3.4	3.4	1.7	2.0	1.9	2.1	2.0	2.4	3.2	3.2	3.4	3.4
1982	3.4	3.4	2.1	2.3	2.7	3.0	3.9	2.8	3.6	3.8	3.6	3.9
1983	3.7	4.1	3.2	4.1	5.0	6.6	3.8	3.4	3.6	3.3	3.9	3.9
1984	3.6	4.4	3.8	2.9	2.3	2.2	1.9	2.3	3.4	3.4	3.5	3.6
1985	3.5	3.4	1.8	1.8	1.7	1.7	1.8	2.2	3.3	3.2	3.4	3.5
1986	3.4	3.4	1.6	1.9	3.9	3.8	2.3	2.8	3.8	3.4	3.5	3.6
1987	3.5	3.5	1.8	1.7	1.9	1.9	1.7	2.4	3.3	3.3	3.5	3.5
1988	3.4	3.4	1.8	1.8	2.0	1.8	1.9	2.1	3.2	3.2	3.4	3.5
1989	3.4	3.3	1.4	1.4	1.6	2.0	1.8	2.2	3.2	3.1	3.4	3.5
1990	3.4	3.4	1.8	1.8	1.7	1.7	1.9	2.4	3.2	3.2	3.5	3.5
1991	3.4	3.4	1.7	1.8	1.9	2.2	1.5	2.0	3.2	3.2	3.4	3.5
1992	3.5	3.4	2.0	2.0	2.6	2.5	2.1	2.4	3.3	3.3	3.5	3.5
1993	3.5	3.4	1.9	2.7	2.7	2.3	2.1	2.7	3.6	3.4	3.5	3.5
1994	3.4	3.4	1.6	1.8	2.0	1.8	1.8	2.3	3.2	3.1	3.4	3.4
1995	3.4	3.4	1.7	3.0	2.4	3.8	2.7	3.1	2.4	2.6	3.6	3.5
1996	3.4	3.4	1.8	2.0	3.1	2.6	2.2	2.8	3.6	3.3	3.5	3.5
1997	3.4	3.4	2.9	6.7	3.1	2.1	1.8	2.6	3.5	3.4	3.5	3.5
1998	3.5	3.6	2.2	2.8	4.5	3.0	2.8	2.9	2.9	2.7	3.7	3.6
1999	3.4	3.4	1.6	1.8	2.4	2.2	2.1	2.4	3.4	3.3	3.4	3.4
2000	3.4	3.4	1.3	1.7	2.8	2.2	2.0	2.5	3.4	3.3	3.4	3.5
2001	3.4	3.4	1.4	1.7	1.9	2.0	1.7	2.3	3.3	3.3	3.4	3.5
2002	3.4	3.4	1.7	1.9	1.7	1.8	1.8	2.2	3.2	3.1	3.4	3.4
2003	3.4	3.4	2.2	2.2	2.0	1.6	2.0	2.4	3.2	3.1	3.4	3.4
Average	3.4	3.5	1.9	2.3	2.5	2.4	2.1	2.5	3.4	3.3	3.5	3.5
Critical	3.4	3.4	1.8	1.8	2.0	1.9	1.8	2.2	3.3	3.2	3.4	3.5
Dry	3.4	3.4	1.6	1.8	1.8	1.9	1.8	2.3	3.3	3.2	3.4	3.5
BN	3.4	3.4	1.5	1.9	2.1	2.1	2.0	2.5	3.3	3.2	3.4	3.5
AN	3.4	3.4	1.9	2.5	2.8	2.3	2.1	2.6	3.5	3.4	3.5	3.5
Wet	3.5	3.5	2.2	2.9	2.9	2.9	2.4	2.7	3.4	3.3	3.5	3.6

Table 2-4. Middle River downstream of barrier Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	1.8	2.0	2.1	3.5	2.5	2.2	1.7	1.8	1.6	1.7	1.6	1.8
1971	1.7	1.8	2.2	1.9	1.6	1.6	1.8	1.9	1.6	1.6	1.8	1.9
1972	1.6	1.6	1.5	1.7	2.0	1.9	1.8	1.8	1.8	1.8	1.9	1.9
1973	2.1	1.9	2.2	2.6	2.9	2.2	1.8	1.9	1.6	1.6	1.8	1.7
1974	1.6	1.6	2.0	2.7	1.9	2.6	2.5	2.0	1.8	1.7	1.8	2.0
1975	1.7	1.6	1.6	1.6	2.3	2.4	2.2	1.8	1.8	1.7	1.8	1.8
1976	1.6	1.5	1.4	1.6	1.9	1.7	1.8	1.8	1.7	2.0	2.2	2.1
1977	1.9	1.8	1.9	1.8	1.8	1.5	1.5	1.7	1.6	1.7	1.8	2.0
1978	1.8	1.6	1.9	2.6	2.8	2.7	2.7	2.2	1.7	1.8	1.8	1.9
1979	1.8	1.6	1.5	2.1	2.2	2.2	2.1	2.0	1.6	1.6	1.8	1.8
1980	1.7	1.6	1.8	2.9	3.8	3.0	2.1	2.0	1.8	1.8	1.9	2.0
1981	1.7	1.4	1.7	2.0	1.9	2.1	2.0	1.9	1.6	1.7	1.7	1.7
1982	1.7	1.7	2.1	2.3	2.7	3.0	3.9	2.8	2.2	1.9	1.9	2.3
1983	2.1	2.7	3.2	4.1	5.0	6.6	3.8	3.4	3.6	3.3	2.5	2.6
1984	2.1	3.0	3.8	2.9	2.3	2.2	1.9	1.8	1.7	1.9	2.0	2.2
1985	1.7	1.8	1.8	1.8	1.7	1.7	1.8	1.7	1.7	1.6	1.6	1.9
1986	1.7	1.4	1.6	1.9	3.9	3.8	2.3	2.1	1.7	1.7	1.8	2.1
1987	1.9	1.7	1.8	1.7	1.9	1.9	1.7	1.9	1.6	1.7	2.0	1.9
1988	1.7	1.7	1.8	1.8	2.0	1.8	1.9	1.6	1.4	1.5	1.7	1.8
1989	1.6	1.3	1.4	1.4	1.6	2.0	1.8	1.7	1.6	1.6	1.9	1.9
1990	1.7	1.5	1.8	1.8	1.7	1.7	1.9	1.8	1.7	1.8	1.9	1.9
1991	1.7	1.5	1.6	1.8	1.9	2.2	1.5	1.5	1.6	1.7	1.8	1.9
1992	1.9	1.5	1.9	2.0	2.6	2.5	2.1	2.0	1.8	1.8	2.0	1.9
1993	2.0	1.7	1.9	2.7	2.7	2.3	2.1	2.3	2.0	1.9	1.9	2.0
1994	1.8	1.6	1.6	1.8	2.0	1.8	1.8	1.8	1.7	1.7	1.7	1.7
1995	1.8	1.4	1.7	3.0	2.4	3.8	2.7	3.1	2.4	2.6	2.1	2.1
1996	1.8	1.5	1.8	2.0	3.1	2.6	2.2	2.3	1.7	1.8	1.8	2.0
1997	1.7	1.5	2.8	6.7	3.1	2.1	1.8	2.0	1.9	1.9	2.1	2.1
1998	2.1	2.4	2.2	2.8	4.5	3.0	2.8	2.9	2.9	2.7	2.1	2.1
1999	1.6	1.6	1.6	1.8	2.4	2.2	2.1	1.8	1.6	1.6	1.7	1.8
2000	1.6	1.4	1.2	1.7	2.8	2.2	2.0	1.9	1.7	1.7	1.7	1.9
2001	1.7	1.3	1.3	1.7	1.9	2.0	1.7	1.8	1.6	1.6	1.7	1.8
2002	1.6	1.6	1.7	1.9	1.7	1.8	1.8	1.7	1.5	1.6	1.7	1.8
2003	1.7	1.6	2.1	2.2	2.0	1.6	2.0	1.9	1.5	1.5	1.8	1.8
Average	1.8	1.7	1.9	2.3	2.5	2.4	2.1	2.0	1.8	1.8	1.9	1.9
Critical	1.8	1.6	1.7	1.8	2.0	1.9	1.8	1.7	1.6	1.7	1.9	1.9
Dry	1.7	1.5	1.6	1.8	1.8	1.9	1.8	1.8	1.6	1.6	1.8	1.8
BN	1.7	1.6	1.5	1.9	2.1	2.1	2.0	1.9	1.7	1.7	1.9	1.9
AN	1.8	1.6	1.8	2.5	2.8	2.3	2.1	2.0	1.7	1.7	1.8	1.9
Wet	1.8	1.9	2.2	2.9	2.9	2.9	2.4	2.3	2.0	2.0	1.9	2.1

Table 2-5. Old River upstream of barrier Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	4.1	4.1	2.1	3.7	2.6	2.4	1.9	2.4	3.9	3.7	3.6	3.8
1971	3.9	3.8	2.2	2.0	1.6	1.6	2.0	2.6	3.8	3.6	3.7	3.8
1972	3.9	3.8	1.5	1.7	2.1	1.9	2.0	2.4	3.8	3.5	3.7	3.8
1973	4.0	3.9	2.2	2.6	2.9	2.3	2.0	2.6	4.0	3.7	4.0	3.9
1974	3.9	3.7	2.0	2.7	2.0	2.7	2.7	2.7	4.7	4.2	4.1	4.0
1975	4.0	3.9	1.6	1.6	2.3	2.5	2.4	2.5	5.2	4.3	4.1	3.9
1976	3.9	3.9	1.4	1.6	1.9	1.7	1.9	2.3	3.7	3.6	4.1	4.0
1977	4.0	3.8	2.0	1.8	1.8	1.6	1.6	2.2	3.5	3.5	3.6	3.9
1978	3.8	3.7	1.9	2.6	2.8	2.7	3.0	3.4	5.5	4.4	4.1	4.1
1979	3.8	3.8	1.5	2.2	2.3	2.3	2.3	2.9	3.7	3.6	4.0	3.9
1980	3.9	3.8	1.7	3.1	4.4	3.5	2.3	2.9	5.6	5.1	4.2	4.0
1981	4.0	3.8	1.7	2.0	1.9	2.1	2.1	2.5	3.6	3.5	3.6	3.7
1982	3.8	3.7	2.1	2.4	2.8	3.1	4.8	3.3	5.0	5.4	4.7	5.3
1983	5.1	6.0	3.7	4.9	6.1	8.3	4.5	4.1	4.4	4.0	5.5	5.5
1984	4.4	6.6	4.6	3.2	2.5	2.3	2.1	2.5	4.1	3.9	4.0	4.3
1985	4.1	3.9	1.8	1.8	1.7	1.7	1.9	2.3	3.7	3.6	3.8	3.9
1986	3.9	3.7	1.6	2.0	4.2	4.4	2.7	3.3	5.4	4.1	4.2	4.3
1987	4.2	4.1	1.8	1.7	2.0	2.0	1.8	2.5	3.6	3.6	3.9	3.9
1988	3.9	3.9	1.9	1.9	2.1	1.9	2.0	2.2	3.5	3.4	3.7	3.8
1989	3.7	3.6	1.4	1.4	1.6	2.1	1.9	2.2	3.5	3.3	3.6	3.8
1990	3.7	3.8	1.9	1.8	1.7	1.7	1.9	2.4	3.5	3.4	3.8	3.9
1991	3.8	3.8	1.8	1.9	2.0	2.3	1.6	2.1	3.5	3.4	3.7	3.8
1992	3.9	3.8	2.0	2.0	2.7	2.5	2.1	2.4	3.6	3.5	3.7	3.8
1993	3.9	3.8	1.9	2.8	2.7	2.3	2.3	2.9	4.5	4.0	4.0	3.9
1994	3.9	3.8	1.6	1.8	2.0	1.9	1.8	2.3	3.5	3.3	3.5	3.6
1995	3.8	3.7	1.7	3.0	2.4	4.1	3.0	3.7	2.6	3.0	4.6	4.0
1996	4.0	3.9	1.9	2.1	3.2	2.7	2.4	3.1	4.7	3.9	4.0	4.0
1997	3.9	3.9	3.3	8.4	3.7	2.3	2.0	2.8	4.4	3.8	4.1	4.1
1998	4.1	4.2	2.2	2.8	5.1	3.2	3.2	3.3	3.2	3.1	4.8	4.5
1999	4.1	3.9	1.6	1.9	2.5	2.3	2.3	2.5	4.2	3.7	3.8	3.8
2000	3.9	3.8	1.2	1.8	3.0	2.3	2.2	2.6	4.0	3.7	3.8	4.0
2001	4.0	3.7	1.3	1.7	1.9	2.0	1.8	2.4	3.6	3.6	3.8	3.9
2002	3.8	3.8	1.7	2.0	1.7	1.8	1.9	2.3	3.5	3.4	3.7	3.8
2003	3.8	3.8	2.2	2.2	2.1	1.6	2.1	2.4	3.5	3.4	3.7	3.7
Average	4.0	4.0	2.0	2.4	2.6	2.5	2.3	2.7	4.0	3.7	4.0	4.0
Critical	3.9	3.8	1.8	1.8	2.0	1.9	1.9	2.3	3.5	3.4	3.7	3.8
Dry	4.0	3.8	1.6	1.8	1.8	2.0	1.9	2.4	3.6	3.5	3.7	3.8
BN	3.8	3.8	1.5	2.0	2.2	2.1	2.2	2.7	3.8	3.5	3.8	3.8
AN	3.9	3.8	1.9	2.5	3.0	2.4	2.3	2.8	4.5	4.1	4.0	3.9
Wet	4.1	4.2	2.4	3.1	3.2	3.2	2.8	3.0	4.3	3.9	4.2	4.3

Table 2-6. Old River downstream of barrier Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	1.5	1.9	2.1	3.6	2.5	2.3	1.8	1.8	1.5	1.4	1.3	1.5
1971	1.5	1.7	2.1	1.9	1.6	1.6	1.9	1.9	1.4	1.3	1.4	1.7
1972	1.4	1.4	1.4	1.7	2.0	1.9	1.9	1.9	1.6	1.5	1.6	1.7
1973	1.9	1.7	2.2	2.6	2.8	2.2	2.0	2.0	1.5	1.3	1.5	1.5
1974	1.4	1.4	2.0	2.6	1.9	2.6	2.7	2.1	1.7	1.4	1.5	1.8
1975	1.5	1.4	1.5	1.6	2.3	2.5	2.4	1.9	1.7	1.4	1.5	1.6
1976	1.3	1.3	1.3	1.6	1.8	1.6	1.9	1.8	1.6	1.8	2.0	1.9
1977	1.8	1.6	1.9	1.7	1.8	1.5	1.5	1.7	1.5	1.6	1.5	1.9
1978	1.7	1.5	1.8	2.6	2.7	2.6	2.9	2.4	1.5	1.5	1.5	1.6
1979	1.5	1.4	1.4	2.1	2.2	2.3	2.3	2.1	1.4	1.3	1.5	1.6
1980	1.5	1.4	1.7	3.0	4.2	3.3	2.3	2.1	1.7	1.6	1.7	1.7
1981	1.6	1.1	1.6	2.0	1.9	2.1	2.0	1.9	1.4	1.4	1.4	1.5
1982	1.5	1.5	2.1	2.3	2.7	3.0	4.6	3.2	2.1	1.7	1.6	2.1
1983	1.9	2.5	3.5	4.6	5.9	8.0	4.3	3.9	4.2	3.8	2.3	2.5
1984	1.9	3.1	4.4	3.1	2.4	2.3	2.1	1.9	1.5	1.7	1.7	2.0
1985	1.5	1.5	1.7	1.8	1.7	1.7	1.9	1.7	1.5	1.3	1.4	1.6
1986	1.5	1.2	1.5	1.9	4.1	4.2	2.6	2.2	1.6	1.5	1.5	2.0
1987	1.8	1.5	1.7	1.6	1.9	2.0	1.8	2.0	1.4	1.5	1.9	1.7
1988	1.5	1.5	1.8	1.8	2.1	1.9	1.9	1.7	1.3	1.3	1.6	1.6
1989	1.4	1.1	1.3	1.4	1.6	2.0	1.8	1.7	1.4	1.3	1.7	1.7
1990	1.5	1.3	1.8	1.7	1.7	1.7	1.9	1.9	1.6	1.6	1.7	1.8
1991	1.6	1.3	1.6	1.8	1.9	2.2	1.6	1.5	1.4	1.5	1.6	1.7
1992	1.7	1.4	2.0	2.0	2.7	2.4	2.1	2.0	1.6	1.6	1.8	1.8
1993	1.8	1.5	1.8	2.7	2.6	2.2	2.2	2.3	1.8	1.6	1.6	1.7
1994	1.6	1.4	1.5	1.7	2.0	1.8	1.8	1.8	1.6	1.4	1.4	1.5
1995	1.7	1.3	1.6	3.0	2.4	4.0	2.9	3.5	2.5	2.9	1.8	1.8
1996	1.6	1.3	1.8	2.0	3.2	2.6	2.4	2.4	1.5	1.5	1.5	1.7
1997	1.4	1.2	3.1	8.0	3.5	2.2	1.9	2.1	1.7	1.7	1.8	1.9
1998	1.9	2.3	2.1	2.8	4.9	3.1	3.1	3.2	3.1	3.0	1.9	1.9
1999	1.4	1.3	1.5	1.8	2.5	2.2	2.2	1.9	1.4	1.3	1.4	1.6
2000	1.5	1.2	1.2	1.7	2.9	2.2	2.1	2.0	1.5	1.5	1.4	1.6
2001	1.5	1.0	1.3	1.7	1.9	2.0	1.8	1.9	1.4	1.4	1.5	1.7
2002	1.4	1.4	1.6	1.9	1.6	1.8	1.8	1.7	1.3	1.3	1.5	1.5
2003	1.5	1.4	2.1	2.2	2.0	1.6	2.1	1.9	1.3	1.3	1.5	1.7
Average	1.6	1.5	1.9	2.4	2.5	2.5	2.2	2.1	1.7	1.6	1.6	1.7
Critical	1.6	1.4	1.7	1.8	2.0	1.9	1.8	1.8	1.5	1.5	1.7	1.8
Dry	1.5	1.3	1.5	1.7	1.8	1.9	1.8	1.8	1.4	1.4	1.6	1.6
BN	1.5	1.4	1.4	1.9	2.1	2.1	2.1	2.0	1.5	1.4	1.5	1.6
AN	1.6	1.4	1.8	2.5	2.9	2.4	2.3	2.1	1.6	1.5	1.5	1.6
Wet	1.6	1.7	2.3	3.0	3.1	3.1	2.7	2.5	2.0	1.9	1.6	1.9

Table 2-7. Grant Line upstream of barrier stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-8. Grant Line upstream of barrier stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.6	-2.8	-2.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-2.1	-0.7
1977	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-1.5	-1.0	-0.8
1978	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.8	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.8	-1.6
1982	0.0	0.0	-0.1	-0.4	-2.3	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-2.4	-2.3	-0.8
1988	-0.1	0.1	0.0	-0.1	0.0	0.1	0.0	0.2	0.0	-3.2	-2.2	-0.4
1989	-0.1	0.1	-0.1	0.2	0.2	-0.2	-0.1	0.3	0.1	0.0	-0.9	-0.7
1990	0.1	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-2.5	-1.1	-0.5
1991	0.0	0.1	0.1	0.2	0.0	-0.1	-0.1	0.0	0.0	-2.1	-0.9	-0.3
1992	0.0	0.1	0.1	0.1	-0.1	-0.1	0.0	0.2	0.1	-4.2	-2.0	-0.6
1993	-0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	-0.5	-3.3	-1.2	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.9	-1.2
1995	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.0	-1.5	-0.5
2002	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.7	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-0.7	-0.6	-0.2
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	-2.1	-1.9	-0.7
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-1.1	-1.1	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.6	-0.4	-0.1	-0.6	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-9. Grant Line downstream of barrier stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-10. Grant Line downstream of barrier stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.6	-2.8	-2.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.3	-6.6	-2.6
1977	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-7.9	-1.2	-1.8
1978	-0.1	0.2	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.8	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-7.6	-0.1
1982	0.0	0.0	-0.1	-0.4	-2.3	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	-3.5	-7.4	-2.2
1988	0.0	0.2	0.0	-0.1	0.0	0.1	0.0	0.2	0.1	-8.3	-3.8	-2.0
1989	0.0	0.3	-0.1	0.2	0.2	-0.2	-0.1	0.3	0.3	-0.1	-5.1	-0.2
1990	0.1	0.2	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-7.5	-2.9	-1.8
1991	0.2	0.2	0.2	0.2	0.0	-0.1	-0.1	0.0	0.2	-6.6	-2.2	-1.3
1992	0.1	0.2	0.1	0.1	-0.1	-0.1	0.0	0.2	0.2	-5.3	-4.2	-1.5
1993	-0.2	0.2	-0.1	-0.2	-0.2	-0.2	-0.1	-0.5	-3.5	-2.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-4.3	-4.1
1995	0.1	0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
1998	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-4.6	-5.5	-2.2
2002	0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	-0.1	-0.1	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-9.2	0.0	0.0
Average	0.0	0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-1.8	-1.5	-0.6
Critical	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	-5.9	-3.6	-2.2
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-1.4	-4.3	-0.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.1	0.0	-0.1	-0.3	-0.6	-0.4	-0.1	-0.6	-1.9	0.0	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-11. Middle River upstream of barrier stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-12. Middle River upstream of barrier stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.2	-1.0	-0.5	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-1.0	-0.4
1977	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-1.3	-0.5	-0.4
1978	-0.1	0.0	0.0	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-1.4	-0.8	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.5
1982	0.0	0.0	-0.2	-0.1	-1.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-1.5	-1.3	-0.3
1988	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-4.1	-0.6	-0.2
1989	-0.1	0.0	-0.1	0.3	0.2	-0.3	-0.2	0.2	0.0	-0.1	-0.6	-0.1
1990	0.0	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-2.6	-0.5	-0.2
1991	0.0	0.0	0.2	0.2	0.0	-0.1	-0.1	0.0	0.0	-2.0	-0.4	-0.2
1992	0.0	0.0	0.2	0.1	-0.1	-0.1	0.0	0.2	0.0	-3.6	-0.9	-0.3
1993	-0.1	0.0	-0.1	-0.2	-0.2	-0.3	-0.1	-0.2	-1.2	-0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-2.4	-0.7
1995	0.0	0.0	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.3	-0.7	-0.2
2002	0.0	0.0	-0.1	-0.2	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-1.8	-0.1	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.6	-0.3	-0.1
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-2.1	-0.9	-0.3
Dry	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.6	-0.6	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.4	-0.1	0.0	-0.2	-0.4	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-13. Middle River downstream of barrier stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-14. Middle River downstream of barrier stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.2	-1.0	-0.5	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.1	-4.9	-1.9
1977	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-5.6	-0.7	-1.3
1978	0.0	0.1	0.0	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-1.4	-0.8	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-4.3	-0.2
1982	0.0	0.0	-0.2	-0.1	-1.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	-1.8	-6.0	-1.6
1988	0.1	0.1	-0.1	-0.1	0.0	0.0	0.0	0.2	0.1	-5.3	-3.1	-1.6
1989	0.1	0.2	-0.1	0.3	0.2	-0.3	-0.2	0.3	0.2	-0.1	-1.6	-0.2
1990	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-5.0	-2.1	-1.4
1991	0.2	0.2	0.2	0.2	0.0	-0.1	-0.1	0.0	0.1	-4.3	-1.9	-1.1
1992	0.1	0.2	0.2	0.1	-0.1	-0.1	0.0	0.2	0.1	-2.5	-2.6	-1.2
1993	-0.1	0.1	-0.1	-0.2	-0.2	-0.3	-0.1	-0.2	-1.0	-0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.2	-2.0	-2.3
1995	0.2	0.1	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-2.4	-3.8	-1.7
2002	0.2	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	0.0	-0.1	-0.1
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	-2.6	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-1.0	-1.0	-0.4
Critical	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	-3.6	-2.5	-1.5
Dry	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.1	-0.7	-2.6	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.4	-0.1	-0.1	-0.2	-0.5	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-15. Old River upstream of barrier stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-16. Old River upstream of barrier stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.3	-1.5	-0.9	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-2.7	-1.0
1977	-0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.0	0.0	-2.1	-1.2	-0.9
1978	-0.1	0.0	0.0	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-2.1	-0.9	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-1.6	-1.6
1982	0.0	0.0	-0.2	-0.2	-1.5	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	-2.5	-2.6	-1.1
1988	-0.1	0.1	-0.1	-0.1	0.0	0.1	0.0	0.2	0.0	-3.7	-2.3	-0.7
1989	-0.1	0.1	-0.1	0.4	0.3	-0.3	-0.2	0.3	0.1	0.0	-1.3	-0.7
1990	0.1	0.1	0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	-3.3	-1.3	-0.6
1991	0.0	0.1	0.2	0.3	0.0	-0.1	-0.1	0.0	0.1	-2.8	-1.2	-0.7
1992	0.0	0.1	0.2	0.2	-0.1	-0.1	0.0	0.2	0.1	-4.1	-2.1	-0.8
1993	-0.1	0.0	-0.1	-0.2	-0.2	-0.3	-0.1	-0.5	-3.7	-1.3	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-4.2	-1.3
1995	-0.1	0.0	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-3.3	-1.5	-0.6
2002	0.0	0.0	-0.1	-0.2	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.0
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.9	-0.6	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1	-0.7	-0.7	-0.3
Critical	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	-2.5	-2.1	-0.9
Dry	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	-1.0	-1.2	-0.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.5	-0.5	-0.2	-0.1	-0.6	-0.4	-0.1	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-17. Old River downstream of barrier stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-18. Old River downstream of barrier stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.2	-1.4	-0.8	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.3	-8.4	-3.0
1977	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	-9.7	-1.0	-1.7
1978	0.0	0.2	0.0	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-2.3	-0.8	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-13.7	-0.1
1982	0.1	0.0	-0.2	-0.2	-1.5	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	-4.5	-11.2	-3.1
1988	0.4	0.3	-0.1	-0.1	0.0	0.2	0.0	0.3	0.1	-12.6	-5.1	-2.7
1989	0.3	0.5	-0.1	0.5	0.3	-0.3	-0.2	0.5	0.4	-0.1	-6.6	-0.2
1990	0.2	0.3	0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	-11.2	-4.2	-2.4
1991	0.3	0.4	0.3	0.3	0.0	-0.1	-0.1	0.0	0.3	-10.3	-3.7	-2.0
1992	0.3	0.3	0.2	0.2	-0.1	-0.1	0.0	0.4	0.3	-5.6	-5.6	-1.8
1993	-0.1	0.3	-0.1	-0.2	-0.2	-0.3	-0.1	-0.3	-1.4	-0.8	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.3	-3.3	-5.0
1995	0.3	0.3	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
1998	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
2001	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3	-5.3	-7.9	-3.0
2002	0.6	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	-10.8	0.0	0.0
Average	0.1	0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-2.3	-2.1	-0.7
Critical	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.1	0.1	-8.1	-4.5	-2.7
Dry	0.1	0.1	0.0	0.0	0.0	-0.1	0.0	0.1	0.2	-1.6	-6.6	-1.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.1	0.0	-0.1	-0.5	-0.5	-0.2	-0.1	-0.3	-1.9	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-19. Grant Line upstream of barrier stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-20. Grant Line upstream of barrier stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.7	-0.3
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.6	-0.5
1978	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	2.2	-1.3	-1.1
1982	0.0	0.0	-0.1	-0.4	-2.3	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-1.0	-0.4
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-0.6	-0.3
1989	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.3	-0.3
1990	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-1.5	-0.6	-0.3
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-0.5	-0.2
1992	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.8	-0.5	-0.4
1993	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.4	-3.3	-1.2	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-2.4	-0.8
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	-0.5	-0.3
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.3	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.3	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.8	-0.4
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-0.5	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-21. Grant Line downstream of barrier stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1982	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-22. Grant Line downstream of barrier stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.3	-3.2	-1.1
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.3	-0.8	-1.2
1978	-0.2	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.4	-4.5	-0.5
1982	-0.3	0.0	-0.1	-0.4	-2.3	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.3	-4.0	-1.1
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.9	-2.0	-1.2
1989	-0.2	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1	-2.3	-0.1
1990	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-4.9	-1.6	-1.1
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.4	-1.4	-0.9
1992	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-2.2	-1.5	-0.9
1993	-0.2	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.4	-3.5	-2.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-2.9	-2.1
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.3	-2.0	-1.3
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.5	-0.8	-0.2
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-1.1	-0.8	-0.3
Critical	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.2	-1.9	-1.2
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-2.1	-0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.6	-1.1	-0.1	0.0
Wet	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-23. Middle River upstream of barrier stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-24. Middle River upstream of barrier stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.3	-0.2
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.3	-0.2
1978	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.6	-0.7	-0.2
1982	0.0	0.0	-0.2	-0.1	-1.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.6	-0.2
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.6	-0.3	-0.1
1989	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.2	0.0
1990	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-1.4	-0.3	-0.1
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-0.3	-0.1
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3	-0.1
1993	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.2	-1.2	-0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-1.4	-0.5
1995	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.3	-0.2	-0.1
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.4	-0.2
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-25. Middle River downstream of barrier stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-26. Middle River downstream of barrier stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.9	-2.3	-0.9
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.6	-0.5	-0.8
1978	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-3.4	-0.7
1982	-0.4	0.0	-0.2	-0.1	-1.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-3.2	-0.9
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.1	-1.7	-1.0
1989	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1	-0.7	-0.1
1990	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-3.5	-1.3	-0.8
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.1	-1.2	-0.7
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.8	-1.1	-0.7
1993	-0.1	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.1	-1.0	-0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-1.6	-1.2
1995	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-1.6	-1.7	-1.0
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.6	-0.2
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.6	-0.3
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.7	-1.4	-0.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-1.5	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-27. Old River upstream of barrier stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-28. Old River upstream of barrier stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-1.1	-0.5
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.6	-0.7	-0.5
1978	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	2.3	-1.1	-1.1
1982	0.0	0.0	-0.1	-0.2	-1.5	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-1.5	-0.7
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	-0.9	-0.5
1989	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.4	-0.3
1990	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-2.1	-0.9	-0.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	-0.9	-0.4
1992	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.9	-0.8	-0.5
1993	-0.1	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.4	-3.7	-1.3	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-2.9	-0.8
1995	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.8	-0.8	-0.5
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.2	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.2	-0.4	-0.2
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-1.2	-0.5
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.3	-0.6	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.6	-0.3	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-29. Old River downstream of barrier stage (ft) difference No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-30. Old River downstream of barriers stage (ft) of barrier stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.2	-4.0	-1.4
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.1	-0.7	-1.1
1978	-0.2	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	-8.8	-0.6
1982	-0.5	0.0	-0.2	-0.2	-1.4	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.4	-5.5	-1.7
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-9.2	-2.5	-1.6
1989	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1	-2.5	-0.1
1990	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-7.6	-2.4	-1.3
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-6.7	-2.2	-1.2
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-3.8	-2.2	-1.1
1993	-0.1	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.2	-1.3	-0.8	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-2.4	-2.3
1995	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-3.9	-3.0	-1.6
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.9	-1.1	-0.3
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-1.6	-1.1	-0.4
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.9	-2.3	-1.4
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-3.3	-0.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.9	-0.2	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-31. Grant Line upstream of barrier stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-32. Grant Line upstream of barrier stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.6	-2.8	-2.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-0.9	-0.3
1977	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.8	-0.4	-0.4
1978	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.8	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.8	-1.5
1982	0.0	0.0	-0.1	-0.4	-2.3	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-1.7	-1.5	-0.5
1988	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.2	0.0	-1.9	-0.9	-0.2
1989	0.0	0.1	-0.1	0.2	0.2	-0.2	-0.1	0.3	0.1	0.0	-0.9	-0.7
1990	0.1	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-1.5	-0.6	-0.2
1991	0.0	0.1	0.1	0.2	0.0	-0.1	-0.1	0.0	0.0	-1.0	-0.4	-0.1
1992	0.0	0.1	0.1	0.1	-0.1	-0.1	0.0	0.2	0.1	-2.5	-1.3	-0.4
1993	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	-0.5	-3.3	-1.2	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.2	-0.8
1995	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.4	-1.0	-0.3
2002	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.7	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-0.5	-0.4	-0.2
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	-1.3	-1.0	-0.3
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.9	-0.8	-0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.6	-0.4	-0.1	-0.6	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-33. Grant Line downstream of barrier stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-34. Grant Line downstream of barrier stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.6	-2.8	-2.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.5	-4.0	-1.4
1977	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-4.5	-0.6	-0.9
1978	0.1	0.2	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.8	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-7.3	-0.1
1982	0.0	0.0	-0.1	-0.4	-2.3	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	-3.0	-5.1	-1.4
1988	0.1	0.2	0.0	-0.1	0.0	0.1	0.0	0.2	0.1	-7.7	-2.0	-1.2
1989	0.1	0.3	-0.1	0.2	0.2	-0.2	-0.1	0.3	0.3	-0.1	-5.1	-0.2
1990	0.1	0.2	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-5.1	-1.6	-1.0
1991	0.2	0.2	0.2	0.2	0.0	-0.1	-0.1	0.0	0.2	-3.7	-1.1	-0.6
1992	0.2	0.2	0.1	0.1	-0.1	-0.1	0.0	0.2	0.2	-3.8	-2.6	-0.9
1993	-0.1	0.2	-0.1	-0.2	-0.2	-0.2	-0.1	-0.5	-3.5	-2.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.7	-2.4
1995	0.2	0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
1998	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-4.1	-3.0	-1.4
2002	0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	-0.1	-0.1	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-9.2	0.0	0.0
Average	0.0	0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-1.4	-1.0	-0.3
Critical	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	-4.3	-2.1	-1.2
Dry	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	-1.2	-3.4	-0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.1	0.0	-0.1	-0.3	-0.6	-0.4	-0.1	-0.6	-1.9	0.0	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-35. Middle River upstream of barrier stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-36. Middle River upstream of barrier stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.2	-1.0	-0.5	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.4	-0.2
1977	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.7	-0.2	-0.2
1978	0.0	0.0	0.0	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-1.4	-0.8	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.4
1982	0.0	0.0	-0.2	-0.1	-1.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-1.1	-0.9	-0.2
1988	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.1	0.0	-2.1	-0.3	-0.1
1989	0.0	0.0	-0.1	0.3	0.2	-0.3	-0.2	0.2	0.0	-0.1	-0.6	-0.1
1990	0.0	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-1.4	-0.3	-0.1
1991	0.0	0.0	0.2	0.2	0.0	-0.1	-0.1	0.0	0.0	-1.1	-0.2	-0.1
1992	0.0	0.0	0.2	0.1	-0.1	-0.1	0.0	0.2	0.0	-2.3	-0.5	-0.2
1993	0.0	0.0	-0.1	-0.2	-0.2	-0.3	-0.1	-0.2	-1.2	-0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-1.4	-0.4
1995	0.0	0.0	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.9	-0.4	-0.1
2002	0.0	0.0	-0.1	-0.2	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-1.8	-0.1	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.4	-0.2	-0.1
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-0.5	-0.2
Dry	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.5	-0.4	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.4	-0.1	0.0	-0.2	-0.4	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-37. Middle River downstream of barrier stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-38. Middle River downstream of barrier stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.2	-1.0	-0.5	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.1	-2.9	-1.0
1977	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-3.0	-0.3	-0.6
1978	0.1	0.1	0.0	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-1.4	-0.8	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-4.2	-0.2
1982	0.0	0.0	-0.2	-0.1	-1.1	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	-1.5	-4.1	-1.0
1988	0.1	0.1	-0.1	-0.1	0.0	0.0	0.0	0.2	0.1	-5.1	-1.7	-1.0
1989	0.1	0.2	-0.1	0.3	0.2	-0.3	-0.2	0.3	0.2	-0.1	-1.6	-0.2
1990	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-3.7	-1.3	-0.9
1991	0.2	0.2	0.2	0.2	0.0	-0.1	-0.1	0.0	0.2	-2.6	-1.0	-0.5
1992	0.1	0.2	0.2	0.1	-0.1	-0.1	0.0	0.2	0.1	-1.9	-1.8	-0.7
1993	0.0	0.1	-0.1	-0.2	-0.2	-0.3	-0.1	-0.2	-1.0	-0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-1.5	-1.3
1995	0.2	0.1	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-2.1	-2.1	-1.0
2002	0.2	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	0.0	-0.1	-0.1
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	-2.6	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.7	-0.7	-0.3
Critical	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	-2.6	-1.5	-0.9
Dry	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.1	-0.6	-2.0	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.4	-0.1	-0.1	-0.2	-0.5	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-39. Old River upstream of barrier stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-40. Old River upstream of barrier stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.3	-1.5	-0.9	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-1.3	-0.5
1977	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.0	0.0	-1.3	-0.5	-0.4
1978	0.0	0.0	0.0	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-2.1	-0.9	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-1.6	-1.6
1982	0.0	0.0	-0.2	-0.2	-1.5	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	-1.9	-1.9	-0.6
1988	0.0	0.1	-0.1	-0.1	0.0	0.1	0.0	0.2	0.0	-2.4	-0.9	-0.5
1989	0.0	0.1	-0.1	0.4	0.3	-0.3	-0.2	0.3	0.1	0.0	-1.3	-0.7
1990	0.1	0.1	0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	-2.2	-0.8	-0.4
1991	0.1	0.1	0.2	0.3	0.0	-0.1	-0.1	0.0	0.1	-1.7	-0.6	-0.4
1992	0.0	0.1	0.2	0.2	-0.1	-0.1	0.0	0.2	0.1	-2.5	-1.3	-0.5
1993	0.0	0.0	-0.1	-0.2	-0.2	-0.3	-0.1	-0.5	-3.7	-1.3	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-2.8	-0.8
1995	0.0	0.0	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-2.7	-1.0	-0.3
2002	0.1	0.0	-0.1	-0.2	-0.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	0.0
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.9	-0.6	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.1	-0.5	-0.4	-0.2
Critical	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	-1.6	-1.2	-0.5
Dry	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	-0.8	-1.0	-0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.5	-0.5	-0.2	-0.1	-0.6	-0.4	-0.1	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-41. Old River downstream of barrier stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-42. Old River downstream of barrier stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.2	-1.4	-0.8	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.6	-5.1	-1.7
1977	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	-5.3	-0.5	-0.8
1978	0.2	0.2	0.0	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-2.3	-0.8	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-13.4	-0.1
1982	0.1	0.0	-0.2	-0.2	-1.5	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	-4.0	-7.2	-1.9
1988	0.4	0.3	-0.1	-0.1	0.0	0.2	0.0	0.3	0.1	-12.5	-2.6	-1.6
1989	0.4	0.5	-0.1	0.5	0.3	-0.3	-0.2	0.5	0.4	-0.1	-6.6	-0.2
1990	0.2	0.3	0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	-7.9	-2.4	-1.4
1991	0.3	0.4	0.3	0.3	0.0	-0.1	-0.1	0.0	0.3	-5.6	-1.9	-0.9
1992	0.3	0.3	0.2	0.2	-0.1	-0.1	0.0	0.4	0.3	-4.4	-3.6	-0.9
1993	0.0	0.3	-0.1	-0.2	-0.2	-0.3	-0.1	-0.3	-1.4	-0.8	0.0	0.0
1994	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-2.2	-2.9
1995	0.3	0.3	-0.1	-0.2	-0.2	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0
1996	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
1998	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
2001	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3	-4.8	-3.7	-1.9
2002	0.6	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1
2003	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	-10.8	0.0	0.0
Average	0.1	0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-1.9	-1.4	-0.4
Critical	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.1	0.1	-6.2	-2.6	-1.5
Dry	0.2	0.1	0.0	0.0	0.0	-0.1	0.0	0.1	0.2	-1.5	-5.2	-0.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.1	0.0	-0.1	-0.5	-0.5	-0.2	-0.1	-0.3	-1.9	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-43. Old River near Middle River location Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	4.2	4.2	3.4	8.5	5.4	5.4	3.8	3.3	4.0	3.8	3.8	3.9
1971	4.0	3.9	3.1	3.0	2.8	3.9	3.9	3.5	4.0	3.7	3.8	3.9
1972	4.0	3.9	2.4	2.5	2.9	2.8	3.2	3.1	3.9	3.7	3.8	3.9
1973	4.1	3.9	3.1	3.4	4.4	5.2	4.6	4.1	4.2	3.9	4.1	4.0
1974	4.0	3.8	3.3	4.7	3.5	5.6	5.5	4.0	5.2	4.4	4.2	4.2
1975	4.1	4.0	2.6	2.6	4.3	5.8	4.9	3.3	6.1	4.5	4.3	4.0
1976	4.0	4.0	2.3	2.6	2.8	2.6	3.0	2.9	3.8	3.7	4.1	4.1
1977	4.0	3.9	2.7	2.6	2.5	2.1	2.1	2.5	3.5	3.6	3.7	3.9
1978	3.8	3.7	2.6	3.6	4.9	5.3	7.0	6.4	6.8	4.7	4.3	4.2
1979	3.9	3.9	2.4	3.6	4.7	5.7	5.0	5.1	3.9	3.7	4.1	3.9
1980	4.0	3.9	2.6	7.1	9.7	8.6	4.9	4.7	7.1	5.9	4.4	4.2
1981	4.1	3.9	2.5	2.9	2.9	3.6	3.6	3.2	3.7	3.7	3.8	3.8
1982	3.9	3.8	3.0	3.6	6.9	8.1	11.8	8.9	7.4	6.4	5.0	6.0
1983	5.8	7.5	9.7	11.9	13.3	16.8	11.0	10.6	11.8	10.8	6.8	6.4
1984	4.6	9.2	10.7	7.9	6.0	5.2	4.6	3.6	4.3	4.1	4.2	4.5
1985	4.3	4.0	2.6	2.8	2.9	3.3	3.6	3.1	3.8	3.7	3.9	4.0
1986	3.9	3.8	2.6	2.8	9.4	11.4	6.8	6.2	6.6	4.3	4.3	4.5
1987	4.3	4.2	2.7	2.6	2.9	3.1	2.8	3.0	3.7	3.7	4.0	4.0
1988	4.0	3.9	2.7	2.6	2.8	2.6	2.7	2.6	3.5	3.5	3.7	3.9
1989	3.8	3.7	2.2	2.2	2.5	2.9	2.7	2.5	3.6	3.4	3.7	3.9
1990	3.7	3.8	2.6	2.5	2.5	2.4	2.5	2.7	3.6	3.5	3.8	3.9
1991	3.9	3.8	2.5	2.5	2.7	3.2	2.5	2.4	3.5	3.5	3.7	3.8
1992	3.9	3.8	2.7	2.7	3.6	3.3	2.7	2.7	3.6	3.6	3.7	3.8
1993	3.9	3.8	2.6	4.2	4.0	3.6	3.4	3.6	4.8	4.2	4.1	4.1
1994	4.0	3.9	2.4	2.5	2.8	2.6	2.5	2.7	3.6	3.4	3.6	3.7
1995	3.9	3.7	2.5	4.2	3.4	9.0	7.3	9.7	7.8	9.2	5.1	4.2
1996	4.1	3.9	2.8	3.1	6.8	6.4	5.2	4.9	5.2	4.1	4.1	4.1
1997	4.0	4.0	9.3	18.5	10.6	6.2	3.9	4.4	4.7	3.9	4.2	4.2
1998	4.2	4.2	3.0	4.3	10.7	8.0	8.1	8.3	9.1	9.4	5.3	4.9
1999	4.3	4.0	2.8	3.8	6.4	4.9	4.6	3.6	4.4	3.8	3.9	4.0
2000	3.9	3.8	2.0	2.7	6.6	5.7	4.6	3.9	4.1	3.8	3.9	4.1
2001	4.1	3.8	2.3	2.7	2.9	3.4	3.5	3.1	3.7	3.7	3.8	4.0
2002	3.9	3.8	2.6	3.0	2.5	2.8	2.8	2.8	3.6	3.5	3.8	3.9
2003	3.9	3.8	3.0	2.9	2.8	2.6	3.4	3.0	3.6	3.5	3.8	3.8
Average	4.1	4.2	3.3	4.2	4.9	5.1	4.5	4.2	4.9	4.5	4.1	4.2
Critical	3.9	3.9	2.5	2.6	2.8	2.7	2.6	2.6	3.6	3.5	3.8	3.9
Dry	4.1	3.9	2.5	2.7	2.8	3.2	3.2	2.9	3.7	3.6	3.8	3.9
BN	3.9	3.9	2.4	3.1	3.8	4.3	4.1	4.1	3.9	3.7	4.0	3.9
AN	3.9	3.8	2.6	4.0	5.4	5.2	4.6	4.3	5.1	4.3	4.1	4.1
Wet	4.2	4.6	4.5	6.1	6.9	7.4	6.3	5.7	6.2	5.6	4.5	4.5

Table 2-44. Old River near Tracy location Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	4.1	4.2	2.6	5.0	3.4	3.2	2.4	2.5	3.9	3.7	3.7	3.8
1971	3.9	3.8	2.6	2.3	2.0	2.3	2.5	2.7	3.8	3.6	3.7	3.8
1972	3.9	3.8	1.8	2.1	2.4	2.2	2.3	2.5	3.8	3.6	3.7	3.8
1973	4.0	3.9	2.5	2.9	3.4	3.1	2.7	2.9	4.0	3.7	4.0	3.9
1974	3.9	3.7	2.4	3.3	2.4	3.4	3.5	2.9	4.8	4.2	4.1	4.0
1975	4.0	3.9	1.9	2.0	2.9	3.4	3.1	2.6	5.3	4.3	4.1	3.9
1976	3.9	3.9	1.7	2.0	2.2	2.0	2.3	2.4	3.7	3.6	4.1	4.1
1977	4.0	3.8	2.3	2.1	2.1	1.8	1.8	2.2	3.5	3.5	3.6	3.9
1978	3.8	3.7	2.2	3.0	3.4	3.4	4.1	4.0	5.6	4.5	4.1	4.1
1979	3.8	3.9	1.8	2.6	3.0	3.3	3.1	3.3	3.8	3.6	4.0	3.9
1980	3.9	3.8	2.0	4.2	6.0	4.9	3.0	3.2	5.8	5.2	4.3	4.0
1981	4.0	3.8	1.9	2.4	2.3	2.6	2.5	2.6	3.6	3.6	3.7	3.7
1982	3.8	3.7	2.4	2.8	3.9	4.5	7.4	4.9	5.5	5.4	4.7	5.4
1983	5.2	6.2	5.6	7.5	8.8	11.6	6.8	6.3	7.2	6.4	5.7	5.6
1984	4.4	7.1	6.6	4.5	3.5	3.1	2.8	2.7	4.2	3.9	4.1	4.3
1985	4.1	3.9	2.0	2.2	2.1	2.2	2.4	2.4	3.7	3.6	3.8	3.9
1986	3.9	3.7	2.0	2.3	5.8	6.9	3.8	3.8	5.5	4.2	4.2	4.3
1987	4.2	4.1	2.2	2.0	2.3	2.4	2.1	2.6	3.7	3.6	4.0	3.9
1988	3.9	3.9	2.2	2.2	2.4	2.2	2.2	2.2	3.4	3.4	3.7	3.8
1989	3.7	3.6	1.8	1.7	2.0	2.3	2.1	2.3	3.5	3.3	3.7	3.9
1990	3.7	3.8	2.2	2.1	2.0	2.0	2.1	2.5	3.5	3.5	3.8	3.9
1991	3.8	3.8	2.1	2.2	2.2	2.6	1.9	2.1	3.5	3.4	3.7	3.8
1992	3.9	3.8	2.3	2.3	3.0	2.7	2.3	2.5	3.5	3.5	3.7	3.8
1993	3.9	3.8	2.2	3.2	3.1	2.7	2.6	3.0	4.5	4.1	4.0	4.0
1994	3.9	3.8	1.8	2.1	2.2	2.1	2.1	2.4	3.5	3.3	3.5	3.6
1995	3.8	3.7	2.1	3.4	2.8	5.5	4.1	5.6	4.0	5.0	4.7	4.1
1996	4.0	3.9	2.2	2.5	4.2	3.7	3.2	3.4	4.7	4.0	4.0	4.0
1997	4.0	3.9	5.2	12.6	6.2	3.3	2.5	3.1	4.4	3.8	4.1	4.1
1998	4.1	4.2	2.4	3.3	7.0	4.5	4.5	4.7	5.0	5.1	4.8	4.6
1999	4.1	3.9	2.0	2.5	3.6	3.0	2.9	2.7	4.2	3.7	3.8	3.9
2000	3.9	3.8	1.5	2.1	4.0	3.2	2.8	2.8	4.0	3.7	3.8	4.0
2001	4.0	3.7	1.6	2.1	2.3	2.5	2.3	2.5	3.6	3.6	3.8	3.9
2002	3.8	3.8	2.1	2.3	2.0	2.2	2.2	2.4	3.5	3.4	3.7	3.8
2003	3.8	3.8	2.5	2.5	2.4	2.0	2.5	2.5	3.5	3.4	3.7	3.7
Average	4.0	4.0	2.4	3.1	3.3	3.3	3.0	3.0	4.2	4.0	4.0	4.0
Critical	3.9	3.8	2.1	2.1	2.3	2.2	2.1	2.3	3.5	3.5	3.7	3.8
Dry	4.0	3.8	1.9	2.1	2.2	2.4	2.3	2.5	3.6	3.5	3.8	3.8
BN	3.8	3.8	1.8	2.4	2.7	2.7	2.7	2.9	3.8	3.6	3.9	3.8
AN	3.9	3.8	2.2	3.0	3.7	3.2	3.0	3.1	4.6	4.1	4.0	4.0
Wet	4.1	4.3	3.1	4.2	4.3	4.5	3.8	3.7	4.8	4.4	4.3	4.3

Table 2-45. Middle River downstream of Old River location Base stage (ft).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	3.9	3.9	3.1	7.6	4.8	4.7	3.3	2.9	3.7	3.5	3.6	3.7
1971	3.7	3.7	2.9	2.8	2.5	3.4	3.5	3.2	3.6	3.4	3.6	3.7
1972	3.7	3.7	2.3	2.4	2.7	2.5	2.9	2.8	3.6	3.4	3.6	3.7
1973	3.8	3.7	2.9	3.3	4.1	4.6	4.0	3.6	3.8	3.6	3.8	3.7
1974	3.8	3.6	3.0	4.3	3.1	4.9	4.9	3.5	4.6	4.0	3.9	3.9
1975	3.8	3.8	2.4	2.4	3.8	5.1	4.3	3.0	5.3	4.0	3.9	3.8
1976	3.8	3.7	2.1	2.4	2.6	2.3	2.7	2.6	3.5	3.5	3.9	3.9
1977	3.8	3.7	2.6	2.5	2.3	2.0	2.0	2.4	3.3	3.4	3.5	3.7
1978	3.6	3.6	2.5	3.4	4.4	4.8	6.2	5.6	6.0	4.2	3.9	3.9
1979	3.7	3.7	2.3	3.3	4.2	5.0	4.4	4.4	3.6	3.4	3.8	3.7
1980	3.8	3.7	2.4	6.3	8.7	7.7	4.3	4.1	6.3	5.2	4.1	3.9
1981	3.8	3.6	2.4	2.8	2.7	3.3	3.2	2.9	3.4	3.4	3.6	3.6
1982	3.7	3.6	2.8	3.4	6.1	7.2	10.7	7.8	6.5	5.6	4.5	5.4
1983	5.2	6.7	8.6	10.7	12.1	15.3	9.9	9.5	10.6	9.7	6.0	5.7
1984	4.2	8.3	9.6	7.0	5.3	4.6	4.0	3.2	3.9	3.7	3.9	4.1
1985	4.0	3.8	2.4	2.6	2.7	3.0	3.2	2.7	3.5	3.4	3.7	3.7
1986	3.7	3.6	2.4	2.6	8.4	10.2	6.0	5.4	5.8	3.9	4.0	4.1
1987	4.0	3.9	2.6	2.4	2.7	2.9	2.5	2.8	3.5	3.5	3.8	3.7
1988	3.7	3.7	2.5	2.5	2.7	2.4	2.5	2.4	3.3	3.3	3.6	3.7
1989	3.6	3.5	2.1	2.1	2.3	2.7	2.5	2.4	3.4	3.2	3.6	3.7
1990	3.6	3.6	2.5	2.4	2.3	2.2	2.4	2.6	3.4	3.3	3.6	3.7
1991	3.7	3.6	2.3	2.4	2.5	3.0	2.2	2.2	3.4	3.3	3.6	3.7
1992	3.7	3.6	2.5	2.5	3.4	3.1	2.6	2.6	3.4	3.4	3.6	3.6
1993	3.7	3.6	2.5	3.9	3.7	3.4	3.1	3.4	4.3	3.8	3.8	3.8
1994	3.7	3.7	2.2	2.4	2.7	2.4	2.3	2.6	3.4	3.2	3.5	3.5
1995	3.7	3.5	2.3	4.0	3.2	8.1	6.4	8.7	6.8	8.1	4.6	3.9
1996	3.8	3.7	2.6	2.9	6.1	5.7	4.6	4.4	4.5	3.7	3.8	3.8
1997	3.8	3.8	8.3	16.8	9.5	5.5	3.4	3.9	4.2	3.6	3.9	3.9
1998	3.9	4.0	2.8	4.0	9.7	7.2	7.2	7.4	8.0	8.3	4.8	4.4
1999	3.9	3.7	2.5	3.4	5.7	4.4	4.1	3.2	3.9	3.5	3.7	3.7
2000	3.7	3.6	1.9	2.5	5.9	5.0	4.0	3.5	3.8	3.5	3.7	3.9
2001	3.8	3.6	2.1	2.5	2.7	3.1	3.2	2.8	3.4	3.5	3.6	3.7
2002	3.6	3.6	2.5	2.8	2.4	2.6	2.5	2.6	3.4	3.3	3.6	3.7
2003	3.6	3.6	2.8	2.8	2.7	2.4	3.1	2.8	3.4	3.3	3.6	3.6
Average	3.8	3.9	3.1	3.9	4.4	4.6	4.1	3.8	4.4	4.1	3.9	3.9
Critical	3.7	3.7	2.4	2.4	2.7	2.5	2.4	2.5	3.4	3.4	3.6	3.7
Dry	3.8	3.7	2.3	2.5	2.6	2.9	2.9	2.7	3.4	3.4	3.6	3.7
BN	3.7	3.7	2.3	2.8	3.5	3.8	3.6	3.6	3.6	3.4	3.7	3.7
AN	3.7	3.6	2.5	3.7	4.9	4.7	4.1	3.8	4.6	3.9	3.8	3.8
Wet	3.9	4.3	4.1	5.5	6.2	6.6	5.6	5.1	5.5	5.0	4.2	4.2

Table 2-46. Old River near Middle River location stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-47. Old River near Middle River location stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.4	-4.2	-3.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-1.7	-0.7
1977	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-1.1	-1.0	-0.7
1978	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-1.5
1982	0.0	0.0	-0.1	-1.1	-3.1	-1.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-2.0	-1.9	-0.8
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-3.0	-2.6	-0.3
1989	-0.1	0.1	0.0	0.1	0.1	-0.1	-0.1	0.2	0.1	0.0	-0.8	-0.7
1990	0.1	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	-2.9	-1.0	-0.4
1991	0.0	0.1	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	-2.3	-0.8	-0.3
1992	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.2	0.1	-3.7	-1.9	-0.3
1993	-0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-1.1	-4.4	-1.4	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.3	-1.2
1995	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.3	-1.2	-0.5
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.7	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.1	-0.6	-0.5	-0.2
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	-1.7	-0.6
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.9	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.5	-0.2	-0.7	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-48. Old River near Tracy location stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-49. Old River near Tracy location stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.6	-2.8	-2.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-2.1	-0.7
1977	-0.1	0.0	0.1	0.2	0.1	0.1	0.2	0.0	0.0	-1.5	-1.0	-0.8
1978	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.8	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-1.6
1982	0.0	0.0	-0.1	-0.4	-2.4	-1.2	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-2.3	-2.2	-0.8
1988	-0.1	0.1	0.0	-0.1	0.0	0.1	0.0	0.1	0.0	-3.3	-2.6	-0.4
1989	-0.1	0.1	-0.1	0.3	0.2	-0.2	-0.2	0.3	0.1	0.0	-0.9	-0.7
1990	0.1	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-2.5	-1.1	-0.4
1991	0.0	0.1	0.2	0.2	0.0	-0.1	-0.1	0.0	0.0	-2.2	-0.9	-0.3
1992	0.0	0.1	0.2	0.2	-0.1	-0.1	0.0	0.2	0.1	-4.1	-2.1	-0.4
1993	-0.1	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	-0.5	-3.6	-1.3	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.8	-1.3
1995	-0.1	0.0	0.0	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.4	-2.7	-0.5
2002	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.7	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.1	-0.7	-0.6	-0.2
Critical	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	-2.1	-1.9	-0.6
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.9	-1.2	-0.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.6	-0.4	-0.1	-0.6	-0.4	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-50. Middle River downstream of Old River location stage (ft) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-51. Middle River downstream of Old River location stage percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.3	-4.2	-3.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-1.5	-0.6
1977	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-1.0	-0.8	-0.6
1978	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-1.2
1982	0.0	0.0	-0.1	-0.9	-3.1	-1.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-1.7	-1.5	-0.6
1988	-0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.0	-3.6	-2.0	-0.3
1989	-0.1	0.0	0.0	0.1	0.2	-0.2	-0.1	0.2	0.1	0.0	-0.7	-0.6
1990	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	-2.3	-0.8	-0.3
1991	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	-1.8	-0.6	-0.2
1992	0.0	0.0	0.2	0.1	-0.1	-0.1	0.0	0.2	0.0	-3.5	-1.4	-0.2
1993	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.8	-3.8	-1.2	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.7	-0.8
1995	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.8	-1.0	-0.4
2002	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-0.6	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.1	-0.6	-0.4	-0.2
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-1.9	-1.4	-0.4
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.7	-0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.5	-0.1	-0.6	-0.4	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-52. Old River near Middle River location stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-53. Old River near Middle River location stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-0.6	-0.3
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.6	-0.5
1978	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	2.7	-1.2	-1.1
1982	0.0	0.0	-0.1	-1.1	-3.1	-1.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.8	-0.4
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-1.1	-0.2
1989	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.3	-0.3
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-0.5	-0.2
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.5	-0.2
1992	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	2.0	-0.4	-0.2
1993	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0	-1.1	-4.4	-1.4	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-2.2	-0.7
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.2	-0.4	-0.3
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.3	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.8	-0.3
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	-0.4	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.7	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-54. Old River near Tracy location stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-55. Old River near Tracy location stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.7	-0.3
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.6	-0.5
1978	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	2.2	-1.3	-1.1
1982	0.0	0.0	-0.1	-0.4	-2.4	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-1.0	-0.4
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-0.9	-0.3
1989	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.3	-0.2
1990	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-1.5	-0.6	-0.3
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.5	-0.2
1992	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.7	-0.5	-0.3
1993	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.4	-3.6	-1.3	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-2.5	-0.8
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.6	-0.5	-0.3
2002	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.3	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.9	-0.4
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	-0.5	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.6	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-56. Middle River downstream of Old River location stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-57. Middle River downstream of Old River location stage percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.5	-0.2
1977	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.5	-0.4
1978	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.7	-1.0	-0.9
1982	0.0	0.0	-0.1	-0.9	-3.1	-1.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.6	-0.3
1988	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-0.8	-0.2
1989	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.2	-0.2
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.4	-0.2
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-0.4	-0.2
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	1.1	-0.3	-0.2
1993	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	-0.8	-3.8	-1.2	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-1.7	-0.5
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.4	-0.4	-0.3
2002	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.3	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.7	-0.3
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-0.4	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.6	-0.3	0.0	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-58. Old River near Middle River location stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-59. Old River near Middle River location stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.4	-4.2	-3.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-0.7	-0.3
1977	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.5	-0.4	-0.3
1978	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-1.5
1982	0.0	0.0	-0.1	-1.1	-3.1	-1.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-1.4	-1.2	-0.5
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-1.6	-1.4	-0.2
1989	0.0	0.1	0.0	0.1	0.1	-0.1	-0.1	0.2	0.1	0.0	-0.8	-0.7
1990	0.1	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	-1.8	-0.5	-0.2
1991	0.0	0.1	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	-1.1	-0.4	-0.1
1992	0.0	0.1	0.1	0.1	-0.1	0.0	0.0	0.2	0.1	-2.2	-1.2	-0.1
1993	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-1.1	-4.4	-1.4	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.1	-0.7
1995	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.7	-0.8	-0.3
2002	0.1	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.7	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.1	-0.4	-0.3	-0.1
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-1.0	-0.3
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	-0.7	-0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.5	-0.2	-0.7	-0.3	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-60. Old River near Tracy location stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
1982	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-61. Old River near Tracy location stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.6	-2.8	-2.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.5	-0.9	-0.3
1977	0.0	0.0	0.1	0.2	0.1	0.1	0.2	0.0	0.0	-0.8	-0.4	-0.4
1978	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.8	-0.5	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-1.6
1982	0.0	0.0	-0.1	-0.4	-2.4	-1.2	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-1.6	-1.5	-0.5
1988	0.0	0.1	0.0	-0.1	0.0	0.1	0.0	0.2	0.0	-1.9	-1.3	-0.2
1989	0.0	0.1	-0.1	0.3	0.2	-0.2	-0.2	0.3	0.1	0.0	-0.9	-0.7
1990	0.1	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	-1.6	-0.6	-0.2
1991	0.0	0.1	0.2	0.2	0.0	-0.1	-0.1	0.0	0.0	-1.1	-0.4	-0.1
1992	0.0	0.1	0.2	0.2	-0.1	-0.1	0.0	0.2	0.1	-2.5	-1.3	-0.2
1993	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	-0.5	-3.6	-1.3	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.3	-0.8
1995	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.0	-1.8	-0.3
2002	0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.7	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.1	-0.5	-0.4	-0.2
Critical	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	-1.3	-1.0	-0.3
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.8	-1.0	-0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.1	-0.3	-0.6	-0.4	-0.1	-0.6	-0.4	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-62. Middle River downstream of Old River location stage (ft) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-63. Middle River downstream of Old River location stage percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.3	-4.2	-3.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-0.6	-0.2
1977	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.5	-0.4	-0.3
1978	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	-1.2
1982	0.0	0.0	-0.1	-0.9	-3.1	-1.4	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	-1.2	-0.9	-0.4
1988	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.1	0.0	-1.9	-1.1	-0.2
1989	0.0	0.0	0.0	0.1	0.2	-0.2	-0.1	0.2	0.1	0.0	-0.7	-0.6
1990	0.0	0.0	0.1	0.0	-0.1	0.0	0.0	0.0	0.0	-1.5	-0.4	-0.2
1991	0.0	0.0	0.1	0.1	0.0	-0.1	-0.1	0.0	0.0	-0.9	-0.3	-0.1
1992	0.0	0.0	0.2	0.1	-0.1	-0.1	0.0	0.2	0.0	-2.2	-0.9	-0.1
1993	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.8	-3.8	-1.2	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.6	-0.5
1995	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.3	-0.7	-0.2
2002	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	-0.6	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	-0.1	-0.4	-0.3	-0.1
Critical	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-0.7	-0.2
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.6	-0.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.5	-0.1	-0.6	-0.4	-0.1	0.0
Wet	0.0	0.0	0.0	-0.1	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-64. Middle River downstream of Old River location maximum stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-65. Old River near Tracy location maximum stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-66. Old River near Middle River location maximum stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-67. Grant Line Canal upstream of barrier location maximum stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
1982	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2-68. Old River upstream of barrier location maximum stage (ft) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

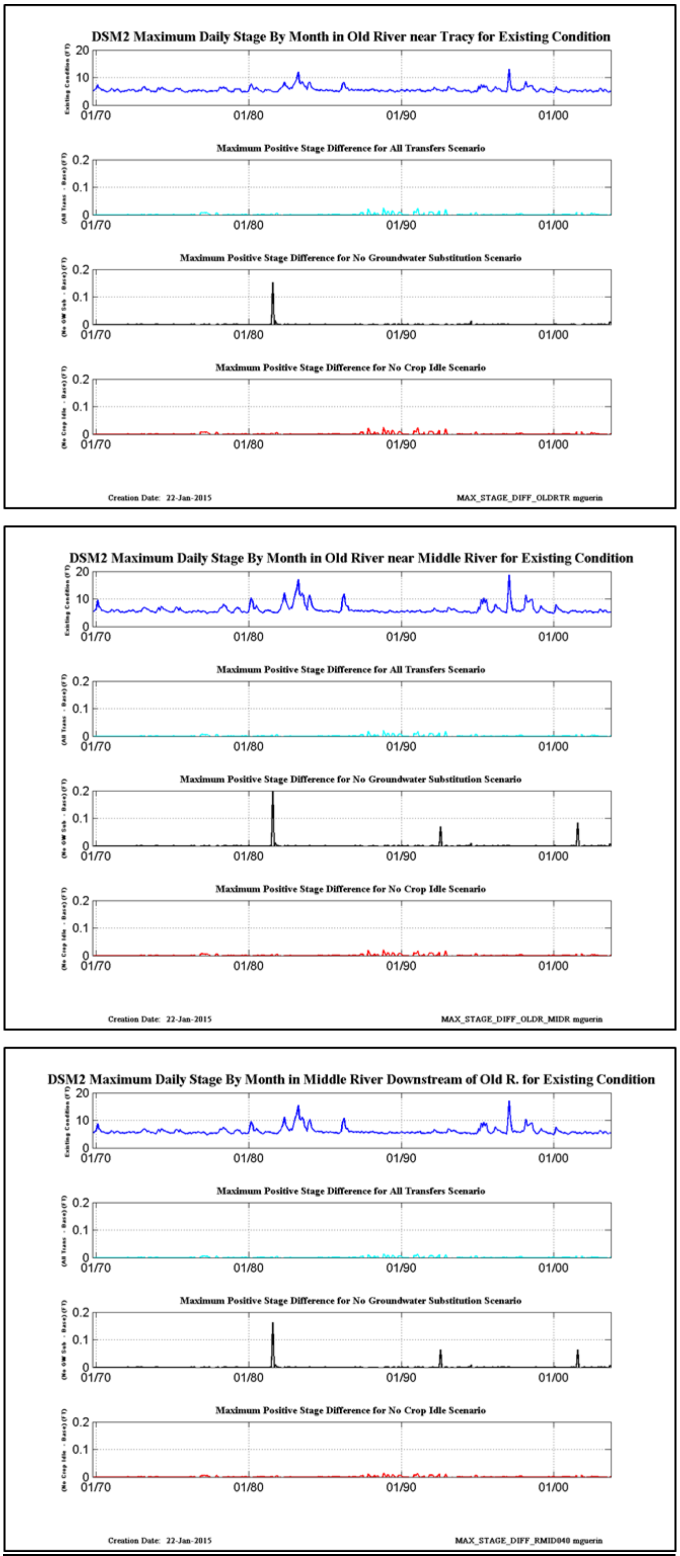
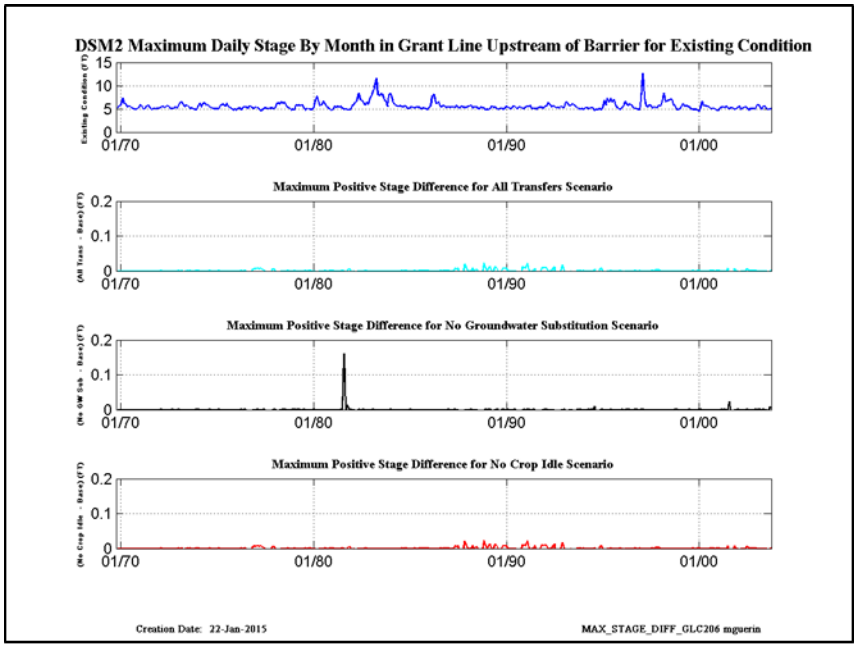


Figure 2-11. Figures show the maximum positive stage difference at three locations.



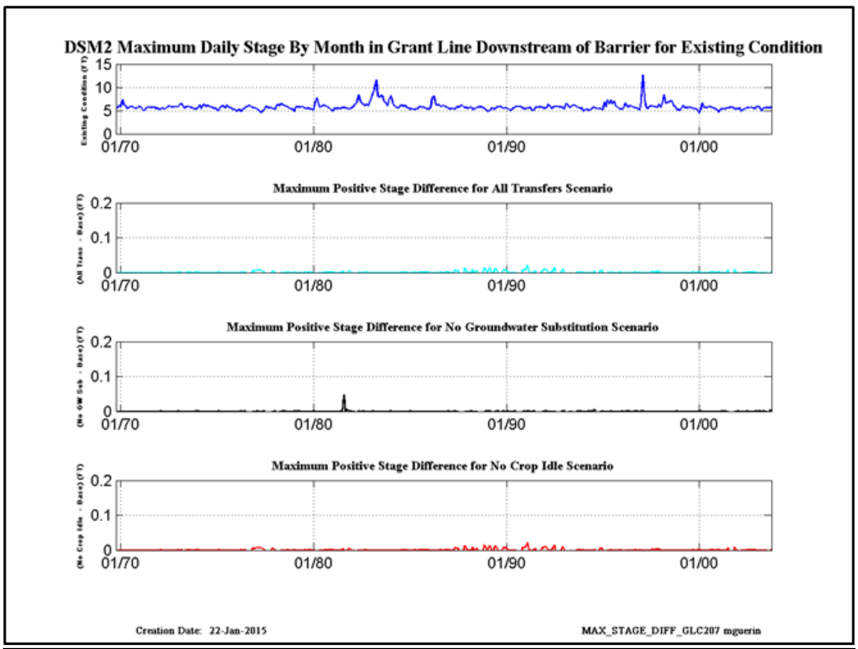


Figure 2-12. Figures show the maximum positive stage difference upstream and downstream of the barrier in Grant Line Canal.

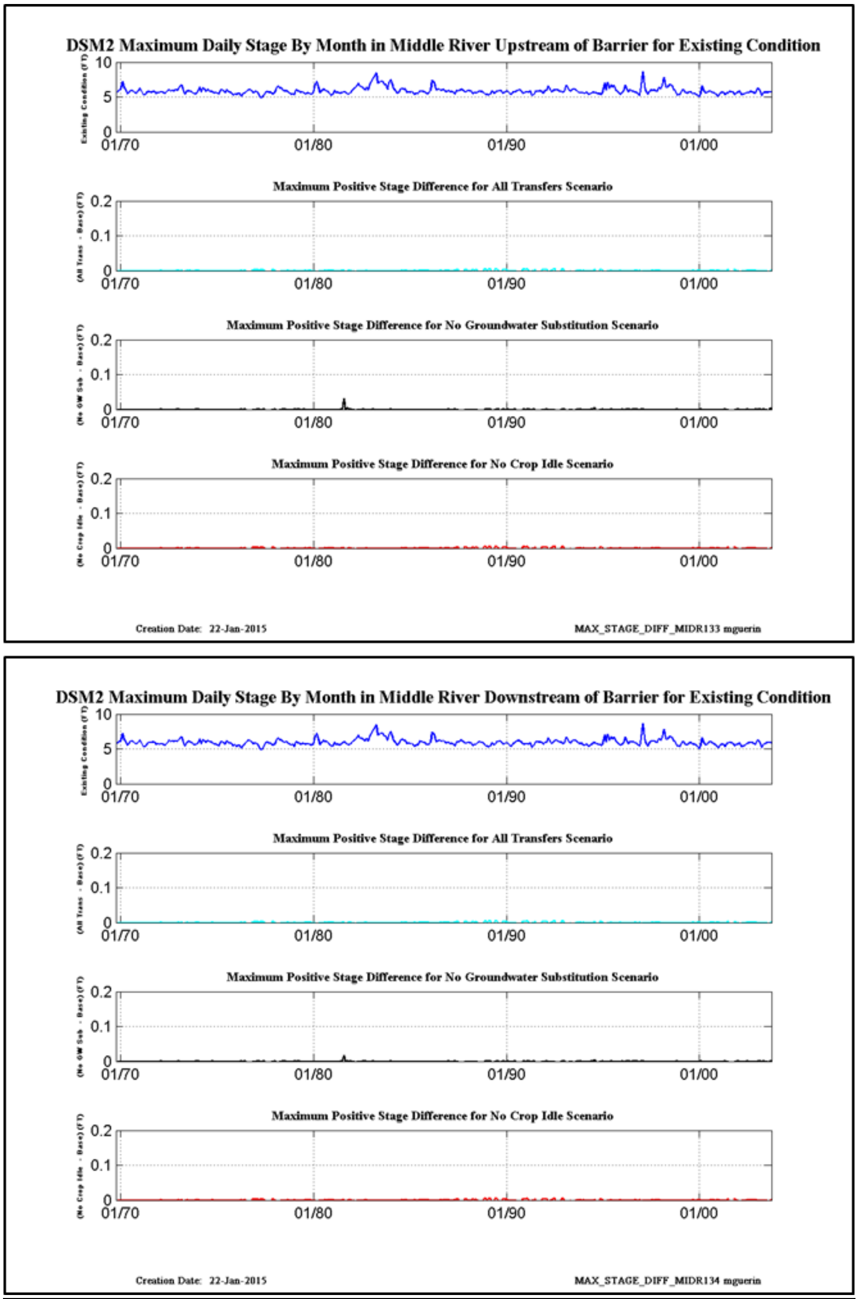
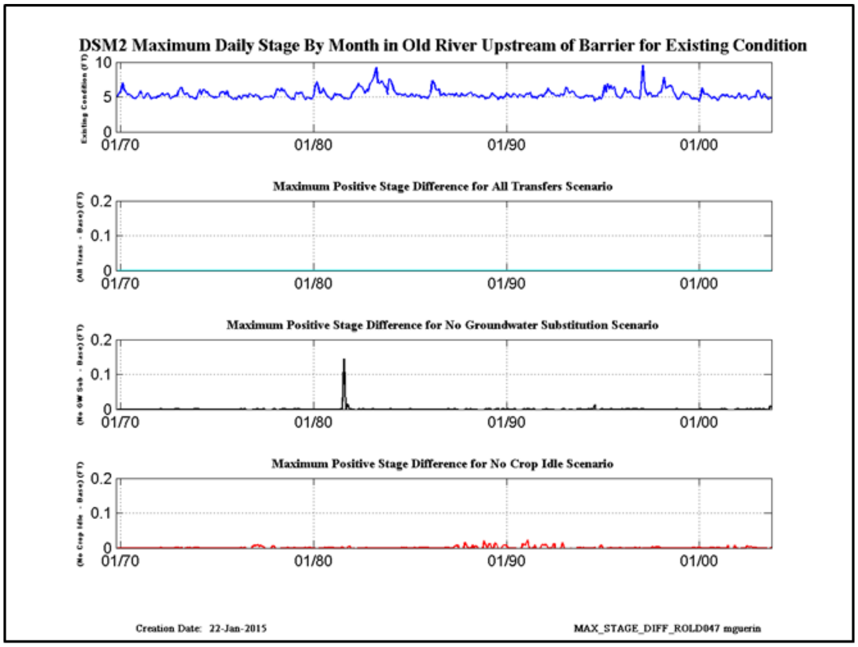


Figure 2-13. Figures show the maximum positive stage difference upstream and downstream of the barrier in Middle River.



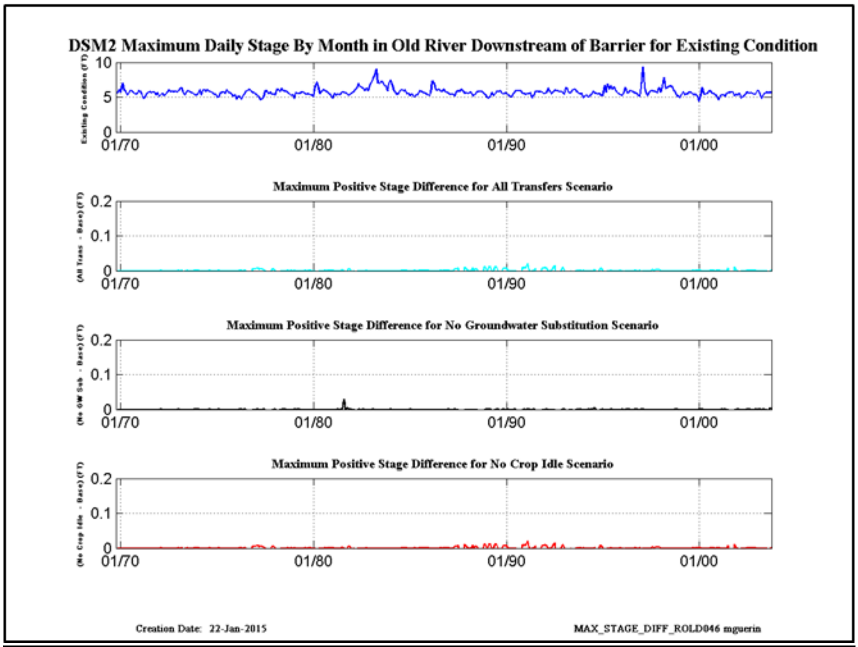


Figure 2-14. Figures show the maximum positive stage difference upstream and downstream of the barrier in Old River.

C.1.3 X2 Model Output

X2 is defined as the distance in km from Golden Gate to the position of 2.0 ppt (parts per thousand) bottom salinity. Using EC data analysis at stations throughout the Delta, regression relationships were developed relating Net Delta Outflow (NDO) to EC measurements (Jassby *et.al.*, 1995). Using these data, it was also found that 2.0 ppt corresponds to 2640 µS cm^{-1} surface EC and to 3000 µS cm^{-1} bottom EC.

The position of X2 is regulated from February to June each year by the 1995 Bay/Delta Plan (SWRCB, 1995). The compliance standard for the position of X2 can be met either with flow objectives specified by the Net Delta Outflow Index (NDOI) or as an equivalent EC standard, each of which vary with the Sacramento Water Year Type[1]. Compliance is met by a 3-day NDOI for an X2 location at Collinsville (81 km, NDOI=7100 cfs), Chipps (75 km, NDOI=11,400 cfs) or at Port Chicago (64 km, NDOI=29,200 cfs). Equivalently, compliance can also be met at these locations using surface EC of 2640 µmhos cm^{-1}on a daily basis or on a 14-day running average basis.

DSM2 is depth-averaged EC, so as a proxy for X2, the methodology developed to use DSM2 EC output for the calculation of X2 assumed that the average of the top and bottom EC values for X2, 2820 µmhos cm^{-1} was the *de facto* location of X2. Using this estimate, the monthly average DSM2 EC output at six RKI[2] locations in the western Delta – RSAC054, RSAC064, RSAC075, RSAC077, RSAC081, RSAC084, RSAC092 and RSAC101 – were used to calculate X2 (see **Error! Reference source not found.**). Eastward movement of X2 is less desirable from a fish habitat standpoint.

Linear interpolation was used to estimate the location of X2 between successive points. Two exceptions occurred: if EC at RSAC054 (Martinez boundary) EC was less than 2820 µmhos cm^{-1}, X2 was set to be 54 km, or if EC at RSAC101was greater than 2820 µmhos cm^{-1}, X2 was set to be101 km – the latter case did not occur. When 2820 µmhos cm^{-1} occurred between two adjacent RKI locations, RKI_1 and RKI_2 (in km), the average change in EC per km between the points, delta_X2, was used to calculate the position of X2 as follows, where EC(RKI_1) is the EC at RKI_1:

$$X2 = RKI_1 + (2820 – EC (RKI_1))/delta\_X2$$

[1]Sacramento R. Water Year Index = 0.4 * Current Apr-Jul Runoff Forecast (MAF) + 0.3 * Current Oct-Mar Runoff (MAF) + 0.3 * Previous Water Year's Index (if it exceeds 10.0, then 10.0 is used)

[2]RKI is River Kilometer Index, the distance from the Golden Gate in km.

For each scenario, the position of X2 was calculated using the linear interpolation method. Plots of monthly average of X2 position are presented below, with Figure 3-3 also showing the change in X2, (Scenario minus Base), for all three alternative scenarios.

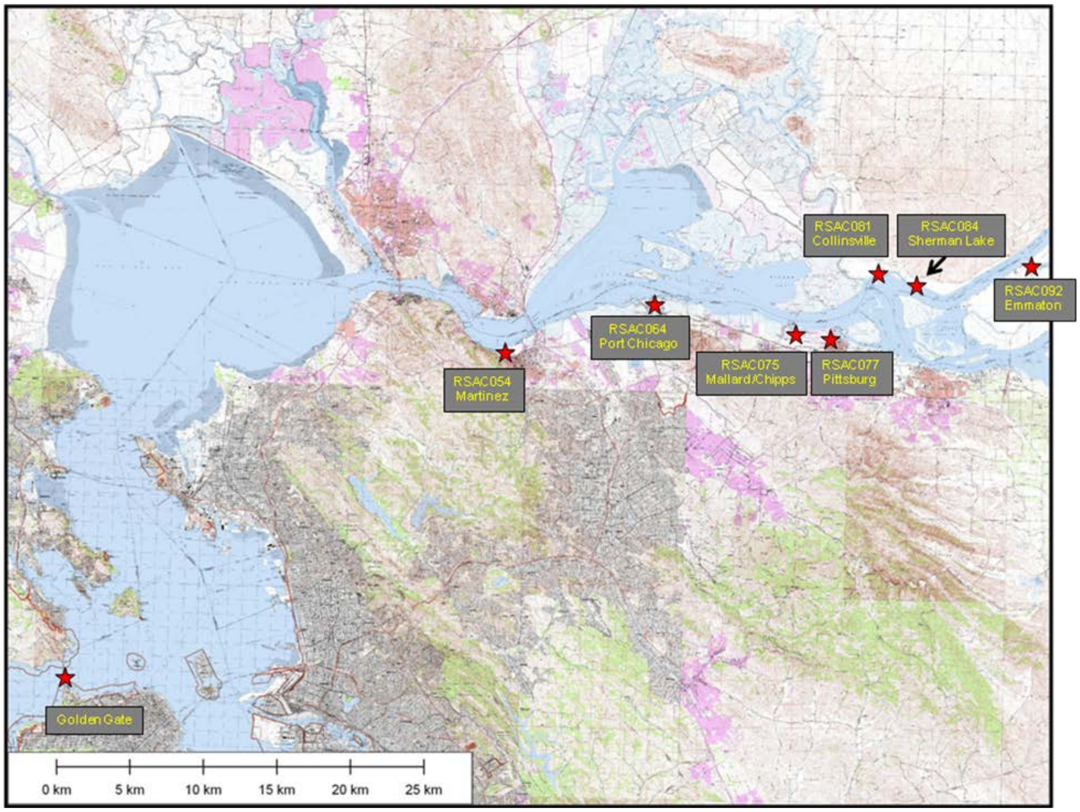


Figure 3-1. DSM2 Output locations used in the calculation of X2 are on the Sacramento River from Rio Vista (upstream of Emmaton) to Martinez

C.1.3.1 Reference

Jassby, A.D., W.J. Kimmerer, S.G. Monosmith, C. Armour, J.E. Cloern, T.M. Powell, J.R. Schubel, T.J. Vendlinski. 1995. “Isohaline Position as a Habitat Indicator”, Ecological Applications 5:1, pp 272 – 289.

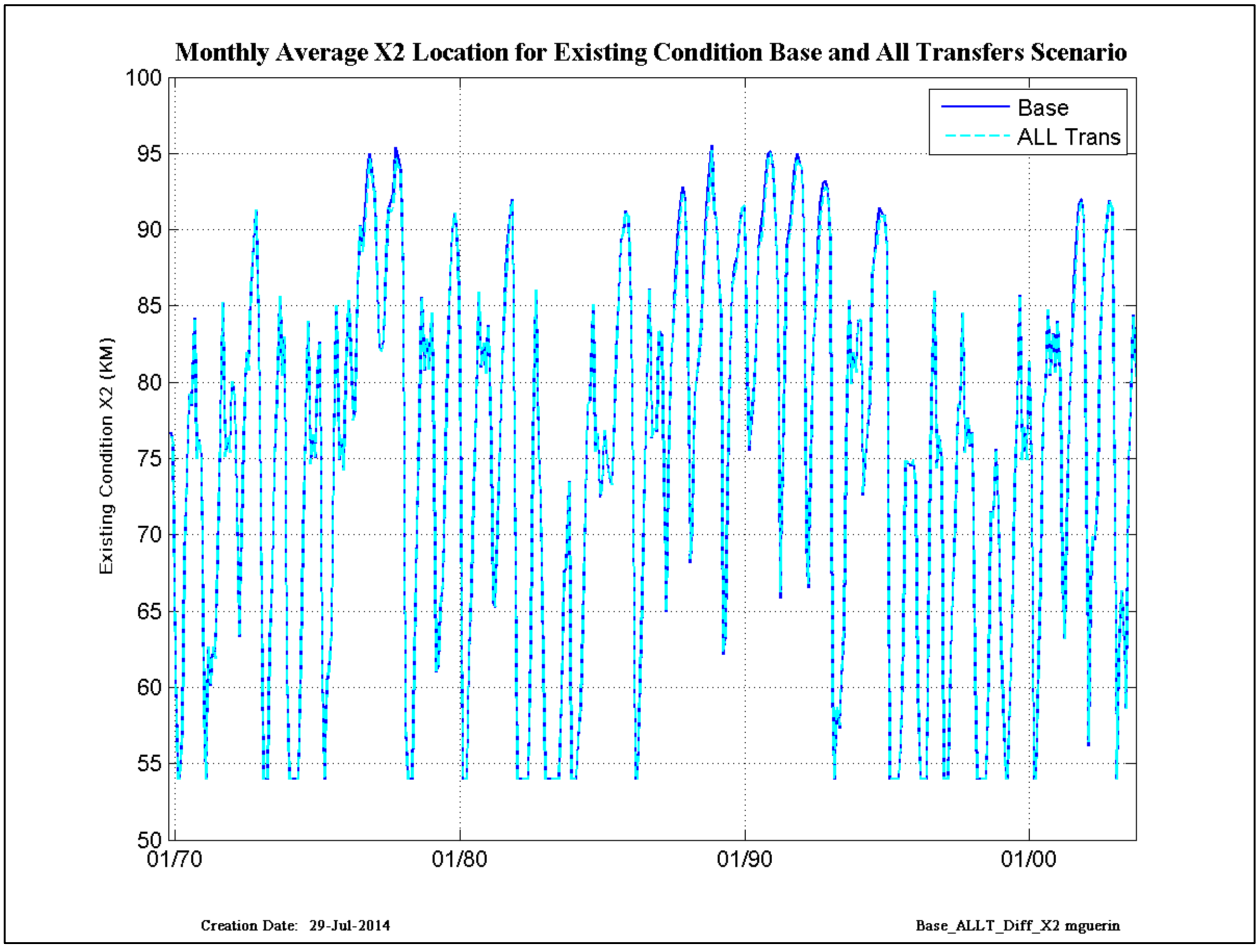


Figure 3-2. Monthly Average X2 Location for Existing Condition Base and All Transfers Scenario.

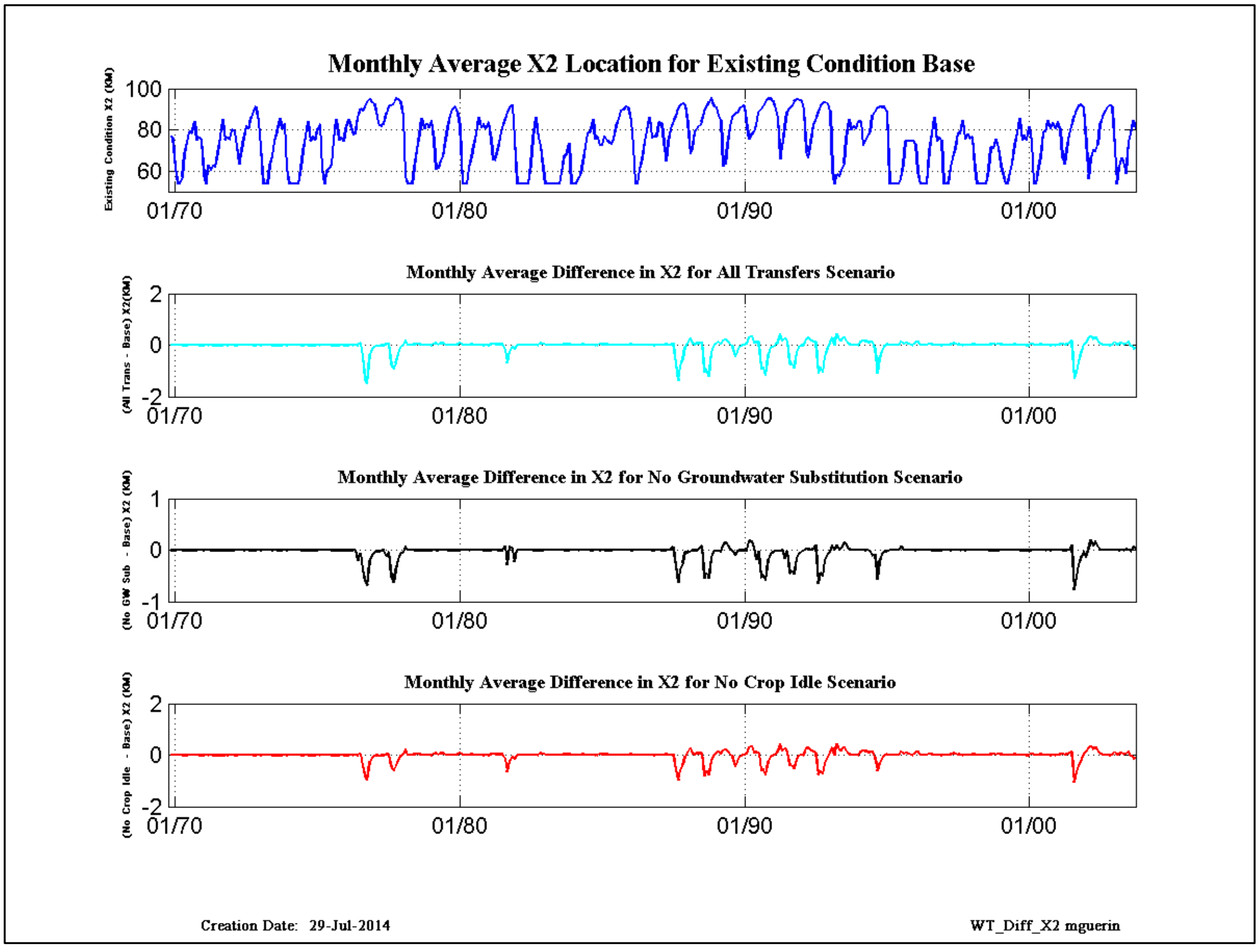


Figure 3-3. Monthly Average X2 Location for Existing Condition Base and the differences Scenario – Base.

Table 3-1. X2 (km) Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	76.7	75.9	61.1	54.0	54.0	57.2	68.7	73.9	79.2	78.5	84.2	75.0
1971	76.2	75.1	58.5	54.0	62.7	60.1	62.6	61.9	68.8	76.7	85.3	75.1
1972	76.4	75.4	80.1	79.0	72.1	63.3	70.3	76.2	82.0	80.8	86.1	89.1
1973	91.3	83.9	71.8	54.0	54.0	54.0	62.9	67.2	74.7	79.0	85.6	80.5
1974	83.0	61.3	54.0	54.0	54.0	54.0	54.0	61.9	69.8	77.2	84.0	74.7
1975	76.6	75.1	80.6	82.6	60.8	54.0	60.4	61.2	63.6	75.6	85.1	74.9
1976	76.3	74.3	80.4	85.3	82.0	77.5	78.2	86.2	90.3	89.0	91.3	93.7
1977	95.0	93.3	92.5	86.3	82.3	82.0	82.8	88.2	91.4	91.9	92.4	95.4
1978	94.5	93.8	86.7	57.6	54.0	54.0	54.0	61.8	70.7	78.0	85.6	80.8
1979	82.8	80.9	84.6	75.1	61.0	61.4	65.2	66.8	75.4	81.8	87.0	89.9
1980	91.1	88.3	82.2	54.0	54.0	54.0	62.1	66.7	72.7	78.5	85.9	81.0
1981	82.6	80.6	83.7	75.8	65.5	65.2	70.6	76.3	81.2	85.4	88.7	90.7
1982	92.0	75.4	54.0	54.0	54.0	54.0	54.0	54.0	63.4	75.8	86.1	75.9
1983	72.3	61.6	54.0	54.0	54.0	54.0	54.0	54.0	54.0	59.5	67.6	67.8
1984	73.5	54.0	54.0	54.0	56.6	58.9	64.2	72.0	78.5	78.8	85.1	75.5
1985	76.6	72.5	72.9	76.8	74.8	73.9	73.3	75.6	82.0	85.6	89.3	89.9
1986	91.2	90.9	84.5	72.6	54.0	54.0	60.7	65.9	74.4	79.6	86.1	76.4
1987	77.0	76.8	83.4	83.1	73.9	65.0	73.9	80.6	83.3	86.9	90.3	91.7
1988	92.8	92.0	83.5	68.2	70.5	79.1	80.4	81.9	83.9	88.7	91.4	93.3
1989	95.5	91.4	90.6	87.1	84.3	62.2	63.3	73.1	81.8	86.3	87.7	88.3
1990	90.3	91.4	91.6	80.9	75.6	77.5	79.1	82.2	88.6	90.1	91.5	93.5
1991	95.0	95.1	94.0	90.1	85.7	65.8	71.4	81.7	88.9	90.2	91.3	93.7
1992	95.0	94.4	94.1	89.8	69.5	66.5	74.4	82.5	84.7	88.8	91.7	93.0
1993	93.2	92.7	89.1	60.3	54.0	58.3	57.4	60.5	63.8	75.6	85.3	79.9
1994	81.9	80.7	84.0	84.0	72.6	74.9	76.8	78.8	86.9	88.4	90.3	91.4
1995	91.1	90.9	88.7	54.0	54.0	54.0	54.0	54.0	56.2	63.2	74.7	74.7
1996	74.5	74.9	73.2	59.9	54.0	54.0	54.0	54.0	70.1	78.8	86.0	74.4
1997	76.5	74.9	54.0	54.0	54.0	61.9	66.4	70.9	78.5	78.3	84.5	75.4
1998	77.7	75.8	76.7	61.4	54.0	54.0	54.0	54.0	54.0	60.8	71.5	71.1
1999	75.6	71.6	62.7	59.0	54.0	54.0	59.4	63.7	73.2	78.4	85.7	74.9
2000	77.0	74.9	81.3	74.3	54.0	54.0	61.9	67.1	78.5	79.3	84.7	80.4
2001	83.2	80.7	84.0	80.2	66.8	63.2	70.6	77.8	81.5	86.5	89.8	91.7
2002	92.0	90.7	73.4	56.2	66.5	69.8	69.7	73.1	82.5	86.4	88.8	90.9
2003	91.9	91.4	71.2	54.0	61.8	66.3	62.8	58.6	74.4	78.7	84.4	80.5
Average	84.4	81.0	76.8	68.2	63.4	62.1	65.5	69.5	76.0	80.5	86.0	83.1
Critical	89.5	88.7	88.6	83.5	76.9	74.8	77.6	83.1	87.8	89.6	91.4	93.4
Dry	84.5	82.1	81.3	76.5	72.0	66.5	70.2	76.1	82.0	86.2	89.1	90.5
BN	79.6	78.1	82.3	77.1	66.6	62.4	67.8	71.5	78.7	81.3	86.6	89.5
AN	89.8	87.5	80.4	59.0	55.3	56.8	60.2	63.6	72.5	78.2	85.3	80.5
Wet	79.8	73.6	65.8	59.0	55.4	55.7	59.0	61.7	68.0	73.9	82.0	74.3

Table 3-2. X2 (km) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.4	-1.3	-1.5
1977	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	-0.8	-0.9	-0.7
1978	-0.3	-0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.7	-0.2
1982	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.7	-1.4	-0.8
1988	-0.5	-0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.1	-1.1	-1.0	-1.2
1989	-0.3	-0.1	0.1	0.1	0.0	0.2	0.2	0.1	0.0	-0.1	-0.4	-0.2
1990	-0.1	0.0	0.0	0.0	0.3	0.3	0.1	0.1	0.1	-0.9	-0.9	-1.2
1991	-0.4	-0.1	0.0	0.0	0.1	0.4	0.2	0.2	0.2	-0.7	-0.7	-0.9
1992	-0.3	-0.1	0.0	0.0	0.3	0.3	0.2	0.1	0.1	-1.1	-0.9	-1.0
1993	-0.4	-0.1	0.1	0.3	0.0	0.4	0.2	0.2	0.3	0.2	0.0	0.0
1994	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	-0.2	-1.1	-0.5
1995	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1996	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	-1.3	-1.0	-0.6
2002	-0.2	0.0	0.1	0.3	0.4	0.2	0.3	0.1	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	-0.1	-0.1
Average	-0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	-0.2	-0.3	-0.3
Critical	-0.2	-0.1	0.0	0.1	0.1	0.2	0.1	0.1	0.1	-0.7	-1.0	-1.0
Dry	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.4	-0.6	-0.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-3. X2 percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.5	-1.4	-1.6
1977	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	-0.8	-1.0	-0.7
1978	-0.4	-0.1	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.2	-0.8	-0.3
1982	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.8	-1.5	-0.9
1988	-0.5	-0.1	0.1	0.4	0.1	0.0	0.1	0.1	0.1	-1.2	-1.0	-1.3
1989	-0.3	-0.1	0.1	0.1	0.0	0.3	0.4	0.2	0.0	-0.1	-0.5	-0.3
1990	-0.1	0.0	0.0	0.1	0.4	0.4	0.2	0.1	0.1	-1.0	-1.0	-1.2
1991	-0.4	-0.1	-0.1	0.0	0.1	0.7	0.3	0.3	0.2	-0.8	-0.8	-1.0
1992	-0.3	-0.1	0.0	0.0	0.4	0.4	0.2	0.2	0.2	-1.2	-0.9	-1.1
1993	-0.5	-0.1	0.1	0.5	0.0	0.8	0.3	0.3	0.5	0.2	0.0	0.0
1994	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.1	-0.2	-1.2	-0.6
1995	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1
1996	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	-1.5	-1.2	-0.7
2002	-0.2	0.0	0.1	0.5	0.5	0.3	0.4	0.2	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.0	-0.2	-0.1
Average	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.2	-0.3	-0.3
Critical	-0.2	-0.1	0.0	0.1	0.2	0.2	0.1	0.1	0.1	-0.8	-1.1	-1.1
Dry	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.4	-0.7	-0.4
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-4. X2 (km) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	-0.4	-0.6	-0.7
1977	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	-0.5	-0.6	-0.4
1978	-0.2	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	0.1
1982	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	-0.6	-0.4
1988	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.5	-0.5	-0.5
1989	-0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.2	0.2	0.0	-0.2	0.0	-0.5	-0.5	-0.6
1991	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.5	-0.4	-0.5
1992	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.6	-0.4	-0.5
1993	-0.2	-0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.6	-0.2
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.8	-0.5	-0.3
2002	-0.1	0.0	-0.1	0.0	0.2	0.1	0.2	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Critical	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.4	-0.5	-0.5
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.2	-0.2	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-5. X2 percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	-0.4	-0.7	-0.7
1977	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1	0.0	-0.5	-0.7	-0.4
1978	-0.2	-0.1	-0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	0.1
1982	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.3	-0.7	-0.4
1988	-0.3	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	-0.6	-0.5	-0.6
1989	-0.2	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.0	0.0	-0.1	0.0
1990	0.0	0.0	0.0	0.0	0.2	0.2	0.1	-0.2	0.0	-0.6	-0.5	-0.6
1991	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.5	-0.4	-0.5
1992	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.7	-0.5	-0.5
1993	-0.2	-0.1	0.0	0.2	0.0	0.1	0.0	0.1	0.2	0.1	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.6	-0.2
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.9	-0.6	-0.3
2002	-0.1	0.0	-0.2	0.1	0.3	0.1	0.2	0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	-0.1
Critical	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.5	-0.6	-0.5
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	-0.2	-0.3	-0.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-6. X2 (km) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.4	-0.8	-1.0
1977	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.6	-0.4
1978	-0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7	-0.2
1982	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-1.0	-0.6
1988	-0.3	-0.1	0.1	0.3	0.1	0.0	0.1	0.1	0.1	-0.8	-0.6	-0.8
1989	-0.2	0.0	0.1	0.1	0.0	0.2	0.2	0.1	0.0	-0.1	-0.4	-0.2
1990	-0.1	0.0	0.0	0.0	0.3	0.3	0.1	0.1	0.1	-0.6	-0.6	-0.8
1991	-0.2	-0.1	0.0	0.0	0.1	0.4	0.2	0.3	0.1	-0.4	-0.4	-0.5
1992	-0.2	0.0	0.0	0.0	0.3	0.3	0.2	0.1	0.1	-0.7	-0.6	-0.7
1993	-0.3	-0.1	0.1	0.3	0.0	0.4	0.2	0.2	0.3	0.2	0.0	0.0
1994	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	-0.1	-0.6	-0.3
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
1996	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	-1.0	-0.7	-0.4
2002	-0.2	0.0	0.1	0.3	0.4	0.2	0.3	0.1	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	-0.1	-0.1
Average	-0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	-0.1	-0.2	-0.2
Critical	-0.1	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	-0.5	-0.6	-0.6
Dry	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.3	-0.4	-0.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-7. X2 percent difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.4	-0.9	-1.0
1977	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-0.7	-0.4
1978	-0.2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.2	-0.7	-0.3
1982	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-1.1	-0.6
1988	-0.4	-0.1	0.1	0.4	0.1	0.0	0.1	0.1	0.1	-0.9	-0.7	-0.8
1989	-0.2	0.0	0.1	0.2	0.1	0.3	0.4	0.2	0.0	-0.1	-0.5	-0.3
1990	-0.1	0.0	0.0	0.1	0.4	0.4	0.2	0.1	0.1	-0.6	-0.6	-0.8
1991	-0.2	-0.1	0.0	0.0	0.1	0.7	0.3	0.3	0.1	-0.4	-0.5	-0.6
1992	-0.2	0.0	0.0	0.0	0.4	0.4	0.2	0.1	0.1	-0.8	-0.7	-0.8
1993	-0.3	-0.1	0.1	0.5	0.0	0.8	0.3	0.3	0.5	0.2	0.0	0.0
1994	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.1	-0.1	-0.7	-0.3
1995	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1
1996	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1999	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	-1.2	-0.7	-0.4
2002	-0.2	0.1	0.2	0.5	0.5	0.3	0.4	0.2	0.1	0.0	0.0	0.0
2003	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.0	-0.2	-0.1
Average	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	-0.2	-0.2	-0.2
Critical	-0.2	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.1	-0.5	-0.7	-0.7
Dry	-0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-0.3	-0.5	-0.3
BN	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
AN	-0.1	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C.1.4 OMR Model Output

See the text in Appendix C for details on OMR calculation.

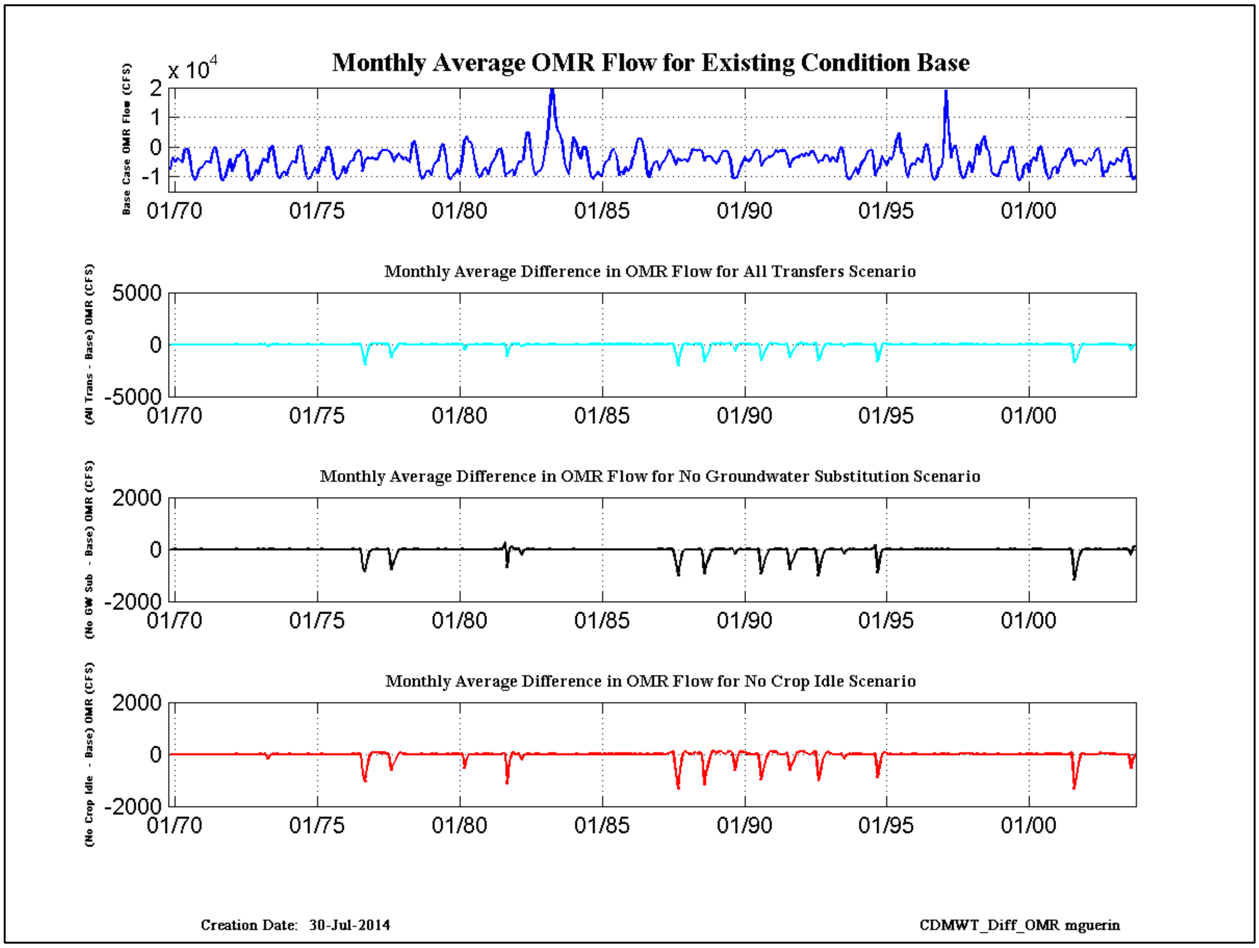


Figure 4-1. Monthly average OMR flow (cfs) and flow differences Scenario – Base.

Table 4-1. OMR Base flow (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-7495.0	-3464.3	-5193.7	-3968.9	-4657.4	-5144.2	-838.1	-480.5	-2947.5	-9091.5	-11098.4	-10579.6
1971	-7441.6	-7054.6	-6102.2	-4882.6	-4896.7	-5212.6	-927.1	-100.0	-3997.9	-10023.2	-11375.0	-10397.2
1972	-7721.4	-3896.0	-8206.4	-5960.7	-2821.5	-3174.6	-1248.8	-875.7	-3019.9	-9758.7	-11402.4	-10155.1
1973	-7693.4	-9240.3	-6633.4	-3803.1	-4672.4	-5087.2	-383.8	334.0	-3915.0	-9755.5	-10777.0	-9170.6
1974	-8189.7	-9657.4	-6835.6	-5095.0	-5015.9	-5284.6	130.3	471.4	-3935.7	-9371.3	-10793.8	-10352.2
1975	-8287.1	-6848.7	-8896.9	-6043.2	-3407.3	-4676.9	-173.2	-164.6	-3941.6	-9273.8	-10672.7	-10398.1
1976	-9165.6	-6304.9	-8885.8	-6076.9	-4928.8	-4609.9	-2019.8	-1272.1	-1366.5	-8305.5	-4666.6	-3688.0
1977	-3841.7	-3701.7	-4128.9	-4221.0	-2532.0	-1464.9	-1161.6	-1099.5	-1380.2	-2147.1	-5029.6	-3591.8
1978	-2282.9	-3035.3	-4315.3	-3571.5	-4666.0	-5157.2	963.5	2011.5	-3331.0	-9152.8	-10701.3	-10188.8
1979	-8335.5	-8103.3	-9588.6	-6164.2	-5169.1	-4567.5	3.3	992.9	-3715.2	-10117.0	-11025.9	-9982.4
1980	-8926.1	-7421.1	-9201.7	-4487.3	2201.7	3445.4	1629.1	797.4	-3300.4	-7879.0	-10231.8	-9888.0
1981	-7345.2	-7238.1	-9173.4	-6025.5	-4897.6	-3968.4	-1173.4	-628.2	-3002.5	-9792.5	-9065.7	-8366.6
1982	-7616.2	-9498.3	-6769.9	-4924.4	-5085.0	-3919.8	4723.9	4629.6	-2739.6	-7452.2	-9635.2	-8335.7
1983	-7887.2	-6060.2	-1619.0	3478.7	12068.5	22937.7	11740.8	5554.3	4635.3	2460.0	-5381.7	-7570.2
1984	-9116.2	-3255.4	3513.1	788.0	-2703.0	-4136.0	-205.9	-19.1	-4008.7	-9476.8	-10683.4	-9929.9
1985	-8377.7	-9464.1	-9686.2	-5972.5	-4989.6	-4205.3	-1330.3	-808.8	-3046.3	-9724.0	-8271.4	-9376.6
1986	-6759.7	-8123.8	-7197.5	-3756.8	-1924.2	2574.2	2707.7	1795.4	-2816.4	-9379.3	-10428.5	-7160.8
1987	-5256.9	-4840.2	-7859.5	-5785.9	-4923.6	-3276.5	-1047.7	-1626.2	-3279.9	-5994.3	-3822.1	-4631.3
1988	-4667.8	-4293.7	-5000.6	-3744.7	-950.8	-1171.6	-1293.8	-932.8	-1245.7	-4640.9	-3277.4	-3180.8
1989	-3462.4	-4802.4	-5735.5	-4941.5	-2721.6	-1485.7	-1475.9	-1615.2	-4393.4	-10291.5	-10455.9	-10015.5
1990	-7697.6	-5239.2	-3583.1	-4555.1	-4935.9	-3642.6	-1762.9	-1045.8	-1320.2	-6402.1	-4903.5	-4140.8
1991	-3394.2	-3376.1	-2922.7	-1120.6	-1640.3	-1340.9	-1199.8	-1339.0	-3168.9	-6723.6	-4869.1	-3758.5
1992	-3431.2	-3332.9	-2520.4	-3192.8	-1912.9	-2954.1	-1653.8	-1473.7	-3008.9	-5423.9	-4623.0	-4489.3
1993	-2888.3	-3001.0	-5118.0	-3503.7	-4459.8	-5009.1	-1053.6	-37.2	-3919.9	-9626.0	-11007.5	-10417.2
1994	-8233.8	-6768.7	-9149.4	-6052.3	-4987.0	-3755.6	-1748.8	-1167.3	-1319.9	-9417.4	-7405.2	-6979.4
1995	-3043.8	-4579.5	-6172.3	-3612.7	-4421.7	-2545.9	1807.5	4740.2	-2032.9	-2203.2	-8142.2	-10113.1
1996	-6769.5	-5665.9	-5765.6	-3894.9	-4786.3	-5034.9	-9.3	1071.4	-3710.7	-9756.7	-11023.6	-10373.6
1997	-7064.9	-6780.9	-2630.0	19251.5	6608.5	-3695.7	-820.4	422.5	-3765.7	-8790.4	-10532.1	-10271.5
1998	-7018.0	-4866.5	-8412.3	-4477.2	937.1	-2501.6	1799.7	3763.3	-563.1	-1587.4	-7883.0	-9353.9
1999	-9407.2	-9806.0	-6755.9	-5150.8	-5094.7	-5158.1	-195.8	196.5	-3994.2	-9899.2	-11214.5	-10337.4
2000	-6307.7	-5443.4	-8668.6	-4384.4	-3438.1	-4725.0	-358.8	328.0	-3933.9	-8212.6	-10685.9	-10399.5
2001	-7263.3	-6505.1	-8861.1	-5976.0	-4378.2	-3651.1	-1071.9	-500.9	-2933.1	-6256.1	-4622.6	-4749.9
2002	-4592.8	-5490.1	-5767.8	-3790.1	-4542.9	-3777.2	-1302.6	-497.6	-2932.2	-9917.0	-8226.5	-8311.4
2003	-5083.1	-5769.4	-5859.2	-3768.6	-4493.8	-4879.6	-1158.5	-534.5	-4162.4	-9521.3	-11054.5	-9888.6
Average	-6531.3	-5968.5	-6167.7	-3511.4	-2889.4	-2654.6	-3.2	320.3	-2809.2	-7732.5	-8676.1	-8251.3
Critical	-5776.0	-4716.7	-5170.1	-4137.6	-3126.8	-2705.7	-1548.7	-1190.1	-1830.0	-6151.5	-4967.8	-4261.2
Dry	-6049.7	-6390.0	-7847.2	-5415.3	-4408.9	-3394.0	-1233.6	-946.1	-3264.6	-8662.6	-7410.7	-7575.2
BN	-8028.5	-5999.6	-8897.5	-6062.4	-3995.3	-3871.1	-622.8	58.6	-3367.6	-9937.8	-11214.1	-10068.7
AN	-5530.2	-5651.8	-6632.7	-3919.8	-3254.7	-3568.8	-60.3	483.2	-3760.4	-9024.5	-10743.0	-9992.1
Wet	-7392.0	-6589.3	-5295.2	-1714.5	-1721.4	-1676.8	1518.5	1683.1	-2601.5	-7218.8	-9912.6	-9628.7

Table 4-2. OMR flow (cfs) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	-0.1	2.6	-186.2	-56.5	1.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.6	-716.9	-1916.3	-931.5
1977	-52.1	78.3	66.0	63.8	58.7	55.1	42.4	18.6	2.9	-1213.9	-768.0	-406.7
1978	-28.2	66.1	15.5	0.0	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1980	8.9	2.7	0.0	0.0	-529.0	-148.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	10.2	2.8	0.0	0.0	0.0	0.0	0.0	27.1	7.7	-1176.1	-275.5
1982	70.5	14.5	0.2	2.9	-205.4	-61.8	1.7	0.0	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	2.7	0.0
1985	0.0	0.0	0.0	0.0	0.0	11.9	3.5	0.0	7.4	11.0	11.1	9.2
1986	8.3	8.4	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	6.6	8.3	1.8	0.0	0.0	31.7	60.0	82.1	-992.9	-2030.9	-903.9
1988	-19.9	98.2	20.6	0.0	-0.1	61.7	18.1	47.2	34.6	-1649.7	-1187.6	-559.1
1989	9.6	137.8	29.7	91.2	110.0	24.5	-0.4	88.2	104.8	22.2	-614.6	-138.3
1990	85.9	88.9	78.4	17.0	0.0	-0.1	-0.1	0.0	-0.1	-1589.4	-1018.3	-500.2
1991	-8.1	106.5	88.5	94.5	25.9	0.0	-0.3	0.0	71.8	-1219.4	-814.6	-385.8
1992	19.8	98.2	101.0	99.2	23.5	-0.3	0.0	75.2	118.3	-1556.8	-1158.0	-433.5
1993	-65.9	93.7	28.7	-0.1	-0.5	-0.6	-0.7	2.9	-160.9	-47.5	1.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	46.3	-1686.1	-846.6
1995	-33.5	81.0	19.0	0.1	-0.4	-0.3	0.0	-0.1	0.1	-0.1	-0.1	-0.1
1996	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0	24.4	6.7	21.9
1998	27.8	33.9	7.7	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	10.6	3.0	0.0	0.0	0.0	0.0	0.0	13.5	3.7	0.0
2001	0.0	0.0	16.1	4.6	0.0	0.0	0.0	0.0	72.2	-1707.1	-1417.7	-656.9
2002	-35.7	20.9	-0.1	0.0	-0.3	-0.2	-0.1	-0.2	41.7	24.5	38.2	28.9
2003	7.3	17.8	5.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	-528.5	-142.5	6.7
Average	-0.2	28.3	14.7	11.1	-15.2	-7.2	1.2	8.8	11.9	-325.4	-407.9	-175.6
Critical	3.7	67.2	50.6	39.2	15.4	16.6	8.6	20.9	32.7	-1128.5	-1221.3	-580.5
Dry	-4.4	29.3	9.5	16.3	18.3	6.0	5.8	24.7	55.9	-439.1	-865.0	-322.8
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-13.0	30.0	10.0	0.5	-87.9	-55.8	-9.6	0.7	-26.8	-93.7	-22.9	1.1
Wet	5.6	10.6	2.2	0.2	-15.8	-4.8	0.1	0.0	0.0	2.6	0.7	1.7

Table 4-3. OMR flow (cfs) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.1	3.7	14.7	0.4	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.1	8.6	41.1	25.3
1977	1.4	-2.1	-1.6	-1.5	-2.3	-3.8	-3.7	-1.7	-0.2	56.5	15.3	11.3
1978	1.2	-2.2	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1980	-0.1	0.0	0.0	0.0	-24.0	-4.3	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.1	13.0	3.3
1982	-0.9	-0.2	0.0	-0.1	4.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3	0.0	-0.2	-0.1	-0.1	-0.1
1986	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.1	0.0	0.0	0.0	-3.0	-3.7	-2.5	16.6	53.1	19.5
1988	0.4	-2.3	-0.4	0.0	0.0	-5.3	-1.4	-5.1	-2.8	35.5	36.2	17.6
1989	-0.3	-2.9	-0.5	-1.8	-4.0	-1.6	0.0	-5.5	-2.4	-0.2	5.9	1.4
1990	-1.1	-1.7	-2.2	-0.4	0.0	0.0	0.0	0.0	0.0	24.8	20.8	12.1
1991	0.2	-3.2	-3.0	-8.4	-1.6	0.0	0.0	0.0	-2.3	18.1	16.7	10.3
1992	-0.6	-2.9	-4.0	-3.1	-1.2	0.0	0.0	-5.1	-3.9	28.7	25.0	9.7
1993	2.3	-3.1	-0.6	0.0	0.0	0.0	0.1	-7.7	4.1	0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	22.8	12.1
1995	1.1	-1.8	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.1	-0.2
1998	-0.4	-0.7	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0
2001	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	-2.5	27.3	30.7	13.8
2002	0.8	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.2	-0.5	-0.3
2003	-0.1	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.3	-0.1
Average	0.1	-0.7	-0.4	-0.5	-0.9	-0.3	0.2	-0.8	-0.4	6.5	8.3	4.0
Critical	0.0	-1.7	-1.6	-1.9	-0.7	-1.3	-0.7	-1.8	-1.3	24.6	25.4	14.0
Dry	0.1	-0.6	-0.1	-0.3	-0.7	-0.3	-0.5	-1.5	-1.7	7.2	17.0	6.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.5	-0.9	-0.2	0.0	-4.0	-0.1	2.5	-1.2	0.7	1.0	0.2	0.0
Wet	0.0	-0.2	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 4-4. OMR flow (cfs) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-692.0	-863.7	-447.6
1977	-71.4	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	-775.1	-484.4	-262.0
1978	-48.4	0.0	0.0	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-3.1	268.6	-687.0	73.1
1982	89.1	0.0	0.3	2.9	-205.4	-61.8	1.7	0.0	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-489.9	-1028.8	-509.1
1988	-71.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-920.2	-627.3	-346.6
1989	-66.9	0.0	0.0	0.0	0.0	0.1	-0.2	-0.2	0.0	32.7	-187.2	-35.9
1990	7.2	0.0	0.0	0.0	0.1	-0.1	0.0	-0.1	0.1	-948.7	-602.3	-307.9
1991	-58.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-774.1	-497.1	-255.0
1992	-48.4	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	-3.7	-1039.1	-632.8	-259.3
1993	-46.3	0.0	0.0	0.0	-0.3	-0.4	-0.1	3.0	-160.6	-47.3	1.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	165.4	-891.5	-435.4
1995	-39.8	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.2	-0.1	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-3.2	-1160.0	-734.4	-359.3
2002	-67.9	0.0	0.0	0.2	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-234.6	107.2	114.9
Average	-12.4	0.0	0.0	0.1	-6.1	-1.8	0.0	0.1	-5.0	-194.5	-209.7	-89.1
Critical	-34.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	-711.9	-657.0	-330.5
Dry	-22.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-224.8	-439.6	-138.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-15.8	0.0	0.0	0.0	-0.1	-0.1	0.0	0.5	-26.8	-47.0	18.0	19.1
Wet	3.8	0.0	0.0	0.2	-15.8	-4.8	0.1	0.0	0.0	0.0	0.0	0.0

Table 4-5. OMR flow (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	18.5	12.1
1977	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.1	9.6	7.3
1978	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-2.7	7.6	-0.9
1982	-1.2	0.0	0.0	-0.1	4.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	26.9	11.0
1988	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.8	19.1	10.9
1989	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	1.8	0.4
1990	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	12.3	7.4
1991	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	10.2	6.8
1992	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	19.2	13.7	5.8
1993	1.6	0.0	0.0	0.0	0.0	0.0	0.0	-7.9	4.1	0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.8	12.0	6.2
1995	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	18.5	15.9	7.6
2002	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	-1.0	-1.2
Average	0.4	0.0	0.0	0.0	0.1	0.0	0.0	-0.2	0.1	4.0	4.3	2.2
Critical	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.4	13.6	8.1
Dry	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	8.7	3.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.6	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	0.7	0.5	-0.2	-0.2
Wet	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 4-6. OMR flow (cfs) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	-0.1	2.6	-186.2	-56.5	1.2	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.6	-729.0	-1045.4	-515.7
1977	-7.9	78.3	66.0	63.8	58.7	55.1	42.4	18.6	2.9	-606.4	-372.8	-178.8
1978	14.7	66.1	15.5	0.0	-0.3	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1980	8.9	2.7	0.0	0.0	-529.0	-148.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	10.2	2.8	0.0	0.0	0.0	0.0	0.0	27.1	10.6	-1153.1	-263.5
1982	72.0	14.5	0.2	2.9	-205.4	-61.8	1.7	0.0	-0.1	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	2.7	0.0
1985	0.0	0.0	0.0	0.0	0.0	11.9	3.5	0.0	7.4	11.0	11.1	9.2
1986	8.3	8.4	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	6.6	8.3	1.8	0.0	0.0	31.7	60.0	82.1	-725.7	-1349.3	-573.9
1988	24.4	98.2	20.6	0.0	-0.1	61.7	18.1	47.2	34.6	-1187.9	-697.5	-309.5
1989	51.5	137.8	29.7	91.2	110.0	24.5	-0.4	88.2	104.8	22.2	-614.6	-138.3
1990	85.9	88.9	78.4	17.0	0.0	-0.1	-0.1	0.0	-0.1	-967.7	-595.1	-271.1
1991	36.1	106.5	88.5	94.5	25.9	0.0	-0.3	0.0	71.8	-613.9	-406.1	-163.2
1992	62.7	98.2	101.0	99.2	23.5	-0.3	0.0	75.2	118.3	-1015.7	-754.9	-229.1
1993	-28.0	93.7	28.7	-0.1	-0.5	-0.6	-0.7	2.9	-160.9	-47.5	1.1	0.0
1994	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.5	-884.1	-454.8
1995	6.3	80.9	19.0	0.1	-0.4	-0.3	0.0	-0.1	0.1	-0.1	-0.1	-0.1
1996	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.1	-0.1	0.0	0.0	0.0	0.0	0.0	24.4	6.7	21.9
1998	27.8	33.9	7.7	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	10.6	3.0	0.0	0.0	0.0	0.0	0.0	13.5	3.7	0.0
2001	0.0	0.0	16.1	4.6	0.0	0.0	0.0	0.0	72.2	-1325.9	-810.5	-356.7
2002	8.7	20.9	-0.1	0.0	-0.3	-0.2	-0.1	-0.2	41.7	24.5	38.2	28.9
2003	7.3	17.8	5.2	-0.1	-0.1	0.0	0.0	0.0	-0.1	-528.5	-142.5	6.7
Average	11.1	28.3	14.7	11.1	-15.2	-7.2	1.2	8.8	11.9	-224.5	-257.7	-99.7
Critical	28.8	67.2	50.6	39.2	15.4	16.6	8.6	20.9	32.7	-731.5	-679.4	-303.2
Dry	10.0	29.3	9.5	16.3	18.3	6.0	5.8	24.7	55.9	-330.6	-646.4	-215.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.5	30.0	10.0	0.5	-87.9	-55.8	-9.6	0.7	-26.8	-93.7	-22.9	1.1
Wet	8.8	10.6	2.2	0.2	-15.8	-4.8	0.1	0.0	0.0	2.6	0.7	1.7

Table 4-7. OMR flow (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	-0.1	3.7	14.7	0.4	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-0.1	8.8	22.4	14.0
1977	0.2	-2.1	-1.6	-1.5	-2.3	-3.8	-3.7	-1.7	-0.2	28.2	7.4	5.0
1978	-0.6	-2.2	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1980	-0.1	0.0	0.0	0.0	-24.0	-4.3	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	-0.1	12.7	3.1
1982	-0.9	-0.2	0.0	-0.1	4.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-0.3	-0.3	0.0	-0.2	-0.1	-0.1	-0.1
1986	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.1	0.0	0.0	0.0	-3.0	-3.7	-2.5	12.1	35.3	12.4
1988	-0.5	-2.3	-0.4	0.0	0.0	-5.3	-1.4	-5.1	-2.8	25.6	21.3	9.7
1989	-1.5	-2.9	-0.5	-1.8	-4.0	-1.6	0.0	-5.5	-2.4	-0.2	5.9	1.4
1990	-1.1	-1.7	-2.2	-0.4	0.0	0.0	0.0	0.0	0.0	15.1	12.1	6.5
1991	-1.1	-3.2	-3.0	-8.4	-1.6	0.0	0.0	0.0	-2.3	9.1	8.3	4.3
1992	-1.8	-2.9	-4.0	-3.1	-1.2	0.0	0.0	-5.1	-3.9	18.7	16.3	5.1
1993	1.0	-3.1	-0.6	0.0	0.0	0.0	0.1	-7.7	4.1	0.5	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	6.5
1995	-0.2	-1.8	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-0.1	-0.2
1998	-0.4	-0.7	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0
2001	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	-2.5	21.2	17.5	7.5
2002	-0.2	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	-0.2	-0.5	-0.3
2003	-0.1	-0.3	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.3	-0.1
Average	-0.2	-0.7	-0.4	-0.5	-0.9	-0.3	0.2	-0.8	-0.4	4.2	5.1	2.2
Critical	-0.6	-1.7	-1.6	-1.9	-0.7	-1.3	-0.7	-1.8	-1.3	15.1	14.3	7.3
Dry	-0.3	-0.6	-0.1	-0.3	-0.7	-0.3	-0.5	-1.5	-1.7	5.4	11.8	4.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	-0.9	-0.2	0.0	-4.0	-0.1	2.5	-1.2	0.7	1.0	0.2	0.0
Wet	-0.1	-0.2	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0

C.1.5 Boundary Conditions: Sacramento and San Joaquin River Inflows, Net Delta Outflow (NDO) and San Joaquin River Salinity (EC)

See the text in Appendix C for details on the boundary conditions for the Base and the Alternatives 2- 4.

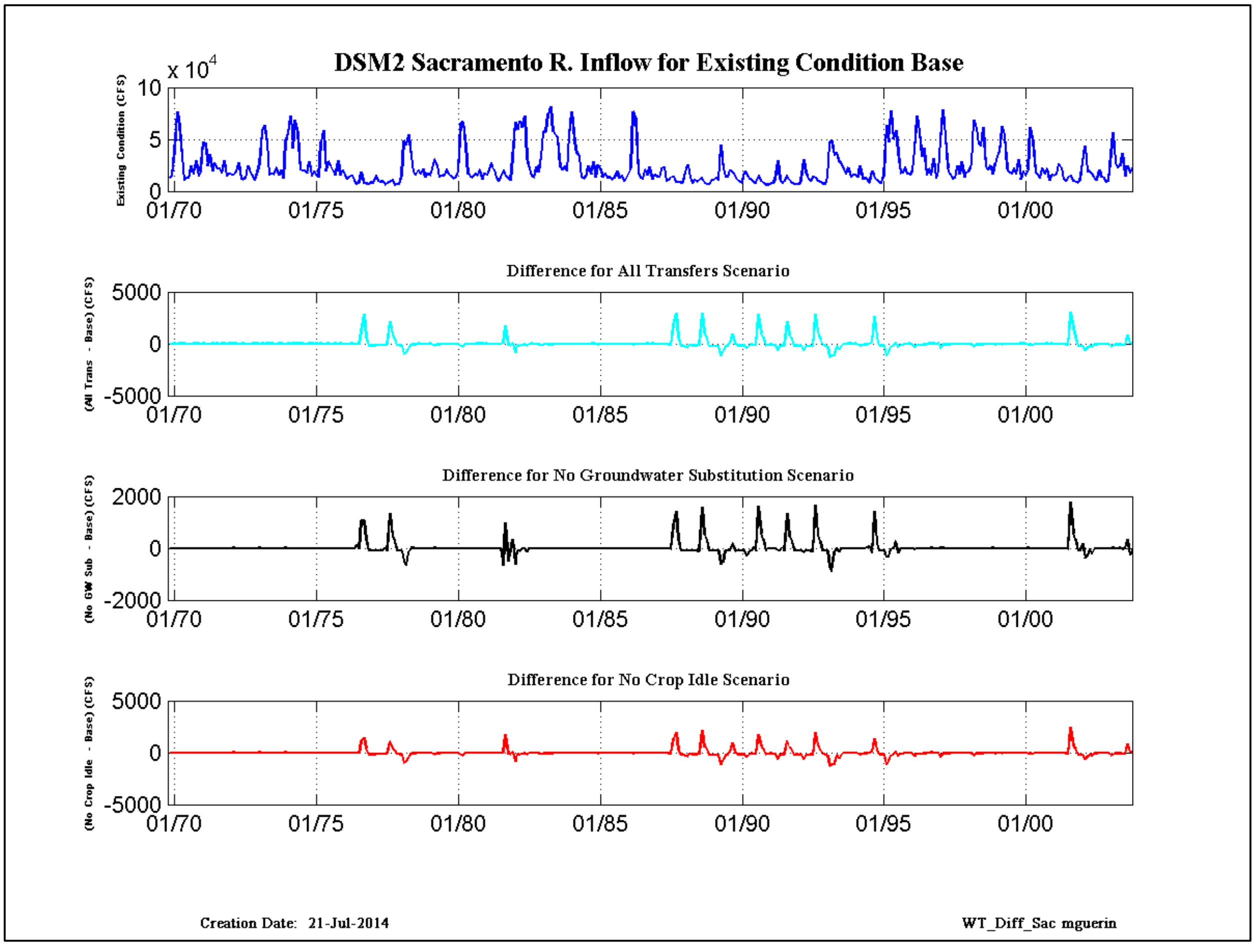


Figure 5-1. Sacramento R. Inflow for the Base condition and change from Base for the scenarios.

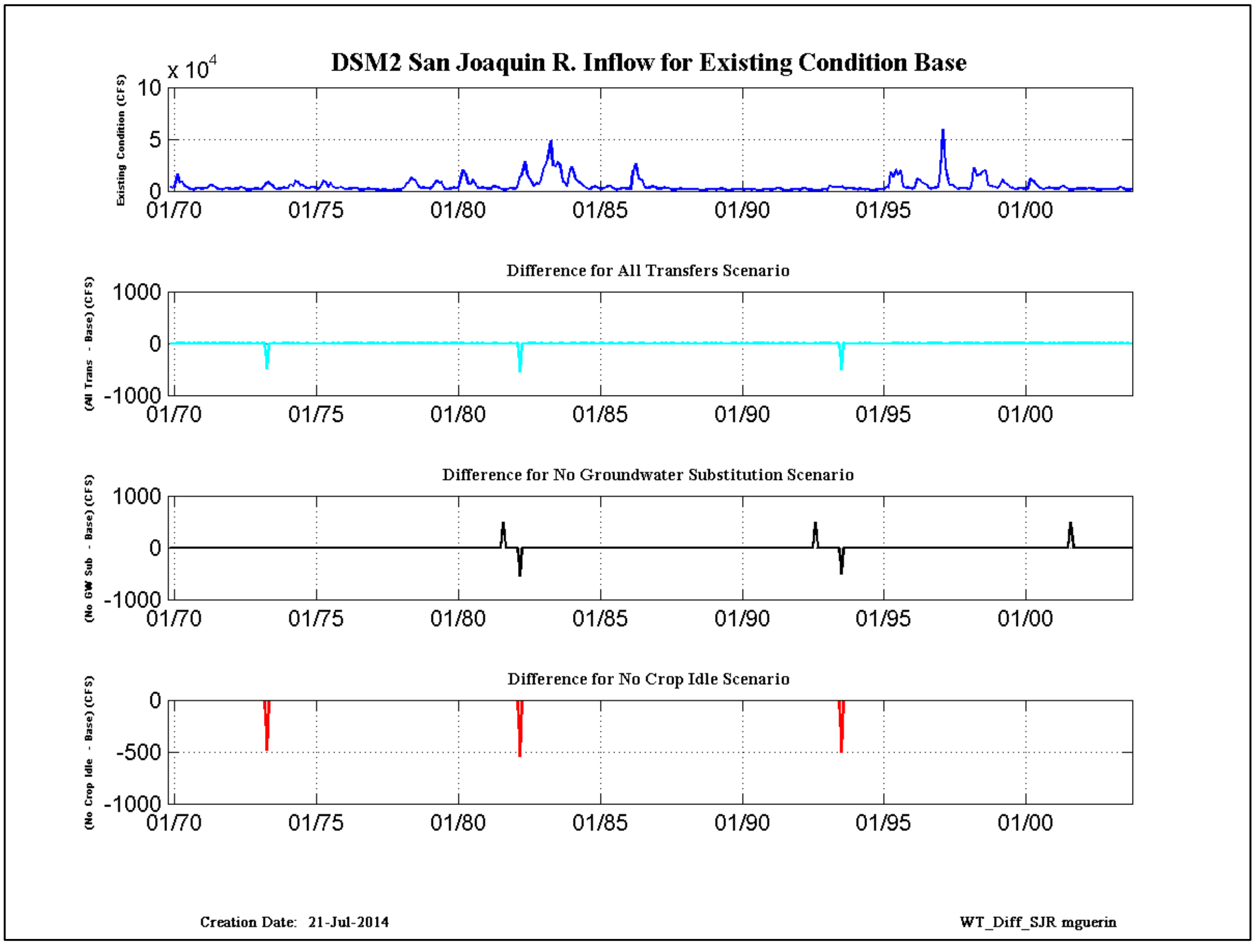


Figure 5-2. San Joaquin R. Inflow for Existing Base condition and change from Base for the scenarios.

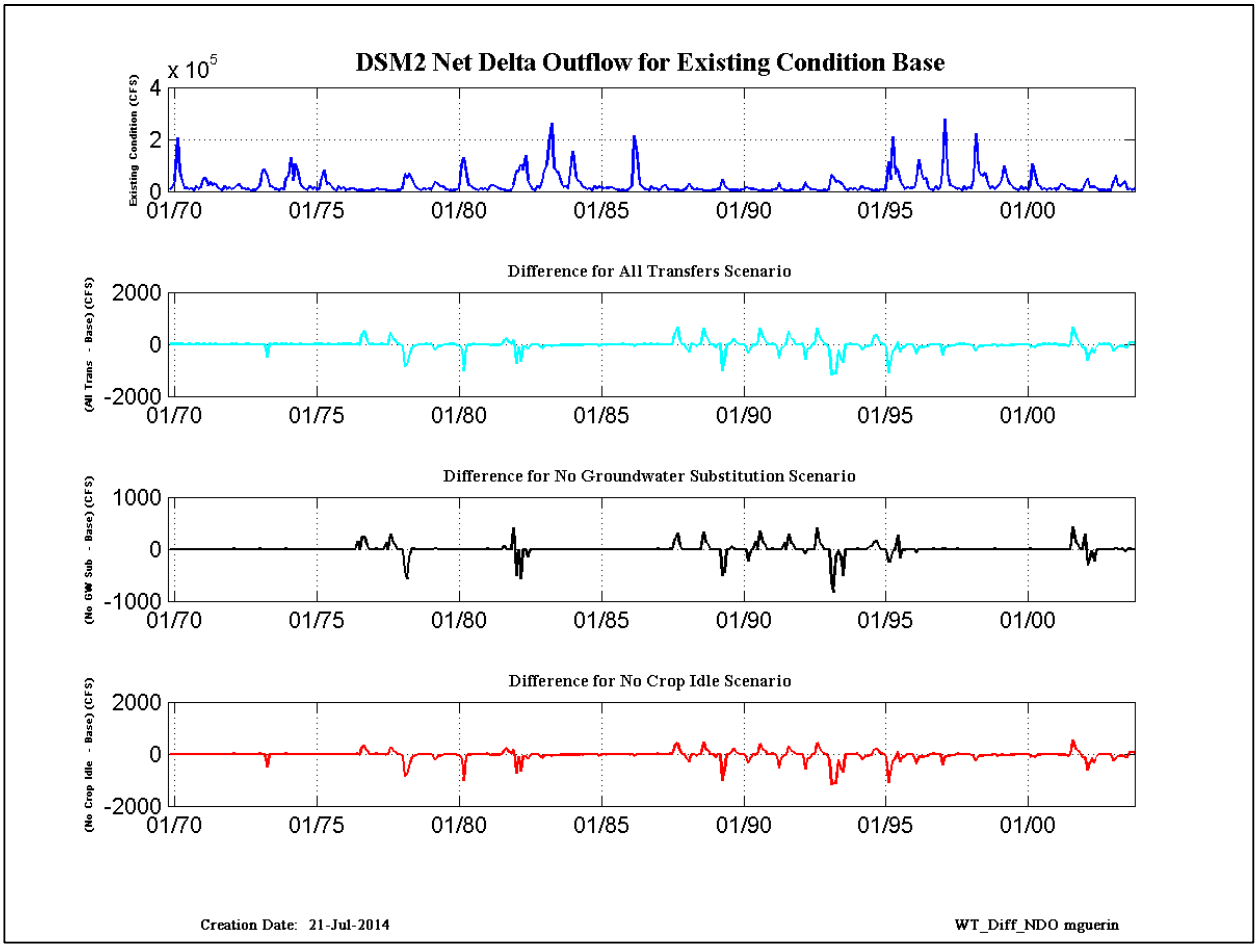


Figure 5-3. Net Delta Outflow for the Base condition and change from Base for the scenarios.

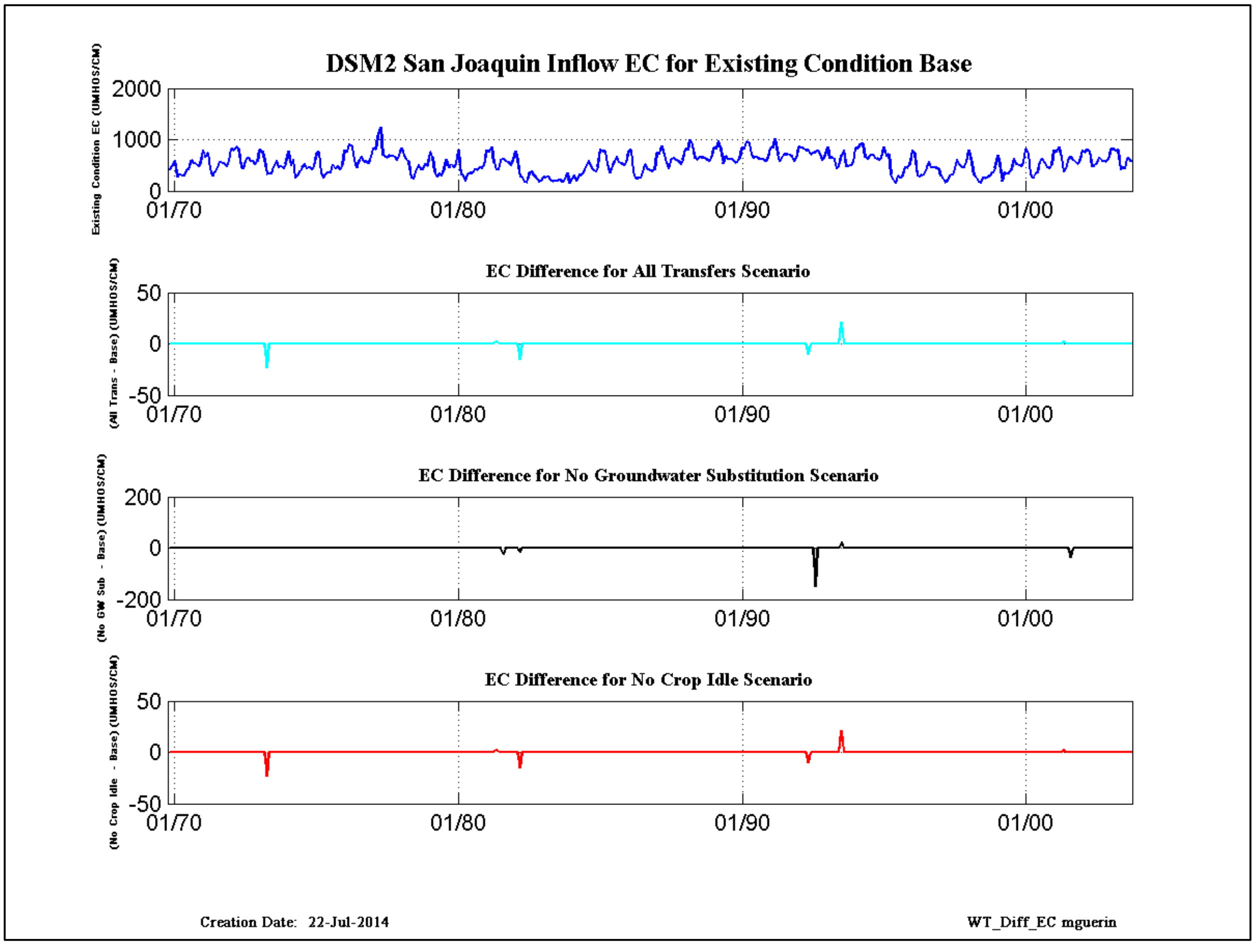


Figure 5-4. San Joaquin Inflow EC for Existing Base condition and change from Base for the scenarios.

Table 5-1. Sacramento River Base inflow (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	13169.5	15030.2	38985.0	76879.2	62925.7	33571.0	10845.8	12666.5	12895.4	24931.4	16762.8	29447.9
1971	14275.5	19579.5	47365.8	46356.4	24724.1	35936.3	19847.8	27399.0	21674.7	22450.3	17237.0	29804.6
1972	14594.1	16600.6	15651.7	16005.6	18971.6	27881.1	12105.4	11262.7	12598.4	24038.4	17049.0	14766.6
1973	10333.5	19133.7	26101.3	57692.8	63491.4	46989.9	15637.7	17111.0	16064.0	22844.1	15510.7	20364.8
1974	12939.5	48514.3	56875.6	72508.5	41804.7	68080.6	56314.9	20618.7	19493.6	19869.4	17033.3	28981.7
1975	14553.8	19396.1	14925.0	13471.1	47130.9	58710.3	19978.5	28823.8	24536.4	19542.2	15205.9	29588.1
1976	15513.8	20084.5	15568.1	11434.5	14117.3	15159.8	10294.9	6564.6	8290.0	18343.1	7883.3	7168.6
1977	6745.2	8287.5	8493.3	14841.8	9657.7	9027.2	9289.1	6067.2	8007.1	9026.5	10821.0	6283.0
1978	6502.4	6568.4	15571.1	48628.7	44316.3	54508.5	33667.7	18061.9	15802.4	20196.7	16452.4	21580.3
1979	13542.1	16845.2	15341.0	21552.7	30939.3	24900.8	13885.9	14651.4	15343.1	20830.1	16020.5	13708.0
1980	11735.6	13714.7	19535.9	65995.4	66815.8	43319.9	16875.5	14379.9	13196.2	16050.3	15327.8	20849.9
1981	11976.7	16798.8	15584.5	20930.6	26922.2	20299.5	13243.5	9847.9	13671.8	20224.2	14425.6	12327.3
1982	10918.3	32589.5	66283.2	59017.8	67544.7	61335.8	72176.4	31567.9	21052.5	14691.5	13190.1	23819.1
1983	18851.4	33898.4	57243.7	57365.0	74553.6	81218.2	57054.8	54471.4	51762.9	23527.8	20390.6	23971.6
1984	19106.7	54919.0	76014.2	47229.0	36617.4	33804.6	13671.3	12395.7	13962.0	24194.7	16007.0	28412.7
1985	13116.1	25317.3	21459.9	13844.3	17498.8	13270.5	13046.1	11392.1	12783.6	19935.3	12823.7	14777.7
1986	9142.0	12206.1	17131.2	22628.1	76672.5	70719.9	17937.1	12683.2	11561.2	20934.2	15431.6	23829.3
1987	11474.7	15878.4	14044.9	13795.9	21956.0	23028.4	9759.0	10535.8	13465.5	14450.3	8665.8	8871.2
1988	8066.7	8118.1	18384.8	25699.3	13287.3	7598.0	11017.1	8974.5	10928.5	12744.7	8109.0	7024.3
1989	6495.4	10332.1	10684.9	12811.6	10178.0	44407.4	21194.7	14106.6	13945.1	20458.9	17722.5	15124.2
1990	11069.6	8833.8	8332.8	18898.9	16052.6	12340.7	11295.6	8140.3	8134.6	15096.8	9890.9	7734.0
1991	6308.1	6374.6	7342.9	7575.1	10520.4	29303.4	11868.6	7820.9	9823.1	14728.1	10043.5	7531.9
1992	6656.3	6784.1	6929.7	10692.7	30330.1	18736.3	11534.3	9091.9	13553.7	12968.0	9805.5	8789.4
1993	7318.7	6683.3	13435.0	46916.1	48160.4	34709.9	37159.0	28605.1	25741.2	21467.4	16654.5	22924.9
1994	13623.7	16004.0	15481.7	13085.1	24379.4	11849.4	12836.6	10303.5	8336.6	19528.4	12459.7	11452.6
1995	8049.6	8315.8	15311.7	63795.5	47429.8	77273.3	50128.1	58571.8	37893.7	17181.4	17824.0	23602.4
1996	16878.4	15916.5	19772.0	40451.0	72313.1	57238.6	33302.4	41069.9	15240.3	21657.7	15847.5	31452.8
1997	12850.3	19289.7	49630.3	78330.0	52800.7	22177.8	16219.0	12429.2	12867.7	24525.7	16157.0	28814.4
1998	13079.6	18351.9	19346.2	26948.0	68021.1	60584.4	45597.2	43198.1	61417.2	23080.1	20056.5	24560.6
1999	16002.5	26617.5	33436.6	38835.1	62496.5	53344.8	22898.0	18412.5	16896.0	21883.1	16097.1	30087.1
2000	11909.9	19359.6	15029.2	21584.9	61207.3	47814.4	18229.8	15990.3	12961.1	22452.3	16925.5	21912.9
2001	10622.2	15674.7	14871.5	16534.5	26400.9	22373.9	11647.8	9239.3	13459.7	14659.4	9709.4	8549.0
2002	8122.6	10127.9	28744.8	43310.3	19020.7	19285.1	16565.0	12021.7	10818.3	20639.9	13591.0	12587.5
2003	8581.7	10299.0	36296.7	56676.5	27324.9	22303.7	24558.4	36943.2	14407.2	24534.2	17315.0	22225.8
Average	11591.9	17719.0	25153.1	35362.4	39311.3	37150.1	22696.6	19277.0	17429.0	19520.2	14542.5	18909.6
Critical	9711.9	10640.9	11504.8	14603.9	16906.4	14859.3	11162.3	8137.5	9581.9	14633.7	9859.0	7997.7
Dry	10301.3	15688.2	17565.1	20204.5	20329.4	23777.5	14242.7	11190.6	13024.0	18394.7	12823.0	12039.5
BN	14068.1	16722.9	15496.3	18779.1	24955.4	26391.0	12995.6	12957.0	13970.7	22434.3	16534.8	14237.3
AN	9397.0	12626.5	20994.8	49582.4	51886.0	41607.7	24354.7	21848.6	16362.0	21257.5	16364.3	21643.1
Wet	13832.1	24971.1	39409.3	49524.2	56541.1	54922.7	33536.3	28792.9	24711.8	21420.7	16710.8	27413.3

Table 5-2. San Joaquin River Base inflow (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	3768.2	2936.4	3586.4	16926.6	8289.8	8768.7	5357.9	3585.1	2204.6	1761.4	1456.6	2037.4
1971	2847.6	2207.8	2077.1	2733.9	2821.6	5836.3	5489.7	4008.9	2341.4	1544.6	1417.8	1861.5
1972	2924.9	2058.9	1938.2	1573.8	2230.1	2234.7	3769.2	2932.7	1486.4	1199.0	1320.9	1604.4
1973	2286.3	2195.7	1935.2	2176.9	4981.5	8475.8	7146.1	5654.0	2685.7	1879.3	2418.0	2497.5
1974	3284.7	2581.8	3403.9	6480.1	4095.8	9057.5	8575.9	5164.3	5551.4	3388.1	2713.8	2788.4
1975	3602.3	3053.1	2450.1	2291.2	5840.3	9579.7	7376.5	3711.5	8129.2	3713.7	2792.5	2578.6
1976	3484.5	2781.3	1995.0	1990.9	2230.6	2355.0	2899.8	2589.0	1290.4	1124.0	1455.5	1619.1
1977	2084.7	1607.9	1500.6	1468.1	1412.9	872.2	1154.7	1419.7	698.1	618.4	695.6	1013.3
1978	1434.9	1460.6	1475.5	3053.5	6647.6	8137.9	12698.4	11108.7	10231.5	4243.7	2783.6	3275.7
1979	2552.3	2952.7	2326.6	3982.2	6950.8	9748.7	7763.4	8020.5	2028.8	1608.8	2452.4	2282.7
1980	3151.8	2543.7	2110.2	12875.6	20072.9	16873.3	7388.5	6912.1	10906.7	7286.5	3055.8	2746.1
1981	3335.6	2850.4	2017.1	2182.5	2411.4	4248.0	4429.0	3239.3	1581.1	1349.2	1320.3	1737.1
1982	2585.7	2139.5	2098.1	3749.6	12819.4	15750.1	28065.2	17966.2	11977.8	8608.9	4699.5	7232.5
1983	6774.0	11265.6	20556.0	27494.0	32934.1	48804.6	24500.0	23551.5	28265.1	24539.8	9180.6	7749.3
1984	4939.3	16633.1	23670.7	14694.0	10099.5	8292.2	6991.7	4493.9	3000.9	1962.5	2287.8	3605.6
1985	4267.1	3050.4	1903.6	2214.9	2981.0	4255.5	4819.7	3328.5	1628.2	1357.5	1616.8	2060.8
1986	2665.3	2419.3	2079.8	1845.6	19484.7	26225.5	12084.3	10712.5	9568.0	3063.4	2887.0	3434.2
1987	4034.1	3487.6	2142.4	2017.2	2162.6	3202.4	2802.8	2523.1	1310.0	1028.5	1243.1	1691.5
1988	2241.1	1938.8	1634.5	1627.8	1676.4	1758.2	1941.6	1694.1	986.3	724.1	932.6	1411.8
1989	1517.4	1744.8	1558.4	1446.6	1802.0	2121.7	2267.2	1399.5	941.0	832.4	1069.8	1808.7
1990	1852.0	1802.4	1508.7	1404.4	1839.9	1685.1	1212.3	1604.7	861.6	701.9	888.7	1376.7
1991	1800.3	1858.9	1396.4	1241.9	1552.3	3094.3	2053.6	1470.9	840.4	669.8	774.7	1066.4
1992	1638.7	1692.9	1288.3	1196.3	2610.9	2260.2	1256.1	1128.0	537.2	465.8	528.5	929.8
1993	1389.8	1500.6	1369.7	4671.8	3769.2	3840.3	3650.7	3617.4	4375.1	2587.8	2233.3	2568.3
1994	2674.2	2309.4	1637.5	1437.5	2120.8	1864.0	1438.9	1842.1	931.6	738.0	831.2	1214.1
1995	1580.5	1666.1	1335.4	3669.2	3160.3	18105.3	13322.5	20874.7	15410.6	19518.4	4737.5	2784.0
1996	3188.6	2690.5	2087.7	2699.3	11657.4	11004.8	8245.0	7120.1	5628.2	2572.5	2475.6	2671.8
1997	3140.8	3506.0	20158.9	59665.2	23357.5	11036.3	5500.8	6373.0	3890.7	1721.8	2302.6	2872.0
1998	2999.0	2154.6	1986.5	4970.9	22897.5	15256.5	15489.5	16158.1	18923.2	19964.7	5513.6	4981.8
1999	4466.2	3499.9	2871.8	5106.5	11331.2	7556.8	6982.8	4317.9	3421.8	1702.9	1887.6	2360.9
2000	2816.7	2278.9	1662.4	2257.2	11533.0	9676.8	6917.6	5094.9	2731.7	1566.5	1820.2	2871.0
2001	3380.6	2625.3	2119.9	2258.2	2392.7	3841.0	4839.5	2973.6	1478.6	1095.8	1311.7	1806.0
2002	2238.8	2042.6	2024.5	2414.6	1915.9	2592.7	2467.8	2213.1	1165.7	1016.7	1241.5	1663.7
2003	1824.1	1823.5	1825.7	1664.0	1812.6	2363.5	3737.7	2741.8	1226.5	1148.7	1359.2	1692.7
Average	2905.1	3040.0	3698.0	6102.4	7467.5	8552.2	6901.1	5927.8	4948.1	3744.3	2226.6	2526.3
Critical	2253.7	1998.8	1565.8	1481.0	1920.5	1984.2	1708.1	1678.4	877.9	720.3	872.4	1233.0
Dry	3128.9	2633.5	1961.0	2089.0	2277.6	3376.9	3604.3	2612.8	1350.8	1113.3	1300.5	1794.6
BN	2738.6	2505.8	2132.4	2778.0	4590.4	5991.7	5766.3	5476.6	1757.6	1403.9	1886.7	1943.6
AN	2150.6	1967.2	1729.8	4449.8	8136.1	8227.9	6923.2	5854.8	5359.5	3118.7	2278.3	2608.5
Wet	3526.3	4365.7	6797.1	11717.4	12983.8	15021.1	11383.2	9849.1	9101.0	7235.6	3411.7	3612.2

Table 5-3. Net Delta Outflow (cfs) Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	7187.5	14640.8	42013.9	207621.7	77822.7	36548.8	13527.3	12532.2	7627.6	11076.4	4000.0	18437.5
1971	8437.5	15312.5	49917.8	48106.2	21508.4	37066.9	23384.3	29218.7	15234.4	8000.0	4000.0	19062.5
1972	8281.3	14591.1	6675.5	11909.4	18112.6	26002.5	12957.0	10053.1	6447.5	8880.9	4000.0	4192.2
1973	4000.0	11709.2	22091.2	80437.1	83604.2	56514.9	20261.8	19386.2	9382.9	8805.8	4000.0	11718.8
1974	6250.0	51476.8	58150.2	131491.9	40998.5	107783.3	69890.1	23550.8	15124.5	8000.0	5228.1	18906.3
1975	8125.0	14572.7	5352.6	9527.8	53868.6	83609.1	26862.2	30682.7	21480.5	8000.0	4000.0	19687.5
1976	8125.0	15937.5	5031.6	7008.7	9542.0	10771.1	9298.9	4000.0	4576.3	4755.4	3884.8	3000.0
1977	3000.0	4674.6	3500.0	10872.0	7521.4	7238.7	7100.0	4024.8	4000.0	4000.0	3368.9	3000.0
1978	4371.6	3500.0	11387.3	67380.2	51430.8	67829.5	46888.4	24774.3	13190.1	8000.0	4000.0	11562.5
1979	5937.5	10625.0	5056.7	21612.8	35577.7	27540.7	19555.2	19587.7	8150.0	6500.0	4086.6	3619.6
1980	4136.9	8004.0	10839.4	100182.6	130651.5	62796.1	21972.3	18834.8	12363.5	8000.0	4000.0	11562.5
1981	6250.0	10312.5	5145.4	19334.2	22884.2	19634.9	14190.8	8977.1	7100.0	5000.0	3996.8	3076.6
1982	4154.8	26104.0	79982.5	75273.3	101687.0	82095.6	139773.6	46361.5	20981.8	8000.0	4000.0	19375.0
1983	13461.7	39419.4	80646.5	102986.7	182104.6	260276.2	90337.6	76100.2	69560.8	34113.1	16717.0	20243.9
1984	11361.2	79829.7	154668.9	63210.5	40204.1	34662.4	18090.3	13461.4	7700.0	10698.3	4000.0	19062.5
1985	8281.3	19246.4	12118.9	10008.1	13889.1	12240.8	14203.4	10270.1	6406.3	5000.0	3791.0	4262.8
1986	4000.0	4617.0	11288.5	22623.1	214875.9	140086.7	26443.4	19792.2	9916.6	8000.0	4000.0	18437.5
1987	8125.0	12707.2	4619.9	9635.3	18313.5	23224.7	9227.1	7459.4	7100.0	5000.0	4147.4	3000.0
1988	4000.0	4500.0	13160.4	26671.0	13525.9	6088.3	9496.1	7100.0	7100.0	4000.0	3889.0	3000.0
1989	3000.0	5311.3	4411.1	8412.2	8635.7	47267.9	19653.7	11116.1	5937.5	5051.9	5359.5	4593.1
1990	4000.0	4500.0	4500.0	14585.4	11869.4	8990.5	9426.7	6832.7	4000.0	4000.0	4254.5	3000.0
1991	3438.6	3500.0	4140.6	7358.0	8748.0	33920.7	10515.9	5636.1	4000.0	4000.0	4409.0	3000.0
1992	3327.2	3618.3	4232.1	7538.7	35067.8	16743.3	9787.2	5997.6	7100.0	4000.0	3704.3	3000.0
1993	4857.6	3500.0	8379.2	63439.0	55587.7	35078.6	39776.0	30179.3	20923.0	8000.0	4000.0	12343.8
1994	6406.3	10312.5	5088.2	8972.5	21936.0	8465.7	11151.5	8677.6	4099.7	4000.0	4044.5	3000.0
1995	6342.1	3500.0	8995.3	112539.3	45657.8	208959.4	67780.3	87602.4	40848.3	22236.6	9017.5	14062.5
1996	11875.0	12570.3	15759.3	44785.6	123345.4	68296.1	46336.4	48365.0	10900.3	8000.0	4000.0	21250.0
1997	7812.5	15625.0	73827.6	276450.7	74642.5	22507.6	18591.8	14870.0	6843.4	11631.7	4000.0	18437.5
1998	7812.5	15312.5	9889.7	47972.5	220892.1	82137.0	64070.5	59459.6	71969.3	28161.0	11827.5	17524.4
1999	8906.3	19896.1	28686.9	40175.6	96127.9	58523.1	30458.2	20578.8	11277.5	8151.2	4000.0	20000.0
2000	7500.0	15398.1	4778.1	21731.5	104608.7	61479.6	22597.5	18264.0	6218.8	10481.6	4000.0	11718.8
2001	5781.3	10468.8	4853.0	13157.7	26754.6	22964.2	13236.0	8390.1	7100.0	5000.0	4185.0	3000.0
2002	4000.0	5791.9	27774.6	48417.2	14571.5	17226.7	16612.9	12736.2	4849.0	5312.3	4327.7	3000.0
2003	4614.9	4500.0	36796.8	61445.9	23945.5	18232.7	27994.6	38807.6	6689.2	9956.5	4000.0	11562.5
Average	6387.1	14576.0	24228.2	53025.7	59132.7	53317.8	29454.4	22461.2	13711.7	8876.8	4830.6	10726.5
Critical	4613.9	6720.4	5664.7	11858.1	15458.6	13174.1	9539.5	6038.4	4982.3	4107.9	3936.4	3000.0
Dry	5906.3	10639.7	9820.5	18160.8	17508.1	23759.9	14520.7	9824.8	6415.5	5060.7	4301.2	3488.8
BN	7109.4	12608.1	5866.1	16761.1	26845.1	26771.6	16256.1	14820.4	7298.8	7690.5	4043.3	3905.9
AN	4913.5	7768.5	15712.0	65769.4	74971.4	50321.9	29915.1	25041.0	11461.3	8874.0	4000.0	11744.8
Wet	8132.8	24067.5	47629.2	90981.9	99518.1	94042.5	48888.2	37121.2	23805.0	13389.9	6060.8	18806.7

Table 5-4. San Joaquin River inflow salinity (EC, UMHOS/CM)

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	417.0	482.0	588.0	267.0	321.0	293.0	302.0	396.0	416.0	600.0	544.0	520.0
1971	480.0	565.0	790.0	660.0	740.0	429.0	289.0	356.0	450.0	567.0	544.0	533.0
1972	482.0	590.0	812.0	797.0	854.0	816.0	471.0	438.0	589.0	640.0	576.0	580.0
1973	519.0	575.0	798.0	768.0	623.0	333.0	335.0	342.0	477.0	592.0	459.0	486.0
1974	442.0	526.0	784.0	501.0	614.0	257.0	300.0	374.0	455.0	527.0	436.0	459.0
1975	424.0	472.0	746.0	754.0	360.0	254.0	330.0	360.0	369.0	514.0	426.0	476.0
1976	418.0	509.0	794.0	772.0	903.0	860.0	597.0	446.0	593.0	657.0	571.0	575.0
1977	527.0	667.0	837.0	817.0	1068.0	1243.0	702.0	675.0	651.0	693.0	677.0	659.0
1978	602.0	691.0	848.0	704.0	609.0	558.0	262.0	235.0	379.0	510.0	430.0	420.0
1979	517.0	490.0	765.0	652.0	366.0	278.0	337.0	295.0	432.0	612.0	457.0	509.0
1980	456.0	531.0	796.0	323.0	300.0	201.0	319.0	347.0	346.0	429.0	407.0	459.0
1981	449.0	503.0	791.0	760.0	857.0	560.0	417.0	416.0	597.0	618.0	579.0	565.0
1982	500.0	582.0	787.0	598.0	278.0	274.0	173.0	167.0	334.0	382.0	301.0	239.0
1983	186.0	192.0	270.0	257.0	281.0	220.0	174.0	198.0	198.0	216.0	163.0	225.0
1984	349.0	153.0	224.0	297.0	195.0	306.0	311.0	359.0	468.0	593.0	480.0	405.0
1985	378.0	471.0	810.0	761.0	768.0	544.0	362.0	437.0	580.0	670.0	556.0	532.0
1986	497.0	553.0	785.0	790.0	371.0	251.0	243.0	243.0	368.0	519.0	419.0	407.0
1987	390.0	424.0	744.0	737.0	876.0	702.0	559.0	438.0	603.0	649.0	600.0	582.0
1988	521.0	610.0	825.0	807.0	1000.0	906.0	637.0	603.0	659.0	648.0	641.0	610.0
1989	575.0	642.0	831.0	820.0	974.0	826.0	544.0	686.0	621.0	617.0	612.0	547.0
1990	573.0	630.0	839.0	830.0	963.0	917.0	717.0	644.0	668.0	633.0	626.0	612.0
1991	574.0	628.0	846.0	843.0	1020.0	714.0	583.0	672.0	715.0	717.0	697.0	670.0
1992	581.0	643.0	856.0	845.0	829.0	790.0	794.0	714.0	739.0	753.0	792.0	721.0
1993	599.0	674.0	856.0	645.0	649.0	624.0	440.0	485.0	701.0	789.0	475.0	481.0
1994	499.0	558.0	833.0	836.0	908.0	925.0	659.0	622.0	688.0	713.0	650.0	633.0
1995	603.0	647.0	853.0	677.0	712.0	332.0	204.0	148.0	294.0	245.0	296.0	467.0
1996	447.0	513.0	788.0	718.0	301.0	279.0	310.0	326.0	457.0	565.0	455.0	472.0
1997	449.0	439.0	287.0	228.0	165.0	196.0	303.0	315.0	435.0	608.0	496.0	462.0
1998	469.0	572.0	800.0	534.0	322.0	248.0	182.0	168.0	255.0	246.0	270.0	302.0
1999	354.0	447.0	695.0	510.0	201.0	347.0	334.0	347.0	414.0	629.0	524.0	504.0
2000	480.0	559.0	828.0	736.0	327.0	251.0	330.0	359.0	575.0	629.0	541.0	467.0
2001	434.0	519.0	788.0	760.0	856.0	654.0	380.0	434.0	602.0	658.0	599.0	565.0
2002	526.0	594.0	793.0	748.0	808.0	768.0	482.0	493.0	543.0	655.0	595.0	579.0
2003	574.0	623.0	812.0	814.0	786.0	798.0	418.0	446.0	439.0	644.0	591.0	581.0
Average	479.1	537.5	750.0	663.7	623.7	528.1	405.9	411.3	503.2	580.5	514.3	508.9
Critical	527.6	606.4	832.9	821.4	955.9	907.9	669.9	625.1	673.3	687.7	664.9	640.0
Dry	458.7	525.5	792.8	764.3	856.5	675.7	457.3	484.0	591.0	644.5	590.2	561.7
BN	499.5	540.0	788.5	724.5	610.0	547.0	404.0	366.5	510.5	626.0	516.5	544.5
AN	538.3	608.8	823.0	665.0	549.0	460.8	350.7	369.0	486.2	598.8	483.8	482.3
Wet	432.1	472.5	645.9	522.4	373.9	283.5	265.8	289.0	377.9	477.8	411.8	420.8

Table 5-5. Sacramento River inflow (cfs) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.5	-0.2	0.0	-0.2	0.3	0.0	0.2	-0.5	-0.4	-0.4	0.2	0.1
1971	0.5	-0.5	0.2	-0.4	-0.1	-0.3	0.2	0.0	0.3	-0.3	0.0	0.4
1972	-0.1	0.4	0.3	0.4	0.4	-0.1	-0.4	0.3	-0.4	-0.4	0.0	0.4
1973	0.5	0.3	-0.3	0.2	-0.4	0.1	0.3	0.0	0.0	-0.1	0.3	0.2
1974	-0.5	-0.3	0.4	-0.5	0.3	0.4	0.1	0.3	0.4	-0.4	-0.3	0.3
1975	0.2	-0.1	0.0	-0.1	0.1	-0.3	-0.5	0.2	-0.4	-0.2	0.1	-0.1
1976	0.3	-0.5	-0.1	-0.5	-0.3	0.2	-2.9	-4.6	-45.0	1279.9	2802.7	693.4
1977	-180.2	-167.5	-155.3	-155.8	-148.7	-146.2	-127.1	-120.2	-97.1	2118.5	826.0	471.0
1978	-146.4	-160.4	-162.1	-961.7	-849.3	-464.5	-123.7	-92.9	-58.4	0.3	-0.4	-0.3
1979	-0.1	-0.2	0.0	-84.7	-239.3	-76.8	-65.9	-49.4	-0.1	-0.1	-0.5	0.0
1980	-12.6	-30.7	-69.9	-196.4	-291.8	-48.9	-34.5	-27.9	-0.2	-0.3	0.2	0.1
1981	0.3	-13.8	0.5	-43.6	-29.2	-28.5	-22.5	-19.9	-37.8	66.8	1740.4	-102.3
1982	-153.3	62.5	-817.2	-198.8	-218.7	-100.8	-84.4	-199.9	-40.5	0.5	-0.1	-0.1
1983	-84.4	-150.4	-64.7	-50.0	-56.6	-63.2	-56.8	-49.4	-40.9	-30.8	-27.6	-25.6
1984	-23.7	-37.0	-37.2	-35.0	-31.4	-29.6	-20.3	-17.7	0.0	-13.7	0.0	0.3
1985	-0.1	-76.3	-20.9	-16.3	-20.8	-16.5	-13.1	-12.1	-10.6	-12.3	-11.7	-9.7
1986	-9.0	-9.1	-22.2	-16.1	-77.5	-19.9	-18.1	-11.2	-0.2	-0.2	0.4	-0.3
1987	0.3	-9.4	-8.9	-8.9	-12.0	-17.4	-46.0	-77.8	-106.5	1818.7	2956.2	659.8
1988	-216.7	-182.1	-276.8	-384.3	-82.3	-173.0	-165.1	-158.5	-126.5	2939.3	1189.0	567.7
1989	-237.4	-229.1	-222.9	-213.6	-204.0	-1104.4	-698.7	-210.6	-196.1	59.1	959.5	-30.2
1990	-186.6	-179.8	-168.8	-189.9	-409.6	-227.7	-85.6	-144.3	-96.6	2801.2	1042.1	616.0
1991	-197.1	-113.6	-91.9	-111.1	-114.4	-620.4	-240.6	-177.9	-198.1	2186.9	856.5	463.1
1992	-209.3	-186.1	-200.7	-193.7	-674.1	-286.3	-234.3	-198.9	-235.7	2889.0	1185.5	443.6
1993	-85.7	-218.3	-298.0	-1265.1	-1190.4	-1136.9	-226.0	-595.1	-184.2	-0.4	-0.5	0.1
1994	0.3	0.0	0.3	-90.1	-216.4	-110.4	-73.6	-64.5	-43.6	142.6	2682.3	503.4
1995	-157.6	-176.8	-189.7	-1176.5	-837.8	-282.3	-183.1	109.2	-311.7	-108.4	-100.0	-0.4
1996	-0.4	0.5	-129.0	-397.0	-117.1	-109.6	-102.4	-97.9	-66.3	0.3	0.5	0.2
1997	-0.3	0.3	-406.3	-92.0	-83.7	-75.8	-54.0	-49.2	0.3	-33.7	0.0	-30.4
1998	-29.6	-37.9	-48.2	-90.0	-272.1	-81.4	-74.2	-67.1	-59.2	-46.1	-41.5	-38.6
1999	0.5	-89.5	-46.6	-39.1	-53.5	-47.8	-46.0	-38.5	-30.0	-0.1	-0.1	-0.1
2000	0.1	0.4	-14.2	-110.9	-69.3	-109.4	-39.8	-31.3	-0.1	-18.3	-0.5	0.1
2001	-0.2	0.3	-22.5	-38.5	-33.9	-31.9	-28.8	-82.3	-112.7	3053.6	1524.6	657.0
2002	-185.6	-220.9	-236.8	-692.3	-440.7	-176.1	-335.0	-76.7	-61.3	-15.9	-49.0	-25.5
2003	-2.7	-24.0	-264.7	-165.5	-81.9	-77.7	-75.4	-137.2	-133.2	800.8	55.0	46.6
Average	-62.3	-66.2	-116.9	-206.4	-201.7	-166.6	-96.4	-79.5	-67.4	584.6	517.3	142.9
Critical	-141.3	-118.5	-127.6	-160.8	-235.1	-223.4	-132.8	-124.1	-120.4	2051.0	1512.0	536.9
Dry	-70.4	-91.6	-85.3	-168.9	-123.4	-229.1	-190.7	-79.9	-87.5	828.3	1186.7	191.5
BN	-0.1	0.1	0.2	-42.1	-119.4	-38.5	-33.1	-24.5	-0.2	-0.3	-0.3	0.2
AN	-41.1	-72.1	-134.8	-449.9	-413.8	-306.2	-83.2	-147.4	-62.7	130.3	9.0	7.8
Wet	-35.2	-33.7	-135.4	-161.2	-134.4	-62.4	-49.2	-32.4	-42.2	-18.0	-12.9	-7.3

Table 5-6. Sacramento River inflow percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.5	7.0	35.6	9.7
1977	-2.7	-2.0	-1.8	-1.0	-1.5	-1.6	-1.4	-2.0	-1.2	23.5	7.6	7.5
1978	-2.3	-2.4	-1.0	-2.0	-1.9	-0.9	-0.4	-0.5	-0.4	0.0	0.0	0.0
1979	0.0	0.0	0.0	-0.4	-0.8	-0.3	-0.5	-0.3	0.0	0.0	0.0	0.0
1980	-0.1	-0.2	-0.4	-0.3	-0.4	-0.1	-0.2	-0.2	0.0	0.0	0.0	0.0
1981	0.0	-0.1	0.0	-0.2	-0.1	-0.1	-0.2	-0.2	-0.3	0.3	12.1	-0.8
1982	-1.4	0.2	-1.2	-0.3	-0.3	-0.2	-0.1	-0.6	-0.2	0.0	0.0	0.0
1983	-0.4	-0.4	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
1984	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0
1985	0.0	-0.3	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
1986	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.5	-0.7	-0.8	12.6	34.1	7.4
1988	-2.7	-2.2	-1.5	-1.5	-0.6	-2.3	-1.5	-1.8	-1.2	23.1	14.7	8.1
1989	-3.7	-2.2	-2.1	-1.7	-2.0	-2.5	-3.3	-1.5	-1.4	0.3	5.4	-0.2
1990	-1.7	-2.0	-2.0	-1.0	-2.6	-1.8	-0.8	-1.8	-1.2	18.6	10.5	8.0
1991	-3.1	-1.8	-1.3	-1.5	-1.1	-2.1	-2.0	-2.3	-2.0	14.8	8.5	6.1
1992	-3.1	-2.7	-2.9	-1.8	-2.2	-1.5	-2.0	-2.2	-1.7	22.3	12.1	5.0
1993	-1.2	-3.3	-2.2	-2.7	-2.5	-3.3	-0.6	-2.1	-0.7	0.0	0.0	0.0
1994	0.0	0.0	0.0	-0.7	-0.9	-0.9	-0.6	-0.6	-0.5	0.7	21.5	4.4
1995	-2.0	-2.1	-1.2	-1.8	-1.8	-0.4	-0.4	0.2	-0.8	-0.6	-0.6	0.0
1996	0.0	0.0	-0.7	-1.0	-0.2	-0.2	-0.3	-0.2	-0.4	0.0	0.0	0.0
1997	0.0	0.0	-0.8	-0.1	-0.2	-0.3	-0.3	-0.4	0.0	-0.1	0.0	-0.1
1998	-0.2	-0.2	-0.2	-0.3	-0.4	-0.1	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2
1999	0.0	-0.3	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	0.0	0.0	0.0
2000	0.0	0.0	-0.1	-0.5	-0.1	-0.2	-0.2	-0.2	0.0	-0.1	0.0	0.0
2001	0.0	0.0	-0.2	-0.2	-0.1	-0.1	-0.2	-0.9	-0.8	20.8	15.7	7.7
2002	-2.3	-2.2	-0.8	-1.6	-2.3	-0.9	-2.0	-0.6	-0.6	-0.1	-0.4	-0.2
2003	0.0	-0.2	-0.7	-0.3	-0.3	-0.3	-0.3	-0.4	-0.9	3.3	0.3	0.2
Average	-0.8	-0.7	-0.6	-0.6	-0.7	-0.6	-0.5	-0.6	-0.5	4.3	5.2	1.8
Critical	-1.9	-1.5	-1.4	-1.1	-1.3	-1.5	-1.2	-1.5	-1.2	15.7	15.8	7.0
Dry	-1.0	-0.8	-0.5	-0.6	-0.8	-0.6	-1.1	-0.7	-0.7	5.6	11.1	2.3
BN	0.0	0.0	0.0	-0.2	-0.4	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0
AN	-0.6	-1.0	-0.7	-1.0	-0.9	-0.8	-0.3	-0.6	-0.3	0.5	0.1	0.0
Wet	-0.3	-0.2	-0.4	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0

Table 5-7. San Joaquin River inflow (cfs) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.2	-0.4	-0.4	0.4	0.2	0.3	0.1	-0.1	0.4	-0.4	0.4	-0.4
1971	0.4	0.2	-0.1	0.1	0.4	-0.3	0.3	0.1	-0.4	0.4	0.2	0.5
1972	0.1	0.1	-0.2	0.2	-0.1	0.3	-0.2	0.3	-0.4	0.0	0.1	-0.4
1973	-0.3	0.3	-0.2	0.1	0.5	-487.8	-0.1	0.0	0.3	-0.3	0.0	-0.5
1974	0.3	0.2	0.1	-0.1	0.2	-0.5	0.1	-0.3	-0.4	-0.1	0.2	-0.4
1975	-0.3	-0.1	-0.1	-0.2	-0.3	0.3	-0.5	-0.5	-0.2	0.3	-0.5	0.4
1976	-0.5	-0.3	0.0	0.1	0.4	0.0	0.2	0.0	-0.4	0.0	-0.5	-0.1
1977	0.3	0.1	0.4	-0.1	0.1	-0.2	0.3	0.3	-0.1	-0.4	0.4	-0.3
1978	0.1	0.4	0.5	0.5	0.4	0.1	-0.4	0.3	-0.5	0.3	0.4	0.3
1979	-0.3	0.3	0.4	-0.2	0.2	0.3	-0.4	-0.5	0.2	0.2	-0.4	0.3
1980	0.2	0.3	-0.2	0.4	0.1	-0.3	-0.5	-0.1	0.3	-0.5	0.2	-0.1
1981	0.4	-0.4	-0.1	-0.5	-0.4	0.0	0.0	-0.3	-0.1	-0.2	-0.3	-0.1
1982	0.3	-0.5	-0.1	0.4	-540.4	-0.1	-0.2	-0.2	0.2	0.1	0.5	-0.5
1983	0.0	0.4	0.0	0.0	-0.1	0.4	0.0	-0.5	-0.1	0.2	0.4	-0.3
1984	-0.3	-0.1	0.3	0.0	-0.5	-0.2	0.3	0.1	0.1	-0.5	0.2	0.4
1985	-0.1	-0.4	0.4	0.1	0.0	-0.5	0.3	0.5	-0.2	-0.5	0.2	0.2
1986	-0.3	-0.3	0.2	0.4	0.3	-0.5	-0.3	0.5	0.0	-0.4	0.0	-0.2
1987	-0.1	0.4	-0.4	-0.2	0.4	-0.4	0.2	-0.1	0.0	0.5	-0.1	-0.5
1988	-0.1	0.2	-0.5	0.2	-0.4	-0.2	0.4	-0.1	-0.3	-0.1	0.4	0.2
1989	-0.4	0.2	-0.4	0.4	0.0	0.3	-0.2	-0.5	0.0	-0.4	0.2	0.3
1990	0.0	-0.4	0.3	-0.4	0.1	-0.1	-0.3	0.3	0.4	0.1	0.3	0.3
1991	-0.3	0.1	-0.4	0.1	-0.3	-0.3	0.4	0.1	-0.4	0.2	0.3	-0.4
1992	0.3	0.1	-0.3	-0.3	0.1	-0.2	-0.1	0.0	-0.2	0.2	-0.5	0.2
1993	0.2	0.4	0.3	0.2	-0.2	-0.3	0.3	-0.4	-504.1	0.2	-0.3	-0.3
1994	-0.2	-0.4	-0.5	-0.5	0.2	0.0	0.1	-0.1	0.4	0.0	-0.2	-0.1
1995	-0.5	-0.1	-0.4	-0.2	-0.3	-0.3	0.5	0.3	0.4	-0.4	0.5	0.0
1996	0.4	-0.5	0.3	-0.3	-0.4	0.2	0.0	-0.1	-0.2	0.5	0.4	0.2
1997	0.2	0.0	0.1	-0.2	-0.5	-0.3	0.2	0.0	0.3	0.2	0.4	0.0
1998	0.0	0.4	0.5	0.1	-0.5	0.5	0.5	-0.1	-0.2	0.3	0.4	0.2
1999	-0.2	0.1	0.2	0.5	-0.2	0.2	0.2	0.1	0.2	0.1	0.4	0.1
2000	0.3	0.1	-0.4	-0.2	0.0	0.2	0.4	0.1	0.3	0.5	-0.2	0.0
2001	0.4	-0.3	0.1	-0.2	0.3	0.0	0.5	0.4	0.4	0.2	0.3	0.0
2002	0.2	0.4	0.5	0.4	0.1	0.3	0.2	-0.1	0.3	0.3	-0.5	0.3
2003	-0.1	0.5	0.3	0.0	0.4	-0.5	0.3	0.2	-0.5	0.3	-0.2	0.0
Average	0.0	0.0	0.0	0.0	-15.9	-14.4	0.1	0.0	-14.8	0.0	0.1	0.0
Critical	-0.1	-0.1	-0.1	-0.1	0.0	-0.2	0.1	0.1	-0.1	0.0	0.0	0.0
Dry	0.1	0.0	0.0	0.0	0.1	-0.1	0.2	0.0	0.1	0.0	0.0	0.0
BN	-0.1	0.2	0.1	0.0	0.1	0.3	-0.3	-0.1	-0.1	0.1	-0.2	-0.1
AN	0.1	0.3	0.1	0.2	0.2	-81.4	0.0	0.0	-84.0	0.1	0.0	-0.1
Wet	0.0	0.0	0.0	0.1	-41.7	0.0	0.1	-0.1	0.0	0.0	0.3	0.0

Table 5-8. San Joaquin River inflow percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-5.8	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.1	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11.5	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	-0.3	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	0.0	-1.9	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-9. NDO (cfs) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.5	0.2	0.1	0.3	0.3	0.2	-0.3	-0.2	0.4	-0.4	0.0	0.5
1971	0.5	-0.5	0.2	-0.2	-0.4	0.1	-0.3	0.3	-0.4	0.0	0.0	-0.5
1972	-0.3	-0.1	0.5	-0.4	0.4	-0.5	0.0	-0.1	0.5	0.1	0.0	-0.2
1973	0.0	-0.2	-0.2	-0.1	-0.2	-487.9	0.2	-0.2	0.1	0.2	0.0	0.3
1974	0.0	0.2	-0.2	0.1	-0.5	-0.3	-0.1	0.2	-0.5	0.0	-0.1	-0.3
1975	0.0	0.3	0.4	0.2	0.4	-0.1	-0.2	0.3	-0.5	0.0	0.0	0.5
1976	0.0	0.5	0.4	0.3	0.0	-0.1	-2.9	10.0	-34.3	389.6	504.2	181.0
1977	0.0	0.4	0.0	0.0	-0.4	0.3	0.0	-12.8	0.0	460.0	205.1	133.0
1978	0.4	0.0	-76.3	-876.2	-763.8	-464.5	-123.4	-93.3	-58.1	0.0	0.0	-0.5
1979	0.5	0.0	0.3	-84.8	-238.7	-76.7	-66.2	-49.7	0.0	0.0	0.4	0.4
1980	0.1	-30.0	-69.4	-196.6	-1026.5	-49.1	-34.3	-27.8	0.5	0.0	0.0	-0.5
1981	0.0	-0.5	-0.4	-44.2	-29.2	-27.9	-22.8	-20.1	0.0	152.0	210.2	79.4
1982	0.2	148.0	-731.5	-113.3	-673.0	-100.6	-84.6	-199.5	-40.8	0.0	0.0	0.0
1983	-83.7	-150.4	-64.5	-50.7	-56.6	-63.2	-56.6	-50.2	-40.8	-31.1	-28.0	-25.9
1984	-24.2	-37.7	-36.9	-34.5	-32.1	-29.4	-20.3	-18.4	0.0	-0.3	0.0	-0.5
1985	-0.3	-76.4	-20.9	-17.1	-21.1	0.2	-13.4	-12.1	-0.3	0.0	0.0	0.2
1986	0.0	0.0	-22.5	-16.1	-76.9	-19.7	-18.4	-11.2	0.4	0.0	0.0	0.5
1987	0.0	-0.2	0.1	-9.3	-11.5	-17.7	-0.1	-0.4	0.0	408.0	640.6	181.0
1988	0.0	0.0	-191.4	-299.0	0.1	-0.3	-80.1	0.0	0.0	637.0	290.0	165.0
1989	0.0	-0.3	-137.1	-0.2	0.3	-1018.9	-613.7	-0.1	0.5	66.1	197.5	47.9
1990	0.0	0.0	0.0	-104.4	-323.4	-142.5	0.3	-51.7	0.0	609.0	261.5	176.0
1991	0.4	0.0	0.4	0.0	-115.0	-534.7	-154.9	-85.1	0.0	485.0	221.0	141.0
1992	-0.2	-0.3	-0.1	0.3	-591.8	-200.3	-148.2	0.4	0.0	628.0	288.7	141.0
1993	0.4	0.0	-212.2	-1180.0	-1104.7	-1136.6	-226.0	-595.3	-689.0	0.0	0.0	0.3
1994	-0.3	-0.5	-0.2	-90.5	-217.0	-110.7	-73.5	-64.6	-42.7	293.0	349.5	143.0
1995	3.9	0.0	-104.3	-1091.3	-752.8	-282.4	-183.3	109.6	-311.3	-108.6	-100.5	-0.5
1996	0.0	-0.3	-129.3	-397.6	-117.4	-110.1	-102.4	-98.0	-66.3	0.0	0.0	0.0
1997	-0.5	0.0	-406.6	-91.7	-83.5	-76.6	-53.8	-50.0	-0.4	0.3	0.0	0.5
1998	-0.5	-0.5	-48.7	-89.5	-272.1	-81.0	-73.5	-66.6	-59.3	-47.0	-41.5	-38.4
1999	0.8	-89.1	-45.9	-39.6	-52.9	-48.1	-46.2	-37.8	-30.5	-0.2	0.0	0.0
2000	0.0	-0.1	-0.1	-110.5	-69.7	-109.6	-39.5	-32.0	0.3	0.4	0.0	0.3
2001	-0.3	0.3	0.0	-38.7	-33.6	-32.2	-28.0	-75.1	0.0	655.0	355.0	181.0
2002	1.0	-134.9	-151.6	-607.2	-354.5	-175.7	-334.9	-76.2	0.0	-0.3	0.3	0.0
2003	0.1	0.0	-263.8	-165.9	-81.5	-77.7	-74.6	-136.6	-133.2	69.5	70.0	51.3
Average	-3.0	-10.9	-79.8	-169.1	-208.8	-161.0	-78.7	-51.3	-44.3	137.2	100.7	45.8
Critical	0.0	0.0	-27.3	-70.5	-178.2	-141.2	-65.6	-29.1	-11.0	500.2	302.9	154.3
Dry	0.1	-35.3	-51.7	-119.4	-74.9	-212.0	-168.8	-30.7	0.0	213.5	233.9	81.6
BN	0.1	-0.1	0.4	-42.6	-119.1	-38.6	-33.1	-24.9	0.3	0.0	0.2	0.1
AN	0.2	-5.0	-103.7	-421.5	-507.8	-387.6	-82.9	-147.5	-146.6	11.7	11.7	8.5
Wet	-7.9	-10.0	-122.3	-148.0	-162.9	-62.4	-49.2	-32.4	-42.3	-14.4	-13.1	-4.9

Table 5-10. NDO percent difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.9	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	-0.8	8.2	13.0	6.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	11.5	6.1	4.4
1978	0.0	0.0	-0.7	-1.3	-1.5	-0.7	-0.3	-0.4	-0.4	0.0	0.0	0.0
1979	0.0	0.0	0.0	-0.4	-0.7	-0.3	-0.3	-0.3	0.0	0.0	0.0	0.0
1980	0.0	-0.4	-0.6	-0.2	-0.8	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	-0.2	-0.1	-0.1	-0.2	-0.2	0.0	3.0	5.3	2.6
1982	0.0	0.6	-0.9	-0.2	-0.7	-0.1	-0.1	-0.4	-0.2	0.0	0.0	0.0
1983	-0.6	-0.4	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1
1984	-0.2	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
1985	0.0	-0.4	-0.2	-0.2	-0.2	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
1986	0.0	0.0	-0.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	8.2	15.4	6.0
1988	0.0	0.0	-1.5	-1.1	0.0	0.0	-0.8	0.0	0.0	15.9	7.5	5.5
1989	0.0	0.0	-3.1	0.0	0.0	-2.2	-3.1	0.0	0.0	1.3	3.7	1.0
1990	0.0	0.0	0.0	-0.7	-2.7	-1.6	0.0	-0.8	0.0	15.2	6.1	5.9
1991	0.0	0.0	0.0	0.0	-1.3	-1.6	-1.5	-1.5	0.0	12.1	5.0	4.7
1992	0.0	0.0	0.0	0.0	-1.7	-1.2	-1.5	0.0	0.0	15.7	7.8	4.7
1993	0.0	0.0	-2.5	-1.9	-2.0	-3.2	-0.6	-2.0	-3.3	0.0	0.0	0.0
1994	0.0	0.0	0.0	-1.0	-1.0	-1.3	-0.7	-0.7	-1.0	7.3	8.6	4.8
1995	0.1	0.0	-1.2	-1.0	-1.6	-0.1	-0.3	0.1	-0.8	-0.5	-1.1	0.0
1996	0.0	0.0	-0.8	-0.9	-0.1	-0.2	-0.2	-0.2	-0.6	0.0	0.0	0.0
1997	0.0	0.0	-0.6	0.0	-0.1	-0.3	-0.3	-0.3	0.0	0.0	0.0	0.0
1998	0.0	0.0	-0.5	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.4	-0.2
1999	0.0	-0.4	-0.2	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	0.0	0.0	0.0
2000	0.0	0.0	0.0	-0.5	-0.1	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	-0.3	-0.1	-0.1	-0.2	-0.9	0.0	13.1	8.5	6.0
2002	0.0	-2.3	-0.5	-1.3	-2.4	-1.0	-2.0	-0.6	0.0	0.0	0.0	0.0
2003	0.0	0.0	-0.7	-0.3	-0.3	-0.4	-0.3	-0.4	-2.0	0.7	1.8	0.4
Average	0.0	-0.1	-0.4	-0.4	-0.5	-0.5	-0.4	-0.3	-0.3	3.3	2.6	1.5
Critical	0.0	0.0	-0.2	-0.4	-1.0	-0.8	-0.6	-0.4	-0.3	12.3	7.7	5.1
Dry	0.0	-0.5	-0.6	-0.3	-0.5	-0.6	-0.9	-0.3	0.0	4.3	5.5	2.6
BN	0.0	0.0	0.0	-0.2	-0.3	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0
AN	0.0	-0.1	-0.8	-0.7	-0.8	-0.9	-0.2	-0.5	-1.0	0.1	0.3	0.1
Wet	-0.1	0.0	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	0.0

Table 5-11. San Joaquin River inflow salinity (EC) difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-23.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	-10.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.4	-0.7	-0.1	0.0	0.6	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-3.8	0.0	0.0	3.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-12. San Joaquin River inflow salinity (EC) percent difference All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-6.9	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-13. Sacramento River inflow (cfs) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	127.7	-27.7	1077.3	1049.4	342.7
1977	-85.5	-85.5	-85.5	-85.5	-85.5	-85.5	-85.5	14.4	-113.2	1325.0	478.4	278.7
1978	-85.5	-85.5	-85.5	-510.8	-663.6	-156.0	1.4	0.5	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-654.7	971.6	-505.6
1982	-85.5	322.3	-601.4	-97.5	-123.4	-14.7	0.0	-142.9	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18.3	-27.7	843.2	1429.5	342.7
1988	-85.5	-85.5	-85.5	-85.5	-82.7	-85.5	-85.5	-103.8	-113.2	1581.1	532.6	313.7
1989	-85.5	-85.5	-85.5	-85.5	-85.4	-601.6	-539.4	-85.5	-85.5	-85.5	191.0	-119.1
1990	-85.5	-85.5	-85.5	-85.5	-310.6	-126.0	-85.5	42.2	-113.2	1630.5	577.5	342.7
1991	-80.1	0.0	0.0	0.0	0.0	-85.5	-85.5	14.4	-113.2	1325.0	478.4	278.7
1992	-85.5	-85.5	-85.5	-85.5	-169.3	-85.5	-85.5	-103.8	-113.2	1655.2	503.2	260.7
1993	-85.5	-85.5	-85.5	-712.7	-910.6	-143.8	0.0	-151.3	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.1	50.4	-189.3	1419.6	162.0
1995	-85.5	-85.5	-85.5	-335.0	-317.2	-50.4	0.0	270.6	-175.7	-6.0	-11.0	0.0
1996	0.0	0.0	0.0	-62.2	0.0	0.0	0.0	-3.2	0.0	0.0	0.1	0.0
1997	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.6	-0.2	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-18.3	-27.7	1776.5	577.5	342.7
2002	-85.5	-85.5	197.7	-398.7	-284.6	-34.1	-227.6	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	15.9	0.0	0.0	0.3	-50.4	0.0	325.3	-244.0	-84.0
Average	-27.5	-13.2	-32.0	-74.4	-88.8	-43.2	-35.1	-5.0	-25.3	311.9	233.9	57.5
Critical	-60.3	-48.9	-48.9	-48.9	-92.6	-66.9	-61.1	4.3	-77.6	1200.7	719.9	282.7
Dry	-28.5	-28.5	18.7	-80.7	-61.7	-106.0	-127.8	-20.3	-23.5	313.2	528.3	10.1
BN	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-28.5	-28.5	-28.5	-201.3	-262.4	-50.0	0.3	-33.5	0.0	54.2	-40.7	-14.0
Wet	-13.1	18.2	-52.9	-38.0	-33.9	-5.0	0.0	9.6	-13.5	-0.5	-0.8	0.0

Table 5-14. Sacramento River inflow (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	-0.3	5.9	13.3	4.8
1977	-1.3	-1.0	-1.0	-0.6	-0.9	-0.9	-0.9	0.2	-1.4	14.7	4.4	4.4
1978	-1.3	-1.3	-0.5	-1.1	-1.5	-0.3	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.2	6.7	-4.1
1982	-0.8	1.0	-0.9	-0.2	-0.2	0.0	0.0	-0.5	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	5.8	16.5	3.9
1988	-1.1	-1.1	-0.5	-0.3	-0.6	-1.1	-0.8	-1.2	-1.0	12.4	6.6	4.5
1989	-1.3	-0.8	-0.8	-0.7	-0.8	-1.4	-2.5	-0.6	-0.6	-0.4	1.1	-0.8
1990	-0.8	-1.0	-1.0	-0.5	-1.9	-1.0	-0.8	0.5	-1.4	10.8	5.8	4.4
1991	-1.3	0.0	0.0	0.0	0.0	-0.3	-0.7	0.2	-1.2	9.0	4.8	3.7
1992	-1.3	-1.3	-1.2	-0.8	-0.6	-0.5	-0.7	-1.1	-0.8	12.8	5.1	3.0
1993	-1.2	-1.3	-0.6	-1.5	-1.9	-0.4	0.0	-0.5	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.6	-1.0	11.4	1.4
1995	-1.1	-1.0	-0.6	-0.5	-0.7	-0.1	0.0	0.5	-0.5	0.0	-0.1	0.0
1996	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	12.1	5.9	4.0
2002	-1.1	-0.8	0.7	-0.9	-1.5	-0.2	-1.4	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	1.3	-1.4	-0.4
Average	-0.4	-0.3	-0.2	-0.2	-0.3	-0.2	-0.2	0.0	-0.2	2.4	2.4	0.8
Critical	-0.8	-0.6	-0.5	-0.3	-0.6	-0.5	-0.6	0.1	-0.8	9.2	7.3	3.7
Dry	-0.4	-0.3	0.0	-0.3	-0.4	-0.3	-0.7	-0.2	-0.2	2.4	5.0	0.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.4	-0.4	-0.2	-0.4	-0.6	-0.1	0.0	-0.1	0.0	0.2	-0.2	-0.1
Wet	-0.1	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-15. San Joaquin River inflow (cfs) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	487.9	0.0	0.0
1982	0.0	0.0	0.0	0.0	-540.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	487.9	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-504.2	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	487.9	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-15.9	0.0	0.0	0.0	-14.8	43.1	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.7	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162.6	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-84.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-41.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-16. San Joaquin River inflow (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.2	0.0	0.0
1982	0.0	0.0	0.0	0.0	-4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	104.8	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11.5	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.5	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.3	5.5	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.9	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-17. NDO (cfs) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	146.0	0.0	238.4	232.8	89.4
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.2	0.0	288.0	118.6	76.6
1978	0.0	0.0	0.0	-425.3	-578.2	-156.0	1.4	0.5	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.1	0.0	0.0
1982	0.0	407.8	-515.9	-12.0	-578.1	-14.6	0.0	-142.9	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	191.6	308.9	89.4
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	339.2	129.5	83.6
1989	0.0	0.0	0.0	0.0	0.0	-516.1	-453.9	0.0	0.0	45.5	3.3	0.0
1990	0.0	0.0	0.0	0.0	-225.3	-40.5	0.0	146.0	0.0	349.1	138.5	89.4
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.2	0.0	288.0	118.6	76.6
1992	0.0	0.0	0.0	0.0	-86.9	0.0	0.0	0.0	0.0	402.8	123.6	73.0
1993	0.0	0.0	0.0	-627.2	-825.2	-143.8	0.0	-151.3	-504.2	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.1	50.4	125.6	154.7	49.5
1995	0.0	0.0	0.0	-249.5	-231.7	-50.4	0.0	270.6	-175.7	-6.0	-11.0	0.0
1996	0.0	0.0	0.0	-62.2	0.0	0.0	0.0	-3.2	0.0	0.0	0.1	0.0
1997	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.6	-0.2	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	427.0	138.5	89.4
2002	0.0	0.0	283.2	-313.2	-199.1	-34.1	-227.6	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	15.9	0.0	0.0	0.3	-50.4	0.0	0.0	0.0	0.0
Average	0.0	12.0	-6.8	-49.2	-79.7	-28.1	-20.0	14.4	-18.5	81.0	42.8	21.1
Critical	0.0	0.0	0.0	0.0	-44.6	-5.8	0.0	81.1	7.2	290.1	145.2	76.9
Dry	0.0	0.0	47.2	-52.2	-33.2	-91.7	-113.6	0.0	0.0	121.5	75.1	29.8
BN	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-172.8	-233.9	-50.0	0.3	-33.5	-84.0	0.0	0.0	0.0
Wet	0.0	31.4	-39.7	-24.9	-62.3	-5.0	0.0	9.6	-13.5	-0.5	-0.8	0.0

Table 5-18. NDO percent difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	5.0	6.0	3.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	7.2	3.5	2.6
1978	0.0	0.0	0.0	-0.6	-1.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
1982	0.0	1.6	-0.6	0.0	-0.6	0.0	0.0	-0.3	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	7.4	3.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	3.3	2.8
1989	0.0	0.0	0.0	0.0	0.0	-1.1	-2.3	0.0	0.0	0.9	0.1	0.0
1990	0.0	0.0	0.0	0.0	-1.9	-0.5	0.0	2.1	0.0	8.7	3.3	3.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	7.2	2.7	2.6
1992	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	10.1	3.3	2.4
1993	0.0	0.0	0.0	-1.0	-1.5	-0.4	0.0	-0.5	-2.4	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.2	3.1	3.8	1.7
1995	0.0	0.0	0.0	-0.2	-0.5	0.0	0.0	0.3	-0.4	0.0	-0.1	0.0
1996	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	3.3	3.0
2002	0.0	0.0	1.0	-0.6	-1.4	-0.2	-1.4	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	-0.1	-0.2	-0.1	-0.1	0.3	0.0	1.9	1.1	0.7
Critical	0.0	0.0	0.0	0.0	-0.3	-0.1	0.0	1.6	0.2	7.1	3.7	2.6
Dry	0.0	0.0	0.2	-0.1	-0.2	-0.2	-0.6	0.0	0.0	2.4	1.8	1.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	-0.3	-0.4	-0.1	0.0	-0.1	-0.4	0.0	0.0	0.0
Wet	0.0	0.1	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-19. San Joaquin River inflow salinity (EC) difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-26.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-149.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-35.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.4	0.0	0.0	0.0	0.6	-6.2	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-21.3	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-10.2	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-20. San Joaquin River inflow salinity (EC) percent difference No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.2	0.0	0.0
1982	0.0	0.0	0.0	0.0	-5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-19.8	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.3	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.1	-0.9	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.8	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.6	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-21. Sacramento River inflow (cfs) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	-2.6	-4.9	-34.2	1191.1	1402.3	423.3
1977	-179.8	-167.3	-155.1	-155.7	-148.5	-146.0	-127.5	-120.9	-85.5	1077.7	420.6	209.5
1978	-146.4	-160.6	-162.1	-962.1	-849.3	-464.9	-123.6	-93.2	-58.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	-85.0	-239.2	-76.5	-66.3	-49.4	0.0	0.0	0.0	0.0
1980	-12.1	-30.5	-69.7	-196.6	-291.3	-48.6	-34.4	-28.3	0.0	0.0	0.0	0.0
1981	0.0	-14.0	0.0	-43.8	-28.8	-28.1	-22.5	-20.1	-38.2	45.7	1710.6	-111.3
1982	-153.7	62.6	-817.0	-198.4	-218.8	-100.4	-84.3	-199.7	-40.9	0.0	0.0	0.0
1983	-83.9	-150.7	-64.4	-50.3	-56.8	-63.1	-57.1	-49.8	-40.9	-30.9	-27.7	-25.4
1984	-23.8	-37.4	-36.9	-34.8	-31.8	-29.2	-20.0	-18.1	0.0	-13.4	0.0	0.0
1985	0.0	-76.1	-21.2	-16.6	-20.6	-16.5	-13.6	-11.9	-10.4	-12.3	-11.9	-9.2
1986	-8.8	-9.0	-22.5	-16.6	-77.2	-20.0	-18.0	-11.5	0.0	0.0	0.0	0.0
1987	0.0	-9.1	-9.0	-9.0	-11.8	-17.7	-45.7	-71.0	-95.2	1357.7	1920.3	390.2
1988	-217.0	-182.3	-277.2	-384.8	-82.7	-172.7	-165.3	-151.4	-115.1	2121.9	591.5	313.2
1989	-237.4	-228.8	-222.4	-213.2	-204.1	-1104.4	-698.7	-211.0	-196.1	59.1	959.7	-29.9
1990	-186.4	-180.2	-169.0	-190.1	-409.2	-227.7	-85.5	-144.2	-85.5	1728.8	624.4	346.3
1991	-197.4	-113.6	-92.1	-110.7	-114.8	-620.5	-240.9	-179.1	-187.3	1146.4	450.8	201.1
1992	-208.9	-185.8	-200.3	-193.9	-674.0	-286.2	-234.2	-191.4	-224.2	1927.2	776.9	214.0
1993	-85.5	-218.2	-298.0	-1265.4	-1190.5	-1136.7	-225.7	-595.3	-184.4	0.0	0.0	0.0
1994	0.0	0.0	0.0	-90.5	-216.8	-110.4	-73.5	-64.9	-43.2	80.1	1389.8	256.6
1995	-157.7	-176.8	-189.5	-1176.3	-838.3	-282.3	-183.2	109.5	-311.3	-108.1	-100.3	0.0
1996	0.0	0.0	-129.2	-397.4	-117.1	-109.7	-102.8	-98.1	-66.4	0.0	0.1	0.0
1997	0.0	0.0	-406.3	-92.0	-83.9	-76.2	-54.1	-49.6	0.0	-33.6	0.0	-30.0
1998	-29.6	-38.4	-48.5	-89.7	-272.2	-81.1	-73.8	-66.7	-59.1	-46.6	-41.9	-38.6
1999	0.6	-89.3	-46.3	-39.2	-53.0	-48.1	-45.8	-38.0	-30.5	0.0	0.0	0.0
2000	0.0	0.0	-14.7	-110.5	-69.7	-109.4	-39.3	-31.8	0.0	-18.5	0.0	0.0
2001	0.0	0.0	-22.4	-38.4	-33.8	-32.1	-28.4	-74.6	-101.7	2404.1	676.8	387.6
2002	-185.8	-220.9	-236.9	-692.7	-440.3	-176.1	-335.0	-76.4	-61.0	-16.3	-49.2	-25.3
2003	-2.9	-24.3	-264.3	-165.4	-81.8	-77.9	-75.0	-137.0	-133.4	801.1	55.0	46.6
Average	-62.2	-66.2	-116.9	-206.4	-201.7	-166.5	-96.4	-78.8	-64.8	401.8	316.1	74.1
Critical	-141.4	-118.5	-127.7	-160.8	-235.1	-223.3	-132.8	-122.4	-110.7	1324.8	808.0	280.6
Dry	-70.5	-91.5	-85.3	-169.0	-123.2	-229.1	-190.7	-77.5	-83.8	639.7	867.7	100.4
BN	0.0	0.0	0.0	-42.5	-119.6	-38.3	-33.2	-24.7	0.0	0.0	0.0	0.0
AN	-41.1	-72.3	-134.8	-450.0	-413.8	-306.3	-83.0	-147.6	-62.6	130.4	9.2	7.8
Wet	-35.1	-33.8	-135.4	-161.1	-134.6	-62.3	-49.2	-32.5	-42.2	-17.9	-13.1	-7.2

Table 5-22. Sacramento River inflow (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.4	6.5	17.8	5.9
1977	-2.7	-2.0	-1.8	-1.0	-1.5	-1.6	-1.4	-2.0	-1.1	11.9	3.9	3.3
1978	-2.3	-2.4	-1.0	-2.0	-1.9	-0.9	-0.4	-0.5	-0.4	0.0	0.0	0.0
1979	0.0	0.0	0.0	-0.4	-0.8	-0.3	-0.5	-0.3	0.0	0.0	0.0	0.0
1980	-0.1	-0.2	-0.4	-0.3	-0.4	-0.1	-0.2	-0.2	0.0	0.0	0.0	0.0
1981	0.0	-0.1	0.0	-0.2	-0.1	-0.1	-0.2	-0.2	-0.3	0.2	11.9	-0.9
1982	-1.4	0.2	-1.2	-0.3	-0.3	-0.2	-0.1	-0.6	-0.2	0.0	0.0	0.0
1983	-0.4	-0.4	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
1984	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0
1985	0.0	-0.3	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
1986	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.5	-0.7	-0.7	9.4	22.2	4.4
1988	-2.7	-2.2	-1.5	-1.5	-0.6	-2.3	-1.5	-1.7	-1.1	16.6	7.3	4.5
1989	-3.7	-2.2	-2.1	-1.7	-2.0	-2.5	-3.3	-1.5	-1.4	0.3	5.4	-0.2
1990	-1.7	-2.0	-2.0	-1.0	-2.5	-1.8	-0.8	-1.8	-1.1	11.5	6.3	4.5
1991	-3.1	-1.8	-1.3	-1.5	-1.1	-2.1	-2.0	-2.3	-1.9	7.8	4.5	2.7
1992	-3.1	-2.7	-2.9	-1.8	-2.2	-1.5	-2.0	-2.1	-1.7	14.9	7.9	2.4
1993	-1.2	-3.3	-2.2	-2.7	-2.5	-3.3	-0.6	-2.1	-0.7	0.0	0.0	0.0
1994	0.0	0.0	0.0	-0.7	-0.9	-0.9	-0.6	-0.6	-0.5	0.4	11.2	2.2
1995	-2.0	-2.1	-1.2	-1.8	-1.8	-0.4	-0.4	0.2	-0.8	-0.6	-0.6	0.0
1996	0.0	0.0	-0.7	-1.0	-0.2	-0.2	-0.3	-0.2	-0.4	0.0	0.0	0.0
1997	0.0	0.0	-0.8	-0.1	-0.2	-0.3	-0.3	-0.4	0.0	-0.1	0.0	-0.1
1998	-0.2	-0.2	-0.3	-0.3	-0.4	-0.1	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2
1999	0.0	-0.3	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	0.0	0.0	0.0
2000	0.0	0.0	-0.1	-0.5	-0.1	-0.2	-0.2	-0.2	0.0	-0.1	0.0	0.0
2001	0.0	0.0	-0.2	-0.2	-0.1	-0.1	-0.2	-0.8	-0.8	16.4	7.0	4.5
2002	-2.3	-2.2	-0.8	-1.6	-2.3	-0.9	-2.0	-0.6	-0.6	-0.1	-0.4	-0.2
2003	0.0	-0.2	-0.7	-0.3	-0.3	-0.3	-0.3	-0.4	-0.9	3.3	0.3	0.2
Average	-0.8	-0.7	-0.6	-0.6	-0.7	-0.6	-0.5	-0.6	-0.4	2.9	3.1	1.0
Critical	-1.9	-1.5	-1.4	-1.1	-1.3	-1.5	-1.2	-1.5	-1.1	9.9	8.4	3.6
Dry	-1.0	-0.8	-0.5	-0.6	-0.8	-0.6	-1.1	-0.7	-0.6	4.4	7.7	1.3
BN	0.0	0.0	0.0	-0.2	-0.4	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0
AN	-0.6	-1.0	-0.7	-1.0	-0.9	-0.8	-0.3	-0.6	-0.3	0.5	0.1	0.0
Wet	-0.3	-0.2	-0.4	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0

Table 5-23. San Joaquin River inflow (cfs) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-487.9	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-540.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-504.2	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-15.9	-14.4	0.0	0.0	-14.8	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-81.3	0.0	0.0	-84.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-41.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-24. San Joaquin River inflow (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-5.8	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11.5	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.1	-0.2	0.0	0.0	-0.3	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	0.0	-1.9	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-25. NDO (cfs) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.2	-0.1	0.0	-487.9	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	-2.6	2.9	-34.2	271.8	319.4	125.1
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20.9	0.0	249.9	121.5	78.6
1978	0.0	0.0	-76.6	-876.6	-764.0	-464.9	-123.6	-93.2	-58.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	-85.0	-239.2	-76.5	-66.3	-49.4	0.0	0.0	0.0	0.0
1980	0.0	-30.5	-69.7	-196.6	-1026.4	-48.6	-34.4	-28.3	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	-43.8	-28.8	-28.1	-22.5	-20.1	0.0	135.2	211.0	77.8
1982	0.0	148.1	-731.5	-112.9	-673.4	-100.4	-84.3	-199.7	-40.9	0.0	0.0	0.0
1983	-83.9	-150.7	-64.4	-50.3	-56.8	-63.1	-57.1	-49.8	-40.9	-30.9	-27.7	-25.4
1984	-23.8	-37.4	-36.9	-34.8	-31.8	-29.2	-20.0	-18.1	0.0	0.0	0.0	0.0
1985	0.0	-76.1	-21.2	-16.6	-20.6	0.0	-13.6	-11.9	0.0	0.0	0.0	0.0
1986	0.0	0.0	-22.5	-16.6	-77.2	-20.0	-18.0	-11.5	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	-9.0	-11.8	-17.7	0.0	0.0	0.0	313.9	430.7	125.1
1988	0.0	0.0	-191.7	-299.3	0.0	0.0	-79.8	0.0	0.0	471.4	168.7	113.1
1989	0.0	0.0	-136.9	0.0	0.0	-1018.9	-613.2	0.0	0.0	65.9	197.2	47.9
1990	0.0	0.0	0.0	-104.6	-323.8	-142.2	0.0	-58.7	0.0	391.9	175.5	120.1
1991	0.0	0.0	0.0	0.0	-114.8	-535.0	-155.4	-93.6	0.0	274.3	137.2	86.7
1992	0.0	0.0	0.0	0.0	-591.6	-200.7	-148.7	0.0	0.0	432.7	204.5	93.7
1993	0.0	0.0	-212.5	-1179.9	-1105.1	-1136.7	-225.7	-595.3	-688.6	0.0	0.0	0.0
1994	0.0	0.0	0.0	-90.5	-216.8	-110.4	-73.5	-64.9	-43.2	166.3	204.9	93.7
1995	3.9	0.0	-104.0	-1090.8	-752.8	-282.3	-183.2	109.5	-311.3	-108.1	-100.3	0.0
1996	0.0	0.0	-129.2	-397.4	-117.1	-109.7	-102.8	-98.1	-66.4	0.0	0.1	0.0
1997	0.0	0.0	-406.3	-92.0	-83.9	-76.2	-54.1	-49.6	0.0	0.0	0.0	0.0
1998	0.0	0.0	-48.5	-89.7	-272.2	-81.1	-73.8	-66.7	-59.1	-46.6	-41.9	-38.6
1999	0.6	-89.3	-46.3	-39.2	-53.0	-48.1	-45.8	-38.0	-30.5	0.0	0.0	0.0
2000	0.0	0.0	0.0	-110.5	-69.7	-109.4	-39.3	-31.8	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	-38.4	-33.8	-32.1	-28.4	-74.6	0.0	523.0	182.6	125.1
2002	0.6	-135.4	-151.4	-607.2	-354.8	-176.1	-335.0	-76.4	0.0	0.0	0.0	0.0
2003	0.0	0.0	-264.3	-165.4	-81.8	-77.9	-75.0	-137.0	-133.4	69.5	69.5	51.3
Average	-3.0	-10.9	-79.8	-169.0	-208.9	-161.0	-78.7	-52.2	-44.3	93.5	66.3	31.6
Critical	0.0	0.0	-27.4	-70.6	-178.1	-141.2	-65.7	-33.6	-11.1	322.6	190.2	101.6
Dry	0.1	-35.3	-51.6	-119.2	-75.0	-212.1	-168.8	-30.5	0.0	173.0	170.3	62.6
BN	0.0	0.0	0.0	-42.5	-119.6	-38.3	-33.2	-24.7	0.0	0.0	0.0	0.0
AN	0.0	-5.1	-103.8	-421.5	-507.8	-387.6	-83.0	-147.6	-146.7	11.6	11.6	8.6
Wet	-7.9	-9.9	-122.3	-148.0	-163.0	-62.3	-49.2	-32.5	-42.2	-14.3	-13.1	-4.9

Table 5-26. NDO (cfs) percent difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-0.9	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.7	5.7	8.2	4.2
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.5	0.0	6.2	3.6	2.6
1978	0.0	0.0	-0.7	-1.3	-1.5	-0.7	-0.3	-0.4	-0.4	0.0	0.0	0.0
1979	0.0	0.0	0.0	-0.4	-0.7	-0.3	-0.3	-0.3	0.0	0.0	0.0	0.0
1980	0.0	-0.4	-0.6	-0.2	-0.8	-0.1	-0.2	-0.2	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	-0.2	-0.1	-0.1	-0.2	-0.2	0.0	2.7	5.3	2.5
1982	0.0	0.6	-0.9	-0.1	-0.7	-0.1	-0.1	-0.4	-0.2	0.0	0.0	0.0
1983	-0.6	-0.4	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1
1984	-0.2	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0
1985	0.0	-0.4	-0.2	-0.2	-0.1	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
1986	0.0	0.0	-0.2	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	6.3	10.4	4.2
1988	0.0	0.0	-1.5	-1.1	0.0	0.0	-0.8	0.0	0.0	11.8	4.3	3.8
1989	0.0	0.0	-3.1	0.0	0.0	-2.2	-3.1	0.0	0.0	1.3	3.7	1.0
1990	0.0	0.0	0.0	-0.7	-2.7	-1.6	0.0	-0.9	0.0	9.8	4.1	4.0
1991	0.0	0.0	0.0	0.0	-1.3	-1.6	-1.5	-1.7	0.0	6.9	3.1	2.9
1992	0.0	0.0	0.0	0.0	-1.7	-1.2	-1.5	0.0	0.0	10.8	5.5	3.1
1993	0.0	0.0	-2.5	-1.9	-2.0	-3.2	-0.6	-2.0	-3.3	0.0	0.0	0.0
1994	0.0	0.0	0.0	-1.0	-1.0	-1.3	-0.7	-0.7	-1.1	4.2	5.1	3.1
1995	0.1	0.0	-1.2	-1.0	-1.6	-0.1	-0.3	0.1	-0.8	-0.5	-1.1	0.0
1996	0.0	0.0	-0.8	-0.9	-0.1	-0.2	-0.2	-0.2	-0.6	0.0	0.0	0.0
1997	0.0	0.0	-0.6	0.0	-0.1	-0.3	-0.3	-0.3	0.0	0.0	0.0	0.0
1998	0.0	0.0	-0.5	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.4	-0.2
1999	0.0	-0.4	-0.2	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	0.0	0.0	0.0
2000	0.0	0.0	0.0	-0.5	-0.1	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	-0.3	-0.1	-0.1	-0.2	-0.9	0.0	10.5	4.4	4.2
2002	0.0	-2.3	-0.5	-1.3	-2.4	-1.0	-2.0	-0.6	0.0	0.0	0.0	0.0
2003	0.0	0.0	-0.7	-0.3	-0.3	-0.4	-0.3	-0.4	-2.0	0.7	1.7	0.4
Average	0.0	-0.1	-0.4	-0.4	-0.5	-0.5	-0.4	-0.3	-0.3	2.2	1.7	1.1
Critical	0.0	0.0	-0.2	-0.4	-1.0	-0.8	-0.6	-0.5	-0.3	7.9	4.9	3.4
Dry	0.0	-0.5	-0.6	-0.3	-0.5	-0.6	-0.9	-0.3	0.0	3.5	4.0	2.0
BN	0.0	0.0	0.0	-0.2	-0.3	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.0
AN	0.0	-0.1	-0.8	-0.7	-0.8	-0.9	-0.2	-0.5	-1.0	0.1	0.3	0.1
Wet	-0.1	0.0	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	0.0

Table 5-27. San Joaquin River salinity (EC) difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-23.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	-10.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.4	-0.7	-0.1	0.0	0.6	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-1.4	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-3.8	0.0	0.0	3.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5-28. San Joaquin River salinity (EC) percent difference No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	-6.9	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	-5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	-1.3	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	-0.2	-0.2	0.0	0.0	0.1	0.0	0.0	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	0.5	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C.1.6 Export Boundary Conditions

See the text in Appendix C for details on the export boundary conditions.

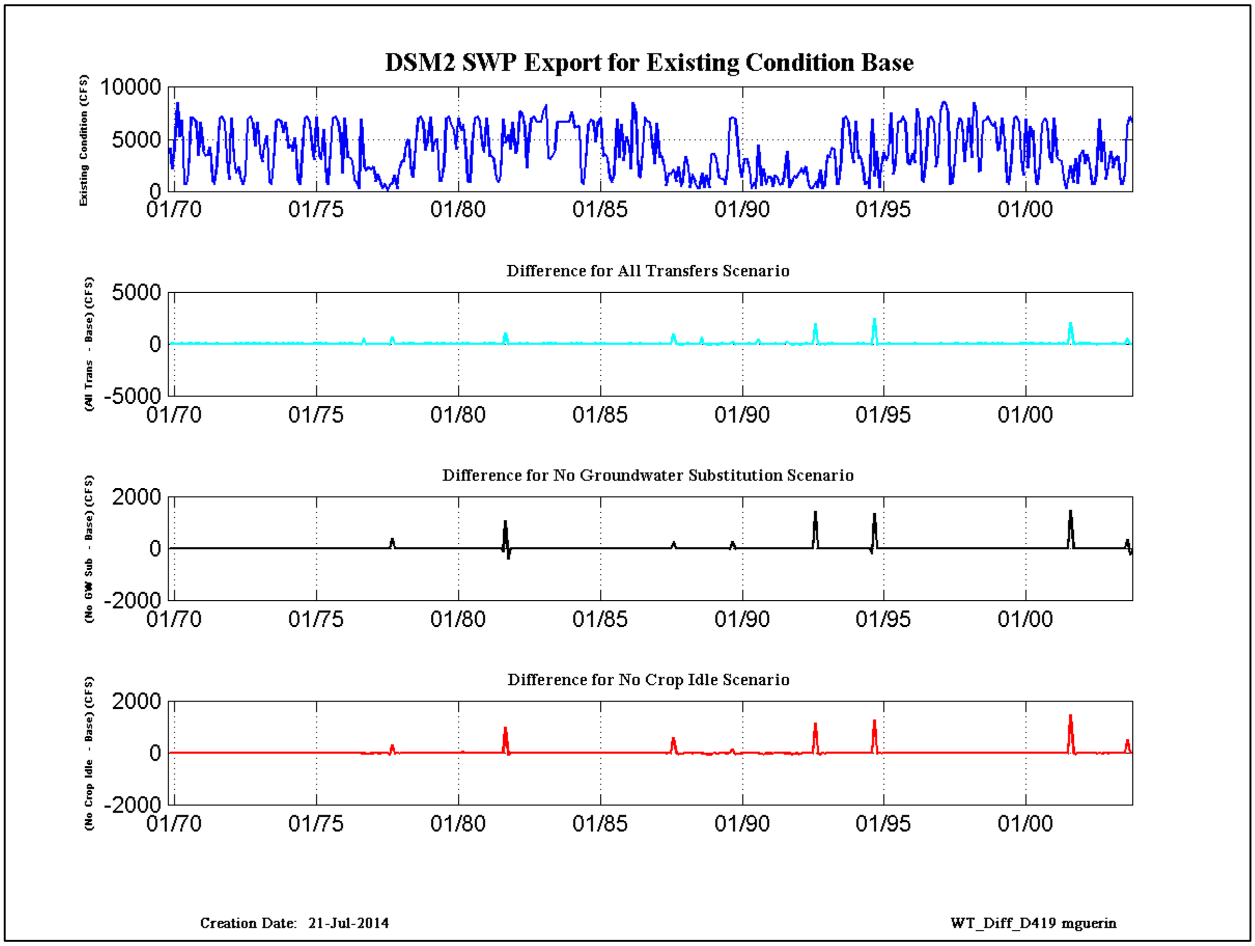


Figure 6-1. SWP Export for the Base condition and change from Base for the scenarios.

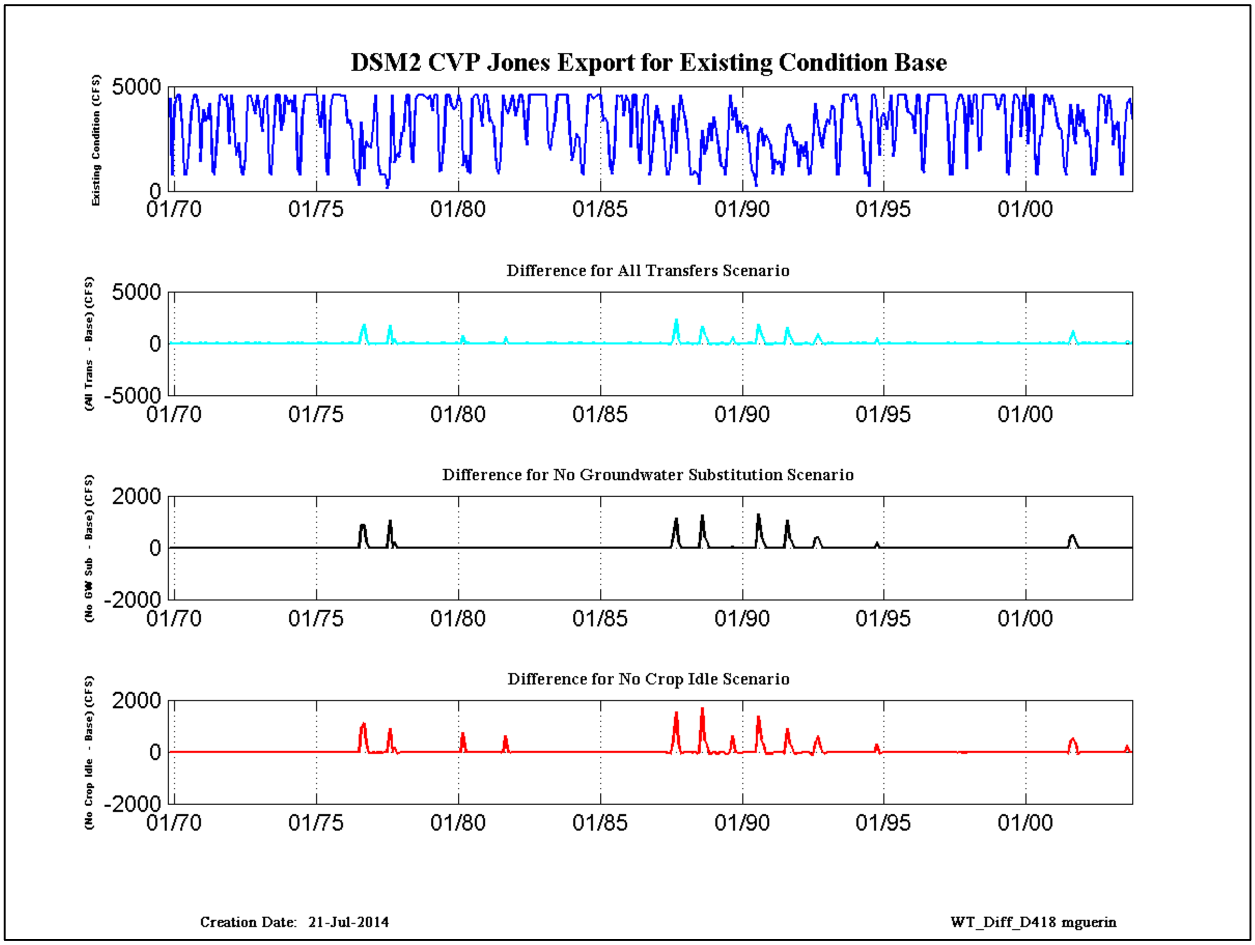


Figure 6-2. CVP Jones Export for the Base condition and change from Base for the scenarios.

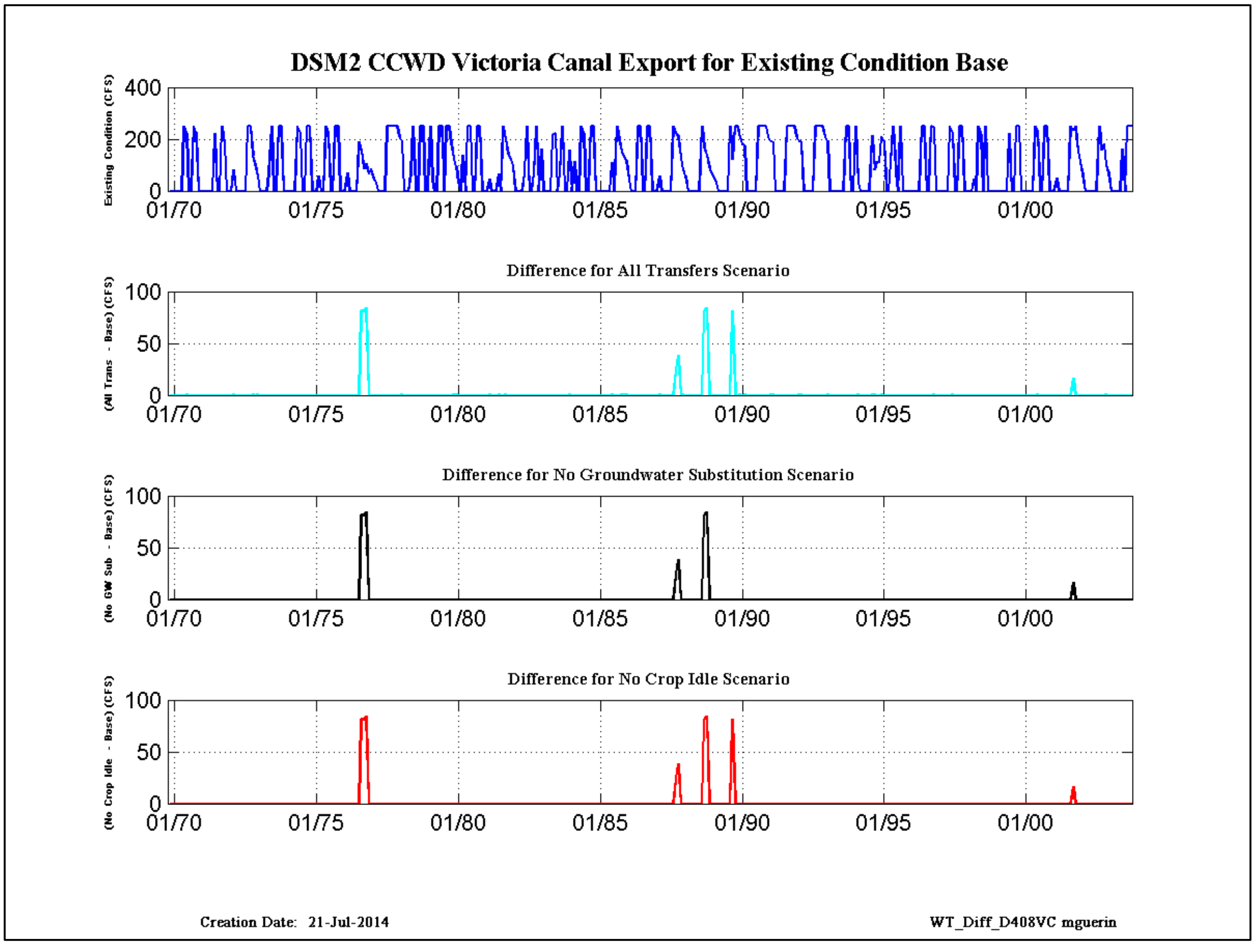


Figure 6-3. CCWD Victoria Canal Export for the Base condition and change from Base for the scenarios.

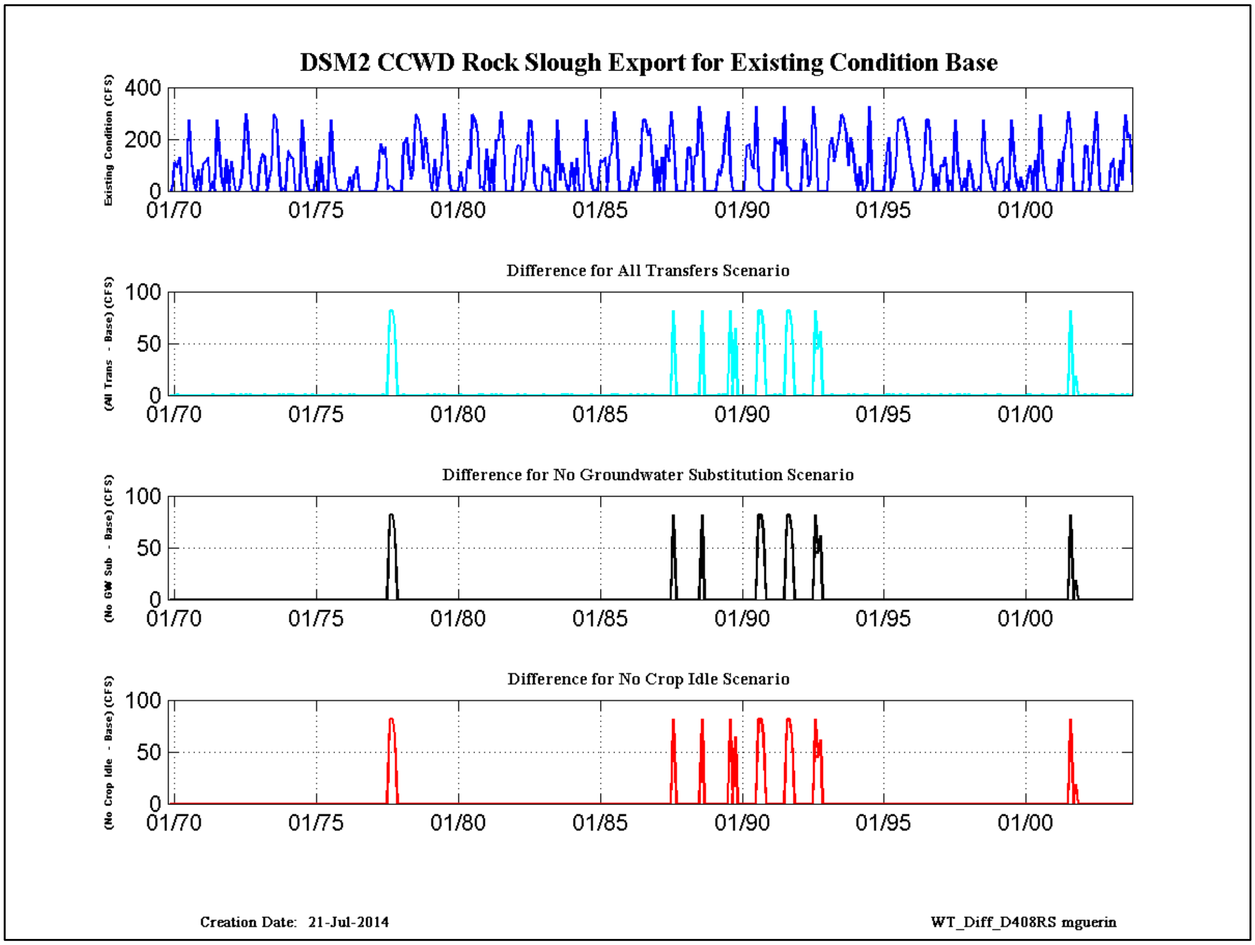


Figure 6-4. CCWD Rock Slough Export for the Base condition and change from Base for the scenarios.

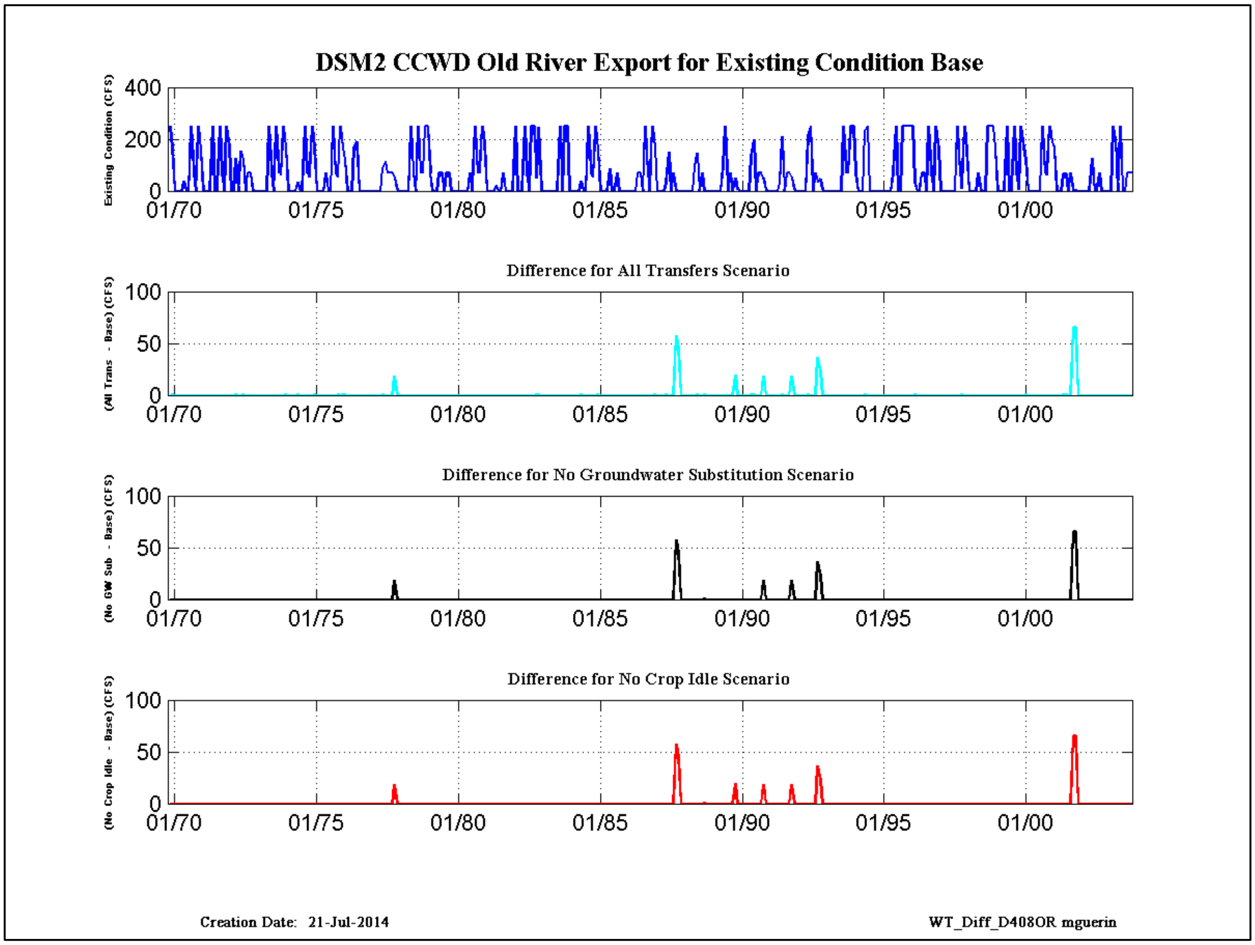


Figure 6-5. CCWD Old River Export for the Base condition and change from Base for the scenarios.

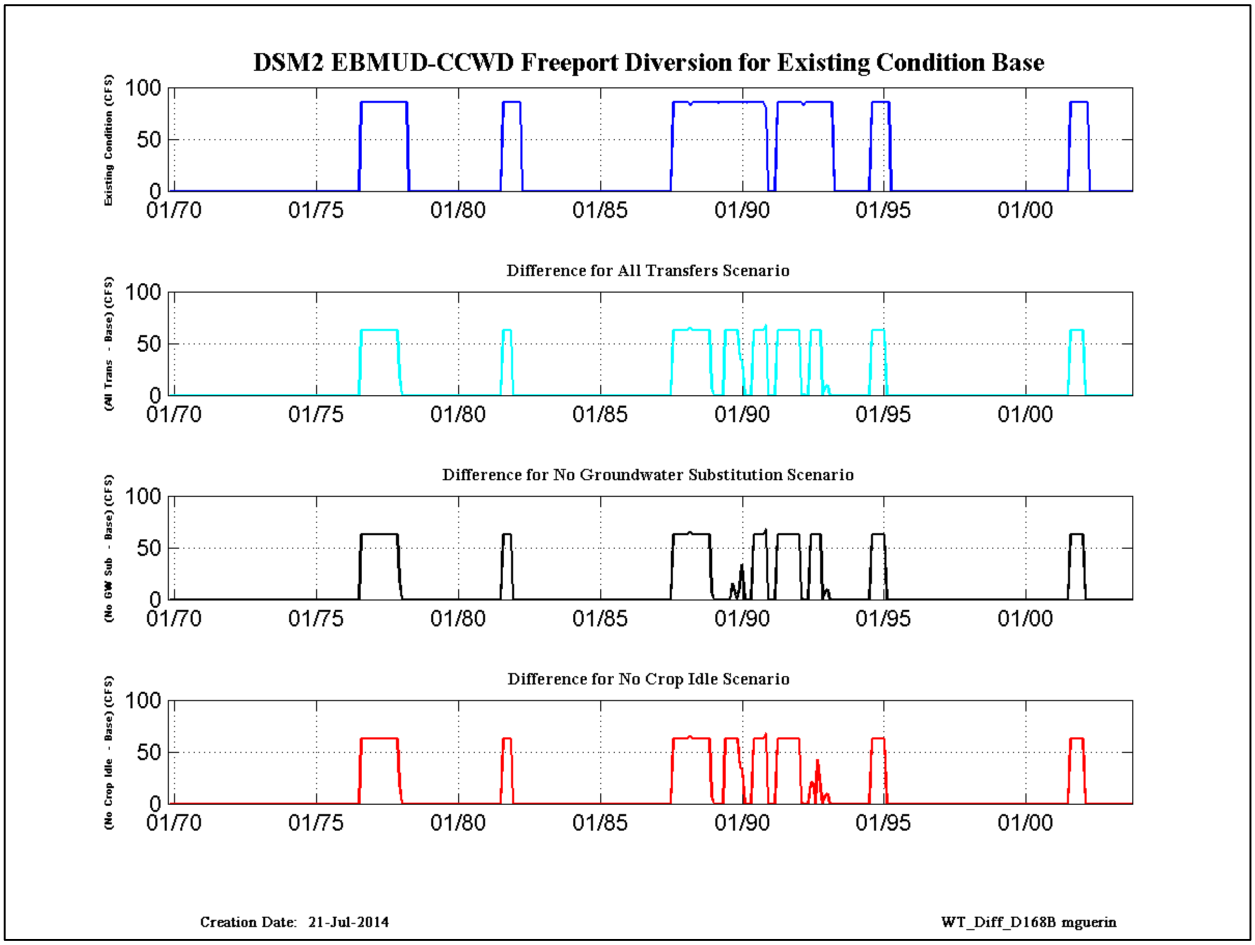


Figure 6-6. EBMUD Freeport Diversion for the Base condition and change from Base for the scenarios.

Table 6-1. EBMUD at Freeport Base exports (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.5	85.5	85.5
1977	85.5	85.5	85.5	85.5	85.5	85.5	85.5	85.5	85.5	85.5	85.5	85.5
1978	85.5	85.5	85.5	85.5	85.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.5	85.5	85.5
1982	85.5	85.5	85.5	85.5	85.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.5	85.5	85.5
1988	85.5	85.5	85.5	85.5	82.7	85.5	85.5	85.5	85.5	85.5	85.5	85.5
1989	85.5	85.5	85.5	85.5	85.4	85.5	85.5	85.5	85.5	85.5	85.5	85.5
1990	85.5	85.5	85.5	85.5	85.4	85.5	85.5	85.5	85.5	85.5	85.5	85.5
1991	80.1	0.0	0.0	0.0	0.0	85.5	85.5	85.5	85.5	85.5	85.5	85.5
1992	85.5	85.5	85.5	85.5	82.4	85.5	85.5	85.5	85.5	85.5	85.5	85.5
1993	85.5	85.5	85.5	85.5	85.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.5	85.5	85.5
1995	85.5	85.5	85.5	85.5	85.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	85.5	85.5	85.5
2002	85.5	85.5	85.5	85.5	85.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	27.5	25.1	25.1	25.1	25.0	15.1	15.1	15.1	15.1	27.7	27.7	27.7
Critical	60.3	48.9	48.9	48.9	48.0	61.1	61.1	61.1	61.1	85.5	85.5	85.5
Dry	28.5	28.5	28.5	28.5	28.5	14.3	14.3	14.3	14.3	57.0	57.0	57.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	28.5	28.5	28.5	28.5	28.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	13.2	13.2	13.2	13.2	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-2. CVP-Jones Base exports (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	4480.8	800.0	4128.0	4600.0	4600.0	3102.3	800.0	800.0	1834.1	3728.1	4600.0	4600.0
1971	3903.3	1444.7	3942.9	3379.3	3474.6	4233.7	914.9	800.0	2639.9	4600.0	4600.0	4356.3
1972	4600.0	2272.1	4600.0	3161.6	1736.9	2331.3	887.5	800.0	1636.9	4583.7	4600.0	4228.6
1973	3721.4	4600.0	3775.4	2881.5	4366.0	4600.0	893.3	800.0	2706.7	4600.0	4600.0	2921.4
1974	3384.7	4600.0	4162.3	4387.9	3806.6	4600.0	1072.0	800.0	3390.2	4600.0	4600.0	4600.0
1975	4600.0	4600.0	4600.0	3344.8	3071.3	4600.0	922.1	800.0	3960.4	4600.0	4600.0	4600.0
1976	4600.0	4598.6	4600.0	3254.0	3425.9	2938.3	1112.2	800.0	284.3	3340.8	1080.2	2382.8
1977	2140.4	2115.7	3081.7	4600.0	1334.3	800.0	800.0	800.0	113.4	675.9	4600.0	1386.5
1978	1778.2	1648.5	2813.8	2873.0	4600.0	4600.0	1587.3	1388.6	4440.5	4600.0	4600.0	4600.0
1979	4525.2	4448.5	4600.0	3879.5	4600.0	4600.0	970.4	1002.6	2566.1	4600.0	4600.0	4125.5
1980	3949.5	4028.1	4600.0	4229.0	1222.7	1728.3	923.6	864.0	4466.8	4600.0	4600.0	4019.0
1981	3111.1	4600.0	4600.0	3355.2	3380.3	3122.1	1107.2	809.8	1642.4	4600.0	3988.5	3732.0
1982	4199.1	4600.0	3634.1	3878.2	4600.0	4600.0	3218.9	2245.8	4600.0	4600.0	4600.0	4600.0
1983	4600.0	4600.0	4600.0	4600.0	2308.6	1991.0	2721.7	3487.1	4600.0	4600.0	4600.0	4600.0
1984	4600.0	2978.3	1461.8	1972.7	2764.8	2529.0	874.0	800.0	2832.0	4600.0	4600.0	4456.4
1985	4559.4	4600.0	4600.0	3381.7	3523.1	3257.4	1204.9	832.1	1668.5	4600.0	4550.0	4600.0
1986	3630.3	4600.0	4272.0	2121.1	4600.0	4600.0	1510.5	1339.1	3908.8	4600.0	4600.0	800.0
1987	1565.4	3157.2	4101.9	3269.7	3352.4	2342.5	800.0	800.0	1638.9	4139.7	1812.7	3183.2
1988	4600.0	3975.4	3317.4	2347.8	800.0	800.0	929.0	800.0	329.6	2917.2	1799.6	2077.9
1989	3272.2	2445.9	3584.9	2856.7	2019.0	1204.1	1133.6	800.0	2364.1	4600.0	3422.9	4014.0
1990	2806.8	3355.7	2819.0	3060.3	3132.8	2125.8	1031.7	800.0	229.5	2787.1	3045.7	2160.1
1991	2686.6	2504.7	2216.2	804.6	1517.8	1290.8	1433.6	800.0	1561.0	3048.2	3221.5	2732.6
1992	2170.0	2379.3	1177.1	2223.9	1690.0	2384.8	800.0	856.7	2308.1	4230.8	3221.9	2474.0
1993	2089.8	2979.7	3459.1	3201.5	4120.7	3944.0	800.0	800.0	3132.0	4600.0	4600.0	4600.0
1994	4310.4	4600.0	4600.0	3168.1	3338.1	2298.4	836.6	866.3	225.1	4600.0	4600.0	3869.4
1995	1714.6	3565.8	3743.9	2985.9	3563.0	4600.0	1665.3	2609.3	4600.0	4600.0	4600.0	4600.0
1996	3808.5	3773.6	3649.3	2798.5	4600.0	4600.0	1030.6	890.0	3364.5	4600.0	4600.0	4600.0
1997	4600.0	4600.0	4600.0	4600.0	4600.0	2980.5	800.0	800.0	3120.9	4229.9	4600.0	4600.0
1998	3984.1	1085.1	4600.0	3205.9	4600.0	4600.0	1936.2	2019.8	4600.0	4600.0	4600.0	4600.0
1999	4600.0	4600.0	3925.6	4072.3	4600.0	4600.0	872.8	800.0	2921.8	4600.0	4600.0	4421.6
2000	2622.6	4600.0	4188.0	2250.7	4600.0	4600.0	864.7	800.0	2680.5	2666.0	4600.0	4600.0
2001	4173.5	4600.0	4246.4	3425.9	3035.8	2905.9	1209.9	800.0	2287.8	4188.4	2863.7	2268.6
2002	4171.7	3148.9	3903.0	2636.0	2944.8	2593.6	800.0	800.0	1610.6	4600.0	4600.0	4519.8
2003	3283.2	4600.0	3829.3	2243.4	3154.2	3345.1	800.0	800.0	3057.7	4245.8	4458.4	3473.5
Average	3613.0	3561.9	3824.5	3207.4	3326.0	3219.1	1154.8	1059.2	2568.3	4158.3	4096.0	3747.2
Critical	3330.6	3361.3	3115.9	2779.8	2177.0	1805.4	991.9	817.6	721.6	3085.7	3081.3	2440.5
Dry	3475.5	3758.7	4172.7	3154.2	3042.6	2570.9	1042.6	807.0	1868.7	4454.7	3539.6	3719.6
BN	4562.6	3360.3	4600.0	3520.6	3168.4	3465.7	929.0	901.3	2101.5	4591.8	4600.0	4177.1
AN	2907.4	3742.7	3777.6	2946.5	3677.3	3802.9	978.1	908.8	3414.1	4218.6	4576.4	4035.7
Wet	4008.1	3526.7	3947.7	3534.4	3937.6	3972.0	1410.7	1399.3	3567.1	4504.5	4600.0	4264.2

Table 6-3. SWP-Banks Base exports (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	4178.7	2198.2	4128.0	8500.0	5205.9	6828.3	700.0	700.0	1834.1	7114.9	7029.9	6675.3
1971	3459.6	6680.0	3942.9	3379.3	3474.6	4233.7	914.9	700.0	2639.9	7004.9	7180.0	6680.0
1972	3210.1	1138.4	7034.3	3161.6	1736.9	2331.3	997.1	700.0	1636.9	6915.0	7180.0	6530.6
1973	4303.6	6680.0	3775.4	2881.5	4366.0	5383.7	893.3	700.0	2706.7	6781.0	6905.7	6680.0
1974	5649.7	6680.0	4162.3	4387.9	3806.6	5169.9	1072.0	700.0	3390.2	7004.9	7180.0	6680.0
1975	4169.5	3019.6	7127.9	3344.8	3071.3	5940.6	922.1	700.0	3960.4	7004.9	7180.0	6680.0
1976	5344.3	1767.3	7044.7	3254.0	3200.6	2938.3	1112.2	895.0	284.3	6976.9	2325.3	1995.7
1977	2302.7	2014.0	2366.9	911.3	1684.8	789.4	300.0	700.0	16.2	554.7	735.9	1543.0
1978	300.0	2007.6	2813.8	2873.0	4676.4	4994.0	1587.3	1388.6	4440.5	7004.9	7180.0	6680.0
1979	3938.2	4789.9	7105.3	3879.5	4680.3	5000.1	970.4	1002.6	2566.1	7004.9	7180.0	6528.9
1980	5864.1	4028.1	7065.7	5838.8	6424.1	3839.7	923.6	864.0	4466.8	7004.9	7180.0	6680.0
1981	4414.0	3748.7	7048.7	3355.2	3380.3	3122.1	1107.2	809.8	1642.4	6928.9	4653.0	5413.9
1982	4065.5	6680.0	3634.1	3878.2	7627.6	7560.6	6125.3	2245.8	5267.0	7004.9	7180.0	6680.0
1983	6680.0	6680.0	7678.1	8342.5	3195.0	3109.4	3357.5	4038.7	6680.0	6680.0	6680.0	6680.0
1984	6680.0	6680.0	7678.1	6131.6	6180.4	6237.3	874.0	700.0	2832.0	6492.0	6933.9	6680.0
1985	4774.8	6680.0	7028.0	3381.7	3523.1	3204.9	1204.9	832.1	1668.5	6915.0	3221.1	6419.4
1986	2997.1	5267.4	4272.0	2121.1	8500.0	7560.6	1510.5	1339.1	3894.4	7114.9	6690.9	6680.0
1987	4335.7	2662.5	6587.7	3269.7	3352.4	2342.5	562.2	1723.1	1638.9	2097.1	985.0	2347.9
1988	438.4	904.4	3317.4	2347.8	304.6	1672.1	929.0	300.0	300.0	1724.8	350.0	1507.0
1989	387.1	3518.2	3584.9	3149.1	1322.9	1204.1	1133.6	700.0	2364.1	6914.9	7058.5	6991.9
1990	4781.7	1814.9	1379.0	3060.3	3132.8	2125.8	300.0	804.7	229.5	4458.0	549.9	2163.2
1991	672.7	1320.5	1352.0	414.3	1517.8	1290.8	620.0	700.0	1561.0	3862.4	380.3	757.5
1992	1496.2	1280.2	1774.0	2182.6	1690.0	2384.8	700.0	300.0	330.1	891.5	350.0	2088.6
1993	300.0	543.2	3459.1	3201.5	4120.7	3944.0	700.0	700.0	3132.0	7004.9	7180.0	6680.0
1994	4085.8	2718.4	6774.6	3168.1	3338.1	2298.4	663.4	866.3	225.1	6976.9	1423.5	3834.3
1995	334.2	2393.5	3743.9	2985.9	3563.0	7560.6	1665.3	2609.3	6680.0	6680.0	7180.0	6680.0
1996	2709.2	2590.6	3649.3	2798.5	7909.4	6853.0	1030.6	890.0	3364.5	7004.9	7180.0	6680.0
1997	2391.4	3493.7	7678.1	8500.0	8500.0	7560.6	700.0	793.2	2955.1	5761.8	7029.9	6680.0
1998	2889.9	4239.9	7043.1	3205.9	8500.0	7560.6	1936.2	2019.8	6680.0	6843.0	7180.0	6680.0
1999	6234.0	6680.0	3925.6	4072.3	7020.4	4748.7	872.8	700.0	2921.8	7004.9	7180.0	6680.0
2000	3159.1	1593.2	6983.9	2250.7	6246.4	5828.3	864.7	700.0	2680.5	6549.6	7029.9	6680.0
2001	3279.3	2798.2	7067.5	3425.9	3035.8	2905.9	1209.9	300.0	928.0	2457.4	897.7	3181.8
2002	719.2	3447.9	3903.0	2636.0	3541.8	2593.6	700.0	700.0	1610.6	6929.0	2852.7	4777.7
2003	1176.8	2477.5	3829.3	2243.4	3154.2	3345.1	700.0	700.0	1600.6	6279.1	7180.0	6680.0
Average	3286.0	3565.2	4998.8	3603.9	4264.2	4248.9	1172.4	1015.4	2621.4	5910.2	5135.4	5382.3
Critical	2731.7	1688.5	3429.8	2191.2	2124.1	1928.5	660.7	652.3	420.9	3635.0	873.6	1984.2
Dry	2985.0	3809.3	5870.0	3202.9	3026.0	2562.2	986.3	844.2	1642.1	5373.7	3278.0	4855.4
BN	3574.1	2964.1	7069.8	3520.6	3208.6	3665.7	983.7	851.3	2101.5	6959.9	7180.0	6529.7
AN	2517.3	2888.2	4654.5	3214.8	4831.3	4555.8	944.8	842.1	3171.2	6770.7	7109.3	6680.0
Wet	4033.8	4867.9	5281.8	4742.2	5888.8	6224.9	1667.8	1395.1	4084.6	6824.3	7061.9	6679.6

Table 6-4. CCDW Old River Base exports (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	250.0	168.1	0.0	0.0	0.0	0.0	37.8	0.0	0.0	250.0	70.0	0.0
1971	250.0	157.0	0.0	0.0	0.0	0.0	250.0	0.0	0.0	250.0	70.0	0.0
1972	250.0	168.3	0.0	0.0	127.7	0.0	153.0	122.3	0.0	70.0	70.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	250.0	70.0	0.0	250.0	70.0	62.5
1974	250.0	171.3	0.0	0.0	0.0	0.0	32.1	0.0	0.0	250.0	70.0	55.6
1975	250.0	168.9	0.0	0.0	0.0	0.0	70.0	0.0	0.0	250.0	70.0	53.2
1976	250.0	169.6	120.2	0.0	0.0	0.0	171.0	190.9	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	89.9	114.0	70.0	70.0	70.0	51.5
1978	4.7	0.0	0.0	0.0	0.0	0.0	250.0	70.0	0.0	250.0	70.0	70.0
1979	250.0	250.0	70.0	0.0	0.0	0.0	70.0	70.0	0.0	70.0	70.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.0	0.0	250.0	70.0	70.0
1981	250.0	184.6	0.0	0.0	0.0	0.0	22.3	0.0	0.0	70.0	0.0	0.0
1982	0.0	0.0	250.0	0.0	0.0	0.0	250.0	70.0	0.0	250.0	250.0	51.5
1983	247.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	250.0	0.0	250.0
1984	250.0	0.0	0.0	0.0	0.0	0.0	37.9	0.0	0.0	250.0	70.0	53.8
1985	250.0	157.8	0.0	0.0	0.0	0.0	86.4	0.0	0.0	70.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	70.0	70.0	0.0	250.0	70.0	0.0
1987	250.0	170.0	0.0	0.0	0.0	0.0	35.2	148.7	0.0	70.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	99.0	147.9	0.0	70.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	98.0	250.0	0.0	70.0	0.0	50.6
1990	6.2	0.0	0.0	0.0	0.0	0.0	135.6	198.6	0.0	70.0	70.0	51.5
1991	4.7	0.0	0.0	0.0	0.0	0.0	35.5	208.1	0.0	70.0	70.0	51.5
1992	4.7	0.0	0.0	0.0	0.0	0.0	215.6	250.0	0.0	70.0	33.3	48.0
1993	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	250.0	70.0	70.0
1994	250.0	250.0	70.0	0.0	0.0	0.0	232.5	250.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	70.0	250.0	0.0	0.0	250.0	250.0
1996	250.0	250.0	250.0	34.8	0.0	0.0	70.0	70.0	0.0	250.0	70.0	0.0
1997	250.0	162.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	250.0	70.0	8.1
1998	250.0	159.6	0.0	0.0	0.0	0.0	70.0	0.0	0.0	0.0	250.0	250.0
1999	250.0	165.7	0.0	0.0	0.0	0.0	250.0	0.0	0.0	250.0	70.0	6.3
2000	250.0	165.8	122.3	0.0	0.0	0.0	0.0	0.0	0.0	250.0	70.0	62.6
2001	250.0	189.4	167.0	0.0	0.0	0.0	64.9	66.9	0.0	70.0	0.0	4.7
2002	0.0	0.0	0.0	0.0	0.0	0.0	127.2	0.0	0.0	70.0	0.0	0.0
2003	0.0	0.0	0.0	250.0	201.3	0.0	250.0	0.0	0.0	70.0	70.0	70.0
Average	140.4	91.4	30.9	8.4	9.7	0.0	105.7	79.0	2.1	146.5	64.2	48.3
Critical	73.7	59.9	27.2	0.0	0.0	0.0	139.9	194.2	10.0	50.0	34.8	28.9
Dry	166.7	117.0	27.8	0.0	0.0	0.0	72.3	77.6	0.0	70.0	0.0	9.2
BN	250.0	209.2	35.0	0.0	63.8	0.0	111.5	96.1	0.0	70.0	70.0	0.0
AN	43.2	27.6	20.4	41.7	33.6	0.0	125.0	35.0	0.0	220.0	70.0	67.5
Wet	192.1	107.9	38.5	2.7	0.0	0.0	92.9	35.4	0.0	211.5	106.2	75.3

Table 6-5. CCDW Rock Slough Base exports (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	3.3	0.0	111.7	88.8	128.8	0.0	0.0	0.0	273.4	113.0	34.2	0.0
1971	81.3	0.0	104.7	112.0	128.8	0.0	38.9	0.0	273.4	113.5	34.2	0.0
1972	123.9	0.0	112.0	28.9	0.0	0.0	31.2	102.9	296.4	210.7	34.9	0.0
1973	0.0	0.0	95.3	143.2	135.7	0.0	47.1	84.2	295.6	275.7	78.3	0.0
1974	9.9	0.0	155.1	128.2	122.0	0.0	0.0	0.0	273.4	111.7	34.2	0.0
1975	3.9	0.0	115.2	0.0	128.8	0.0	4.8	0.0	273.4	113.0	33.4	0.0
1976	3.3	0.0	0.0	0.0	56.0	0.0	61.7	93.5	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	50.2	180.9	142.8	170.4	6.5	20.5	10.8	0.0
1978	0.0	0.0	0.0	187.0	206.0	114.9	47.1	84.2	295.6	275.7	217.1	88.0
1979	205.1	130.5	44.7	0.0	122.0	0.0	64.2	105.2	296.4	210.7	34.3	0.0
1980	0.0	0.0	0.0	73.7	0.0	0.0	117.1	84.2	295.6	275.7	217.1	13.1
1981	14.1	0.0	162.6	0.0	122.0	0.0	192.6	195.0	305.5	184.8	0.0	0.0
1982	0.0	0.0	131.6	175.9	172.8	0.0	31.5	85.9	273.4	268.8	34.2	0.0
1983	0.0	0.0	102.8	72.1	91.0	0.0	0.0	0.0	273.4	43.4	104.0	53.8
1984	5.1	0.0	108.4	0.0	124.3	0.0	0.0	0.0	273.4	113.4	34.1	0.0
1985	4.1	0.0	117.5	112.0	128.8	0.0	128.5	150.0	305.5	166.5	0.0	0.0
1986	0.0	0.0	0.0	48.6	94.1	0.0	31.5	85.9	273.4	272.1	214.5	240.6
1987	118.1	0.0	118.7	0.0	128.8	0.0	179.7	112.2	305.5	190.2	0.0	0.0
1988	0.0	0.0	0.0	164.9	166.8	0.0	133.8	136.5	326.5	210.4	0.0	0.0
1989	0.0	0.0	0.0	0.0	84.0	58.4	116.9	210.9	305.5	79.4	0.0	0.0
1990	0.0	0.0	0.0	0.0	172.8	180.9	97.2	85.8	326.5	20.5	10.8	0.0
1991	0.0	0.0	0.0	0.0	206.0	180.9	197.2	76.3	326.5	20.5	10.8	0.0
1992	0.0	0.0	0.0	0.0	198.9	180.9	17.2	47.3	326.5	220.5	0.0	0.0
1993	0.0	0.0	0.0	172.0	206.0	114.9	167.1	204.2	295.6	275.7	217.1	99.4
1994	205.1	130.5	44.7	0.0	93.4	0.0	0.3	34.4	326.5	0.0	0.0	0.0
1995	0.0	0.0	0.0	134.8	206.0	0.0	31.5	85.9	273.4	272.1	284.5	240.6
1996	197.0	115.8	68.7	0.0	0.0	0.0	31.5	85.9	273.4	272.1	116.8	0.0
1997	64.6	0.0	97.7	94.7	128.8	0.0	42.7	0.0	273.4	112.7	33.3	0.0
1998	50.0	0.0	116.1	56.4	0.0	0.0	16.8	0.0	273.4	113.3	104.2	55.2
1999	6.1	0.0	107.6	110.1	128.8	0.0	38.3	0.0	273.4	112.5	34.0	0.0
2000	53.4	0.0	0.0	56.3	96.4	0.0	117.1	0.0	295.6	116.6	36.5	0.0
2001	5.1	0.0	0.0	0.0	122.0	0.0	150.0	194.1	305.5	221.1	0.0	0.0
2002	0.0	0.0	0.0	175.9	172.8	0.0	87.7	206.7	305.5	24.4	0.0	0.0
2003	0.0	0.0	106.7	125.9	0.0	0.0	117.1	40.6	295.6	205.7	217.1	25.6
Average	33.9	11.1	59.5	66.5	115.4	29.8	73.0	81.2	276.3	154.0	64.1	24.0
Critical	29.8	18.6	6.4	23.6	134.9	103.3	92.9	92.0	234.1	70.4	4.6	0.0
Dry	23.6	0.0	66.5	48.0	126.4	9.7	142.6	178.2	305.5	144.4	0.0	0.0
BN	164.5	65.3	78.4	14.4	61.0	0.0	47.7	104.1	296.4	210.7	34.6	0.0
AN	8.9	0.0	33.7	126.3	107.3	38.3	102.1	82.9	295.6	237.6	163.8	37.7
Wet	32.4	8.9	93.8	78.6	111.9	0.0	20.6	26.4	273.4	156.3	84.3	45.4

Table 6-6. CCDW Victoria Canal Base exports (cfs).

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	250.0	222.8	0.0	0.0	250.0	226.4
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	220.4	0.0	0.0	250.0	183.1
1972	0.0	0.0	0.0	83.1	0.0	0.0	0.0	0.0	0.0	250.0	250.0	136.7
1973	101.0	57.9	0.0	0.0	0.0	0.0	70.0	250.0	0.0	0.0	250.0	250.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	250.0	222.8	0.0	0.0	250.0	250.0
1975	0.0	0.0	0.0	58.6	0.0	0.0	250.0	222.8	0.0	0.0	250.0	250.0
1976	0.0	0.0	0.0	71.0	0.0	0.0	0.0	0.0	190.1	159.6	86.9	104.6
1977	66.7	84.9	48.1	32.5	0.0	0.0	0.0	0.0	250.0	250.0	250.0	250.0
1978	250.0	210.0	192.0	0.0	0.0	0.0	70.0	250.0	0.0	0.0	250.0	250.0
1979	0.0	0.0	250.0	43.4	0.0	0.0	250.0	250.0	0.0	250.0	250.0	187.2
1980	126.9	92.7	34.3	0.0	138.0	0.0	250.0	250.0	0.0	0.0	250.0	250.0
1981	0.0	0.0	0.0	46.0	0.0	0.0	0.0	65.9	0.0	250.0	203.3	143.5
1982	123.7	96.3	0.0	0.0	0.0	0.0	70.0	250.0	0.0	0.0	70.0	250.0
1983	0.0	161.5	0.0	0.0	0.0	0.0	215.2	222.1	0.0	70.0	250.0	0.0
1984	0.0	157.5	0.0	113.7	0.0	0.0	250.0	222.8	0.0	0.0	250.0	250.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.9	0.0	250.0	201.4	150.9
1986	134.9	117.9	44.1	0.0	0.0	0.0	250.0	250.0	0.0	0.0	250.0	250.0
1987	0.0	0.0	0.0	57.9	0.0	0.0	0.0	0.0	0.0	250.0	225.8	211.1
1988	130.7	83.1	56.3	0.0	0.0	0.0	0.0	0.0	0.0	250.0	169.4	139.9
1989	94.9	71.3	50.6	35.9	0.0	0.0	0.0	0.0	0.0	250.0	122.9	250.0
1990	250.0	207.3	181.6	175.9	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0
1991	250.0	210.0	192.0	187.0	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0
1992	250.0	210.0	192.0	187.0	0.0	0.0	0.0	0.0	0.0	250.0	250.0	250.0
1993	250.0	210.0	192.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	250.0	250.0
1994	0.0	0.0	250.0	32.5	0.0	0.0	0.0	0.0	0.0	213.3	82.2	111.9
1995	110.0	208.2	190.6	0.0	0.0	113.8	250.0	70.0	0.0	250.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	250.0	250.0	0.0	0.0	250.0	242.9
1997	0.0	0.0	0.0	0.0	0.0	0.0	250.0	222.3	0.0	0.0	250.0	250.0
1998	0.0	0.0	0.0	0.0	47.0	0.0	250.0	215.7	0.0	250.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	221.8	0.0	0.0	250.0	250.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	250.0	229.7	0.0	0.0	250.0	250.0
2001	0.0	0.0	0.0	50.9	0.0	0.0	0.0	0.0	0.0	250.0	233.8	250.0
2002	152.6	115.5	62.2	0.0	0.0	0.0	0.0	0.0	0.0	250.0	159.6	181.9
2003	102.5	69.3	0.0	0.0	0.0	0.0	0.0	163.6	0.0	250.0	250.0	250.0
Average	70.4	69.5	56.9	34.6	5.4	3.3	100.7	128.9	12.9	130.7	207.5	199.1
Critical	135.3	113.6	131.4	98.0	0.0	0.0	0.0	0.0	62.9	231.8	191.2	193.8
Dry	41.3	31.1	18.8	31.8	0.0	0.0	0.0	29.5	0.0	250.0	191.1	197.9
BN	0.0	0.0	125.0	63.3	0.0	0.0	125.0	125.0	0.0	250.0	250.0	162.0
AN	138.4	106.6	69.7	0.0	23.0	0.0	106.7	190.6	0.0	41.7	250.0	250.0
Wet	28.4	57.0	18.1	13.3	3.6	8.8	195.0	216.4	0.0	43.8	197.7	184.8

Table 6-7. EBMUD at Freeport export difference (cfs) All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1977	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1978	62.5	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1982	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1988	62.5	62.5	62.5	62.5	65.3	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1989	62.5	7.5	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1990	62.5	34.5	33.0	0.9	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1991	67.9	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1992	62.5	62.5	62.5	1.2	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1993	0.0	6.8	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1995	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
2002	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	18.5	11.2	10.5	3.7	3.8	5.5	5.5	11.0	11.0	20.2	20.2	20.2
Critical	45.4	31.7	31.5	18.2	18.3	26.8	26.8	44.6	44.6	62.5	62.5	62.5
Dry	20.8	11.7	10.4	0.0	0.0	0.0	0.0	10.4	10.4	41.7	41.7	41.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	10.4	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	9.6	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-8. EBMUD at Freeport export (cfs) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1977	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1978	73.1	23.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1982	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1988	73.1	73.1	73.1	73.1	79.0	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1989	73.1	8.8	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1
1990	73.1	40.3	38.6	1.1	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1
1991	84.7	0.0	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1992	73.1	73.1	73.1	1.4	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1
1993	0.0	7.9	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1995	73.1	73.1	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
2002	73.1	73.1	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	21.8	13.1	12.2	4.4	4.5	6.4	6.4	12.9	12.9	23.6	23.6	23.6
Critical	53.9	37.1	36.8	21.2	21.7	31.3	31.3	52.2	52.2	73.1	73.1	73.1
Dry	24.4	13.6	12.2	0.0	0.0	0.0	0.0	12.2	12.2	48.7	48.7	48.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	12.2	5.2	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	11.2	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-9. CVP-Jones export difference (cfs) All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.9	0.0	962.3	1853.9	574.1
1977	-51.9	-45.0	-38.3	-52.7	-34.6	-33.0	-42.0	-14.5	0.0	1760.0	0.0	389.1
1978	-60.9	-41.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	722.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-14.0	0.0	0.0	0.0	0.0	0.0	0.0	-28.6	0.0	611.5	0.0
1982	-37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13.4	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-9.1	0.0	0.0	-7.2	-9.2	-8.9	-4.1
1986	-3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-6.8	-5.0	0.0	0.0	0.0	-25.1	-51.1	-71.4	460.3	2369.0	555.9
1988	-72.3	-44.5	0.0	0.0	0.0	-62.6	0.0	-65.9	-29.6	1682.8	955.6	486.3
1989	-83.6	-64.5	0.0	-70.3	-65.3	0.0	0.0	-94.1	-83.0	0.0	630.0	0.0
1990	-55.5	-52.1	-45.9	0.0	0.0	0.0	0.0	0.0	0.0	1812.9	838.5	525.3
1991	-82.2	-78.6	-64.9	-60.9	0.0	0.0	0.0	0.0	-69.9	1551.8	689.1	397.6
1992	-67.9	-69.5	-53.7	-52.5	0.0	0.0	0.0	-105.9	-108.5	369.2	953.1	387.8
1993	0.0	-73.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	503.3
1995	-76.2	-42.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-33.6	0.0	-30.0
1998	-29.6	-38.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	-14.7	0.0	0.0	0.0	0.0	0.0	0.0	-18.5	0.0	0.0
2001	0.0	0.0	-12.3	0.0	0.0	0.0	0.0	0.0	-76.4	411.6	1223.4	554.4
2002	-100.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	235.6	0.0	0.0
Average	-21.2	-16.8	-6.9	-7.0	18.3	-3.1	-2.0	-10.0	-14.0	269.8	297.5	127.6
Critical	-47.1	-41.4	-29.0	-23.7	-4.9	-13.6	-6.0	-27.8	-29.7	1162.7	755.7	466.2
Dry	-30.7	-14.2	-2.9	-11.7	-10.9	-1.5	-4.2	-24.2	-44.4	143.8	804.2	184.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-10.1	-19.1	-2.4	0.0	120.4	0.0	0.0	0.0	0.0	36.2	0.0	0.0
Wet	-11.3	-6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.6	0.0	-2.3

Table 6-10. CVP-Jones export (cfs) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	28.8	171.6	24.1
1977	-2.4	-2.1	-1.2	-1.1	-2.6	-4.1	-5.3	-1.8	0.0	260.4	0.0	28.1
1978	-3.4	-2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	59.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	0.0	15.3	0.0
1982	-0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	-0.4	-0.2	-0.2	-0.1
1986	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.2	-0.1	0.0	0.0	0.0	-3.1	-6.4	-4.4	11.1	130.7	17.5
1988	-1.6	-1.1	0.0	0.0	0.0	-7.8	0.0	-8.2	-9.0	57.7	53.1	23.4
1989	-2.6	-2.6	0.0	-2.5	-3.2	0.0	0.0	-11.8	-3.5	0.0	18.4	0.0
1990	-2.0	-1.6	-1.6	0.0	0.0	0.0	0.0	0.0	0.0	65.0	27.5	24.3
1991	-3.1	-3.1	-2.9	-7.6	0.0	0.0	0.0	0.0	-4.5	50.9	21.4	14.5
1992	-3.1	-2.9	-4.6	-2.4	0.0	0.0	0.0	-12.4	-4.7	8.7	29.6	15.7
1993	0.0	-2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0
1995	-4.4	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	0.0	-0.7
1998	-0.7	-3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	0.0	0.0
2001	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	-3.3	9.8	42.7	24.4
2002	-2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0
Average	-0.8	-0.7	-0.3	-0.4	1.6	-0.4	-0.2	-1.2	-0.9	14.6	15.0	5.4
Critical	-1.7	-1.6	-1.5	-1.6	-0.4	-1.7	-0.8	-3.3	-2.6	67.4	43.3	20.4
Dry	-0.8	-0.5	-0.1	-0.4	-0.5	0.0	-0.5	-3.0	-2.2	3.5	34.5	7.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.8	-0.1	0.0	9.8	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Wet	-0.5	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1

Table 6-11. SWP-Banks export difference (cfs) All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-55.5	460.6	-52.5
1977	-42.5	-36.8	-31.4	-17.6	-28.3	-27.4	0.0	0.0	0.0	-86.2	637.0	-41.3
1978	0.0	-33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	-12.1	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-9.5	0.0	1004.0	-96.2
1982	-30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-7.5	0.0	0.0	-3.2	-3.1	-3.0	-5.2
1986	-5.0	-8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-2.3	-4.0	0.0	0.0	0.0	-20.5	-19.9	-23.8	965.9	-36.9	-67.4
1988	-59.1	-52.3	0.0	0.0	0.0	-24.6	0.0	0.0	0.0	635.1	-41.6	-74.9
1989	-68.3	-78.8	0.0	-57.5	-53.4	0.0	0.0	-31.4	-27.7	-2.5	136.7	-76.4
1990	-45.4	-42.6	-37.6	0.0	0.0	0.0	0.0	0.0	0.0	395.5	-41.8	-75.9
1991	-35.1	-35.0	-27.3	-49.8	0.0	0.0	0.0	0.0	-31.9	166.4	-37.3	-66.1
1992	-55.5	-30.8	-61.1	-55.9	0.0	0.0	0.0	0.0	-30.1	1908.6	-40.0	-76.0
1993	0.0	-59.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-64.2	2418.7	-56.9
1995	0.0	-48.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-10.1	0.0	0.0	0.0	0.0	0.0	-25.5	2002.9	-37.7	-68.6
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-61.0	-16.3	-49.2	-25.3
2003	-2.9	-24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	496.0	-14.6	-4.7
Average	-10.5	-13.3	-5.0	-5.3	-2.0	-1.8	-0.6	-1.5	-6.3	186.5	128.1	-23.2
Critical	-33.9	-28.2	-22.5	-17.6	-4.1	-7.4	0.0	0.0	-8.9	414.2	479.4	-63.4
Dry	-11.4	-13.5	-2.3	-9.6	-8.9	-1.2	-3.4	-8.6	-25.1	491.1	169.0	-56.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-2.5	-19.6	0.0	0.0	2.2	0.0	0.0	0.0	0.0	82.7	-2.4	-0.8
Wet	-2.8	-4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-12. SWP-Banks export (cfs) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	19.8	-2.6
1977	-1.8	-1.8	-1.3	-1.9	-1.7	-3.5	0.0	0.0	-0.1	-15.5	86.6	-2.7
1978	0.0	-1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	-0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	0.0	21.6	-1.8
1982	-0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-0.2	0.0	-0.1	-0.1
1986	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.1	0.0	0.0	0.0	-3.7	-1.2	-1.5	46.1	-3.7	-2.9
1988	-13.5	-5.8	0.0	0.0	0.0	-1.5	0.0	0.0	0.0	36.8	-11.9	-5.0
1989	-17.6	-2.2	0.0	-1.8	-4.0	0.0	0.0	-4.5	-1.2	0.0	1.9	-1.1
1990	-0.9	-2.3	-2.7	0.0	0.0	0.0	0.0	0.0	0.0	8.9	-7.6	-3.5
1991	-5.2	-2.6	-2.0	-12.0	0.0	0.0	0.0	0.0	-2.0	4.3	-9.8	-8.7
1992	-3.7	-2.4	-3.4	-2.6	0.0	0.0	0.0	0.0	-9.1	214.1	-11.4	-3.6
1993	0.0	-11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	169.9	-1.5
1995	0.0	-2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-2.7	81.5	-4.2	-2.2
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.8	-0.2	-1.7	-0.5
2003	-0.2	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	-0.2	-0.1
Average	-1.3	-1.0	-0.3	-0.5	-0.2	-0.2	-0.1	-0.2	-0.6	11.2	7.3	-1.1
Critical	-3.6	-2.1	-1.4	-2.4	-0.2	-0.7	0.0	0.0	-1.6	35.3	33.7	-3.9
Dry	-2.9	-0.4	0.0	-0.3	-0.7	0.0	-0.6	-0.9	-1.7	21.2	2.3	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	-2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
Wet	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-13. CCDW Old River export difference (cfs) All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.1	45.1
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.7	22.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.1	65.3
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	11.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4	21.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-14. CCDW Old River export (cfs) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2
1990	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.4	46.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		1378.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	47.6
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	21.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	283.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-15. CCDW Rock Slough export difference (cfs) All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	64.7
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	44.6	62.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	18.8
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.1	8.5	10.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.1	41.2	36.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.7	0.0	13.9
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-16. CCDW Rock Slough export (cfs) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0
1976	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.1	
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.7	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.6	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	102.5	0.0	
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.1	
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.1	
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.9		
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0	
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.5	68.6	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	180.7	377.5	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.3	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-17. CCDW Victoria Canal export difference (cfs) All Transfers minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	84.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.2	38.9
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.6	84.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	8.3	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	23.1	24.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	6.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-18. CCDW Victoria Canal export (cfs) percent difference of All Transfers from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0	93.6	80.3
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	18.4
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.6	60.1
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	6.6	4.7
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	20.2	20.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	3.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-19. EBMUD at Freeport export difference (cfs) No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1977	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1978	62.5	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1982	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1988	62.5	62.5	62.5	62.5	65.3	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1989	62.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7	5.6
1990	0.0	12.6	33.0	0.9	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1991	67.9	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1992	62.5	62.5	62.5	1.2	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1993	0.0	6.8	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1995	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
2002	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	16.7	10.6	10.5	3.7	3.8	5.5	5.5	9.2	9.2	18.4	18.8	18.5
Critical	36.5	28.6	31.5	18.2	18.3	26.8	26.8	44.6	44.6	62.5	62.5	62.5
Dry	20.8	11.7	10.4	0.0	0.0	0.0	0.0	0.0	0.0	31.3	33.9	32.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	10.4	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	9.6	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-20. EBMUD at Freeport export (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1977	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1978	73.1	23.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1982	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1988	73.1	73.1	73.1	73.1	79.0	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1989	73.1	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	6.5
1990	0.0	14.8	38.6	1.1	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1
1991	84.7	0.0	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1992	73.1	73.1	73.1	1.4	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1
1993	0.0	7.9	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1995	73.1	73.1	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
2002	73.1	73.1	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	19.7	12.4	12.2	4.4	4.5	6.4	6.4	10.7	10.7	21.5	22.0	21.7
Critical	43.4	33.4	36.8	21.2	21.7	31.3	31.3	52.2	52.2	73.1	73.1	73.1
Dry	24.4	13.6	12.2	0.0	0.0	0.0	0.0	0.0	0.0	36.5	39.6	37.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	12.2	5.2	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	11.2	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-21. CVP-Jones export difference (cfs) No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	872.4	850.0	273.7
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1070.5	0.0	222.4
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	460.3	1154.1	273.7
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1275.4	436.6	250.5
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1314.9	472.5	273.7
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1070.5	393.2	222.4
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	369.2	413.0	208.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	198.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	411.6	472.5	273.7
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	201.3	123.7	64.6
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	853.3	366.5	235.5
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	145.3	273.3	91.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-22. CVP-Jones export (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.1	78.7	11.5
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	158.4	0.0	16.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	63.7	8.6
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.7	24.3	12.1
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.2	15.5	12.7
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.1	12.2	8.1
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	12.8	8.4
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8	16.5	12.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	6.6	2.8
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.6	20.5	10.6
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	13.4	3.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-23. SWP-Banks export difference (cfs) No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	393.2	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-146.4	1057.1	-420.1
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	224.7	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-45.5	260.2	-33.6
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1404.6	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-229.4	1350.5	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1459.3	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	325.3	-244.0	-84.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.0	82.9	-15.8
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	167.9	249.1	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	248.7	219.6	-75.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.2	-40.7	-14.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-24. SWP-Banks export (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.4	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.1	22.7	-7.8
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	3.7	-0.5
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	157.6	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.3	94.9	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.4	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	-3.4	-1.3
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	5.0	-0.3
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	21.2	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	4.4	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	-0.6	-0.2
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-25. CCDW Old River export difference (cfs) No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.1	45.1
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.7	22.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.1	65.3
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	5.5
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	11.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4	18.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-26. CCDW Old River export (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.4	46.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		1378.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	46.4
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	21.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	275.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-27. CCDW Rock Slough export difference (cfs) No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	44.6	62.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	18.8
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	8.5	8.2
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.1	41.2	36.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.1	0.0	3.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-28. CCDW Rock Slough export (cfs) percent difference of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.0	
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.7	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.6	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.0	
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.0	
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.9		
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0	
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.5	68.6	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	180.7	377.5	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-29. CCDW Victoria Canal export difference (cfs) No Groundwater Substitution minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	84.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.2	38.9
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.6	84.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	6.0	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	23.1	24.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	6.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-30. CCDW Victoria Canal export difference (cfs) of No Groundwater Substitution from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0	93.6	80.3
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	18.4
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.6	60.1
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	4.7	4.7
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	20.2	20.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	3.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-31. EBMUD at Freeport export difference (cfs) No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1977	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1978	62.5	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1982	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1988	62.5	62.5	62.5	62.5	65.3	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1989	62.5	7.5	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1990	62.5	34.5	33.0	0.9	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1991	67.9	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1992	62.5	62.5	62.5	1.2	0.0	0.0	0.0	20.3	19.7	0.0	42.4	15.5
1993	0.0	6.8	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1995	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
2002	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	18.5	11.2	10.5	3.7	3.8	5.5	5.5	9.8	9.8	18.4	19.6	18.8
Critical	45.4	31.7	31.5	18.2	18.3	26.8	26.8	38.6	38.5	53.6	59.6	55.8
Dry	20.8	11.7	10.4	0.0	0.0	0.0	0.0	10.4	10.4	41.7	41.7	41.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	10.4	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	9.6	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-32. EBMUD at Freeport export difference (cfs) No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1977	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1978	62.5	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1982	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1988	62.5	62.5	62.5	62.5	65.3	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1989	62.5	7.5	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1990	62.5	34.5	33.0	0.9	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5
1991	67.9	0.0	0.0	0.0	0.0	62.5	62.5	62.5	62.5	62.5	62.5	62.5
1992	62.5	62.5	62.5	1.2	0.0	0.0	0.0	20.3	19.7	0.0	42.4	15.5
1993	0.0	6.8	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
1995	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.5	62.5	62.5
2002	62.5	62.5	62.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	18.5	11.2	10.5	3.7	3.8	5.5	5.5	9.8	9.8	18.4	19.6	18.8
Critical	45.4	31.7	31.5	18.2	18.3	26.8	26.8	38.6	38.5	53.6	59.6	55.8
Dry	20.8	11.7	10.4	0.0	0.0	0.0	0.0	10.4	10.4	41.7	41.7	41.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	10.4	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	9.6	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-33. EBMUD at Freeport export (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1977	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1978	73.1	23.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1982	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1988	73.1	73.1	73.1	73.1	79.0	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1989	73.1	8.8	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1
1990	73.1	40.3	38.6	1.1	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1
1991	84.7	0.0	0.0	0.0	0.0	73.1	73.1	73.1	73.1	73.1	73.1	73.1
1992	73.1	73.1	73.1	1.4	0.0	0.0	0.0	23.7	23.1	0.0	49.6	18.1
1993	0.0	7.9	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
1995	73.1	73.1	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.1	73.1	73.1
2002	73.1	73.1	73.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	21.8	13.1	12.2	4.4	4.5	6.4	6.4	11.4	11.4	21.5	23.0	22.0
Critical	53.9	37.1	36.8	21.2	21.7	31.3	31.3	45.2	45.1	62.7	69.7	65.2
Dry	24.4	13.6	12.2	0.0	0.0	0.0	0.0	12.2	12.2	48.7	48.7	48.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	12.2	5.2	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	11.2	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-34. CVP-Jones export difference (cfs) No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.9	0.0	944.1	1114.4	352.2
1977	-51.8	-45.0	-38.3	-52.7	-34.6	-33.0	-42.0	-14.5	0.0	918.2	0.0	173.6
1978	-60.9	-41.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	722.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-14.0	0.0	0.0	0.0	0.0	0.0	0.0	-28.6	0.0	611.5	0.0
1982	-37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13.4	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-9.1	0.0	0.0	-7.2	-9.2	-8.9	-4.1
1986	-3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-6.8	-4.9	0.0	0.0	0.0	-25.1	-51.1	-71.4	460.3	1530.7	334.0
1988	-72.3	-44.5	0.0	0.0	0.0	-62.6	0.0	-65.9	-29.6	1682.8	468.6	276.6
1989	-83.5	-64.5	0.0	-70.2	-65.3	0.0	0.0	-94.1	-83.0	0.0	629.9	0.0
1990	-55.5	-52.1	-46.0	0.0	0.0	0.0	0.0	0.0	0.0	1377.4	494.9	303.5
1991	-82.2	-78.6	-64.9	-60.9	0.0	0.0	0.0	0.0	-69.9	911.2	355.2	182.0
1992	-67.9	-69.5	-53.7	-52.5	0.0	0.0	0.0	-105.9	-108.5	369.2	616.6	197.8
1993	0.0	-73.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	305.3
1995	-76.2	-43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-33.6	0.0	-30.0
1998	-29.6	-38.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	-14.7	0.0	0.0	0.0	0.0	0.0	0.0	-18.5	0.0	0.0
2001	0.0	0.0	-12.3	0.0	0.0	0.0	0.0	0.0	-76.3	411.6	536.0	332.6
2002	-100.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	235.6	0.0	0.0
Average	-21.2	-16.8	-6.9	-6.9	18.3	-3.1	-2.0	-10.0	-14.0	212.8	186.7	71.3
Critical	-47.1	-41.4	-29.0	-23.7	-4.9	-13.7	-6.0	-27.7	-29.7	886.1	435.7	255.8
Dry	-30.7	-14.2	-2.9	-11.7	-10.9	-1.5	-4.2	-24.2	-44.4	143.8	549.9	110.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-10.2	-19.0	-2.5	0.0	120.4	0.0	0.0	0.0	0.0	36.2	0.0	0.0
Wet	-11.3	-6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.6	0.0	-2.3

Table 6-35. CVP-Jones export (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	0.0	28.3	103.2	14.8
1977	-2.4	-2.1	-1.2	-1.1	-2.6	-4.1	-5.2	-1.8	0.0	135.9	0.0	12.5
1978	-3.4	-2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	59.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	0.0	15.3	0.0
1982	-0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	-0.4	-0.2	-0.2	-0.1
1986	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.2	-0.1	0.0	0.0	0.0	-3.1	-6.4	-4.4	11.1	84.4	10.5
1988	-1.6	-1.1	0.0	0.0	0.0	-7.8	0.0	-8.2	-9.0	57.7	26.0	13.3
1989	-2.6	-2.6	0.0	-2.5	-3.2	0.0	0.0	-11.8	-3.5	0.0	18.4	0.0
1990	-2.0	-1.6	-1.6	0.0	0.0	0.0	0.0	0.0	0.0	49.4	16.3	14.1
1991	-3.1	-3.1	-2.9	-7.6	0.0	0.0	0.0	0.0	-4.5	29.9	11.0	6.7
1992	-3.1	-2.9	-4.6	-2.4	0.0	0.0	0.0	-12.4	-4.7	8.7	19.1	8.0
1993	0.0	-2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9
1995	-4.4	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	0.0	-0.7
1998	-0.7	-3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	0.0	0.0
2001	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	-3.3	9.8	18.7	14.7
2002	-2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0
Average	-0.8	-0.7	-0.3	-0.4	1.6	-0.4	-0.2	-1.2	-0.9	9.8	9.2	3.0
Critical	-1.7	-1.6	-1.5	-1.6	-0.4	-1.7	-0.7	-3.3	-2.6	44.3	25.1	11.0
Dry	-0.8	-0.5	-0.1	-0.4	-0.5	0.0	-0.5	-3.0	-2.2	3.5	22.8	4.2
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.6	-0.8	-0.1	0.0	9.8	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Wet	-0.5	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1

Table 6-36. SWP-Banks export difference (cfs) No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20.6	-27.3	-52.5
1977	-42.4	-36.8	-31.3	-17.6	-28.3	-27.4	0.0	0.0	0.0	-86.2	303.3	-41.2
1978	0.0	-33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	-12.1	0.0	0.0	0.0	12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-9.5	-4.0	973.6	-103.6
1982	-30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-7.4	0.0	0.0	-3.2	-3.1	-3.0	-5.1
1986	-4.9	-9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-2.3	-4.0	0.0	0.0	0.0	-20.6	-19.9	-23.8	587.6	-36.9	-67.4
1988	-59.2	-52.3	0.0	0.0	0.0	-24.6	0.0	0.0	0.0	-28.0	-41.6	-75.0
1989	-68.3	-78.8	0.0	-57.5	-53.5	0.0	0.0	-31.4	-27.7	-2.6	136.7	-76.3
1990	-45.4	-42.6	-37.6	0.0	0.0	0.0	0.0	0.0	0.0	-36.3	-41.9	-75.8
1991	-35.1	-34.9	-27.2	-49.8	0.0	0.0	0.0	0.0	-31.9	-34.8	-37.4	-66.1
1992	-55.5	-30.8	-61.1	-55.9	0.0	0.0	0.0	0.0	-30.1	1129.4	-40.0	-76.0
1993	0.0	-59.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.7	1270.4	-56.9
1995	0.0	-48.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-10.1	0.0	0.0	0.0	0.0	0.0	-25.4	1473.7	-37.7	-68.6
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-61.0	-16.3	-49.2	-25.3
2003	-2.9	-24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	496.0	-14.6	-4.7
Average	-10.5	-13.3	-5.0	-5.3	-2.0	-1.7	-0.6	-1.5	-6.3	101.6	69.2	-23.4
Critical	-33.9	-28.2	-22.5	-17.6	-4.0	-7.4	0.0	0.0	-8.9	131.8	197.9	-63.4
Dry	-11.4	-13.5	-2.4	-9.6	-8.9	-1.2	-3.4	-8.5	-25.1	339.2	163.9	-57.7
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-2.5	-19.6	0.0	0.0	2.2	0.0	0.0	0.0	0.0	82.7	-2.4	-0.8
Wet	-2.7	-4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-37. SWP-Banks export (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-1.2	-2.6
1977	-1.8	-1.8	-1.3	-1.9	-1.7	-3.5	0.0	0.0	0.0	-15.5	41.2	-2.7
1978	0.0	-1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	-0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.1	20.9	-1.9
1982	-0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-0.2	0.0	-0.1	-0.1
1986	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	-0.1	-0.1	0.0	0.0	0.0	-3.7	-1.2	-1.5	28.0	-3.7	-2.9
1988	-13.5	-5.8	0.0	0.0	0.0	-1.5	0.0	0.0	0.0	-1.6	-11.9	-5.0
1989	-17.7	-2.2	0.0	-1.8	-4.0	0.0	0.0	-4.5	-1.2	0.0	1.9	-1.1
1990	-0.9	-2.3	-2.7	0.0	0.0	0.0	0.0	0.0	0.0	-0.8	-7.6	-3.5
1991	-5.2	-2.6	-2.0	-12.0	0.0	0.0	0.0	0.0	-2.0	-0.9	-9.8	-8.7
1992	-3.7	-2.4	-3.4	-2.6	0.0	0.0	0.0	0.0	-9.1	126.7	-11.4	-3.6
1993	0.0	-11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.2	-1.5
1995	0.0	-2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-2.7	60.0	-4.2	-2.2
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.8	-0.2	-1.7	-0.5
2003	-0.2	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	-0.2	-0.1
Average	-1.3	-1.0	-0.3	-0.5	-0.2	-0.2	-0.1	-0.2	-0.6	6.0	3.0	-1.1
Critical	-3.6	-2.1	-1.4	-2.4	-0.2	-0.7	0.0	0.0	-1.6	15.4	12.6	-3.9
Dry	-2.9	-0.4	0.0	-0.3	-0.7	0.0	-0.6	-0.9	-1.7	14.6	2.2	-1.4
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	-0.1	-2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0
Wet	-0.1	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-38. CCDW Old River export difference (cfs) No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.1	45.1
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.7	22.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.1	65.3
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	11.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4	21.6
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-39. CCDW Old River export (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.4	46.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		1378.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	47.6
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	21.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	283.3
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-40. CCDW Rock Slough export difference (cfs) No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	64.7
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	65.5
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	44.6	62.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0	18.8
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.1	8.5	10.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.1	41.2	36.9
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.7	0.0	13.9
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-41. CCDW Rock Slough export (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.0	
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.7	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.6	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	102.5	0.0	
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.0	
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	396.4	755.0	
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.9		
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0	
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.5	68.6	0.0
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	180.7	377.5	0.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.3	0.0	0.0
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-42. CCDW Victoria Canal export difference (cfs) No Crop Idle minus Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	81.3	84.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.2	38.9
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.6	84.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.3	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	8.3	6.1
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	23.1	24.0
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	6.5
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6-43. CCDW Victoria Canal export (cfs) percent difference of No Crop Idle from Base.

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0	93.6	80.3
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	18.4
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.6	60.1
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.1	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	6.6	4.7
Critical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	20.2	20.1
Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	3.1
BN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Appendix D

Groundwater Model Documentation

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Appendix D Groundwater Model Documentation

Implementation of conjunctive water management within the Sacramento Valley is one strategy being used to enhance the reliability of the existing water supply, as well as potentially improve water quality, within the San Francisco Bay-Delta. However, the operation of conjunctive water management, or groundwater substitution projects, can result in adverse impacts on water resources within the valley. The two most critical potential impacts of additional groundwater production are depression of local groundwater levels, with associated impacts on well yields from nearby water supply wells, and changes in the hydraulic relationship between the surface water and groundwater systems in the area. To support the evaluation of these potential impacts, a high-resolution, numerical groundwater modeling tool was developed to estimate the impacts of potential future conjunctive water management projects on surface water and groundwater resources within the Sacramento Valley. This model, known as the Sacramento Valley Finite Element Groundwater Model (SACFEM2013), is described herein.

In 2011, prior to selecting the SACFEM model for use in this EIS/EIR analysis, a model evaluation process was undertaken to select the best fitting tool for the groundwater analysis in the EIS/EIR. Each model evaluated, including the selected SACFEM model, has undergone changes and updates over the past few years since the model evaluation. Where appropriate, the text below includes notes as to the more recent model updates/additions.

D.1 Model Evaluation

D.1.1 Introduction

This EIS/EIR analyzes the environmental effects of a variety of types of transfers, including groundwater substitution transfers. For groundwater substitution transfers, a willing seller would pump additional groundwater for irrigation in lieu of a surface water supply. The surface water would then be transferred to the buyer. Additional groundwater pumping could affect the groundwater system through: (1) a decline in groundwater levels (resulting in potential water quality and subsidence concerns) and (2) a change in the groundwater/surface water interaction flows.

A quantitative model can help analyze these impacts by simulating groundwater conditions with the additional groundwater pumping. The distinction between the model code (the computational “engine” behind the simulation) and the model application (the use of the code to simulate conditions in a certain area) should be noted. The process evaluated several available groundwater models against criteria that were deemed relevant to the required EIS/EIR analysis.

D.1.2 Evaluation Criteria

The following criteria were used to evaluate the potential use of several available groundwater models.

- **Numerical Code.** The numerical modeling code must be available for use by others. The code should also have sufficient technical review and/or benchmarking tests to illustrate the model computationally performs in accordance with established solution techniques.
- **Spatial Extent.** The model must encompass most of the Sacramento Valley where potential sellers are located.
- **Grid.** The model's grid should be sufficiently refined such that accurate results (e.g., groundwater levels, changes to groundwater/surface water interaction flows) are simulated. Grid sizes that are too large will not provide accurate results at the scale needed for this study. If the grid is not acceptably discretized, the grid must be able to be refined relatively easily to accommodate the needs of this work.
- **Transient Calibration.** The model application should have been calibrated over transient conditions. A steady-state calibration is, likely, not sufficient for this study because groundwater substitution transfers have the potential to occur over varying hydrologic year types. Therefore, the model should be calibrated over a transient period long enough to encompass multiple hydrologic conditions.
- **Technical Review.** The model application has been thoroughly reviewed and deemed adequate for use in this type of modeling study.
- **Availability.** The model application must be available for public use in the time frame of this study.

D.1.3 Available Models

The majority of potential sellers that would be transferring water through groundwater substitution are in the Sacramento Valley. There are several groundwater models that encompass some or all of the Sacramento Valley. These models are briefly described below. The evaluation criteria from the previous section are included along with a brief discussion of the adequacy of the model to meet the criteria.

D.1.3.1 C2VSIM

The California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) was developed by the California Department of Water Resources (DWR) and uses the Integrated Water Flow Model (IWFM) numerical code. IWFM is a finite-element code that simulates groundwater flow and groundwater/surface water interaction. The model is capable of estimating the amount of historical and future groundwater pumping based on input data such as cropping, evapotranspiration, and surface water delivery patterns. At the time of the model selection, C2VSIM simulated conditions in the entire Central Valley over the period of Water Years[1] (WY) 1921 through 2003 on a monthly basis. The model grid was relatively coarse in both the horizontal and vertical directions (three layers, 1,393 nodes, and 1,392 elements). The model simulates 72 stream reaches, two lakes, and eight bypass canals. There are 97 surface water diversion points simulated in model. Water accounting is carried out over 21 subregions that use four land use types (agriculture, urban, native, and riparian).

- **Numerical Code.** The IWFM code used by C2VSIM is available for use. This code and many of its components have been tested by DWR.
- **Spatial Extent.** C2VSIM covers the entire Central Valley.
- **Grid.** C2VSIM's grid spacing varies throughout the model. In general, node spacing is on the order of miles. This node spacing is not adequate for simulation of potential impacts at the scale needed (see note below).
- **Transient Calibration.** C2VSIM is calibrated for WY 1921 through 2003 (see note below).
- **Technical Review.** The code has been tested and used.
- **Availability.** This model would be available for use.

Note: Since the model selection was completed, C2VSIM has been updated to include simulation through WY 2009. A "fine grid" version of C2VSIM has recently been developed and would be available for use. However, this version was not available at the time this study began.

D.1.3.2 CVHM

The Central Valley Hydrologic Model (CVHM) was developed by the U.S. Geologic Survey (USGS) to aid in making water management decisions throughout the Central Valley (Faunt 2009). The model focuses on groundwater availability and changes in storage. CVHM uses the MODFLOW-2000 finite-difference numerical model code. MODFLOW, developed and maintained by the USGS, is commonly believed to be the most widely accepted

[1] A water year runs from October 1 of the previous calendar year through September 30 of the current calendar year (for example, water year 1970 includes the period of October 1, 1969 through September 30, 1970).

numerical modeling code in use. To develop CVHM, the USGS conducted a "texture analysis" of 8,500 drillers' logs to describe the sediment characteristics of aquifer materials. These characteristics were used to assign hydraulic conductivities to the model. CVHM uses the Farm Management Process to estimate groundwater pumping based on land use patterns and applied surface water, similar to IWFM.

CVHM uses a uniform 1-mile square grid to simulate conditions from WY 1962 through WY 2003 over the entire Central Valley. Similar to IWFM, water budgets are developed over 21 regions that use urban, native, and crop land use categories. The model simulates 43 inflows to streams in the valley and 66 diversions from streams.

- **Numerical Code.** The MODFLOW-2000 code used by CVHM is available for use. MODFLOW is an industry standard modeling platform.
- **Spatial Extent.** CVHM covers the entire Central Valley.
- **Grid.** CVHM's grid has uniform 1-mile by 1-mile square cells. The 1-mile spacing is not adequate for simulation of potential impacts at the scale needed. Several post-processing routines exist that allow the subdivision of all model cells and the extraction of boundary conditions. For example, each 1-mile cell could be divided into four sections yielding 0.5-mile cell spacing. Further subdivision is also possible (e.g. 16 sections would yield 0.25-mile (1,320 ft) cell spacing). Model runtime will increase as the number of cells is increased.
- **Transient Calibration.** CVHM is calibrated for WY 1962 through 2003.
- **Technical Review.** CVHM has been peer reviewed and published by the USGS as Professional Paper 1766.
- **Availability.** CVHM is available for public use.

D.1.3.3 SACFEM

The SACFEM model was developed to simulate groundwater conditions in the Sacramento Valley using the MicroFEM© finite-element numerical code. This model is capable of simulating groundwater conditions and groundwater/surface water interactions in the valley. The model contains 88,992 nodes and 177,095 elements and covers the entire Sacramento Valley groundwater basin from the Cosumnes River in the south to just north of Red Bluff. The model does not include the Redding or San Joaquin Valley groundwater basins as C2VSIM and CVHM do. The node spacing varies from 500 ft to 5,800 ft depending on the location in the model. The areas of fine node discretization exist where detailed groundwater and groundwater/surface water results were required during the development of the model.

SACFEM uses input from the Integrated Demand Calculator (IDC) as guidance to assign deep percolation and groundwater pumping data. The IDC performs the water demand calculations (i.e., land use demand, surface water deliveries, and groundwater pumping) that IWFM and CVHM also conduct. The output from IDC is assigned as input to SACFEM.

- **Numerical Code.** The MicroFEM code used by SACFEM is available for purchase. MicroFEM has been reviewed by the National Groundwater Association's (NGWA) Ground Water Journal (Diodato 2000).

- **Spatial Extent.** SACFEM covers the entire Sacramento Valley groundwater basin.

- **Grid.** SACFEM's grid spacing varies from 500 to 5,800 ft. The current version of the model has already been sufficiently refined in the areas near potential groundwater substitution sellers. However, additional grid refinement may be necessary depending on the locations of potential substitution sellers. Several pre- and post-processing tools can be used to facilitate this process (see note below).

- **Transient Calibration.** SACFEM is calibrated for years 1982 through 2003 (also see note below).

- **Technical Review.** The SACFEM model was peer reviewed in late 2010. The peer review identified several items that could be improved. The review listed seven items as Tier 1 (requires attention and revision/modification), three items as Tier 2 (strengthen model defensibility), and two items as Tier 3 (improve model features/capabilities) [see note below].

- **Availability.** The current version of SACFEM is available for use.

Note: Several updates have been made to the SACFEM model since its initial selection for use in this analysis. The highest priority ("Tier 1") items identified during the peer review process were addressed to improve the technical accuracy of the model. The model's calibration period was extended through WY 2010. The grid of the model was also refined to include smaller node spacing in the areas surrounding the potential sellers and in the areas of the flood bypasses in the valley. After updating the model and incorporating the technical feedback, the model was renamed from SACFEM to SACFEM2013. Further information on SACFEM2013 is provided in the sections below.

D.1.3.4 HydroGeoSphere

The HydroGeoSphere (HGS) model code is being applied to the Sacramento Valley. HGS is likely the most computationally comprehensive of the models discussed here. The code simultaneously solves the groundwater and surface water flow equation and is capable of using sub-gridding (i.e., localized grid refinement) and sub-timing (i.e., varying time steps to improve accuracy) routines. The sub-gridding process would be valuable to improve the accuracy of simulated results near pumping centers, for example. At this time, little additional information regarding the Sacramento Valley application of HydroGeoSphere is known (e.g., number of nodes, elements, rivers, etc.). The construction and calibration of this model are understood to be on-going.

- **Numerical Code.** The HGS code is available for purchase. The extent of testing is unknown.
- **Spatial Extent.** The Sacramento Valley application of HGS covers the entire groundwater basin.
- **Grid.** Work on HGS is underway to allow for sub-gridding. The sub-gridding functionality may not be complete at this time.
- **Transient Calibration.** The transient calibration in the Sacramento Valley application of HGS is not complete at this point.
- **Technical Review.** The Sacramento Valley application of the HGS model is not complete and, therefore, has not had technical review.
- **Availability.** The Sacramento Valley application of the HGS model is not complete.

D.1.3.5 Local Models

In addition to the larger-scale models listed above which cover the Sacramento and/or Central Valleys, several smaller, local groundwater models also exist. These models include applications to the Butte County, Stony Creek Fan, Lower Colusa basin, North American River, Sacramento County, Yolo, and Yuba County areas. The combined extent of each of these models covers much of the Sacramento Valley. Many of the models have been developed in either IWFM or its predecessor, the Integrated Groundwater-Surface Water Model (IGSM). For the most part, each of these local models occupies a separate area and does not overlap extensively with another local model. Therefore, where adjoining models abut, separate boundary conditions have been established for each model. It is possible that the boundary conditions do not fully agree with each other. Additionally, each model may have differing interpretations of hydraulic conductivity and layering. Each model was developed separately and each may not have the most up-to date data included.

- **Numerical Code.** The majority of the local models were developed in either IWFM or IGSM. These codes would be available for use.

- **Spatial Extent.** The combined extent of the local models covers most of the Sacramento Valley. The areas east and west of Red Bluff are not covered by one of the local models. Even though the models cover most of the Sacramento Valley, the simulation of potential impacts may be difficult if the impacts exceed each of the separate model's areas.

- **Grid.** The grid spacing in some of the local models is likely sufficient, but grid spacing for some models is unknown. Revisions to the grid(s) and input data may be required if the grid spacing is deemed too large.

- **Transient Calibration.** Several of the local models (Stony Creek Fan, Butte County, Yuba County, and Yolo County) have been calibrated over an approximate 30-year period. The Lower Colusa model is calibrated for a 19-year period. The calibration period for the other models is not known at this point.

- **Technical Review.** The status of technical reviews of these models is not known. Most of the models have, likely, not undergone significant technical or peer reviews.

- **Availability.** The availability of each of the models would need to be determined by the model's owner. Because most of the models were developed for public agencies they should be available. However, the exact availability for each of the local models is not known.

D.1.4 Selection

Based on the evaluation criteria described above, the SACFEM model was selected for use in the analysis for this EIS/EIR. The model was updated to the SACFEM2013 version as part of this EIS/EIR to address the peer review comments. SACFEM2013 was used for this EIS/EIR.

D.2 SACFEM2013

This section provides a more detailed description of SACFEM2013. Appendix M is the SACFEM User's Manual.

D.2.1 Model Code Description

MicroFEM (Hemker 1997), a finite-element based, three-dimensional, integrated groundwater modeling package developed in The Netherlands, was chosen to simulate the groundwater flow systems in the Sacramento Valley Groundwater Basin. The current version of the program (4.10) has the ability to simulate up to 25 layers and 250,000 surface nodes. MicroFEM is capable of modeling saturated, single-density groundwater flow in layered systems.

Horizontal flow is assumed in each layer, as is vertical flow between adjacent layers.

MicroFEM was the chosen modeling platform for the following reasons:

- The finite-element scheme allowed the construction of a model grid covering large geographic areas (over 5,960 square miles in the Sacramento Valley Groundwater Basin) with coarse node spacing outside of the simulated project areas and finer node spacing in areas of interest (e.g., near potential project areas). The finer node spacing near simulated production wells provides greater resolution of simulated groundwater levels and stream impacts.

- The graphical interface allows rapid assignment of aquifer parameters and allows proofing of these values by graphical means.

- The flexible post-processing tools allow for rapid evaluation of transient water budgets for model simulations and identification of changes to stream discharges and other water fluxes across the model domain.

D.2.2 Sacramento Valley Groundwater Basin

The following briefly summarizes the geology and hydrology of the Sacramento Valley Groundwater Basin.

D.2.2.1 Geologic Setting

The Sacramento Valley Groundwater Basin is a north-northwestern trending asymmetrical trough filled with as much as ten miles of both marine and continental rocks and sediment (Page 1986). On the eastern side, the basin overlies basement bedrock that rises relatively gently to form the Sierra Nevada; and on the western side, the underlying basement bedrock rises more steeply to form the Coast Ranges. Marine sandstone, shale, and conglomerate rocks that generally contain brackish or saline water overlie the basement bedrock. The more recent continental deposits, overlying the marine sediments, contain fresh water. These continental deposits are generally 2,000 to 3,000 feet thick (Page 1986). The depth (below ground surface) to the base of fresh water typically ranges from 1,000 to 3,000 feet (Bertoldi et al. 1991).

In the Sacramento Valley Groundwater Basin, groundwater users pump primarily from deeper continental deposits. Groundwater is recharged by deep percolation of applied water and rainfall, infiltration from streambeds, and lateral inflow along the basin boundaries. The quantity and timing of snowpack melt are the predominant factors affecting the surface water and groundwater hydrology, and peak runoff in the basin typically lags peak precipitation by one to two months (Bertoldi et al. 1991).

D.2.2.2 Hydrology

The Sacramento River is the main surface water feature in the Sacramento Valley Groundwater Basin. It has several major tributaries draining the Sierra Nevada, including the Feather, Yuba, and American Rivers. The flow in these tributaries depends heavily on the precipitation in the Sierra Nevada. Stony, Cache, and Putah Creeks drain the Coast Range and are the main west side tributaries to the Sacramento River. The west side tributaries contribute significantly less streamflow than those on the eastside tributaries. The Sacramento River flows south through the center of the valley before heading west to flow out Suisun Bay.

Streamflow data for streams throughout the Sacramento Valley are collected at gaging stations operated by ~~the California Department of Water Resources~~DWR[2] ~~(DWR)~~ and the ~~U.S. Geological Survey~~USGS[3] ~~(USGS)~~.

D.2.3 Model Construction

This section discusses the development of the groundwater model grid and layering, the assignment of groundwater flux boundary conditions, and the basis for assignment of material properties to the aquifers within the model domain.

D.2.3.1 Spatial Grid

The SACFEM2013 grid used for the groundwater substitution transfer simulations consists of 153,812 nodes and 306,813 elements (see Figure D-1). The current grid was configured to support evaluation of potential conjunctive water management projects associated with the Long-Term Water Transfer Program; however, the SACFEM2013 model was designed to be grid independent, and geographic information system (GIS)-based tools have been developed to build a similar model of the valley on any grid developed to support a particular application. The nodal spacing of the current grid varies from as large as approximately 3,300 feet (1,000 meters) near the model boundary and in areas where long-term water transfer projects are not being evaluated, to as small as 410 feet (125 meters) in areas where long-term water transfer groundwater production is being evaluated. Nodal spacing of approximately 1,640 feet (500 meters) is included along streams and flood bypasses included in SACFEM2013. The finer node spacing near proposed project areas allows for more refined estimates of the effects of groundwater pumping on groundwater levels and groundwater/surface water interaction in the potential project areas. The model domain boundary coincides with the lateral extent of the freshwater aquifer within the Sacramento Valley Groundwater Basin.

D.2.3.2 Vertical Layering

The total model thickness is defined by the thickness of the freshwater aquifer (less than 3,000 micromhos), as defined by Berkstresser (1973) and

[2] http://cdec.water.ca.gov/
[3] http://waterdata.usgs.gov/nwis

subsequently refined in the northern portion of the valley by DWR (DWR ~~2002~~2005). For the southern portion of the model area, defined by Berkstresser data, elevation contour lines of the base of fresh water, along with information from boring locations (point measurements of the elevation of the base of fresh water), were digitized and used to generate a three-dimensional surface defining the elevation of the base of fresh groundwater. For the northern portion of the model area, the locations of geologic cross sections developed by DWR Northern District staff were plotted, along with the estimated base of freshwater elevations obtained from the cross section information; and a base of freshwater elevation contour map was constructed. These data sets were then merged to yield a single interpretation of the structural contour map of the base of freshwater across the Sacramento Valley (see Figure D-2).

Total Aquifer Thickness

The uppermost boundary of the SACFEM2013 model is defined at the water table. To develop a total saturated aquifer thickness distribution and, therefore, a total model thickness distribution, it was necessary to construct a groundwater elevation contour map and then subtract the depth to the base of freshwater from that groundwater elevation contour map. Average calendar year groundwater elevation measurements were obtained from the DWR Water Data Library. These measurements were primarily collected biannually, during the spring and fall periods; and these values were averaged at each well location to compute an average water level for each location. These values were then contoured, considering streambed elevations for the gaining reaches of the major streams included in the model, to develop a target groundwater elevation contour map for the year 2000. As described above, the distribution of the elevation of the base of freshwater was subtracted from this groundwater elevation contour map to provide an estimate of the distribution of the total saturated aquifer thickness across the model domain.

Model Layer Thickness

The strategy used to develop the overall layering of the SACFEM2013 model was to develop a tool that provided sufficient layers to assess the effects of groundwater pumping on shallow features such as wetlands and streams, but also to provide sufficient vertical resolution to allow assignment of pumping stresses to appropriate depths within the aquifer that reflect the major producing zones within the aquifer system. Additionally, to facilitate investigation of potential future conjunctive water management projects using the lower Tuscan aquifer, the layering strategy also provided for two layers explicitly representing this deep aquifer system.

Layer one of the SACFEM2013 model was assigned a maximum thickness of approximately 65 feet (20 meters). The thickness of this layer was limited to provide more accurate shallow groundwater elevations with which to support evaluations of the effects of changing groundwater levels on surface streams and wetland/riparian areas. Layers two through five represent the more regional groundwater-producing zones within the valley. The thicknesses of these layers were assigned using a specified percentage of the available aquifer thickness at a given location, to provide multiple-depth zones within which to assign regional pumping. The assumed layer thicknesses for layers two through five were also selected to reflect typical screened intervals of production wells in the Sacramento Valley. The thicknesses of layers two through four each represent approximately ten percent of the total aquifer thickness (one to 107 meters, three to 350 feet), and the thickness of layer five represents approximately 15 percent of the total aquifer thickness on average (one to 193 meters, three feet to 633 feet).

Where the lower Tuscan aquifer is present (the northeastern and central portions of the valley), the elevation of the top of layer six was defined by the structural contour surface of the top of the lower Tuscan aquifer. Two layers were assigned to represent this unit because in many areas of the model, the depth to the base of fresh water (the base of the model) is as much as 900 feet below the upper surface of the lower Tuscan. Groundwater production wells drilled into the lower Tuscan would almost certainly be screened over a much smaller depth interval. To allow representation of this condition in the model, layer six was assigned a thickness of between 250 to 360 feet (75 to 110 meters) in the central portion of the northern Sacramento Valley Groundwater Basin. The total range in layer six thickness is approximately three to 580 feet (one to 177 meters). The remaining lower Tuscan thickness not apportioned to layer six was assigned to layer 7. The exception to this convention is in the northeastern portion of the model near the City of Chico. The lower Tuscan outcrops in the foothills above Chico; thus, in these areas, all layers of the model represent the lower Tuscan aquifer. Moving west from Chico, a transition zone exists where a decreasing number of layers represent the lower Tuscan until it is limited to layers six and seven, as discussed above. In areas where the lower Tuscan is not present, the thicknesses of layers six and seven represent 18 and 27 percent of the total aquifer thickness, respectively. A contour map of the total saturated aquifer thickness is presented on Figure D-3.

D.2.3.3 Model Time Discretization

Time is continuous in the physical system, but a numerical model must describe the field problem at discrete time intervals. SACFEM2013 was set up to simulate transient flow conditions between Water Years[4] 1970 and 2010 with monthly stress periods. As such, model stresses (such as stream stage, groundwater pumping, deep percolation, etc.) and model output are assigned/evaluated on a monthly basis.

D.2.3.4 Boundary Conditions

A combination of no-flow, specified-flux, and head-dependent boundary conditions were used to simulate the groundwater flow system within the

[4] ~~A water year runs from October 1 of the previous calendar year through September 30 of the current calendar year (for example, water year 1970 includes the period of October 1, 1969 through September 30, 1970).~~

Sacramento Valley. Each of these boundary conditions is discussed in more detail below.

Head-dependent Boundaries

Surface Water Bodies. A head-dependent boundary condition was chosen to simulate the major streams, flood bypasses, and reservoirs within the Sacramento Valley. The MicroFEM wadi system was used to implement streams within the model domain. MicroFEM's wadi package is a two-way head-dependent boundary condition (that is, it can act as a source of groundwater recharge or as a groundwater sink) that calculates the magnitude and direction of nodal fluxes by using the relative values of the user-specified stream stage (wh1) and the calculated head in the upper aquifer (h1), but is limited by a critical depth (wl1). When calculated groundwater elevations fall below this critical depth, it is assumed that the water table de-couples from the river system, and the leakage rate from the river to the aquifer becomes constant. The equations that govern operation of the wadi package are as follows:

Groundwater discharge to a stream is simulated if h1 > wh1:

$$Q_{outflow} = a * (h1 - wh1) / | wc1 | \quad (1)$$

In coupled streams (groundwater elevation is above the stream bottom elevation), groundwater recharge from a stream is simulated if h1 < wh1:

$$Q_{inflow} = a * (wh1 - h1) / | wc1 | \quad (2)$$

In decoupled streams (groundwater elevation is below the stream bottom elevation), groundwater recharge from a stream is simulated if:

$$Q_{inflow} = a * (wh1 - wl1) / | wc1 | \quad (3)$$

Where:

Q = volumetric flux

a = nodal area

h1 = simulated groundwater elevation in layer 1

wh1 = simulated stream stage

wl1 = stream bottom elevation

wc1 = resistance across the streambed

Nodal area is a grid-dependent parameter that can be automatically calculated within MicroFEM. In general, the nodal area around a node that represents a discrete reach of a stream is greater than the surface area of that stream along the reach in the field. The effective resistance term (wc1) incorporates an areal correction factor to account for this discrepancy the wadi resistance term (wc1) is a measure of the resistivity of the streambed sediments. The resistances are calculated as follows:

$$wc1 = Dr/Kv\ ))^{*}\ (a/LW) \qquad (4)$$

Where:

Dr = thickness of streambed sediments

Kv = vertical hydraulic conductivity of streambed sediments

L = stream length represented by the model node

W = field width of the wetted river channel within the stream reach represented by L. Fifty individual streams are simulated with MicroFEM's wadi package in the current version of SACFEM2013.

Stream locations were digitized from existing base maps and USGS topographic quadrangle sheets, and imported into the model domain. Stream length within a given node is a grid-dependent variable calculated by MicroFEM at each river node. The stream-length term is generally overestimated by MicroFEM at stream confluences. Manual corrections of this term were made where necessary. Streambed thickness was assumed to be 3.28 feet (one meter) for all river nodes. Assumptions of streambed Kv were based on the type of streambed deposits expected given stream size. Streams draining the Sierra Nevada were generally assigned lower streambed Kv's, with all streams except the Bear River and Big Chico Creek having values of two meters per day (m/d) (0.0023 centimeters per second [cm/s]) or less. Westside streams were assigned higher values, with most being at or above five m/d (0.0058 cm/s). Wetted stream width was calculated from aerial photographs at two locations along each stream. Few streams showed greater variability in width such that it was necessary to develop a continuously variable distribution along the stream length. This was accomplished by estimating wetted stream width at several points via examination of aerial photographs and fitting a polynomial to the data points.

Streambed elevations (wl1) were estimated using data from 10-meter Digital Elevation Model (DEM) data. It was assumed that the minimum DEM elevation that at/near a given stream node represented the streambed elevation at that location. Polynomials were fitted to the distribution of streambed elevations and cumulative distance along each stream. These polynomials provided relationships that were used to both "smooth" the distribution of streambed elevations and populate values for nodes where the SACFEM2013 nodal resolution was finer than the DEM spacing.

As previously discussed, SACFEM2013 simulates transient conditions from water years 1970 through 2010 on a monthly basis. Monthly varying distributions of stream stage were developed for all streams included in SACFEM2013. Further historical measured stream stage data for model streams was analyzed to determine the timing and location of streams that experience seasonal drying. During months where a given stream is interpreted as experiencing no surface water flow, the SACFEM2013 nodes are converted from a MicroFEM wadi boundary condition to a MicroFEM drainage boundary condition, discussed in more detail below.

The current version of SACFEM2013 incorporates additional recharge from the major flood bypasses in the Sacramento Valley during wet periods. These include the Butte Bypass, the Sutter Bypass, and the Yolo Bypass. Historical weir data were evaluated to determine the timing and location of flood bypass inundation. During periods of bypass flow, the interpreted water surface elevation was compared to the DEM data to determine the spatial distribution of bypass inundation. Active flood bypass nodes were simulated using MicroFEM's wadi boundary condition. The wh1 value for each active flood node was assigned the interpreted water surface elevation (which varied on a monthly basis). The wc1 value was assumed to be ten for all active bypass nodes. During dry periods (and non-inundated bypass nodes), flood bypasses were simulated as groundwater sinks using MicroFEM's drainage package.

The final surface water bodies simulated in SACFEM2013 using MicroFEM's wadi package are the major reservoirs located within the interior of the Sacramento Valley Groundwater Basin, Black Butte Reservoir and Thermalito Afterbay. The lake bottom elevations were assumed to be constant for both reservoirs, and were simulated as 100 feet below the average DEM elevation (assumed to represent lake stage) for Black Butte reservoir and 40 feet below the average DEM elevation for Thermalito Afterbay. The wc1 values were assumed to be one for both reservoirs. The lake stage elevation was assumed to be constant spatially across each reservoir; however, historical data were evaluated to develop monthly-variable lake stage datasets for the SACFEM2013 simulation period.

Drains. MicroFEM's drainage package was used to simulate boundary conditions across the top surface of the model, excluding nodes where wadi boundaries exist. Drainage boundary conditions are one-way head-dependent boundaries that allow the transfer of water out of the model domain only. The elevation of the drain boundaries were set at the land surface. The drain boundaries were included in the model to represent a combination of surficial processes that occur in areas of shallow groundwater, including evapotranspiration and groundwater discharge to the surface. Additionally, as discussed above, specific streams and flood bypasses were converted from wadi boundary conditions to drain boundary conditions during periods when a given surface water body was interpreted as being dry.

Groundwater discharge to a drain is simulated if h1 > dh1:

$$Q_{outflow} = a * (h1 - dh1) / | dc1 | \text{ (where a = nodal area)} \quad (5)$$

Groundwater discharge to a drain is simulated if h1 < dh1:

$$Q_{outflow} = 0 \quad (6)$$

The parameter dc1 represents the drain conductance and is a measure of the resistance to flow across the drain boundary. The dc1 was assumed to be 500 throughout the model domain.

Specified-flux Boundaries. Three sets of specified-flux boundary conditions were implemented in the SACFEM2013 model. These conditions are as follows: (1) deep percolation of applied water and precipitation along with agricultural pumping, (2) mountain-front recharge, and (3) urban pumping. Each is discussed in more detail below.

Deep Percolation of Applied Water, and Precipitation and Agricultural Pumping. The first set of specified-flux boundary conditions reflects the deep percolation of precipitation and applied water across the valley, as well as the regional agricultural pumping. The deep percolation flux values were applied to every surface node in the model. The pumping stresses due to agricultural pumping were applied at selected locations in model layers two through four (the depths of the regional producing zones across the valley). The spatial distribution and magnitudes of these fluxes were derived from the surface water budget calculations described in full detail in the Surface Water Budget section below.

Mountain-front Recharge. The second set of specified-flux boundary conditions represents the subsurface inflow of precipitation falling within the Sacramento River watershed but outside the extent of the model domain. To estimate these flux values, the USGS 10-meter DEM along with GIS-based hydrography coverages for the Sacramento Valley were used to delineate the drainage areas that are tributary to the model domain but fall outside of the watersheds of the rivers explicitly represented in the model. It is these areas that can contribute water to the model domain but are not accounted for in the wadi boundary conditions defined in the model. After the extents of these watershed areas were defined, they were intersected with monthly Parameter – elevation Relationships on Independent Slopes Model (PRISM)[5] rainfall datasets using GIS tools, and the volume of precipitation falling on the watershed was computed. On the basis of the computed total volume of precipitation, the deep percolation to the groundwater system was calculated using the following empirical relationship developed by Turner (1991):

[5] http://prism.oregonstate.edu/

$$DP = (PPT-2.32)*(PPT)^{0.66} \quad (7)$$

Where:

DP = average annual deep percolation of precipitation (inches per year)
PPT = annual precipitation (inches per year)

A summary of the process that was used to estimate the quantity of subsurface inflow, otherwise known as mountain-front recharge, is as follows:

1. The area of each drainage basin tributary to the model domain that is not represented by streams explicitly simulated in SACFEM2013 was computed using a GIS-based analysis of the land surface topography. The extent of these smaller watersheds is shown on Figure D-1.

2. Each drainage area polygon was then intersected with a GIS coverage of annual total rainfall estimated using the PRISM model for each year of the simulation period. This distribution of annual average rainfall was then used to calculate the total volume of rainfall falling on the small watershed areas, and an overall average rainfall rate was computed (inches per year).

3. The total annual rainfall rate was then used to compute a deep percolation quantity using the relationship between annual rainfall and deep percolation rate developed by Turner (1991) and described above.

4. The annual volume of deep percolation computed in Step three was then converted into monthly values that were based on the monthly distribution of streamflow measured in ungauged sections of Deer Creek. These monthly deep percolation quantities were then introduced at the model domain boundary of each small watershed polygon using injection wells into layer one. The quantity applied to each model boundary node was proportional to boundary length of each element divided by the total boundary length of the drainage polygon.

5. The deep percolation rates for individual drainage basins were adjusted during SACFEM2013 calibration to improve the match between simulated and measured groundwater elevations. Final factors applied to the deep percolation rates range from 0.5 to 1.5.

Urban Pumping. The final set of specified-flux boundary conditions applied in the SACFEM2013 model reflects urban pumping within the model domain. The distribution of agricultural pumping that was developed using the surface water budgeting methodologies described below do not include urban pumping. As a first step to estimate the quantity of urban pumping to apply to the model, the year 2010 U.S. Census data were evaluated. Each municipal area with a population greater than 5,000 that used groundwater as a source of municipal supply was further assessed. For municipalities where urban water management plans were available, the reported annual groundwater use was simulated in SACFEM2013. For cities that do not have a current water management plan, a pumping volume that was based on an annual average per capita value of 271 gallons/capita/day was simulated. Further, municipalities in the northern Sacramento area pumping rates were assigned consistent with the Sacramento County Integrated Groundwater and Surface Water Model (SacIGSM) model. Urban pumping was assigned spatially to all SACFEM2013 nodes within a given city area and was apportioned equally to model layers two through four. The monthly variability in urban pumping quantity was distributed on the basis of typical seasonal trends for municipal water use.

No-flow Boundaries
A no-flow boundary was specified across the bottom boundary of the model, representing the freshwater/brackish water interface.

D.2.3.5 Surface Water Budget

Approach
One of the most critical components to the successful operation of ~~the~~ SACFEM2013 is computation of transient surface water budget components. These water budget components were estimated by using a variety of spatial information including land use, cropping patterns, source of irrigation water, surface water availability in different year types and locations, and the spatial distribution of precipitation. Surface water budget components include deep percolation of applied water, deep percolation of precipitation, and agricultural pumping.

Surface water budgets were developed by intersecting existing GIS data developed by DWR with the groundwater model grid to develop land use for each groundwater model node. Additionally, GIS data on water districts and surrounding areas were used to identify district and non-district areas. The resulting intersection provided land use, water district, and water source information for each of the over 150,000 groundwater model nodes.

Methodology
A semi-physically based soil moisture accounting model and historical precipitation data were used to simulate the root zone processes and calculate applied water demand and deep percolation past the root zone for each node. Calculated deep percolation was split between applied water and precipitation depending on the season and the availability of water from each source.

Calculated values for deep percolation were compared to estimated values prepared by DWR's Northern District for the year 2000. Northern District staff calculated detailed water budgets in 2000, which included some of the best available estimates of regional deep percolation. In some areas, soil parameters in the root zone model were adjusted to provide similar volumes of deep percolation. However, considerable uncertainty still exists in any estimate of regional deep percolation because soil conditions vary widely, and it is not possible to measure deep percolation on a regional basis.

The total demand for applied water was used in conjunction with the water source and water district attributes from the GIS intersection to estimate agricultural groundwater pumping. Some areas are supplied solely from groundwater, and calculated total applied water demand represents groundwater pumping. Other areas are supplied by a mix of groundwater and surface water. For these areas, estimates of the availability of surface water each year were made to determine the fraction of applied water demand met from surface water and groundwater. In these areas, additional information on the overlying water district was combined with district water rights and contracts to estimate available surface water. For example, districts within the Tehama-Colusa Canal Authority have water contracts with the Bureau of Reclamation that receive different allocations each year. An estimate of those allocations from an existing level of development simulation of Central Valley Project operations was used to calculate the availability of surface water for groundwater model elements within those districts. Any remaining applied water demand, after consideration of available surface water, is assumed to be met by groundwater pumping.

D.2.3.6 Aquifer Properties

The distribution of aquifer properties across the Sacramento Valley is poorly understood. In certain areas with significant levels of groundwater production, the collection of aquifer test data and the measurement of historical groundwater-level trends in response to known groundwater production rates have provided valuable information on aquifer properties. However, in the majority of the valley, these data are not available.

To estimate the spatial distribution of aquifer properties across the model domain for this numerical modeling effort, a database of well productivity information was used. In consultation with DWR staff, a database was obtained that included all of the specific capacity yield data that were available from well log records. These data were compiled along with well construction information for each production well to yield a representative data set of well productivity across the valley. Wells that did not have available construction data were omitted from further consideration. To protect owner privacy, the exact location of each well was modified by DWR staff to reflect the center of the section in which each well was located. This modification in well location did not adversely affect the use of the data to estimate the spatial distribution of aquifer properties, given the extremely large area encompassed by the model domain. Approximately 1,000 wells in the database within the model domain were used in this analysis.

The intent of the modeling analysis described herein is to simulate the effects of the operation of high-productivity irrigation wells screened within the major producing zones in the valley to support conjunctive water management projects. Therefore, the aquifer properties that are of primary interest are those of the major aquifer zones tapped by large-diameter irrigation wells. The well database described above was filtered to remove data obtained from tests on low-yield and shallow, domestic-type wells. All test data from wells that reported a well yield below 100 gallons per minute were eliminated from consideration, as were the test data from wells with a total depth of less than 100 feet. The only exception to this second consideration was for wells that were located along the basin margins – where aquifers are thin – that reported what appeared to be valid test results. Data from these wells were considered because they were often the only data available in the basin margin areas.

After the data set for consideration was finalized, the reported specific capacity data for each well were used to estimate an aquifer transmissivity for that location. The relationship used to estimate aquifer transmissivity was the following form of a simplified version of the Jacob non-equilibrium equation:

$$Sc = T/2000 \quad (8)$$

Where:

Sc = specific capacity of an operating production well (gallons per minute per foot of drawdown)

T = aquifer transmissivity (gallons per day per foot)

After a transmissivity estimate was computed for each location, the transmissivity value was then divided by the screen length of the production well to yield an estimate of the aquifer horizontal hydraulic conductivity (Kh). The final step in the process was to smooth the Kh field to provide regional-scale information. Individual well tests produce aquifer productivity estimates that are local in nature, and might reflect small-scale aquifer heterogeneity that is not necessarily representative of the basin as a whole. To average these smaller scale variations present in the data set, a FORTRAN program was developed that evaluated each independent Kh estimate in terms of the available surrounding estimates. When this program is executed, each Kh value is considered in conjunction with all others present within a user-specified critical radius, and the geometric mean of the available Kh values is calculated. This geometric mean value is then assigned as the representative regional hydraulic conductivity value for that location. The critical radius used in this analysis was 10,000 meters, or about six miles. The point values obtained by this process were then gridded using the kriging algorithm to develop a Kh distribution across the model domain. The aquifer transmissivity at each model node within each model layer was then computed using the geometric mean Kh values at that node times the thickness of the model layer. Insufficient data were available to attempt to subdivide the data set into depth-varying Kh distributions, and it was, therefore, assumed that the computed mean Kh values were representative of the major aquifer units in all model layers. The distribution of K used throughout most of the SACFEM2013 model layers is shown in Figure D-4. During model calibration, minor adjustments were made to the Kh of model layer one east of Dunnigan Hills and in model layers six and seven in the northern Sacramento Valley based on qualitative assessment of Lower Tuscan aquifer test data in this area.

MicroFEM computes vertical flow between adjacent model layers based on the simulated head difference between adjacent model layers and the vertical resistance term. The vertical resistance term in MicroFEM is calculated as follows:

$$V = \frac{\left(b_i / Kv_i + b_{i+1} / Kv_{i+1} \right)}{2} \qquad (9)$$

Where:

V = Vertical resistance to flow between an upper model layer (i) and adjacent lower model layer (i+1) ($days^{-1}$)

b_i = Saturated thickness of model layer i (meters)

b_{i+1} = Saturated thickness of model layer i+1 (meters)

Kv_i = Vertical hydraulic conductivity of model layer i (m/d)

Kv_{i+1} = Vertical hydraulic conductivity of model layer i+1 (m/d)

The ratio of Kh to vertical hydraulic conductivity (Kv) were assumed to be 500:1 in layers two through seven and 50:1 in layer one at all model nodes except those representing bedrock areas. The Kh:Kv in areas of bedrock outcrop (such as the Sutter Buttes, Black Butte, and Dunnigan Hills) was assumed to be 1:1 in all model layers.

The specific yield of model layer one was assumed to be 12 percent throughout the SACFEM2013 model domain. The aquifer storativity of model layers two through seven is 6.5×10^{-5} multiplied by model layer thickness throughout the majority of the model domain, with variations along small portions of the model boundary.

D.3 Sensitivity

To test the sensitivity of the SACFEM2013 model to various hydrologic parameters, several sensitivity simulations have been run to-date. Each of these sensitivity simulations varied specific sets of hydraulic parameters. The following parameters were varied in simulations performed to-date.

1. Basin Deposits: The hydraulic conductivity of the Basin deposits (geologic terms Qb, Qm, and Qp) were decreased. Basin deposits are generally surficial deposits of fine grain nature. Decreasing the hydraulic conductivity of the basin deposits would have the tendency to slow the flow of water from the surface to the groundwater.

2. Stream Deposits: The hydraulic conductivity of the Stream deposits (geologic terms Qsc, Qa, and Qal) were increased. Stream deposits are located along the historic channel of the river and represent a coarser grained material. Increasing the hydraulic conductivity of these deposits can allow faster movement of water through this area.

3. Basin and Stream Deposits: The hydraulic conductivity of the Basin deposits (geologic terms Qb, Qm, and Qp) were decreased, and the hydraulic conductivity of the Stream deposits (Qsc, Qa, and Qal) were increased. This simulation combines the changes made in the previous two simulations.

4. Horizontal Hydraulic Conductivity: The horizontal hydraulic conductivity throughout the model was decreased by one order of magnitude (i.e., all values were multiplied by 0.1). A decrease in hydraulic conductivity slows the movement of water through the aquifer.

5. Anisotropy Ratio: The anisotropy ratio (the ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity) was changed across the entire model from 500:1 to 1000:1. Increasing this ratio from 500:1 to 1000:1 increases the resistance to flow in the vertical direction by decreasing the vertical hydraulic conductivity of the aquifer.

6. Storage Coefficients: The values of the storage coefficients were increased. The specific yield was increased from 0.12 to 0.2. The storativity value was increased by a factor of 10 across the entire model. Changes to storage coefficients also result in a change in the velocity of groundwater movement within the aquifer.

7. Streambed Hydraulic Conductivity. The hydraulic conductivity of each streambed was decreased by a factor of 10. Decreasing the hydraulic conductivity of the streambeds would slow movement of water between the surface water and groundwater systems.

The SACFEM2013 model has been calibrated (as previously described). It should be noted that model was not recalibrated for each of the parameters sets listed above. The purpose of the sensitivity simulations is to determine which parameters the model results may or may not be sensitive to.

The sensitivity simulations were run with approximately 153,000 acre-feet of water pumped in a single year. This volume of water is roughly equivalent to the average of all pumping in transfer years under the Proposed Action.

Pumping was specified at the locations and depths of the wells used in the Proposed Action. The change in groundwater level (i.e., drawdown) between simulations with and without the 153,000 acre-feet of pumping was plotted at three locations. Locations 6, 21, and 30 were selected as they are spread across the area where drawdown due to the Proposed Action is simulated (Figures 3.3-28a through 3.3-33c). Simulated drawdown has been plotted at each location for the water table and at the depth of pumping in the area surrounding that location.

Figures D-5 and D-6 show the simulated drawdown at Location 6. Figure D-5 shows the drawdown at the water table (model layer 1). Figure D-6 shows the drawdown in model layer 7. At the water table (Figure D-5), each of the simulations show similar or less drawdown as compared to the calibrated model. Three of the sensitivity simulations (stream bed conductivity, anisotropy ratio, hydraulic conductivity) show recovery period that is longer than the calibrated model. In the pumping zone (Figure D-6), two simulations (hydraulic conductivity, anisotropy ratio) show more drawdown than the calibrated model. Three of the simulations show a longer recovery period following the pumping. The increase anisotropy simulation has a similar, but slower recovery, than the calibrated model. The higher storage coefficient and lower streambed conductivity simulations take additional years for the groundwater levels to recover from the pumping.

Figures D-7 and D-8 show similar results at Location 21. Figure D-7 shows the simulated drawdown in model layer 1. Figure D-8 shows the results in model layer 6, where pumping occurs in this area. The results at the water table (Figure D-7) are very similar to those shown for Location 6 (Figure D-5). In the pumping zone (Figure D-8), two simulations show an increase in the total drawdown (hydraulic conductivity, anisotropy ratio). The hydraulic conductivity simulation also shows a longer period to recover from the pumping. The simulation with altered storage coefficients also requires a longer period to recover, although drawdown in this simulation is significantly lower.

Figures D-9 and D-10 show the simulated drawdown at Location 30 in Layers 1 and 3, respectively. Similar to the other locations, the drawdown and recovery period at the water table (Figure D-9) show similar trends to those described for Location 6 (Figure D-5) and Location 21 (Figure D-7). At the depth of pumping (Figure D-10), two simulations (anisotropy ratio, hydraulic conductivity) show an increase in the amount of drawdown that is simulated as compared to the calibrated model. Two of the simulations (storage coefficients, hydraulic conductivity) require a longer period for groundwater levels to recover than the calibrated model.

D.4 References

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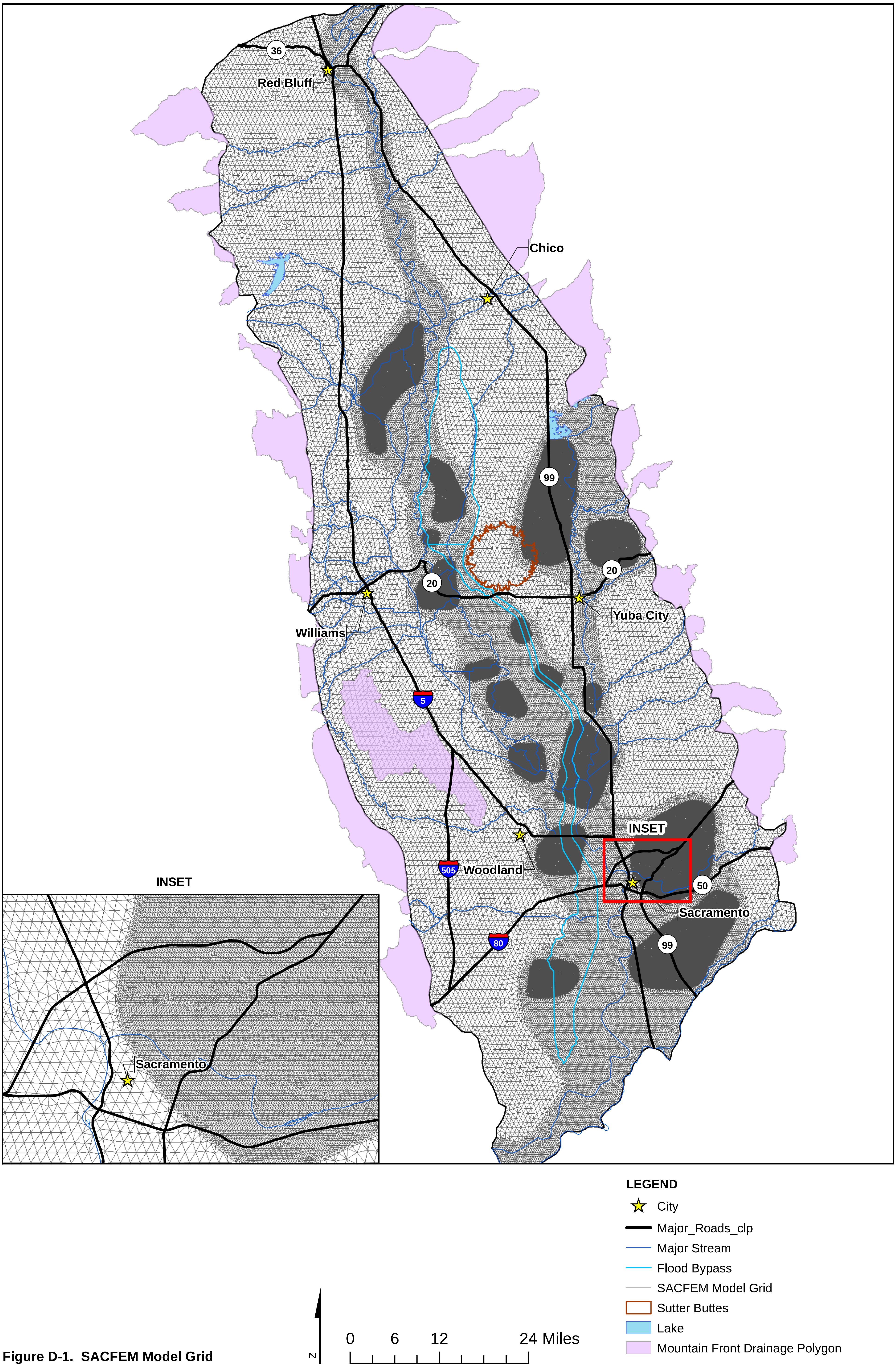

Figure D-1. SACFEM Model Grid

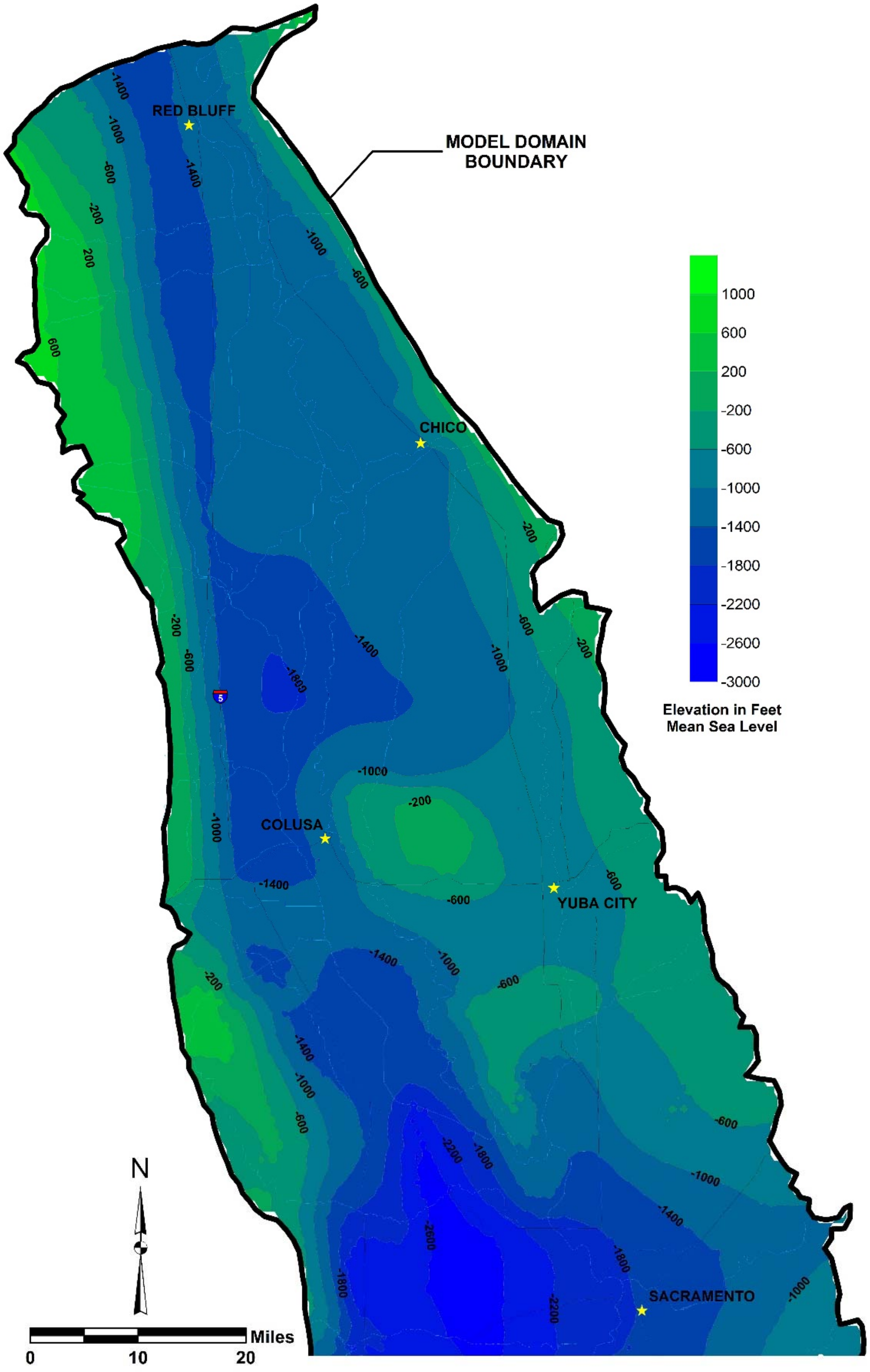

Figure D-2. Elevation of the Base of Fresh Water

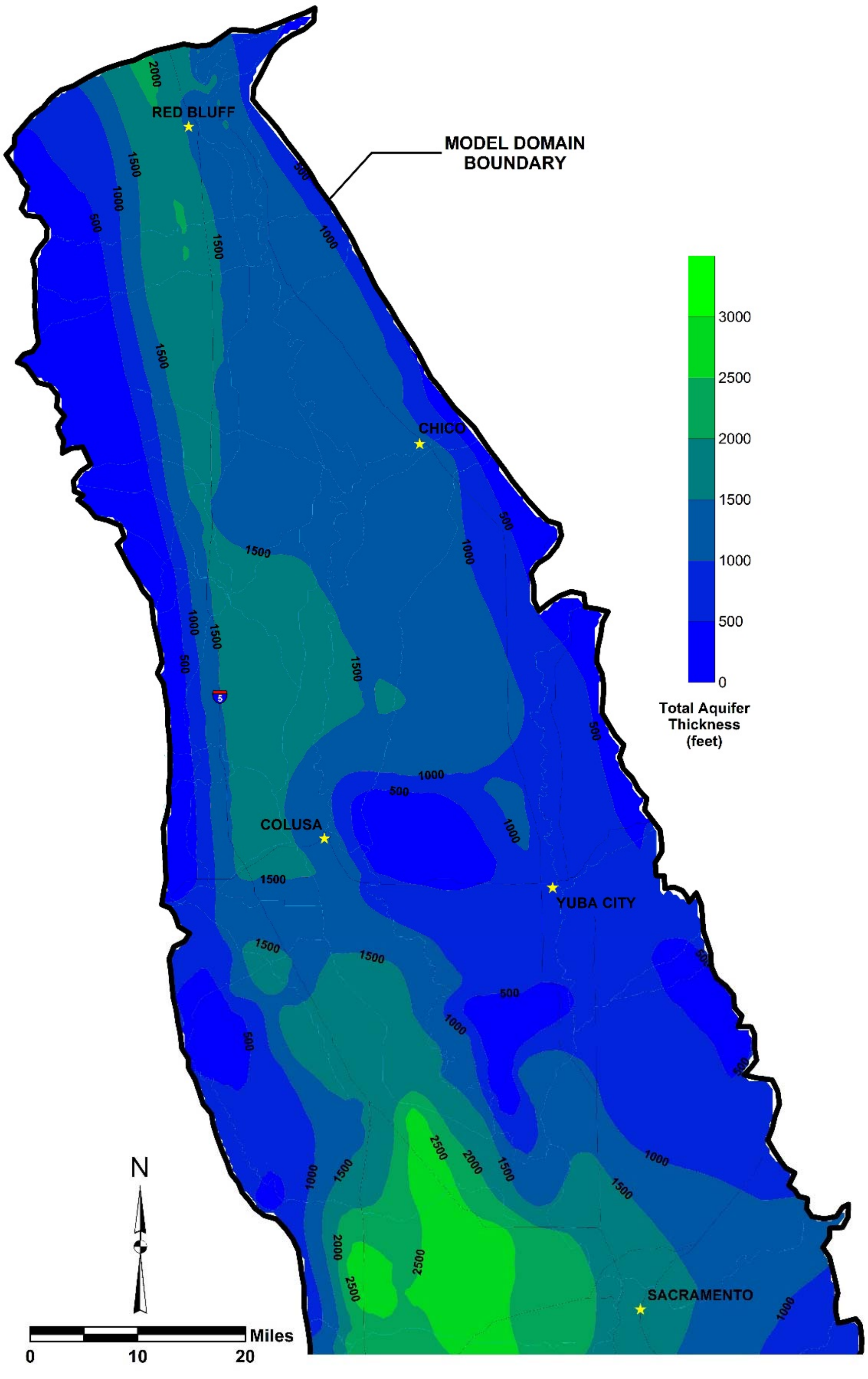

Figure D-3. Total Saturated Aquifer Thickness

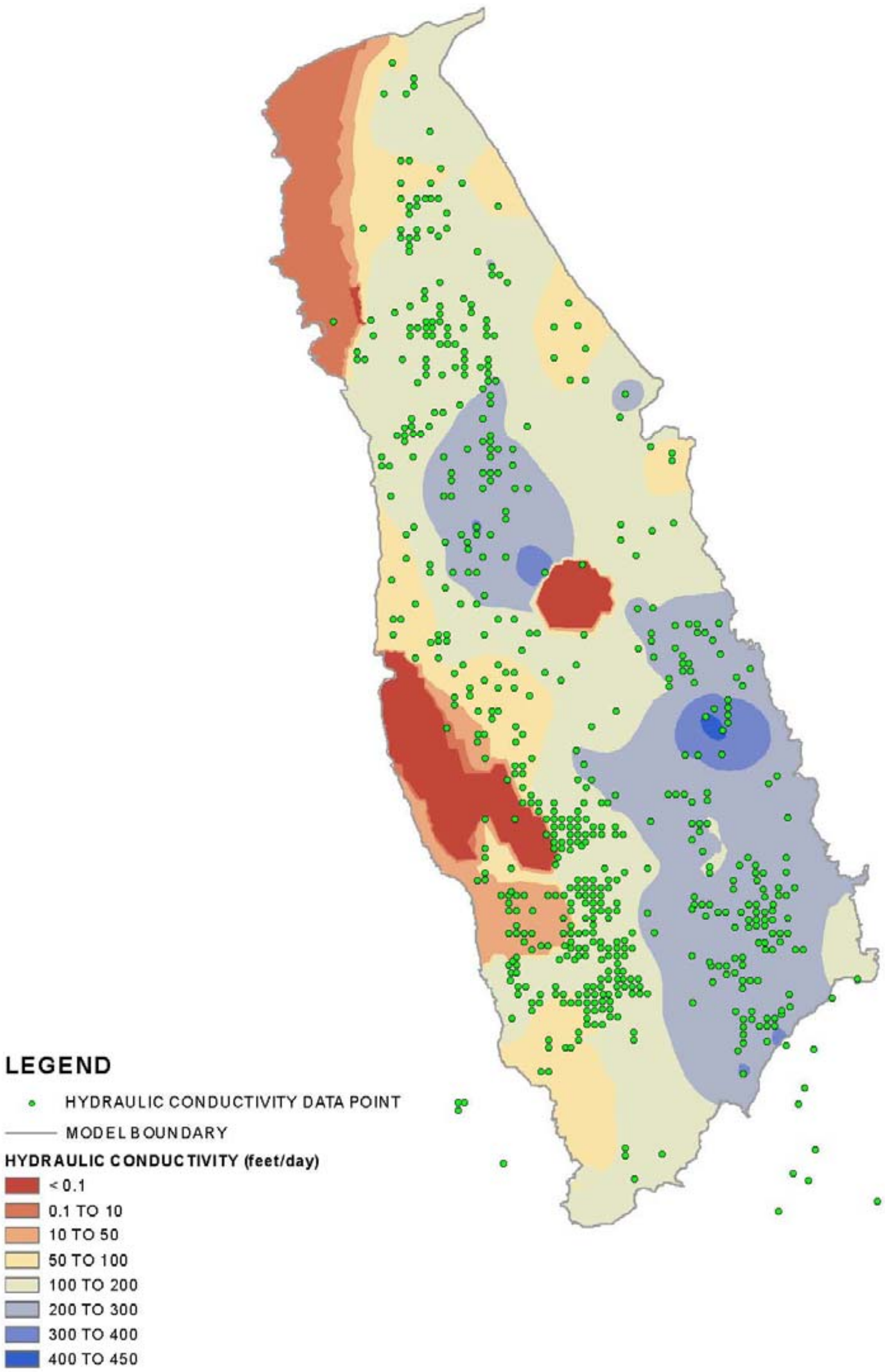

Figure D-4. SACFEM Hydraulic Conductivity Distribution

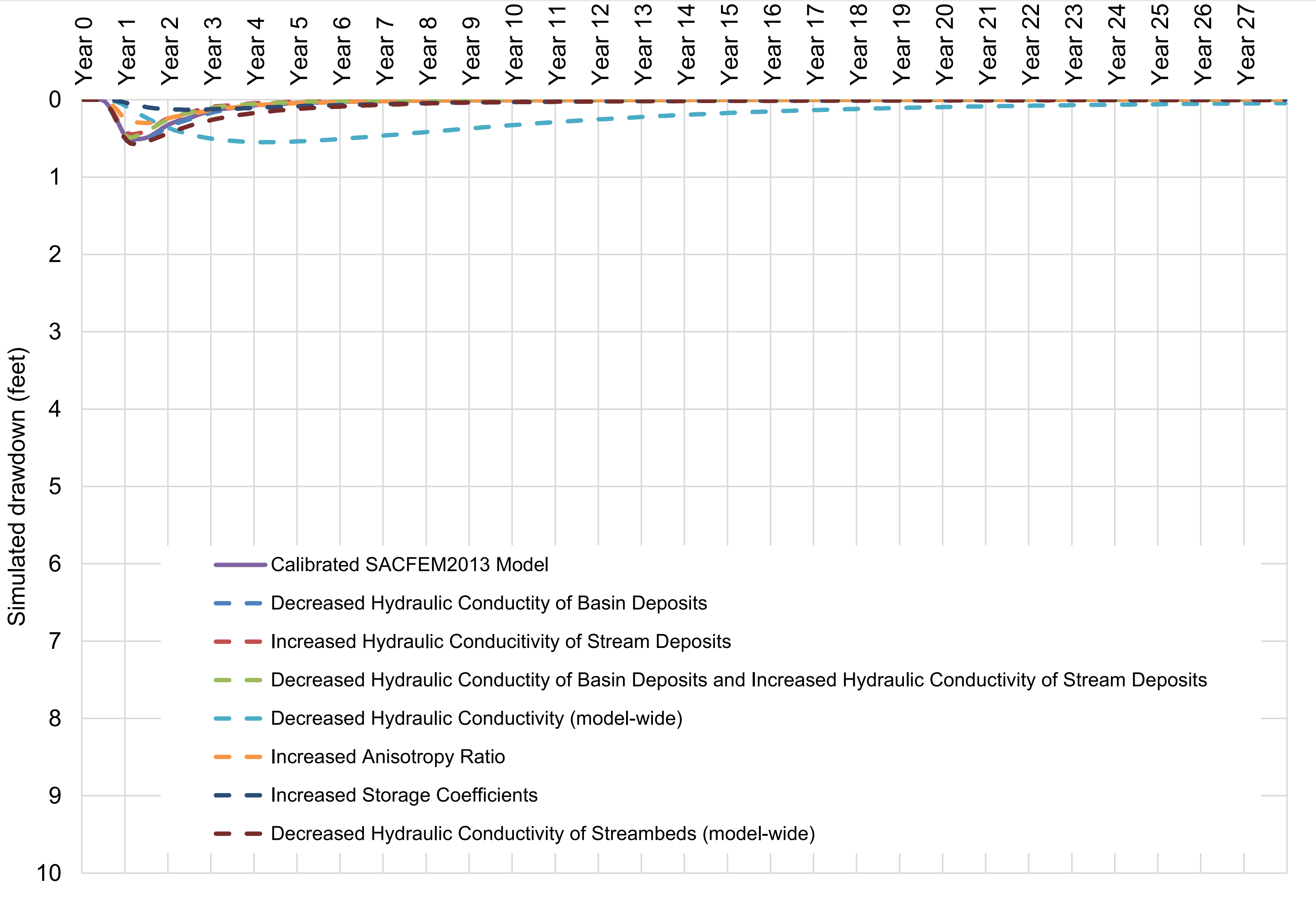

Figure D-5. Simulated Drawdown: Location 6, Layer 1 (Water Table)

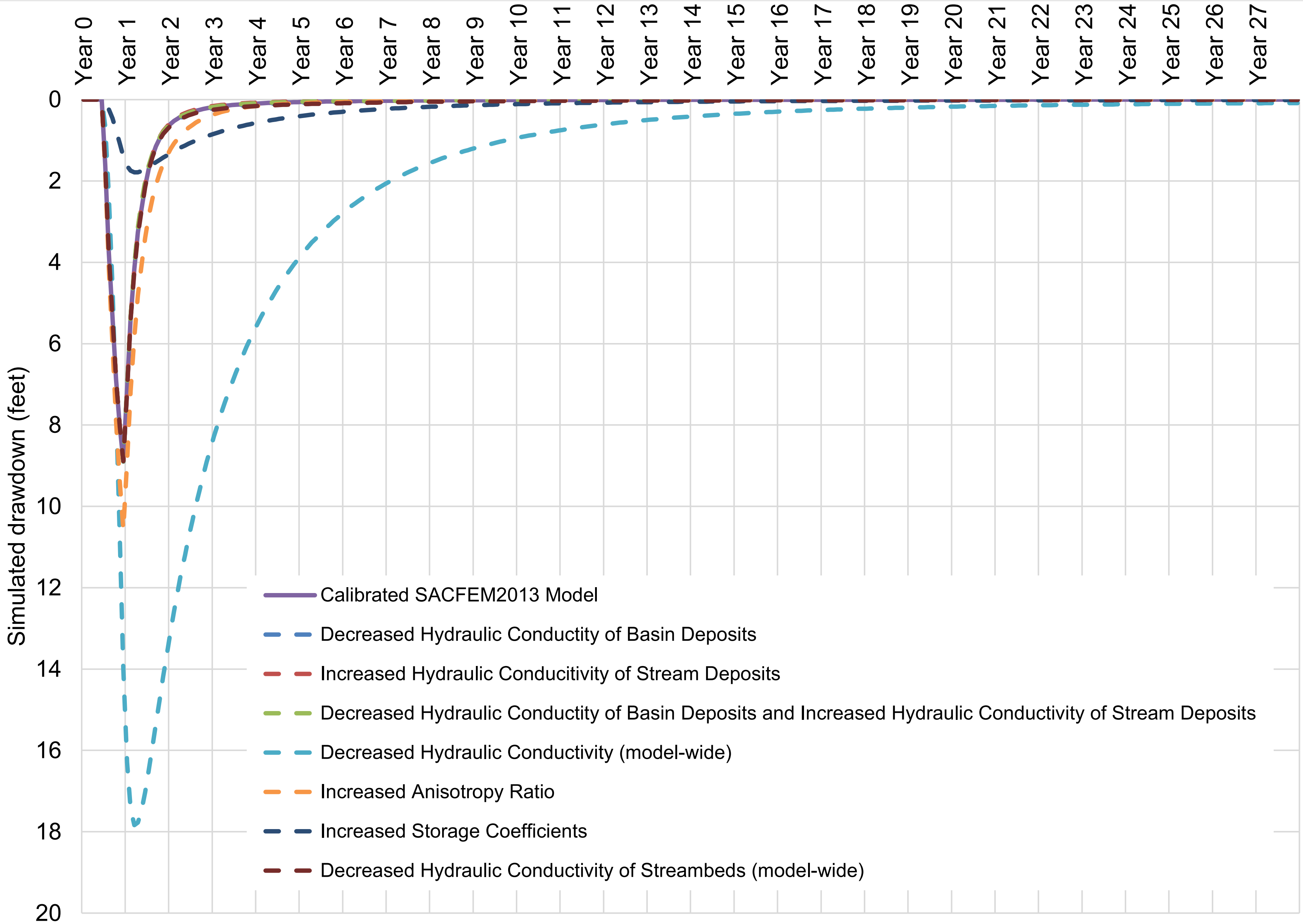

Figure D-6. Simulated Drawdown: Location 6, Layer 7 (Pumping Zone)

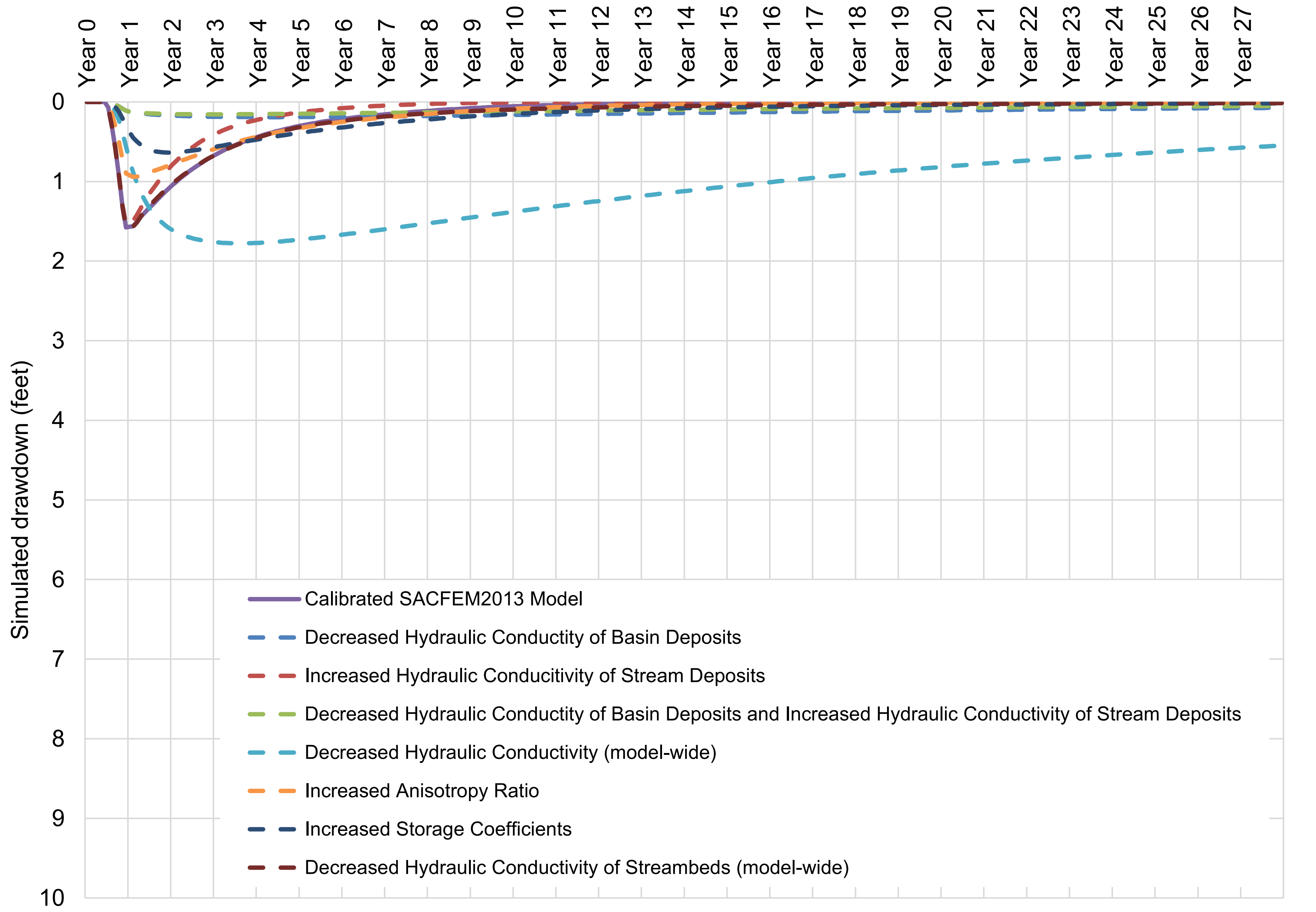

Figure D-7. Simulated Drawdown: Location 21, Layer 1 (Water Table)

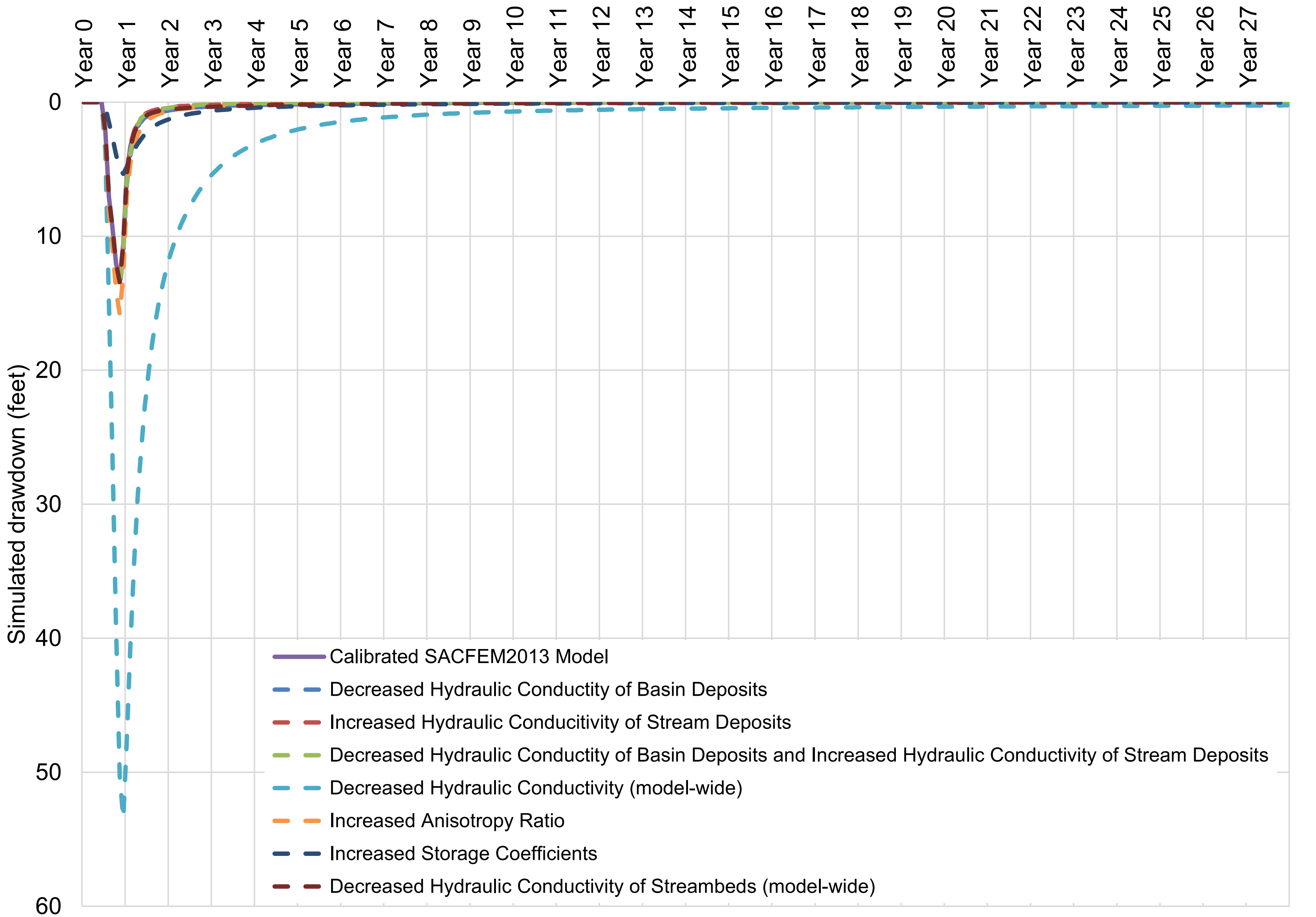

Figure D-8. Simulated Drawdown: Location 21, Layer 6 (Pumping Zone)

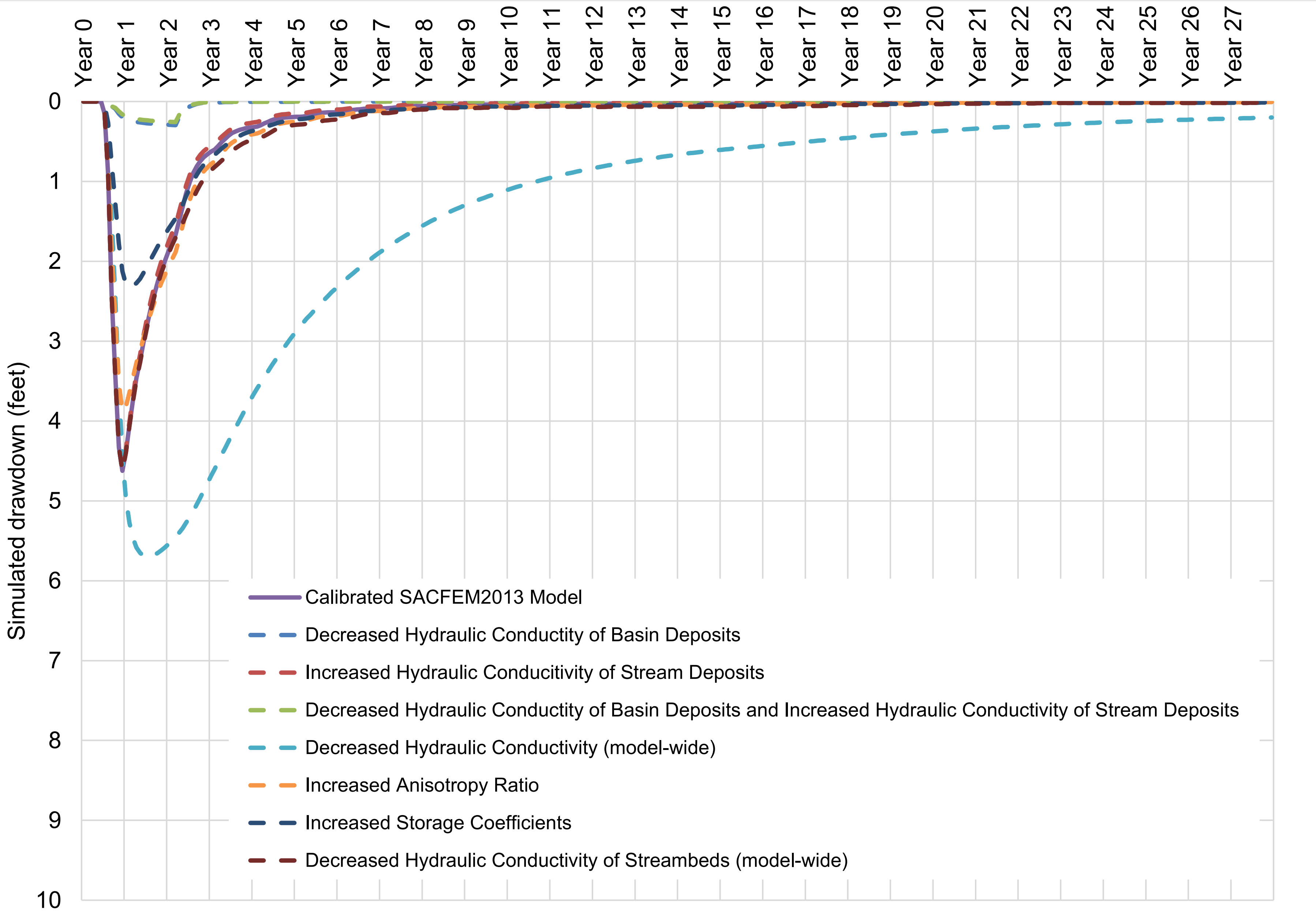

Figure D-9. Simulated Drawdown: Location 30, Layer 1 (Water Table)

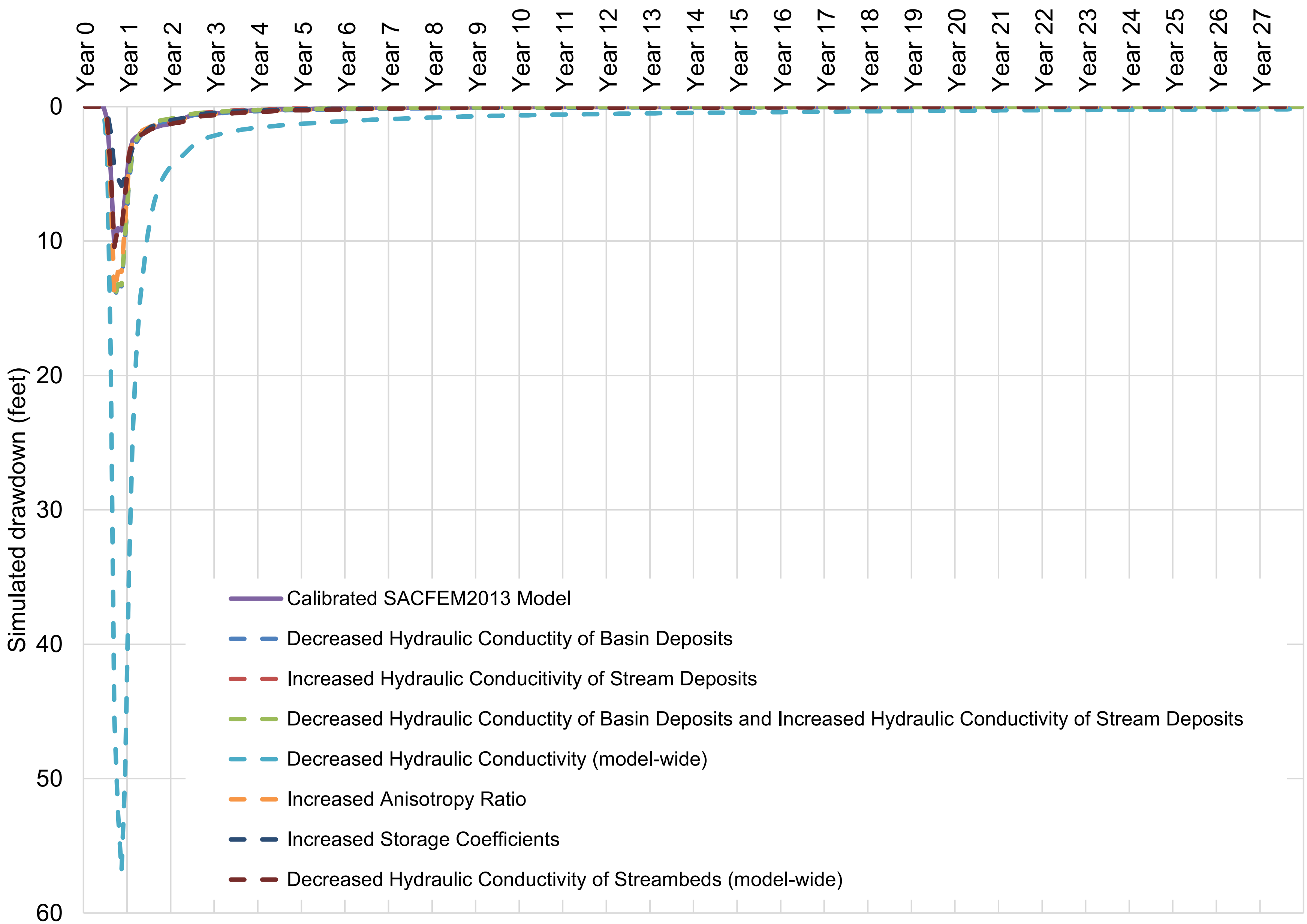

Figure D-10. Simulated Drawdown: Location 30, Layer 3 (Pumping Zone)

Appendix E

Groundwater Modeling Results

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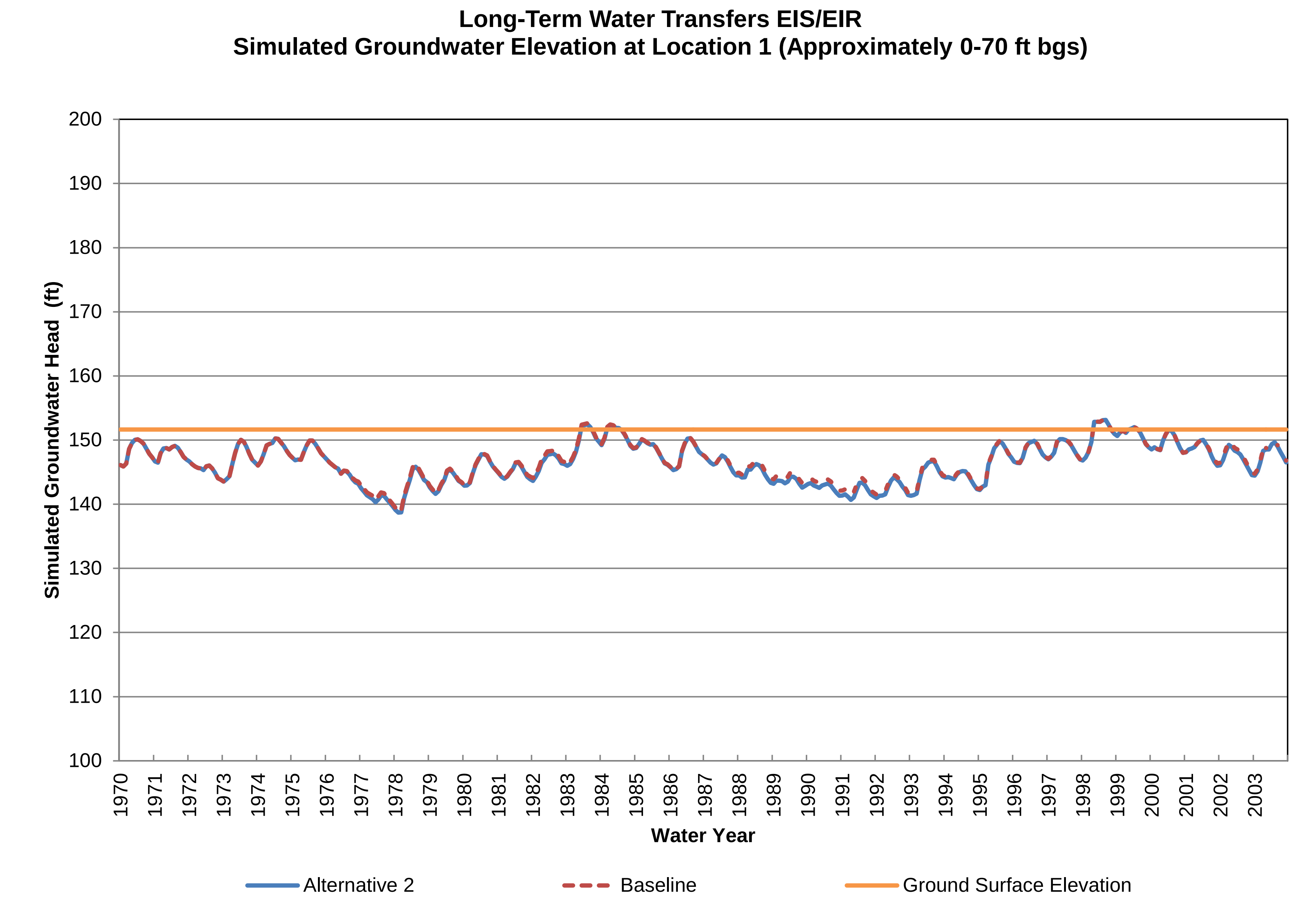
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 1 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
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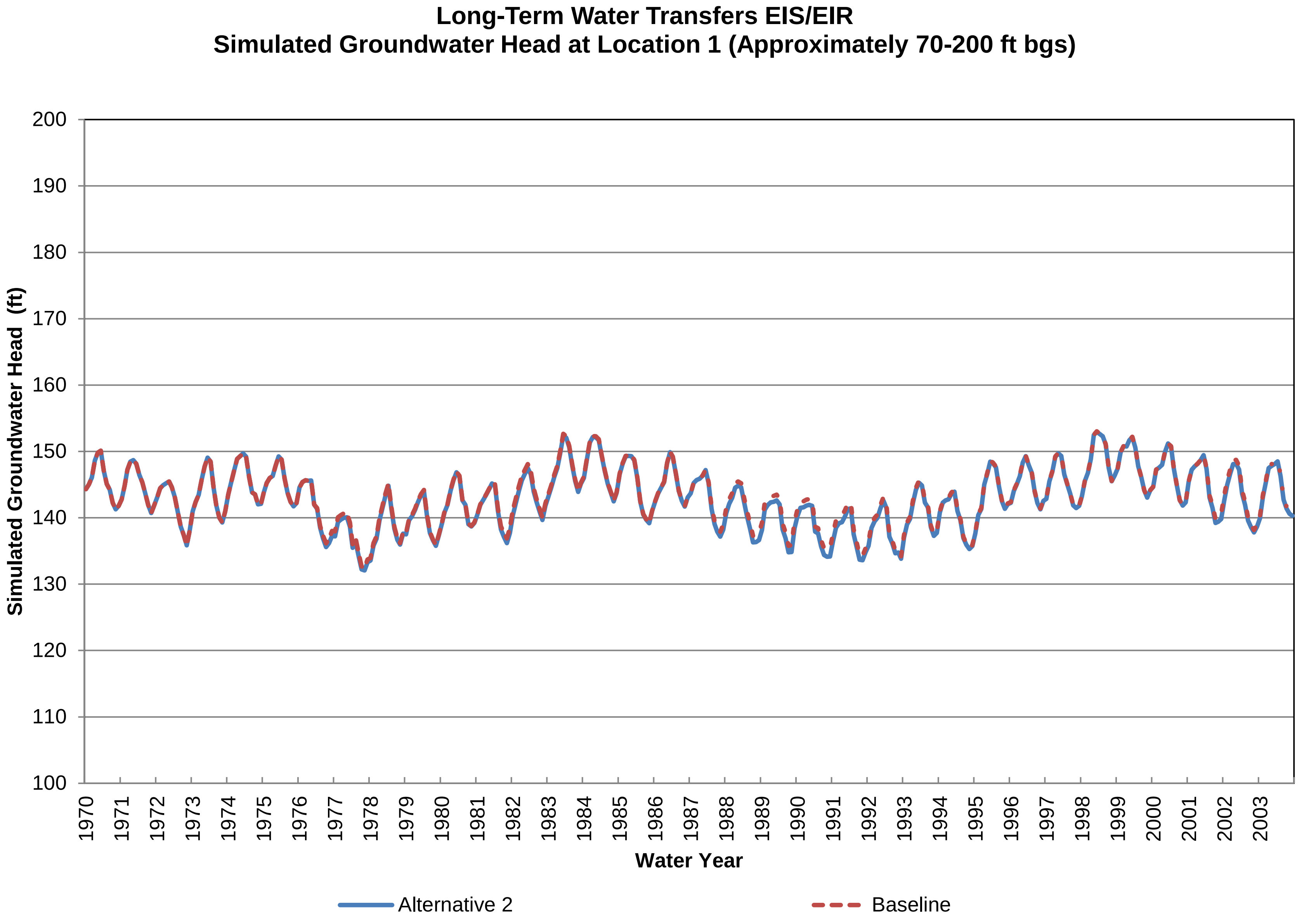
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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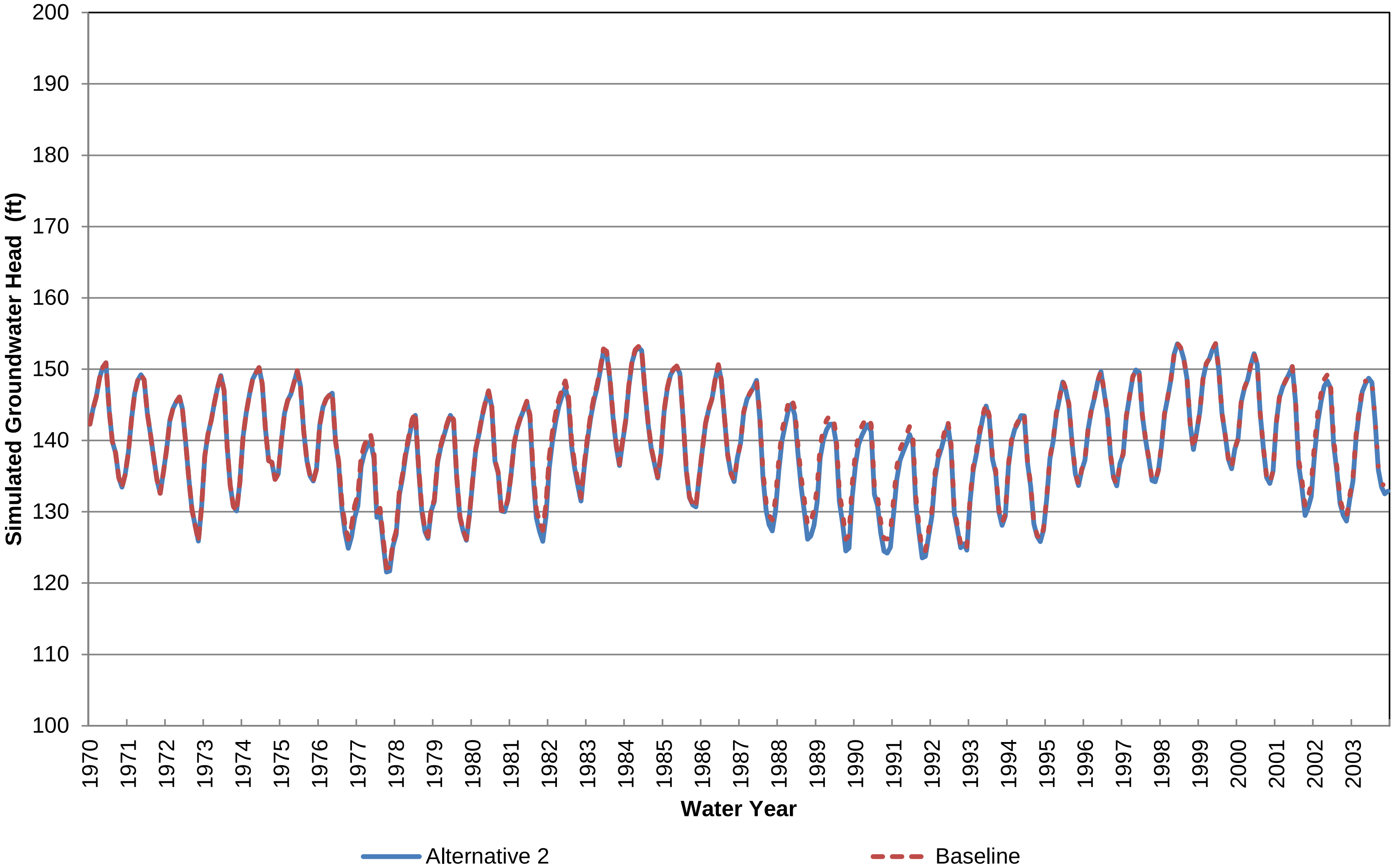
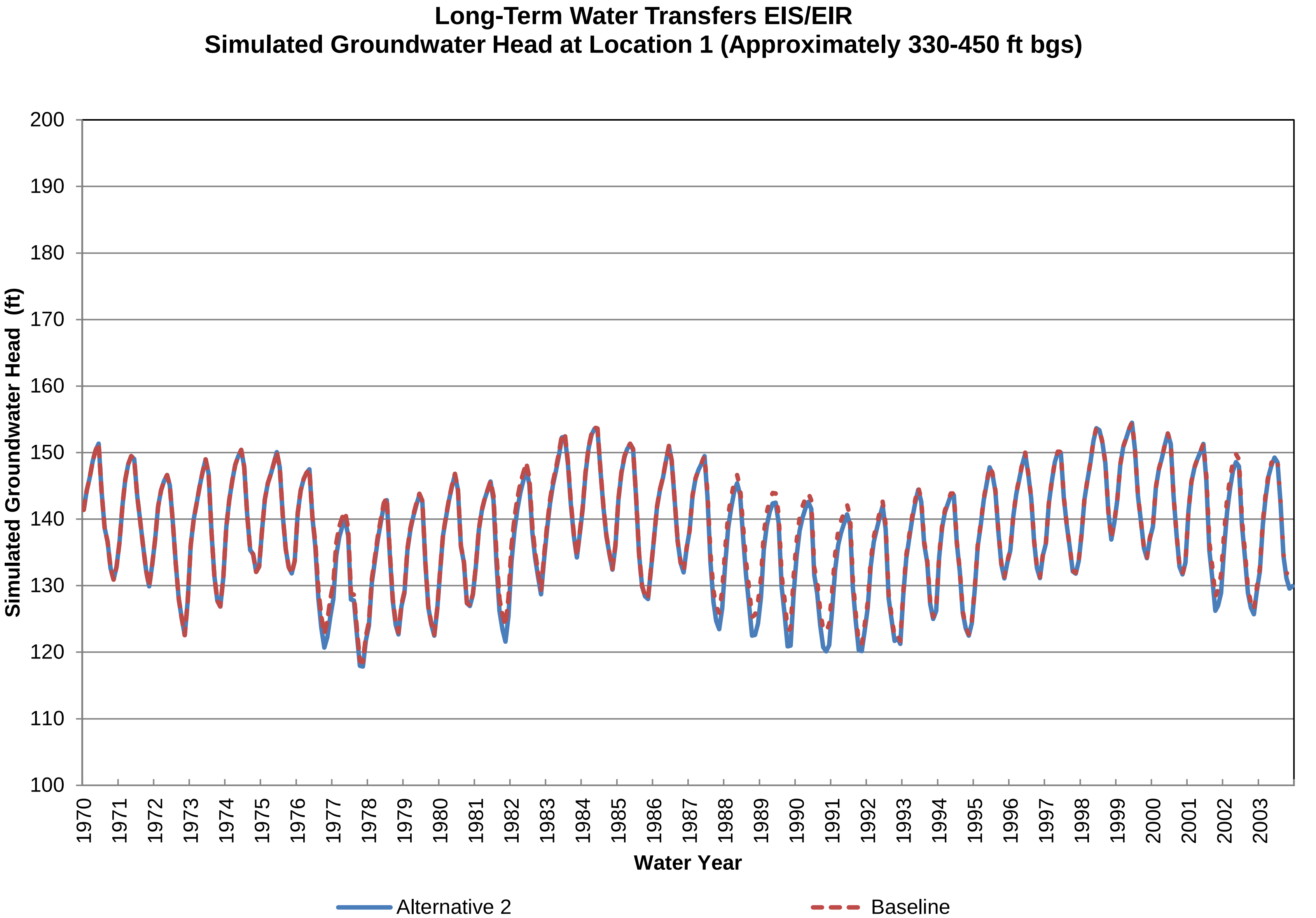
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 200-330 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 330-450 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1987
1988
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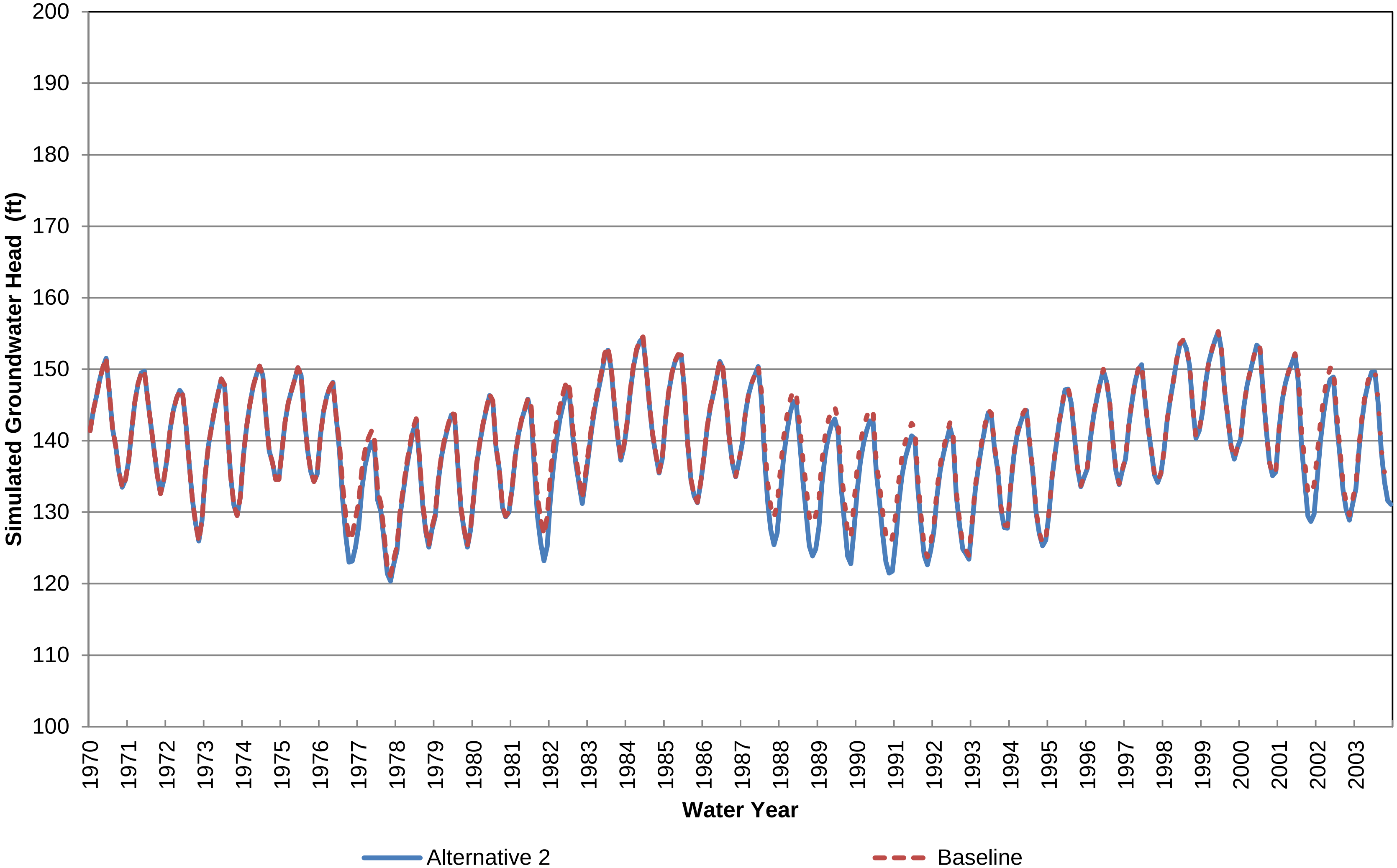
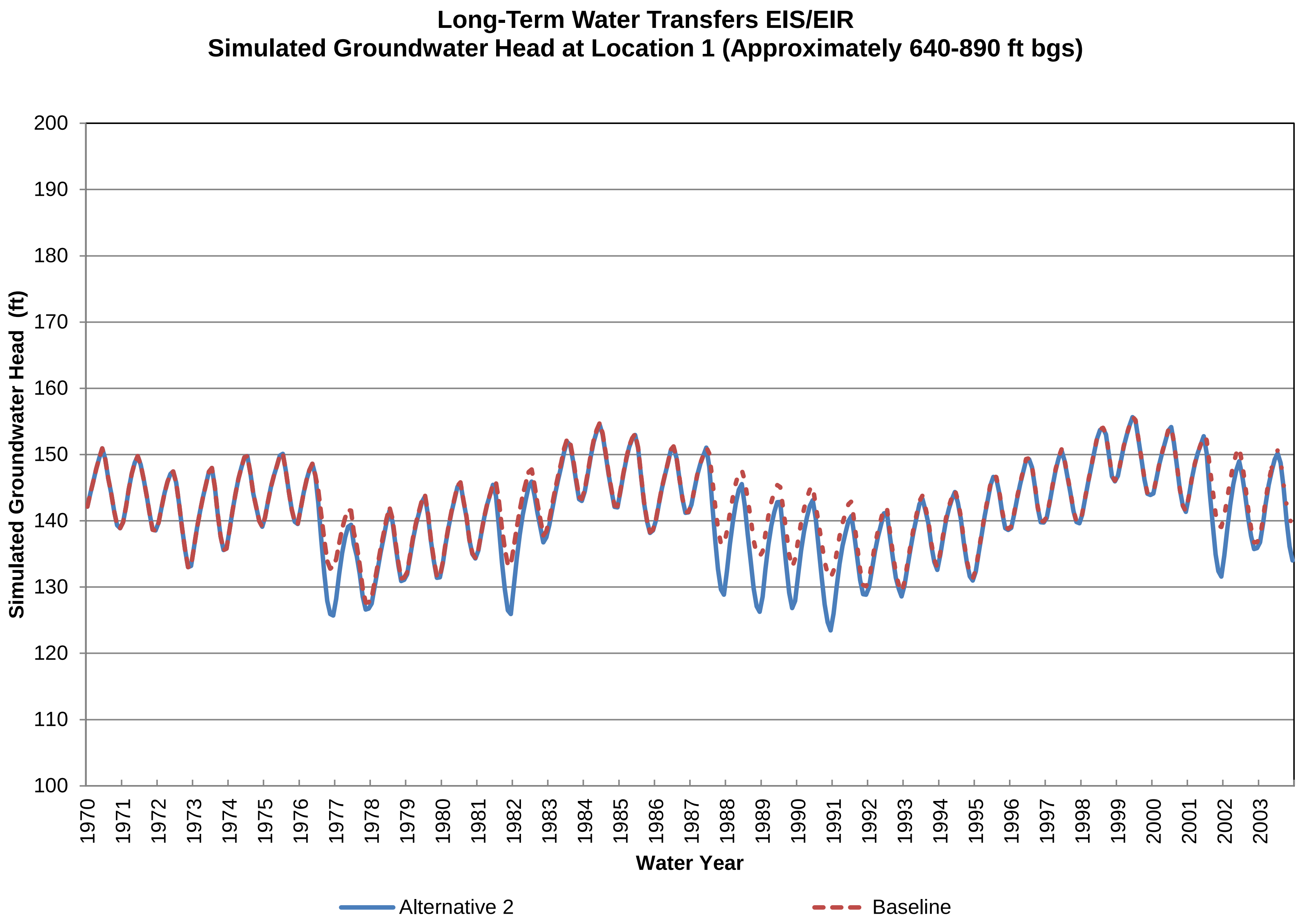
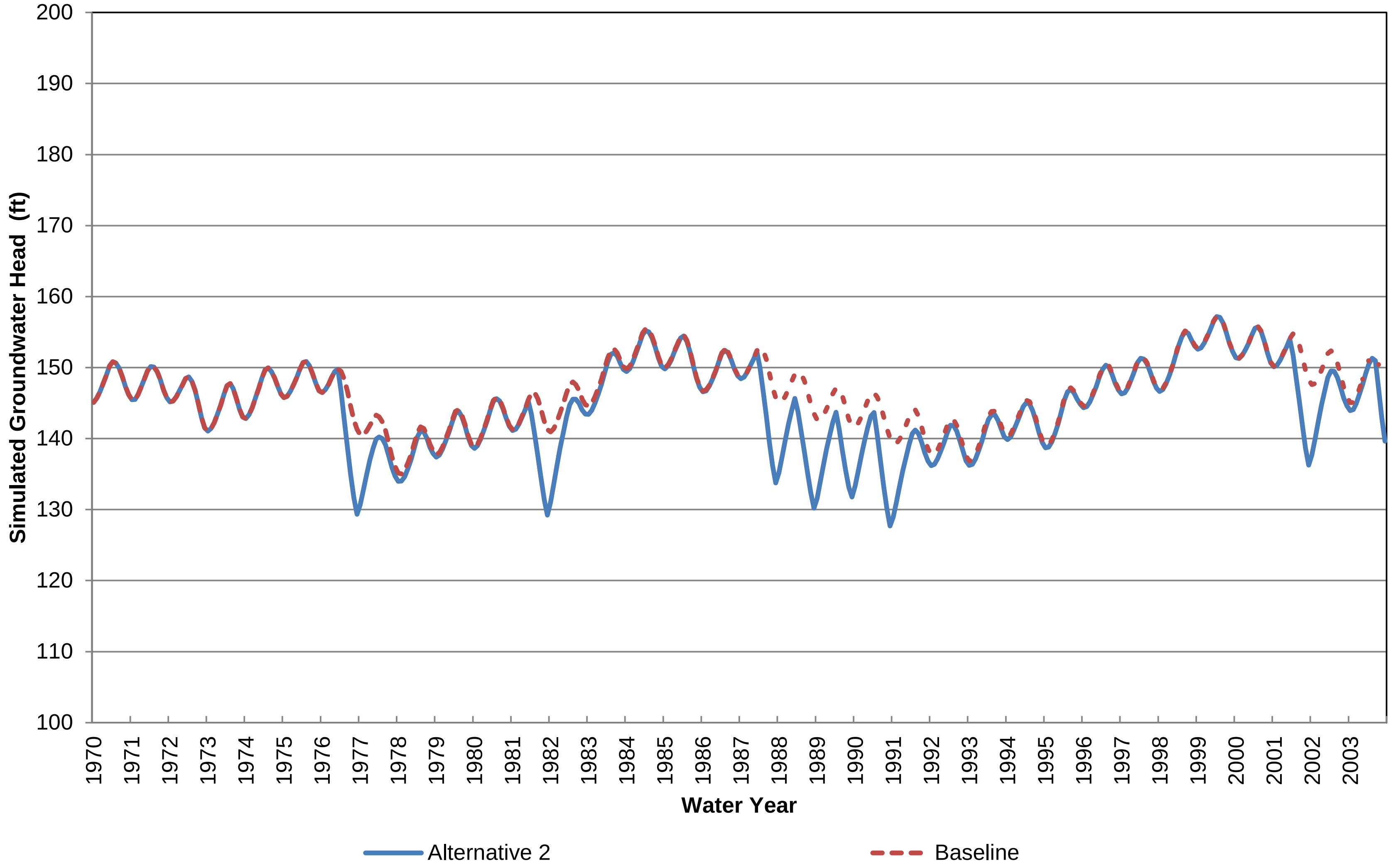
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

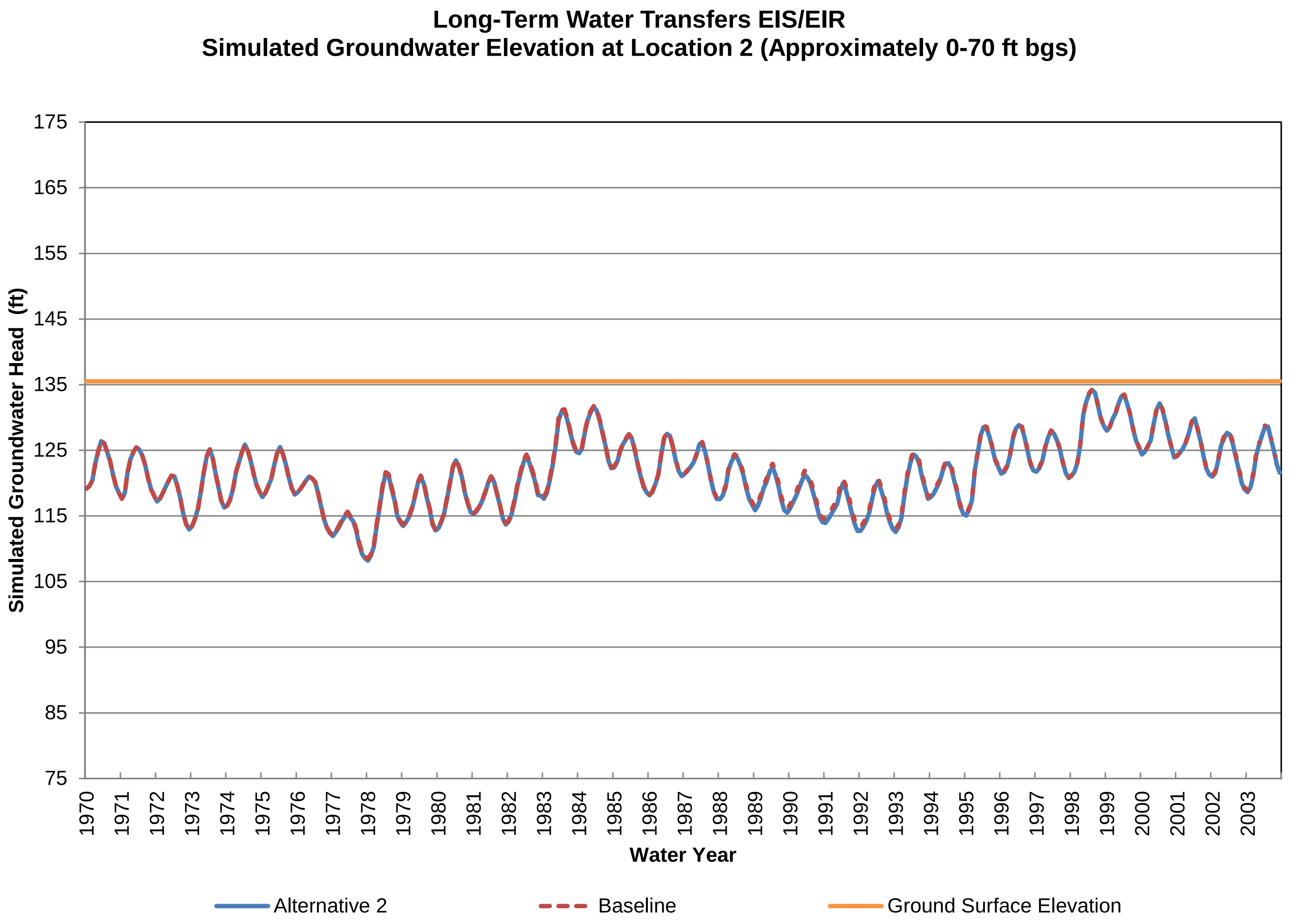
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 450-640 ft bgs)



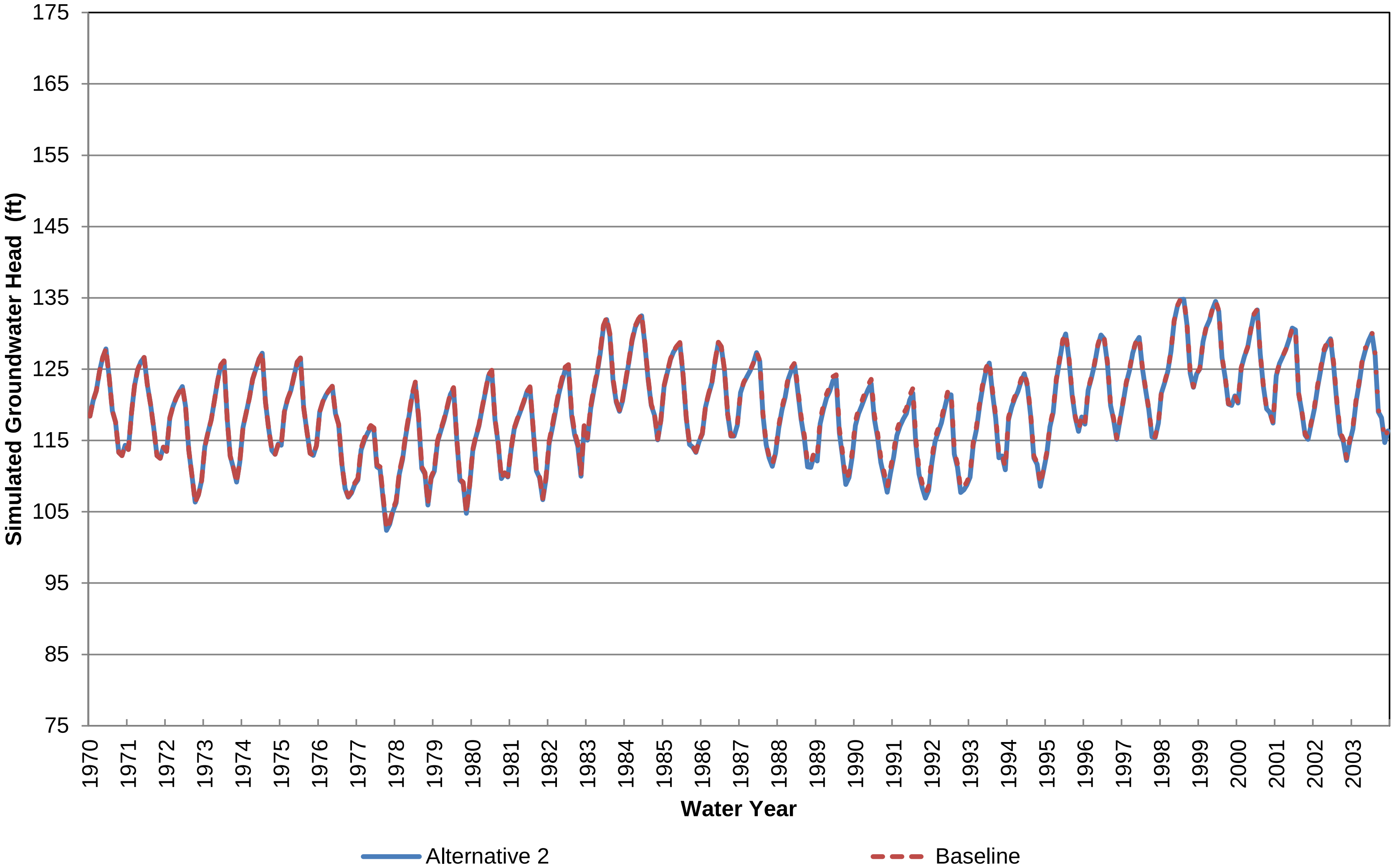

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 640-890 ft bgs)
Simulated Groundwater Head (ft)
200
190
180
170
160
150
140
130
120
110
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

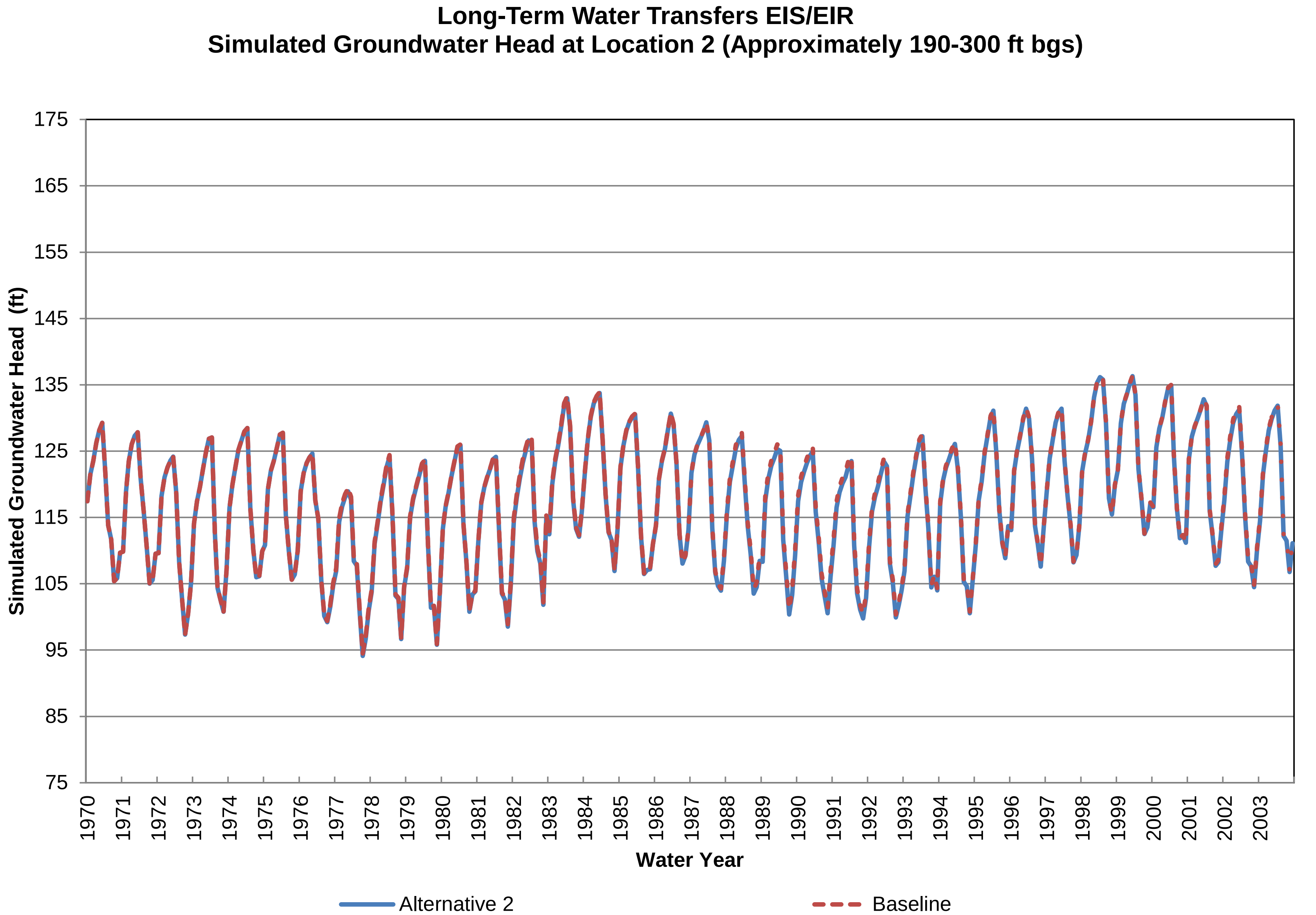
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 1 (Approximately 890-1360 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 2 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 70-190 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 190-300 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1984
1985
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1987
1988
1989
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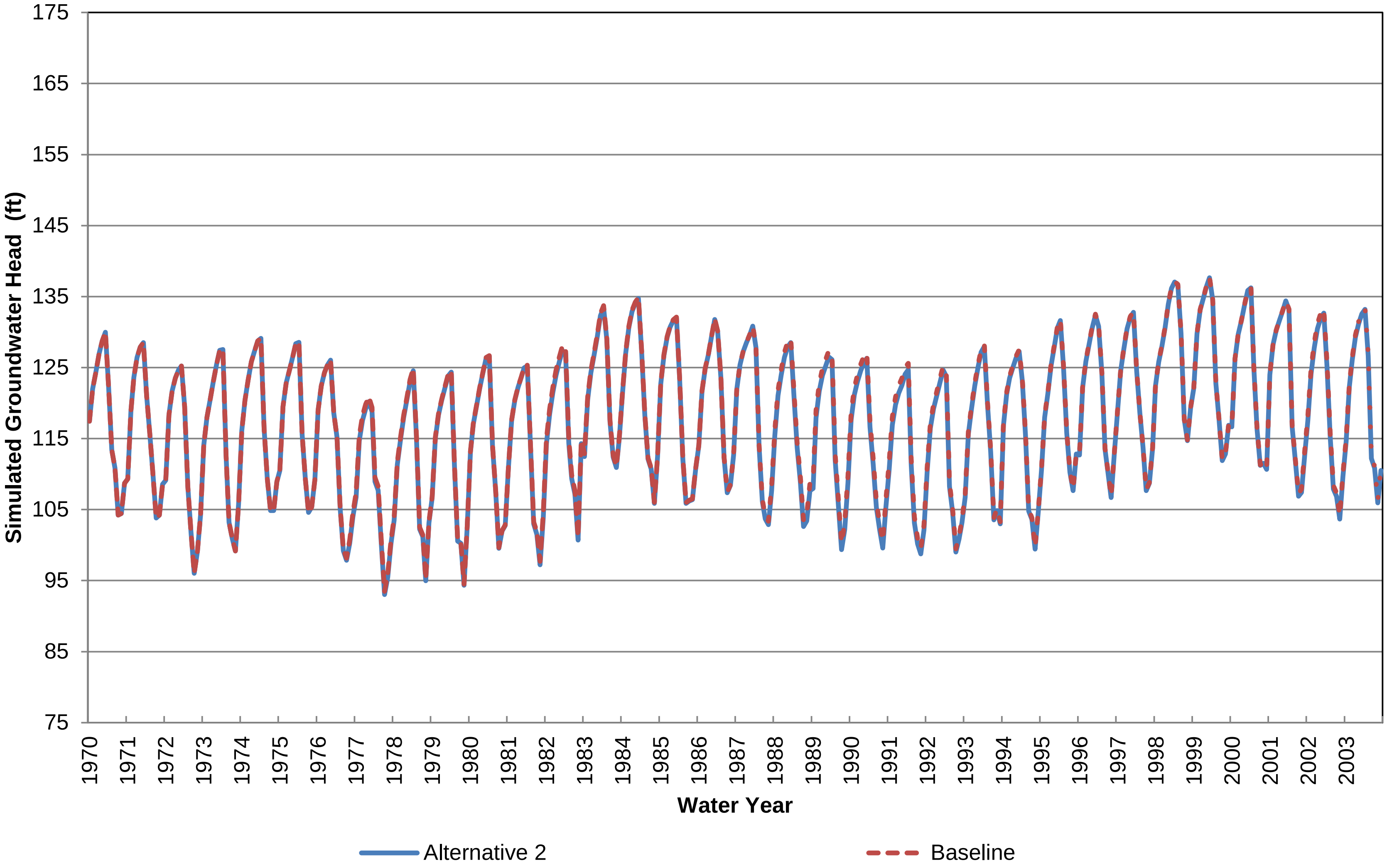
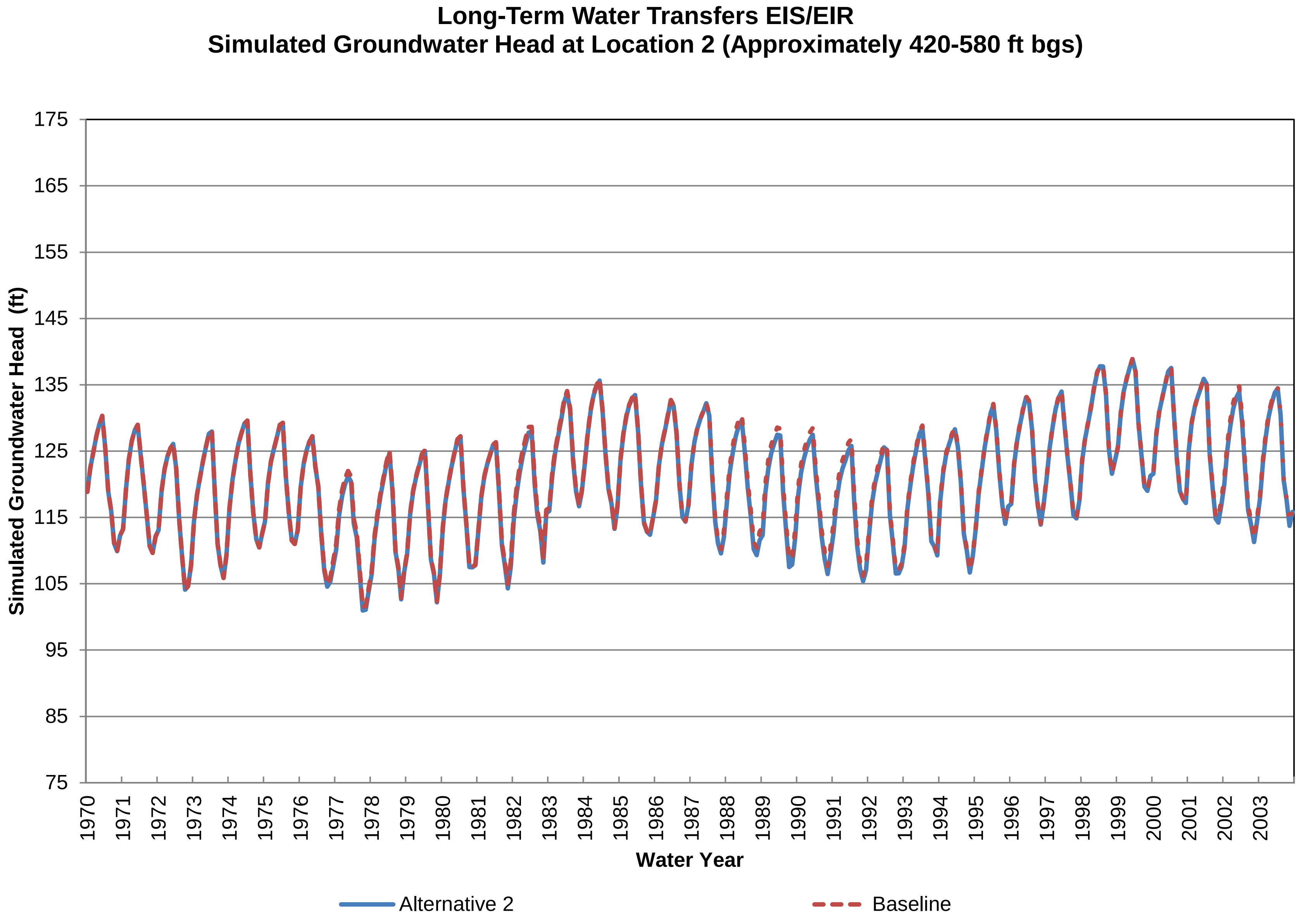
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 300-420 ft bgs)



266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 420-580 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
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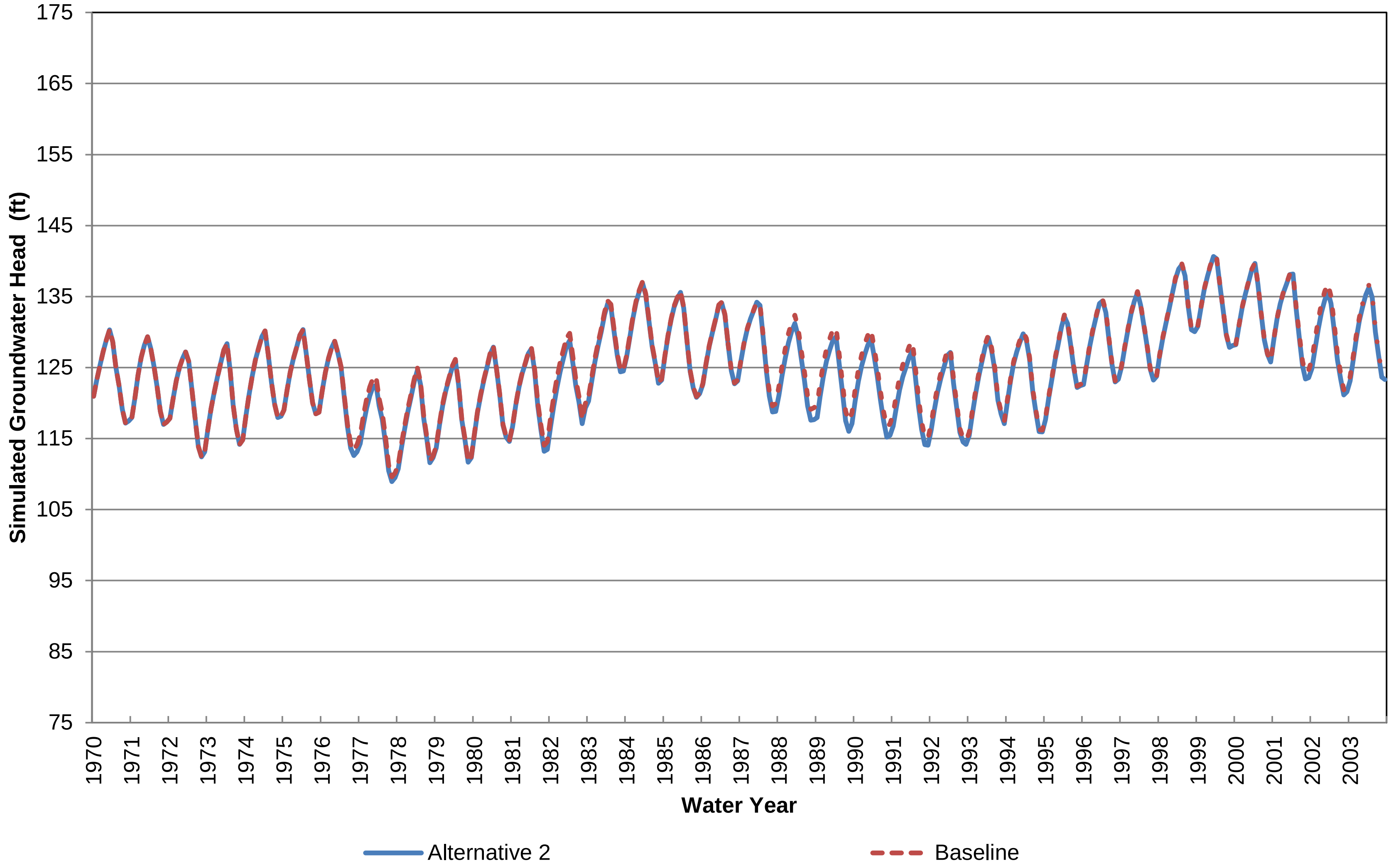
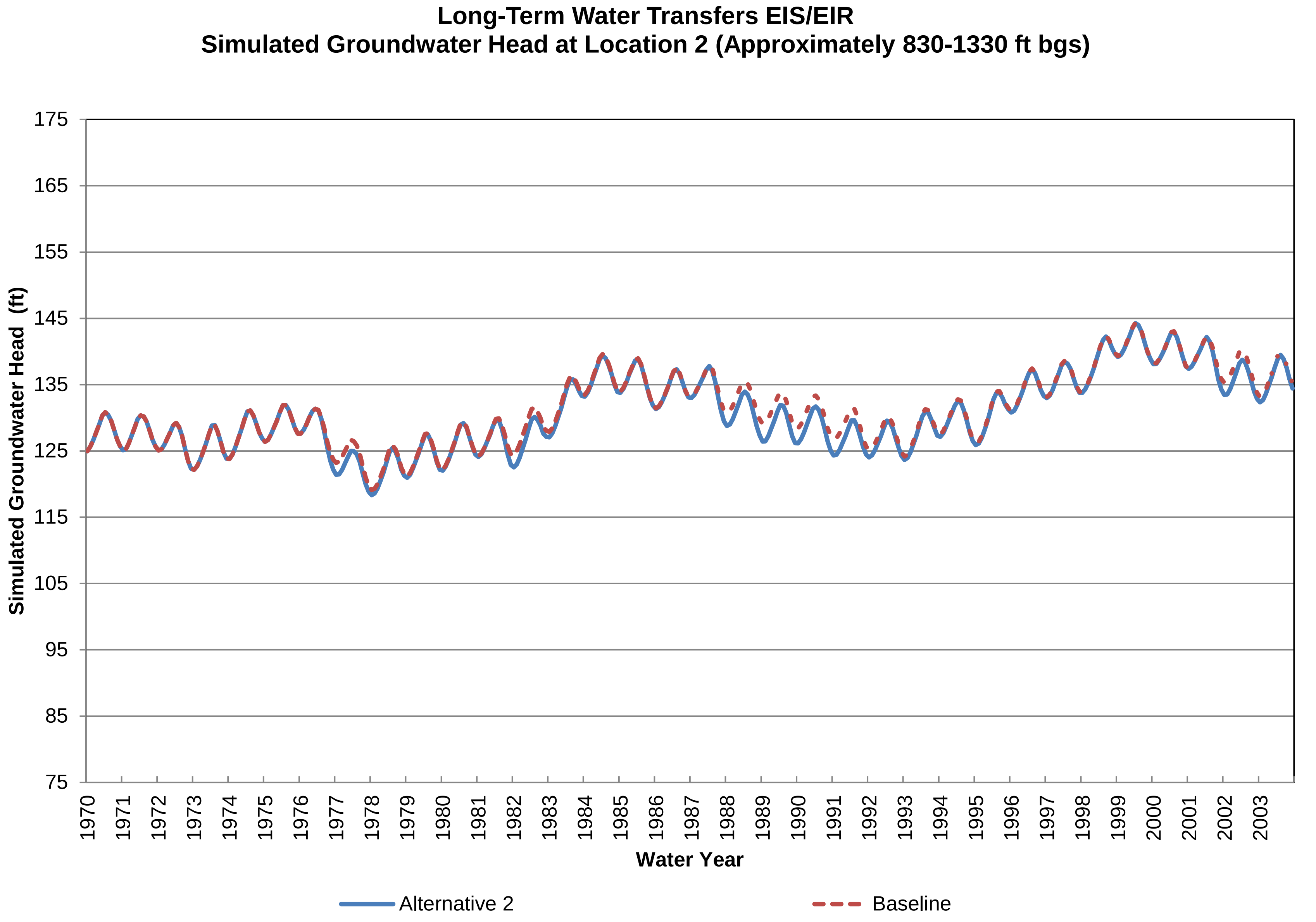
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 580-830 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 2 (Approximately 830-1330 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
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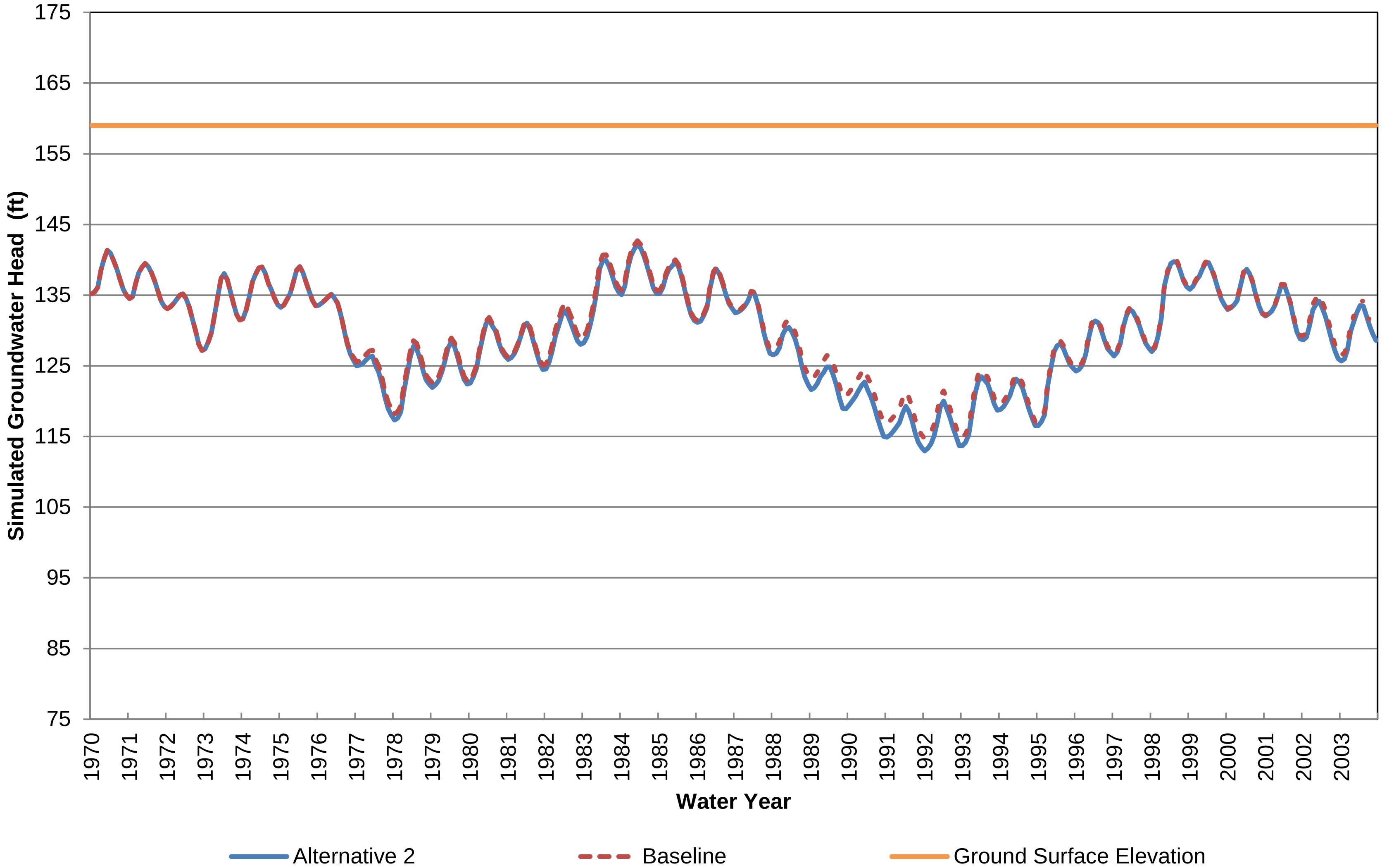
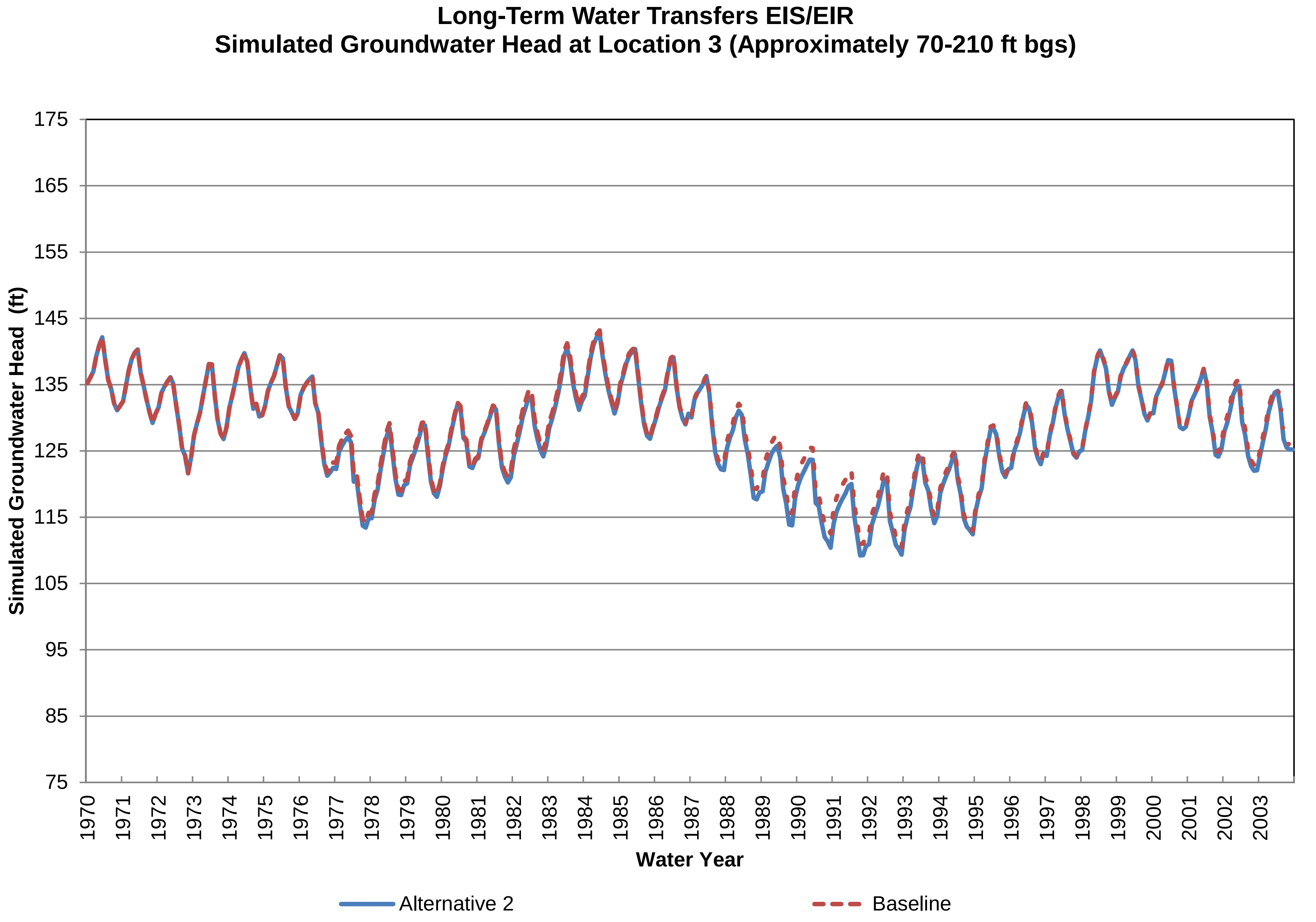
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 3 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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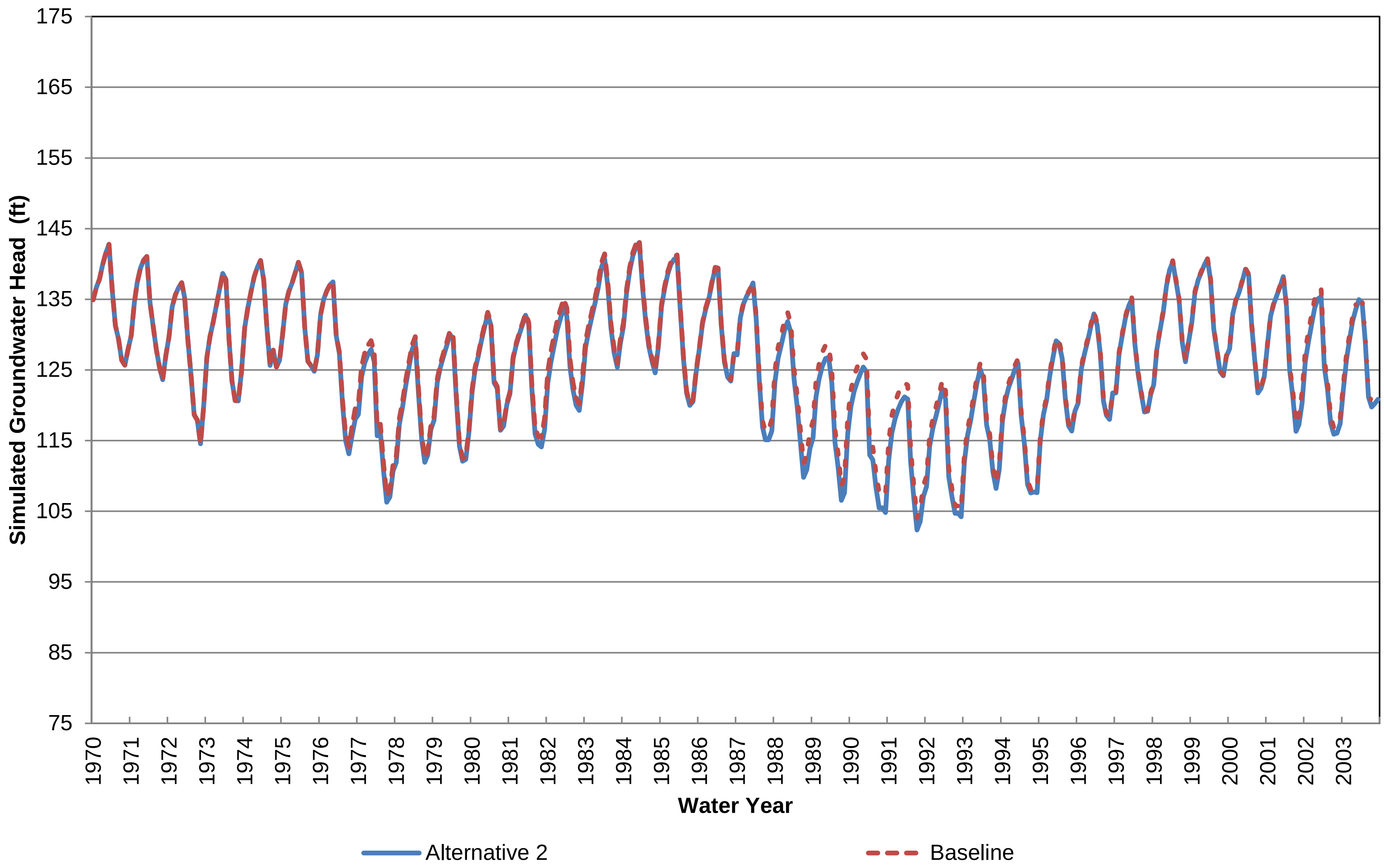
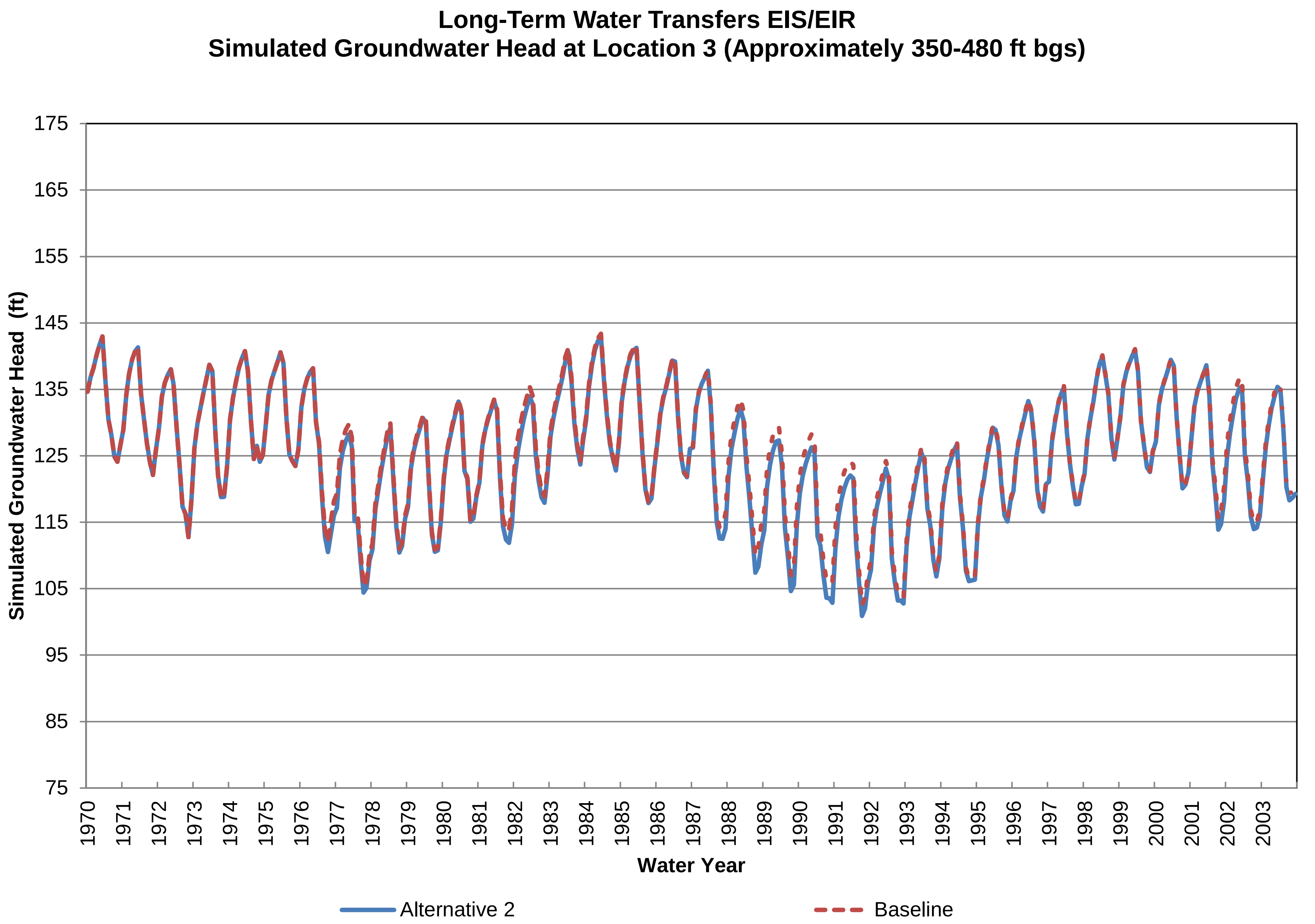
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 210-350 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 350-480 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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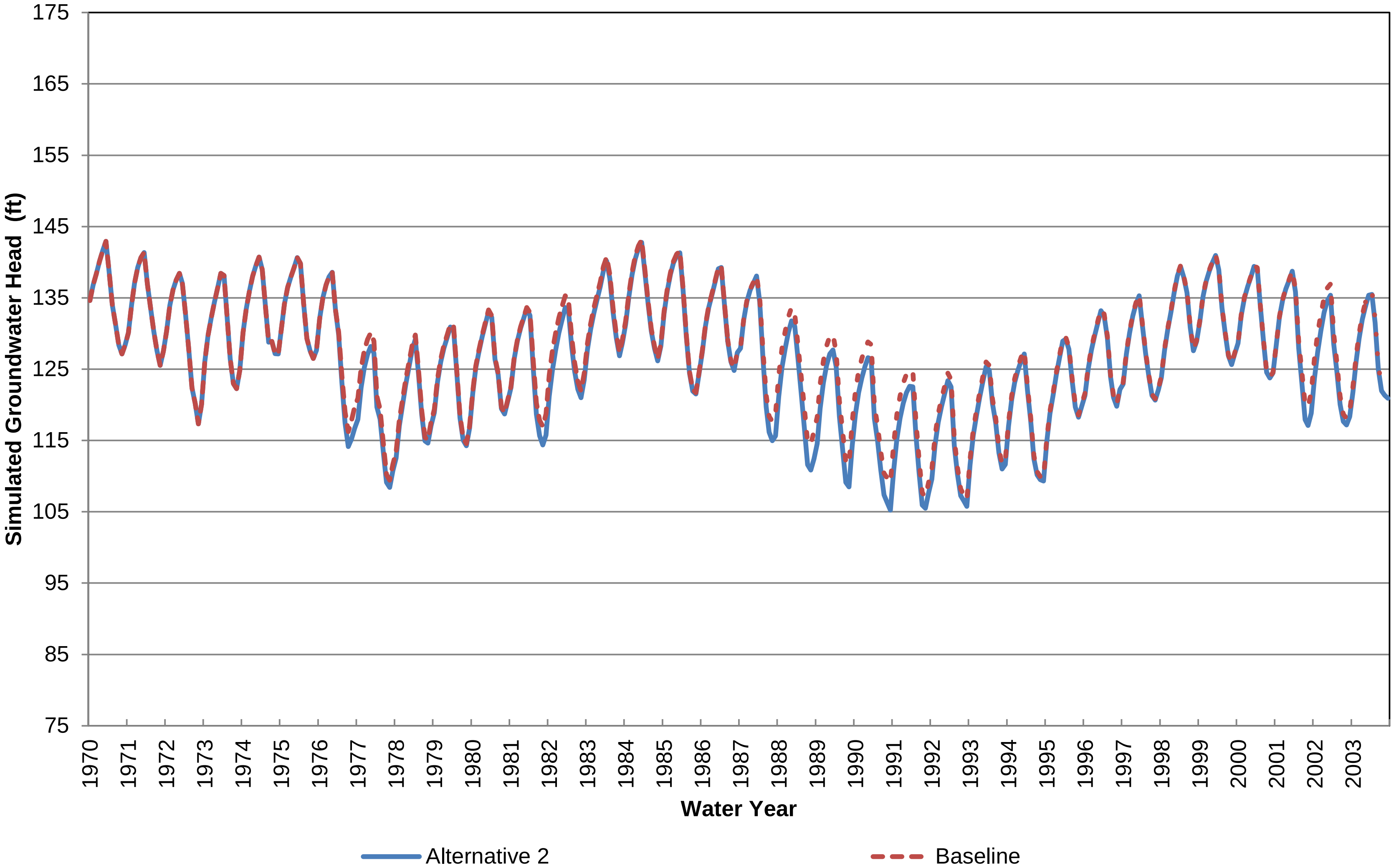
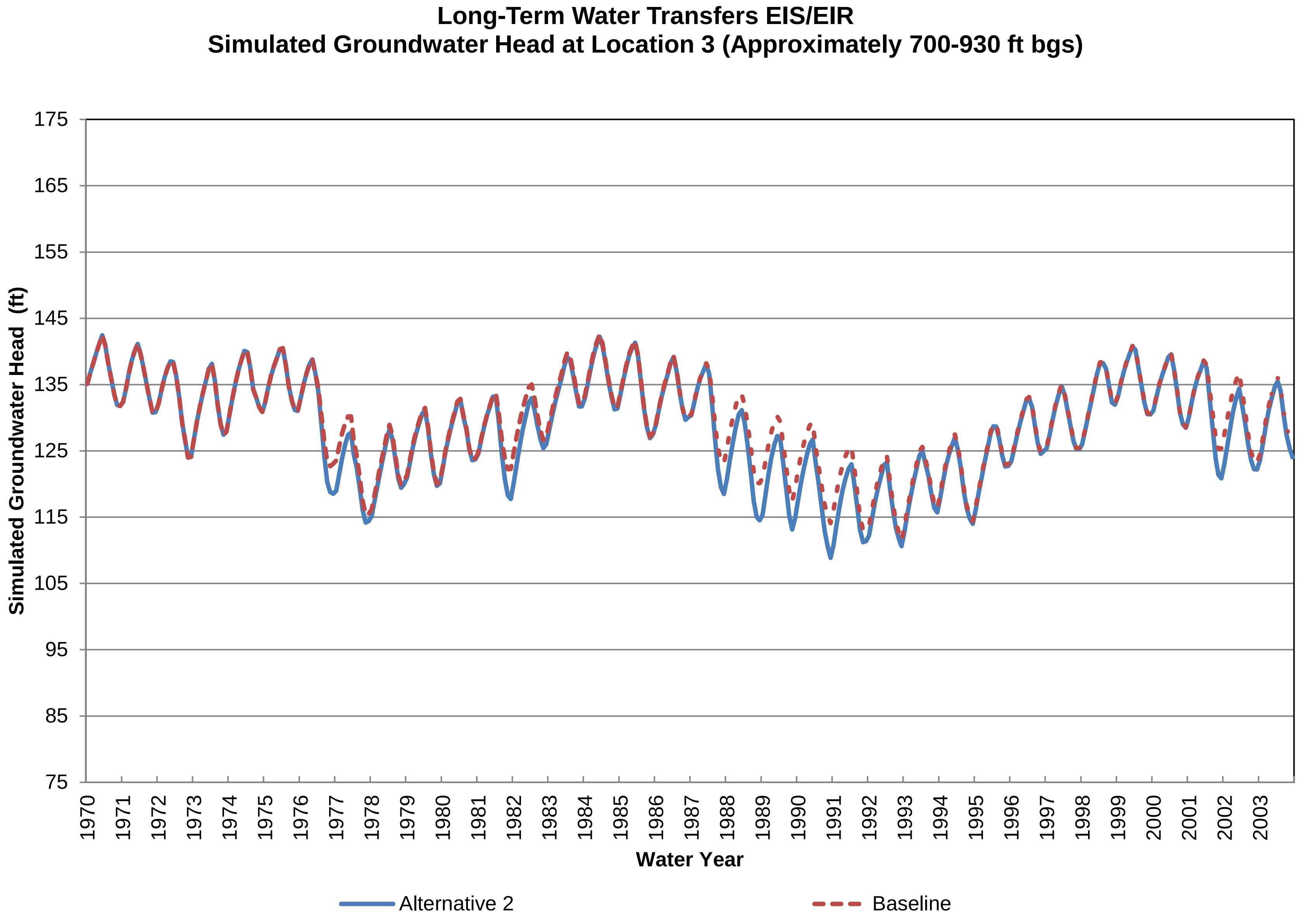
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 480-700 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 700-930 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
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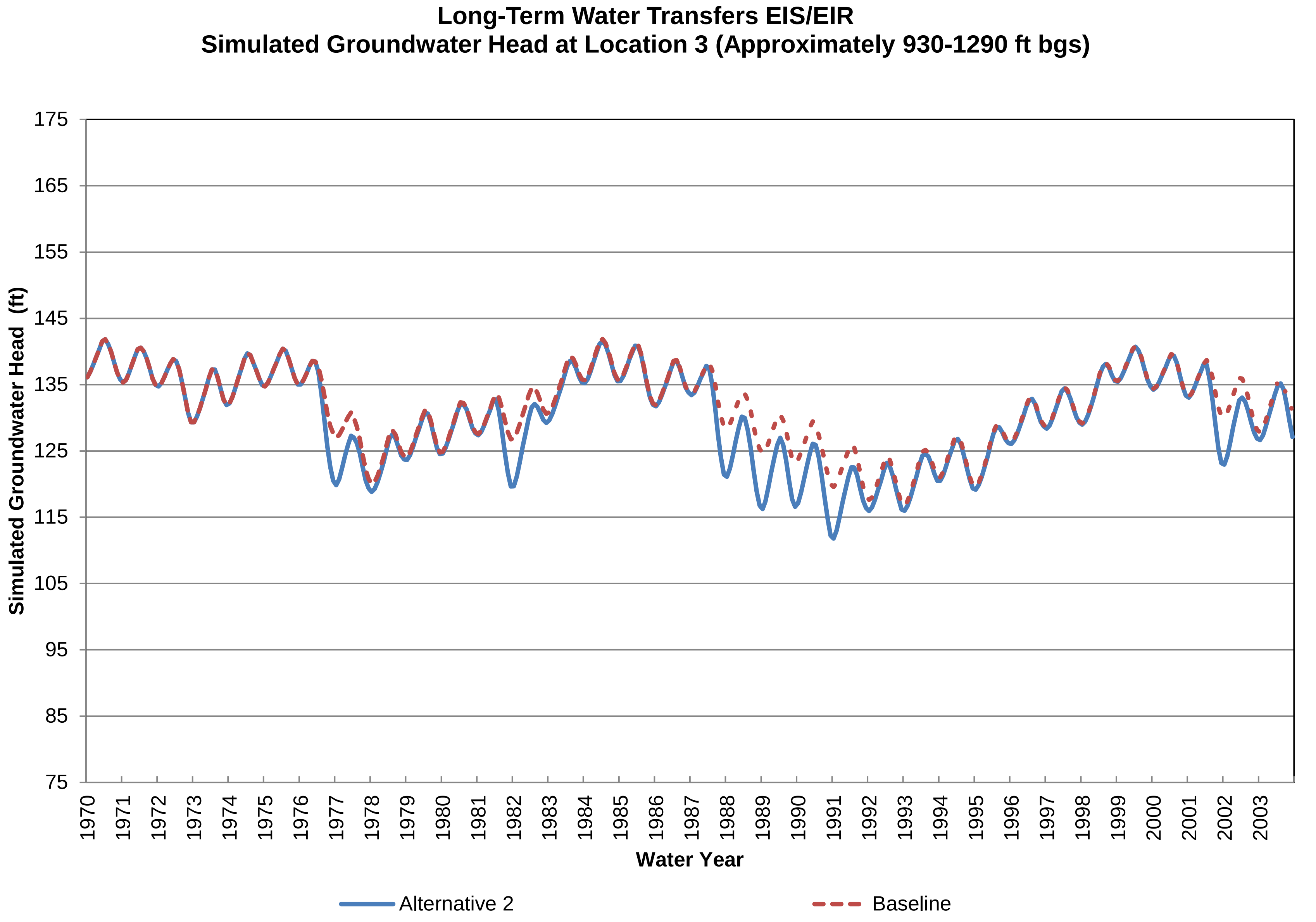
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 3 (Approximately 930-1290 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1998
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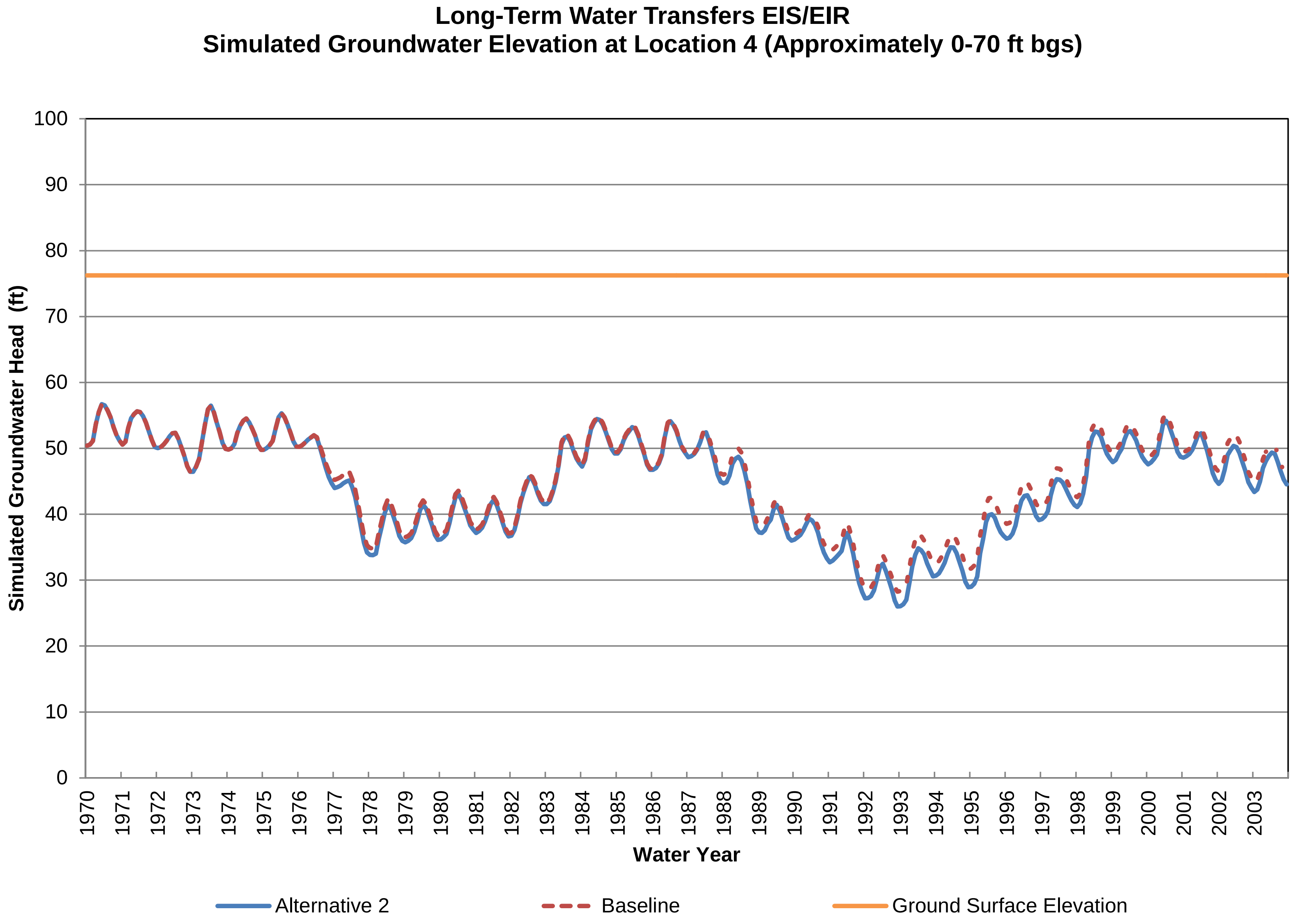
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 4 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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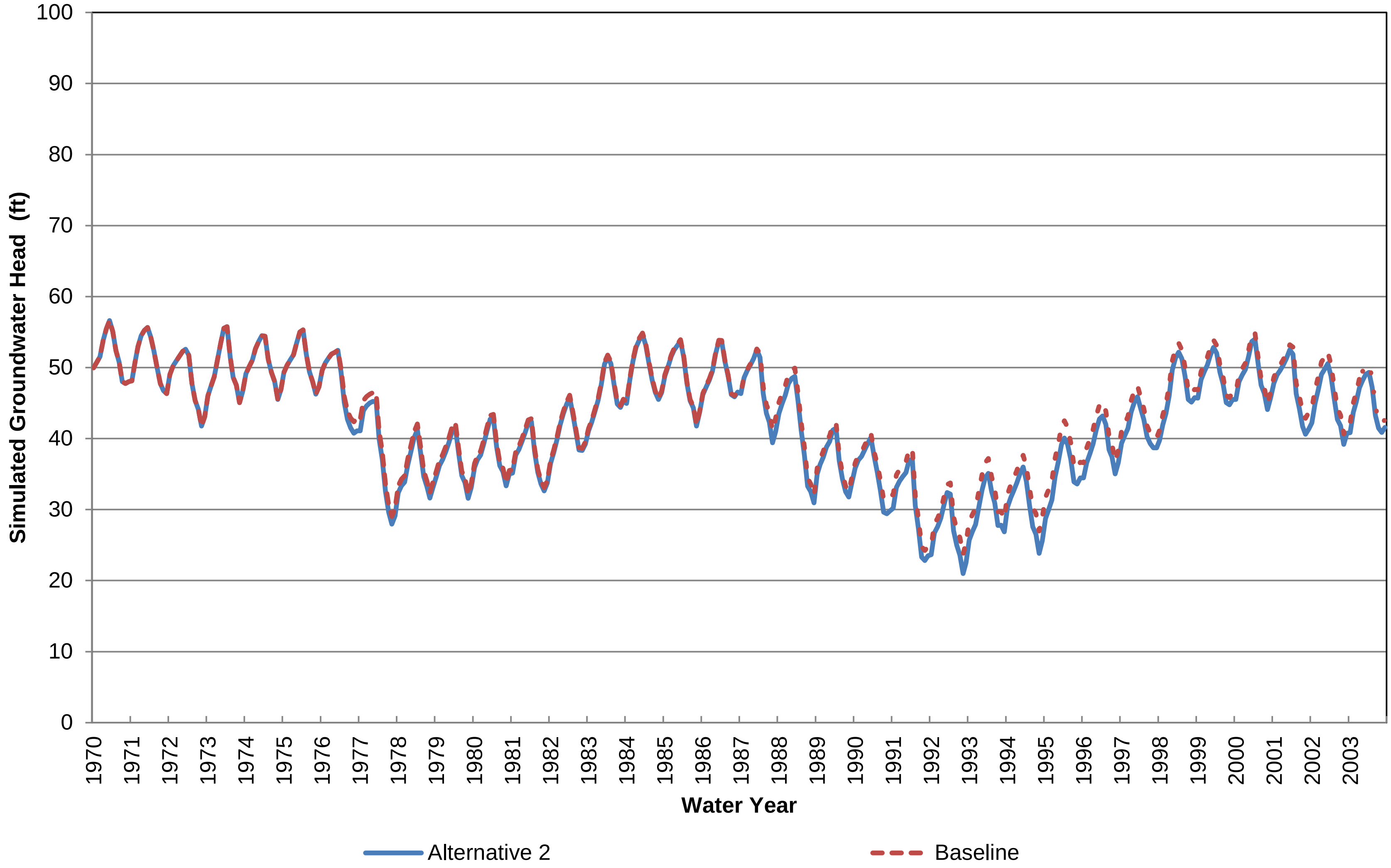
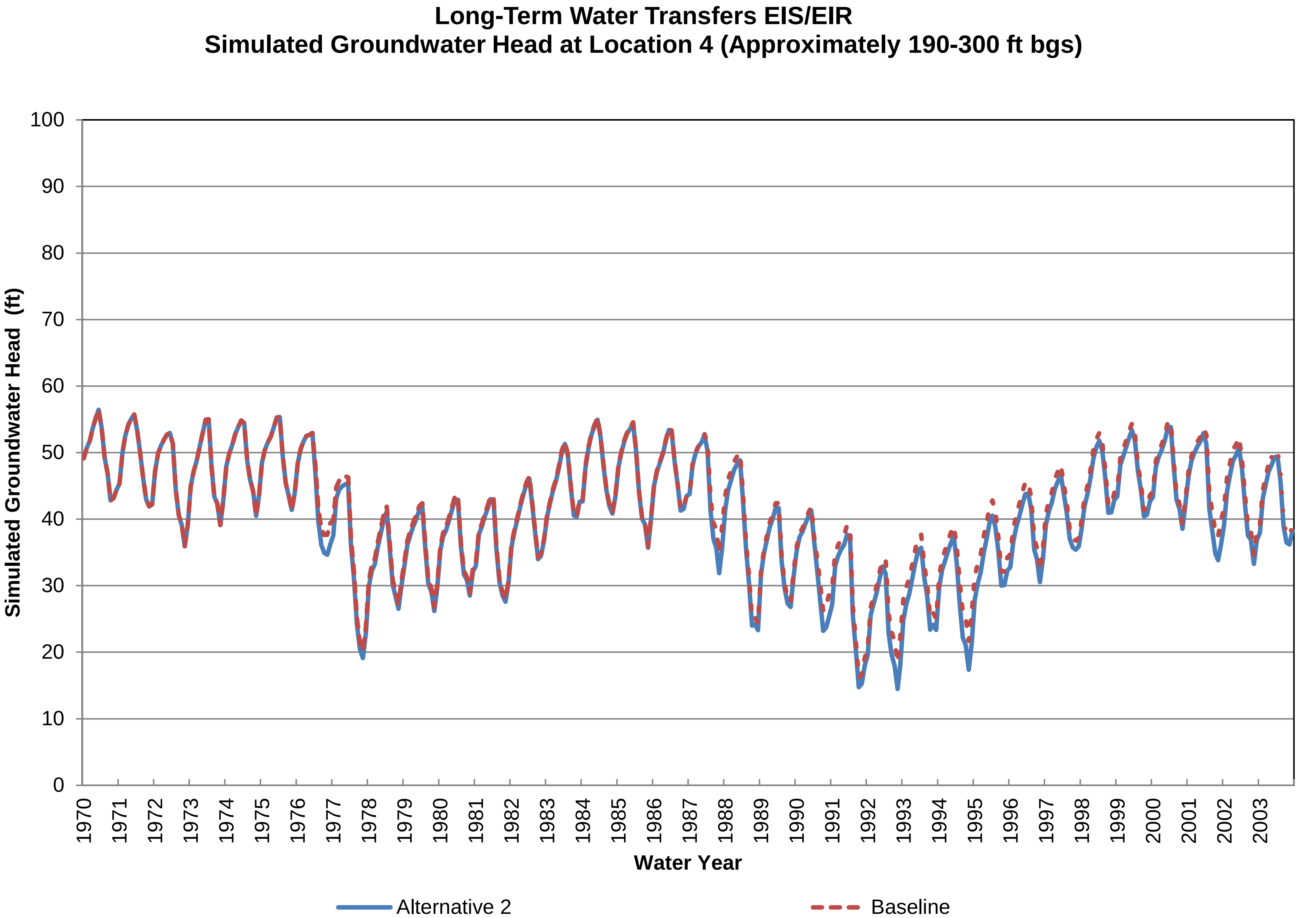
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 70-190 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 190-300 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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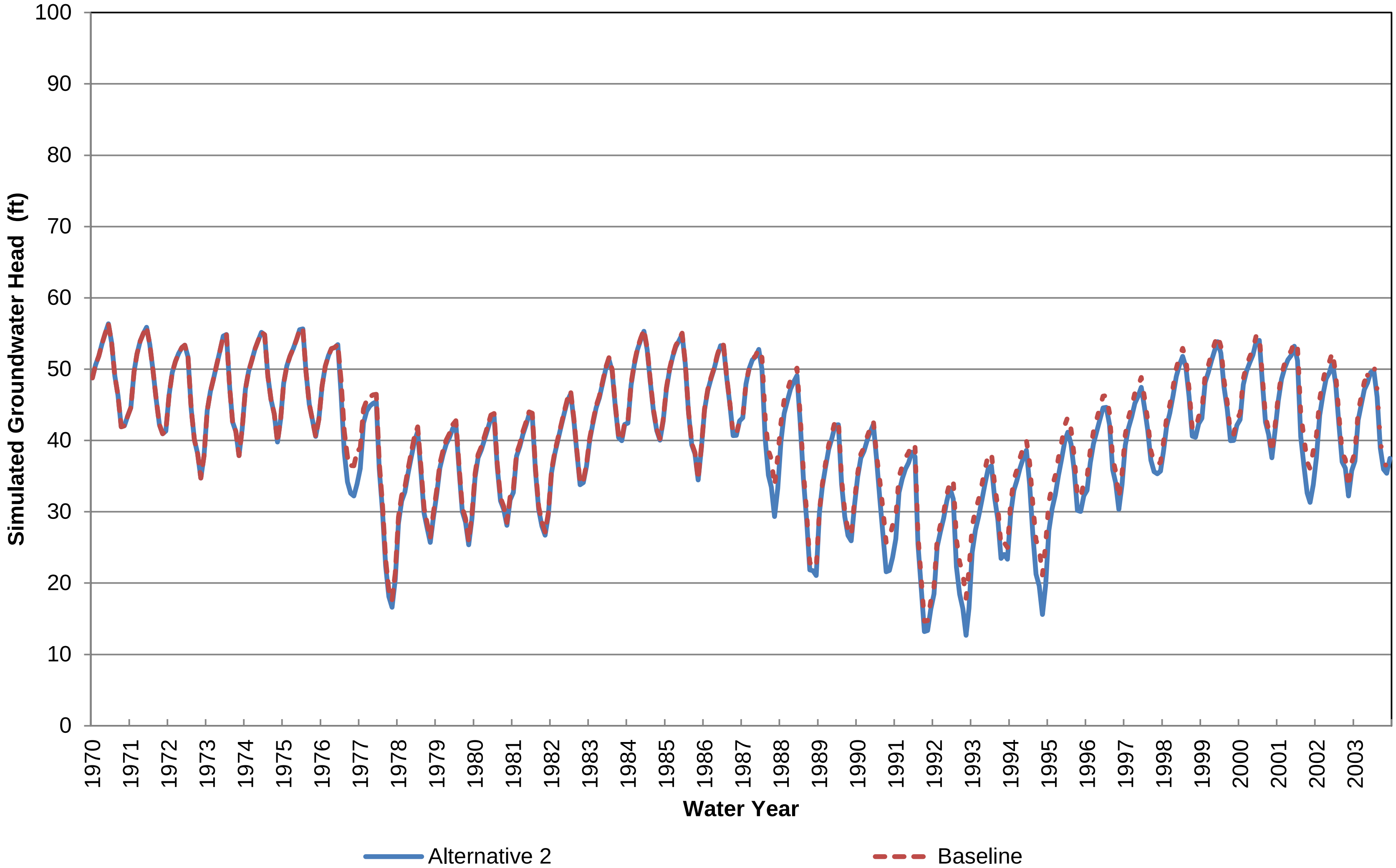
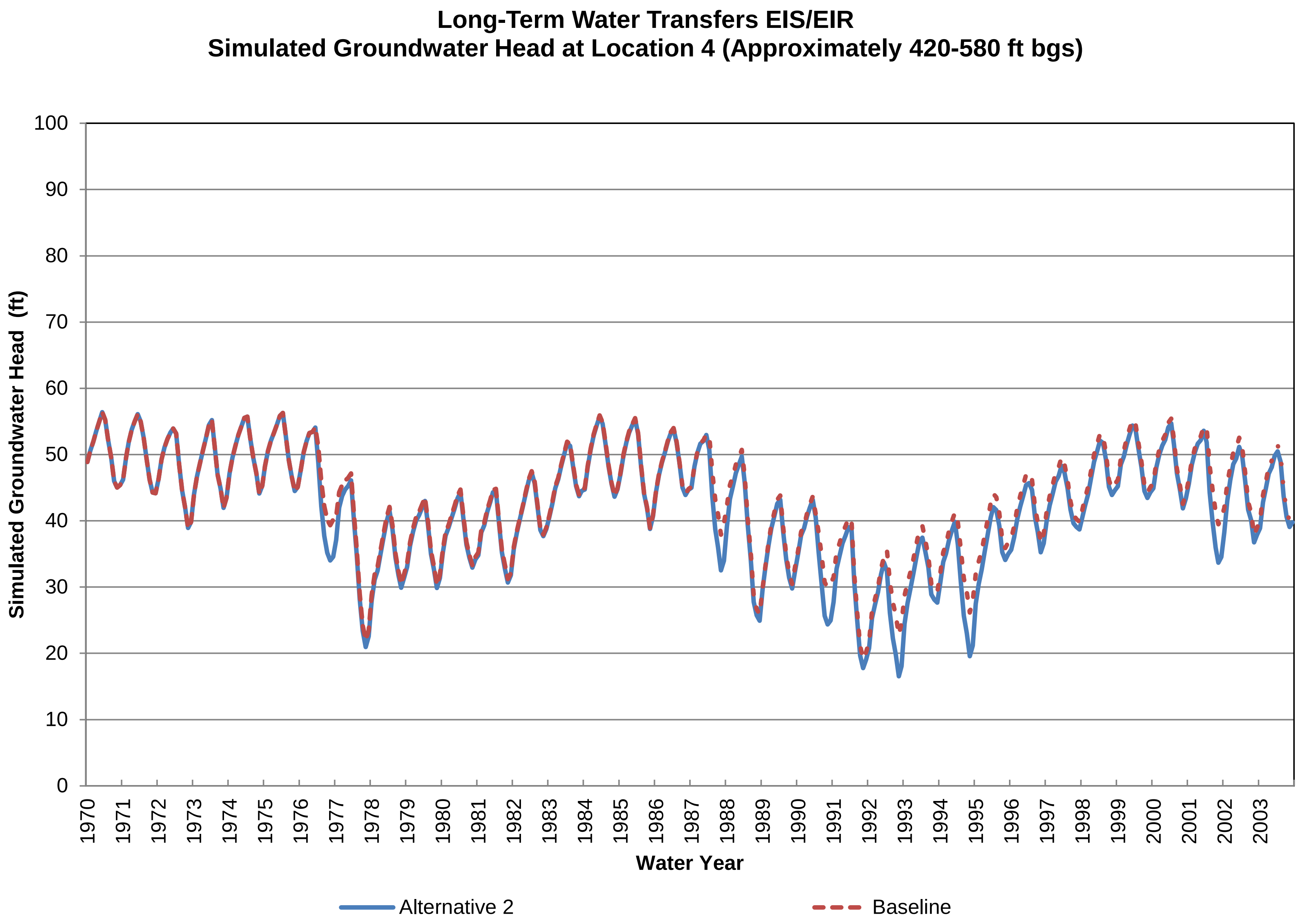
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 300-420 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 420-580 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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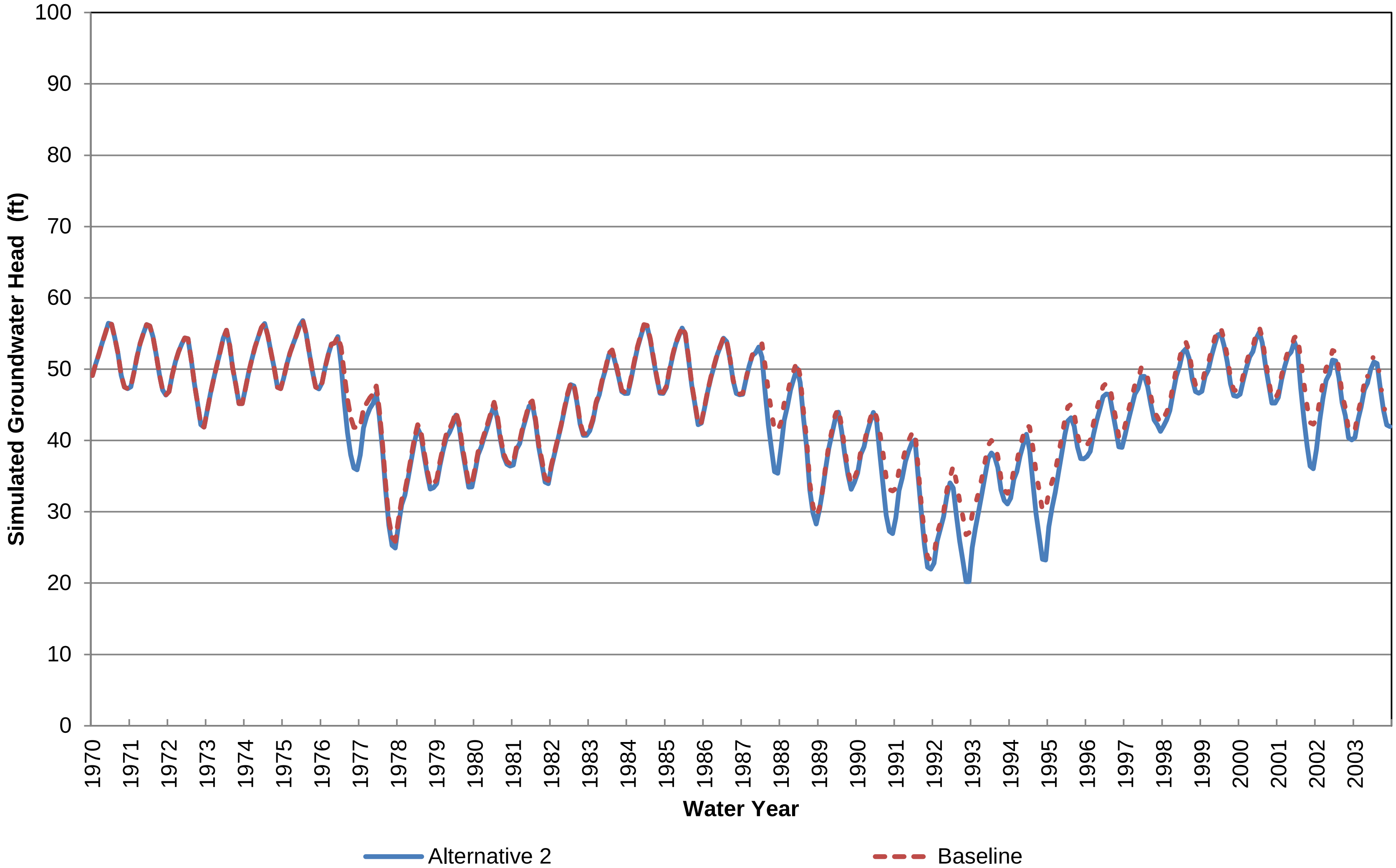
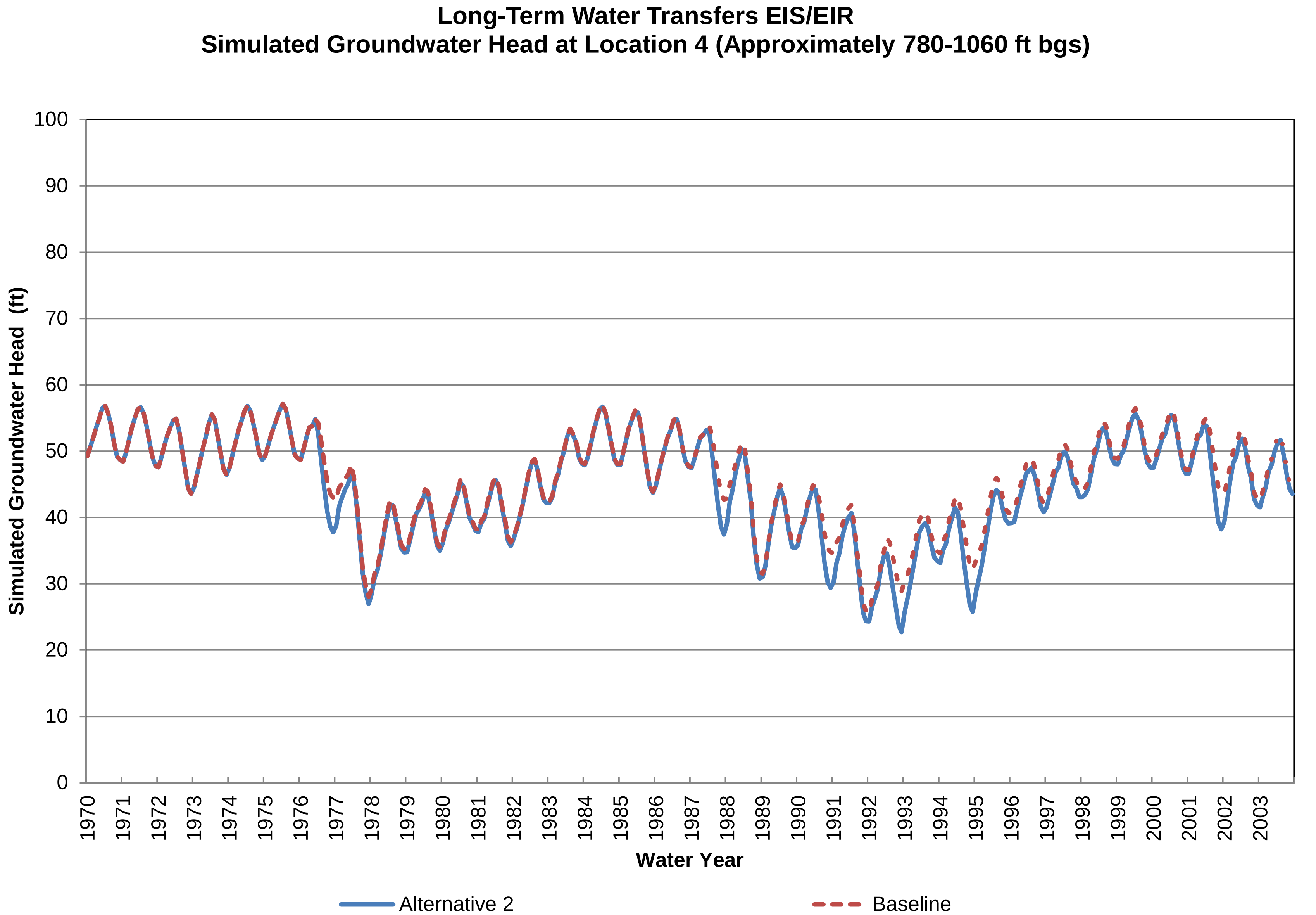
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 580-780 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 4 (Approximately 780-1060 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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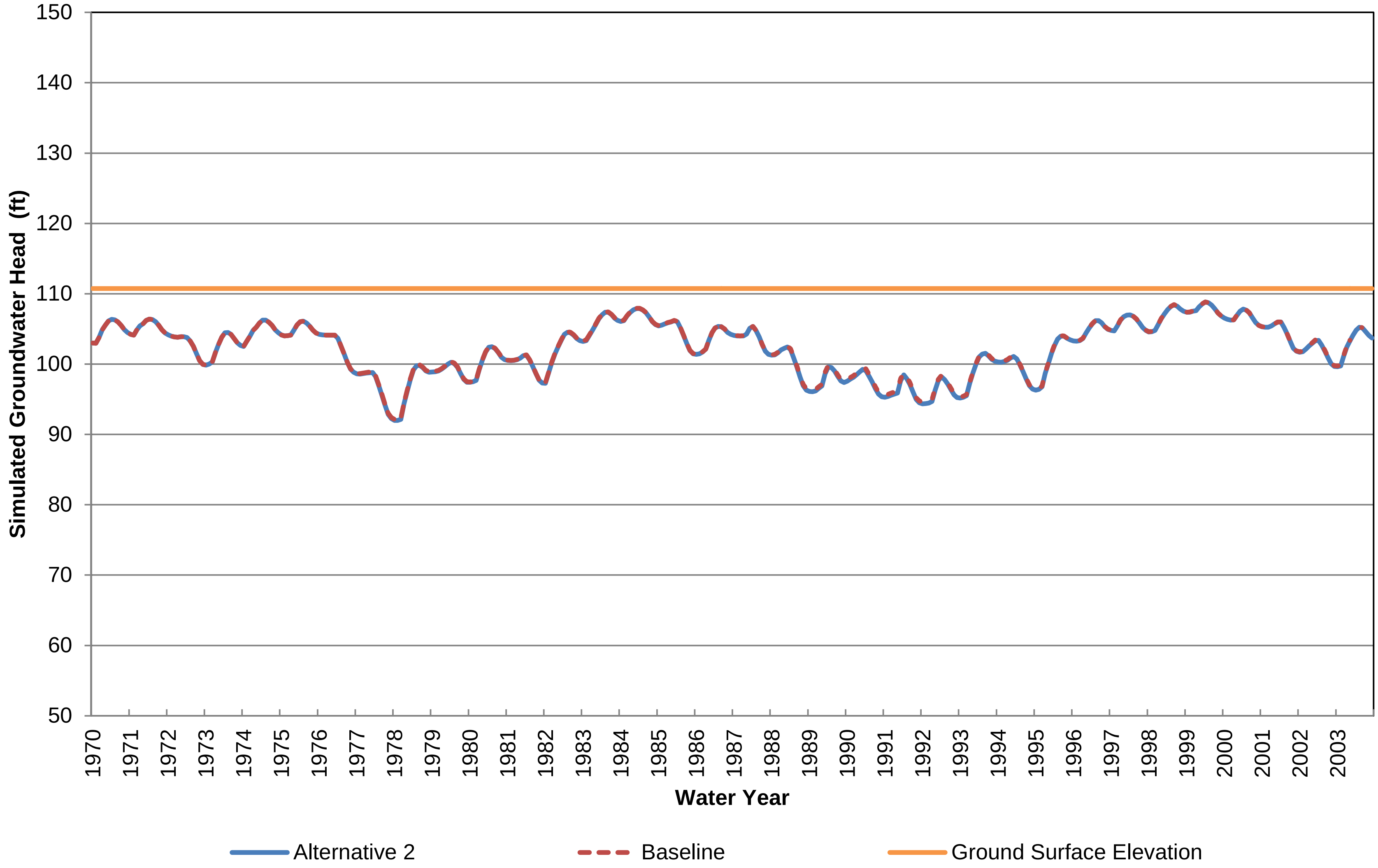
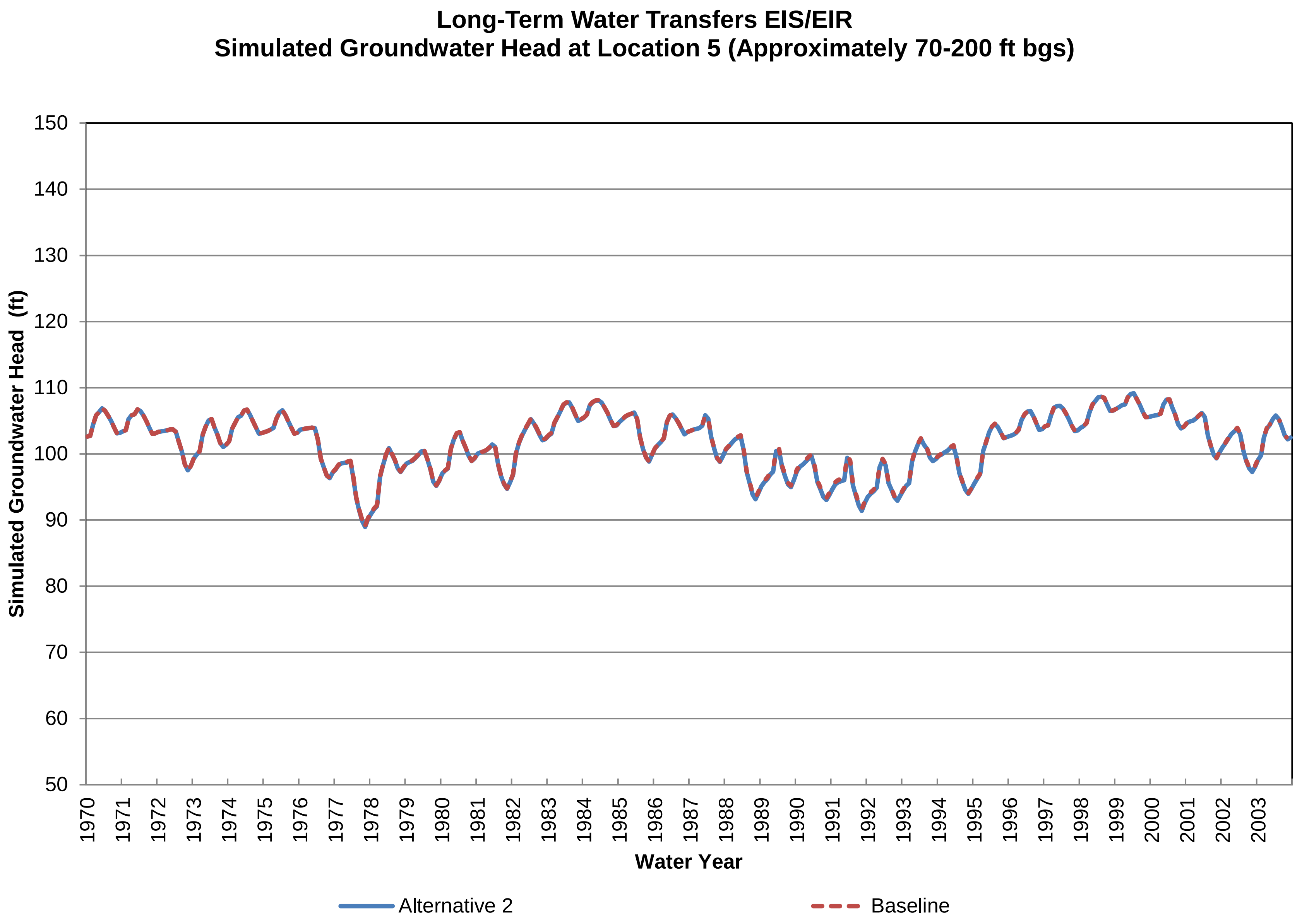
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 5 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
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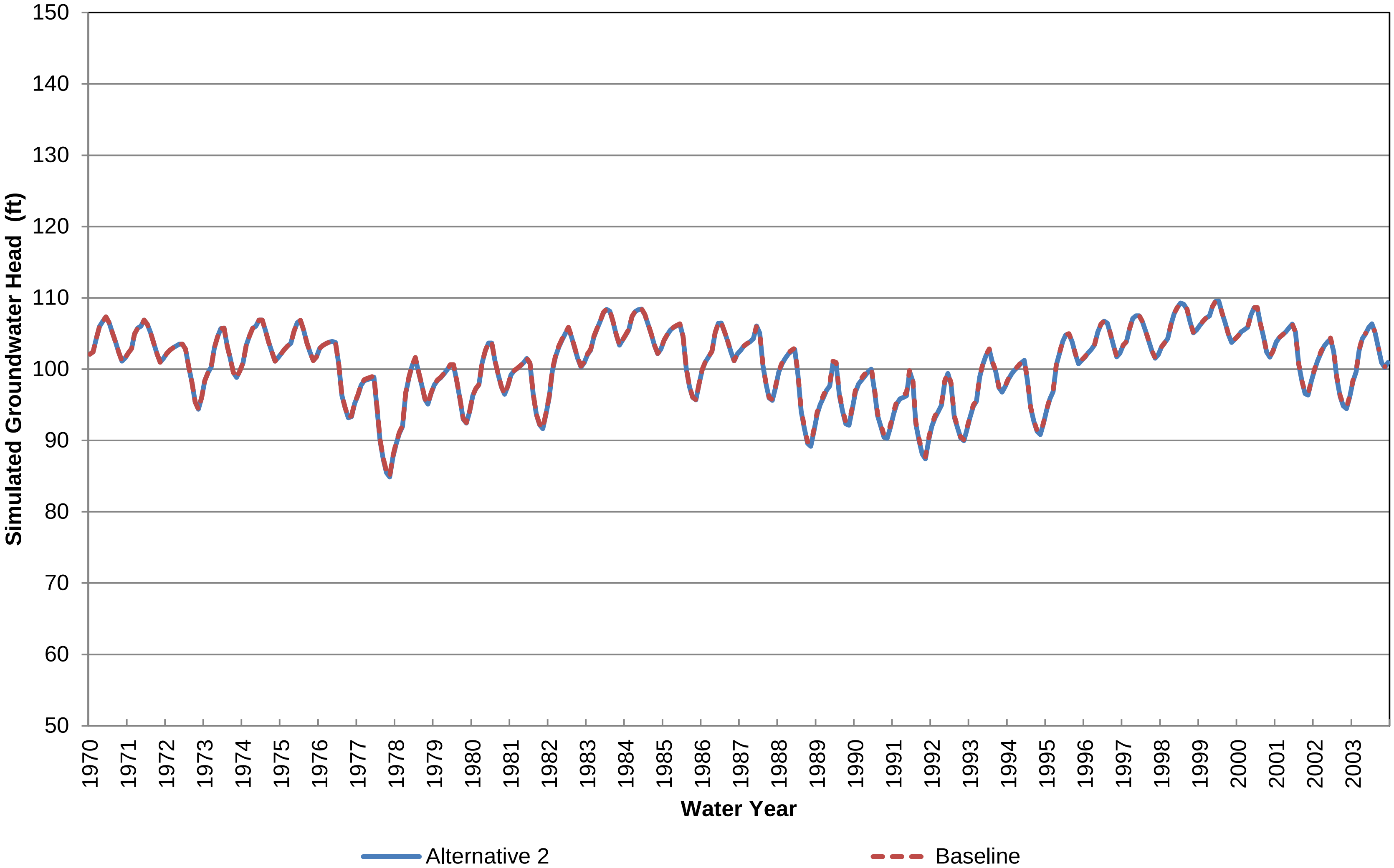
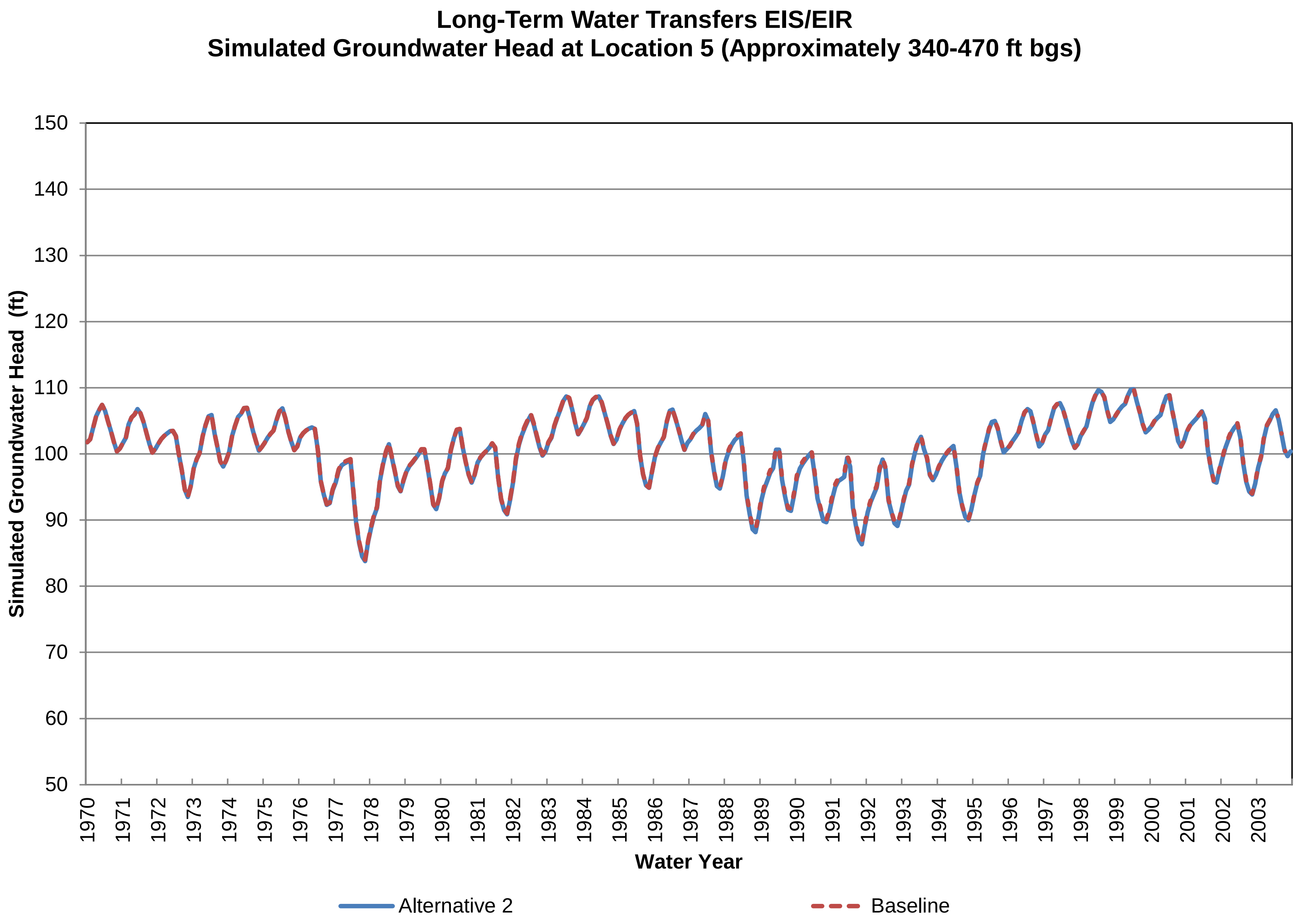
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 200-340 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 340-470 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
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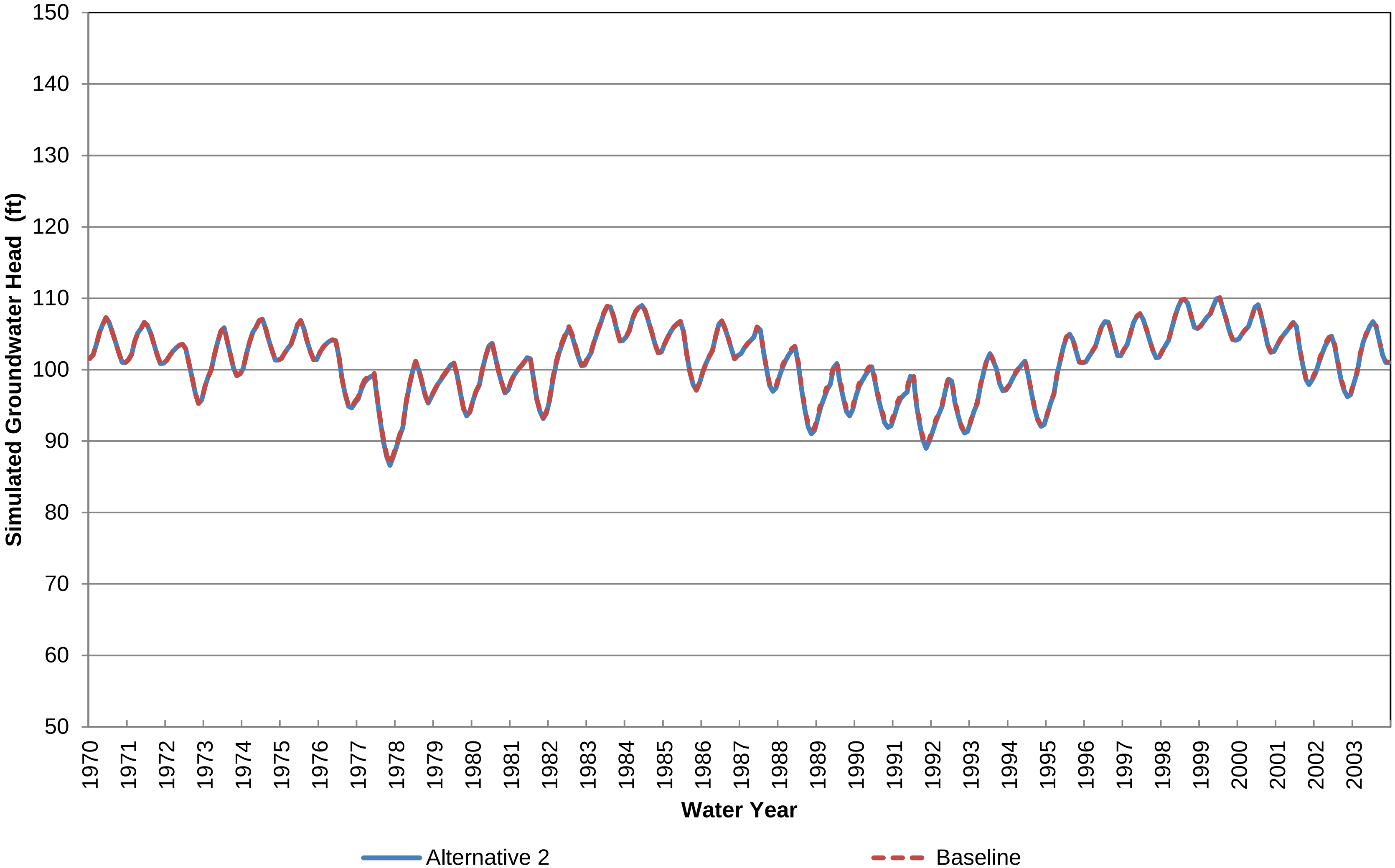
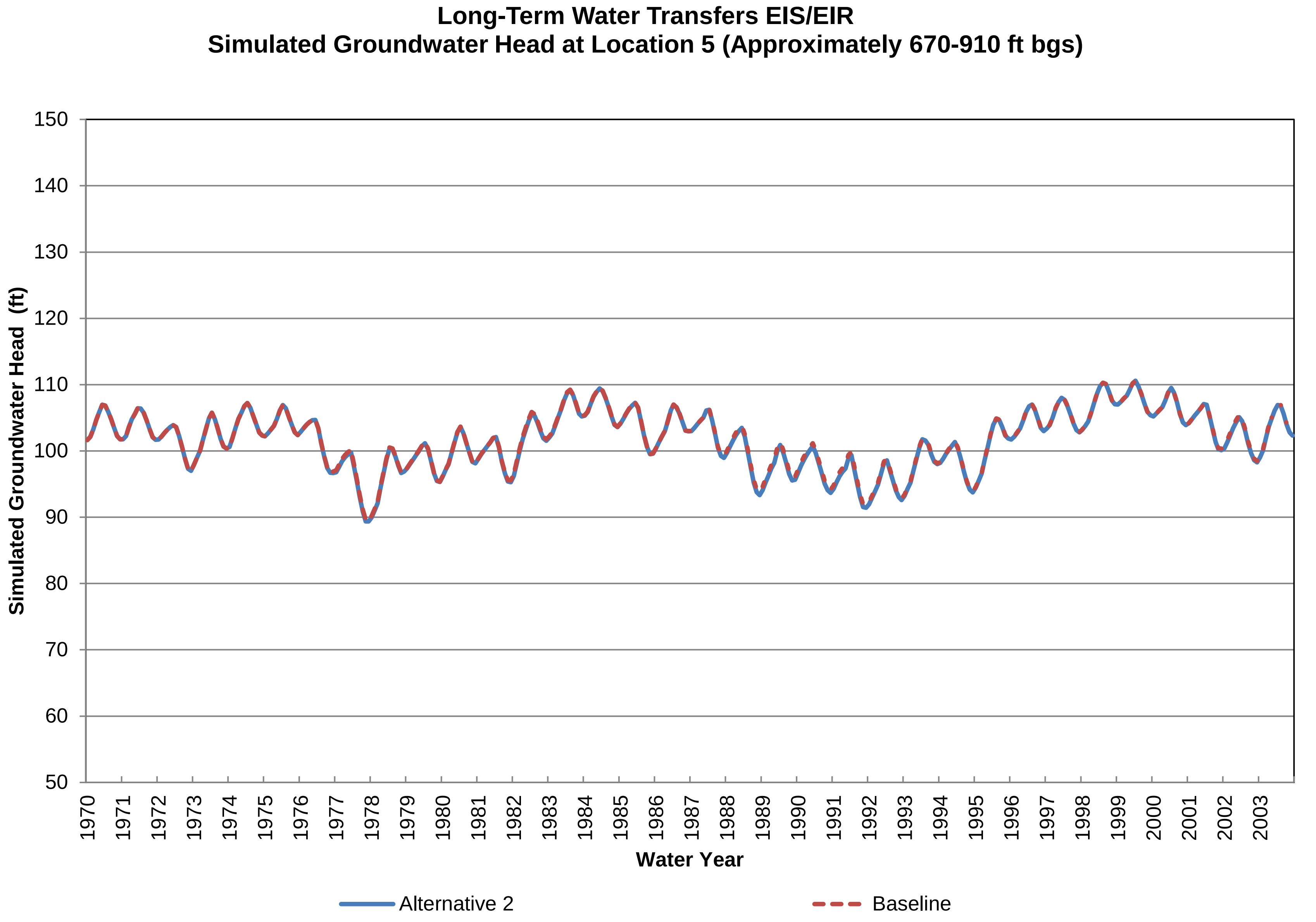
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 470-670 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 670-910 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
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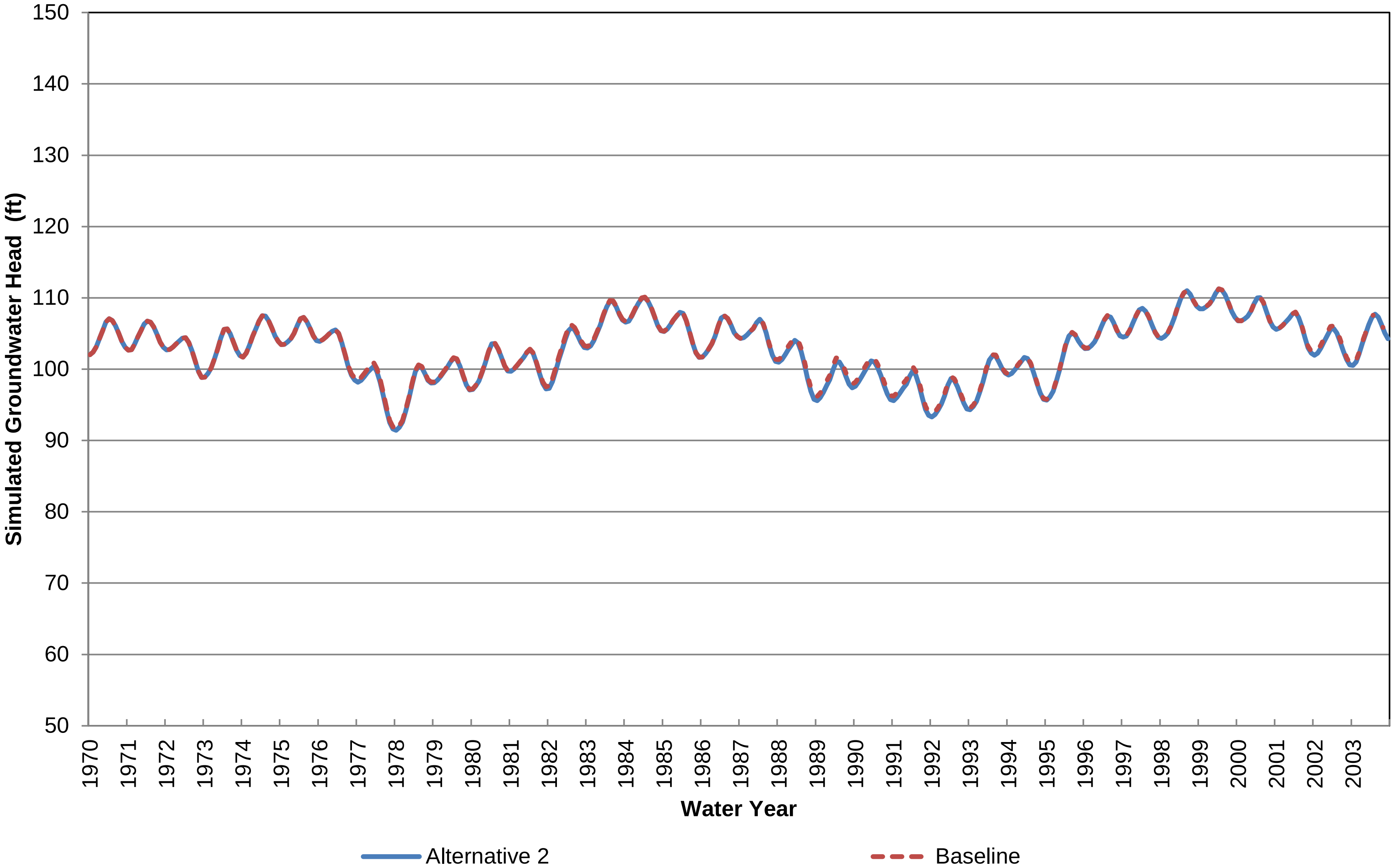
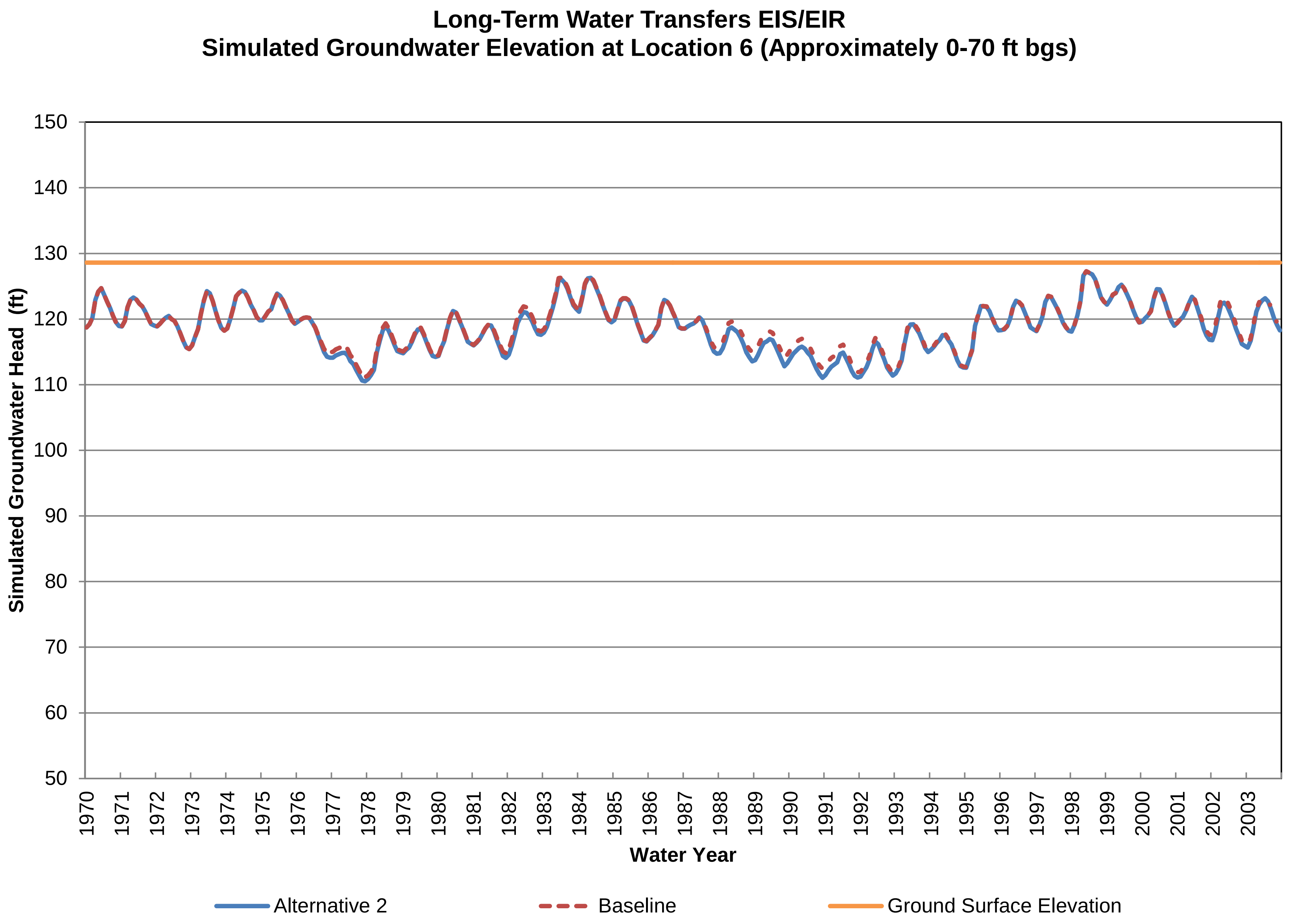
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 5 (Approximately 910-1310 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 6 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
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2002
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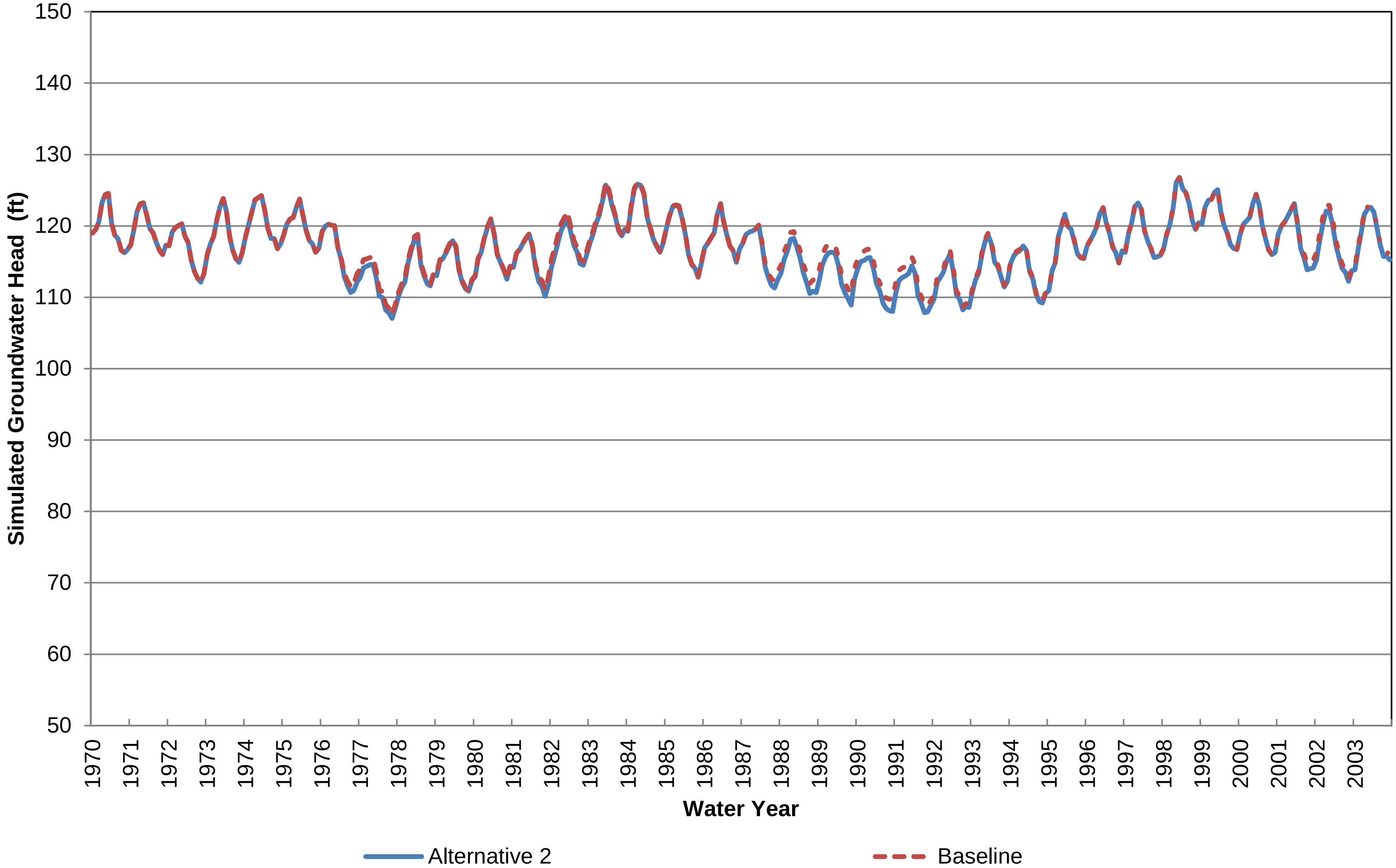
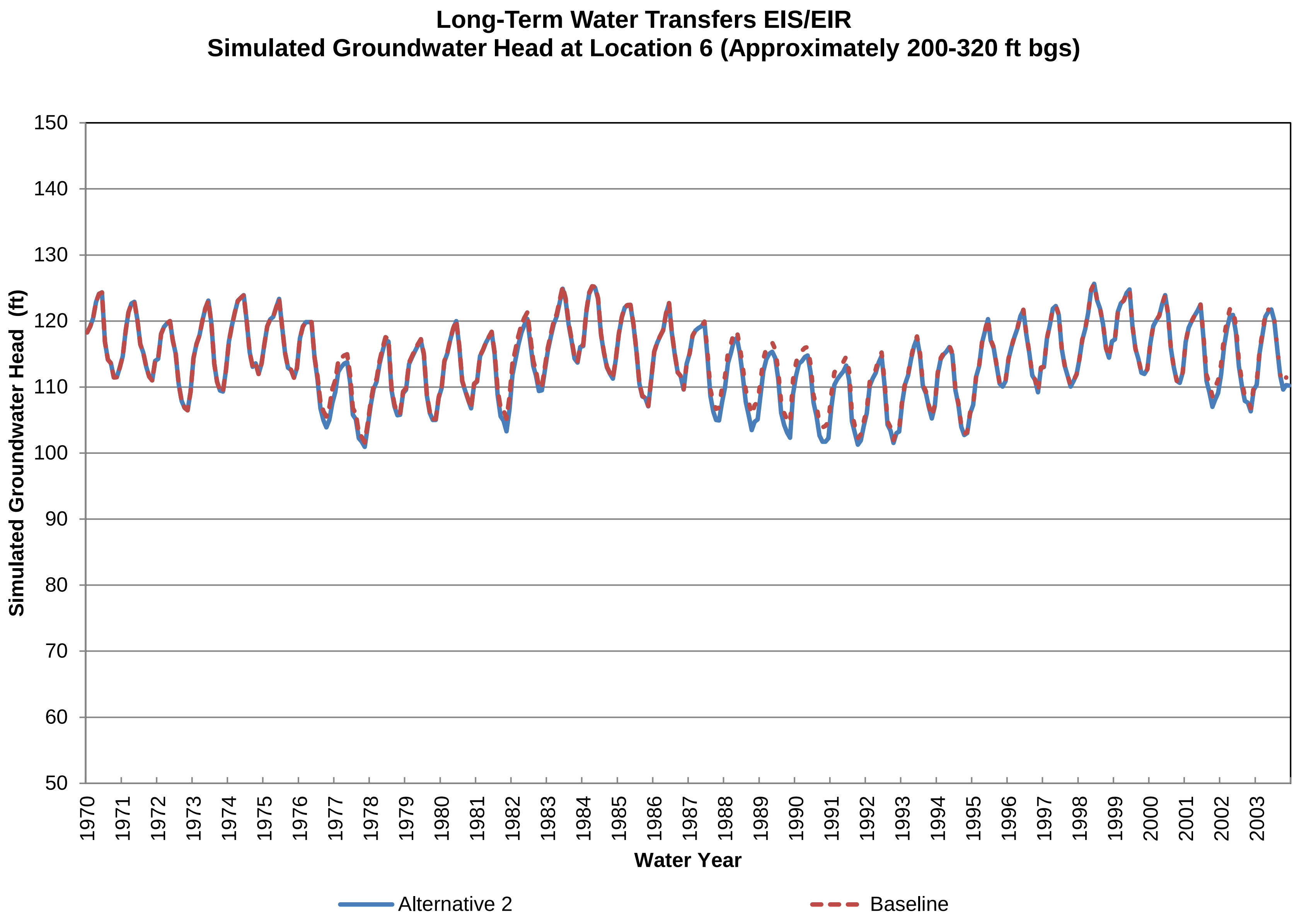
Water Year
Alternative 2
Baseline
Ground Surface Elevation

266B

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 70-200 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 200-320 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
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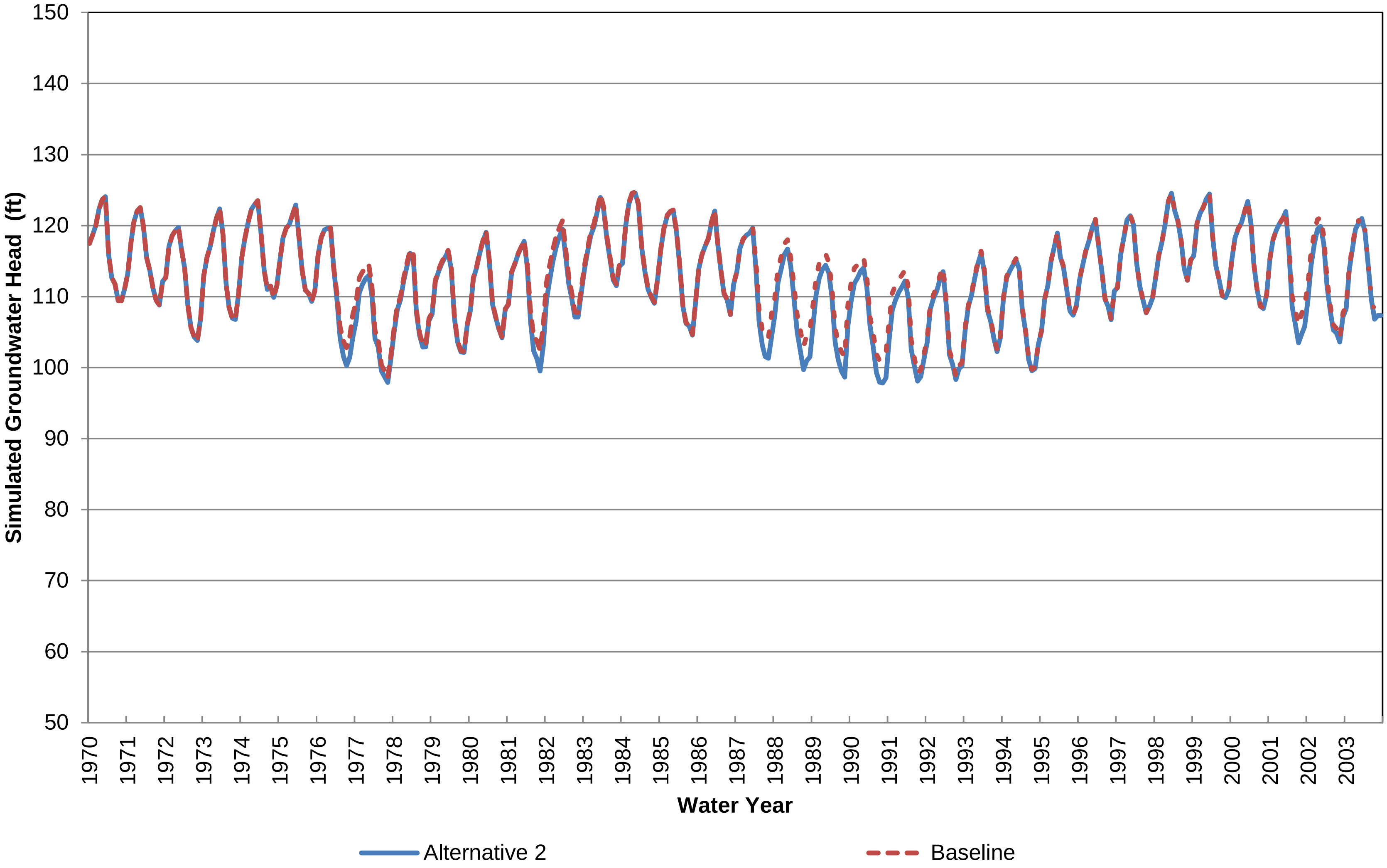
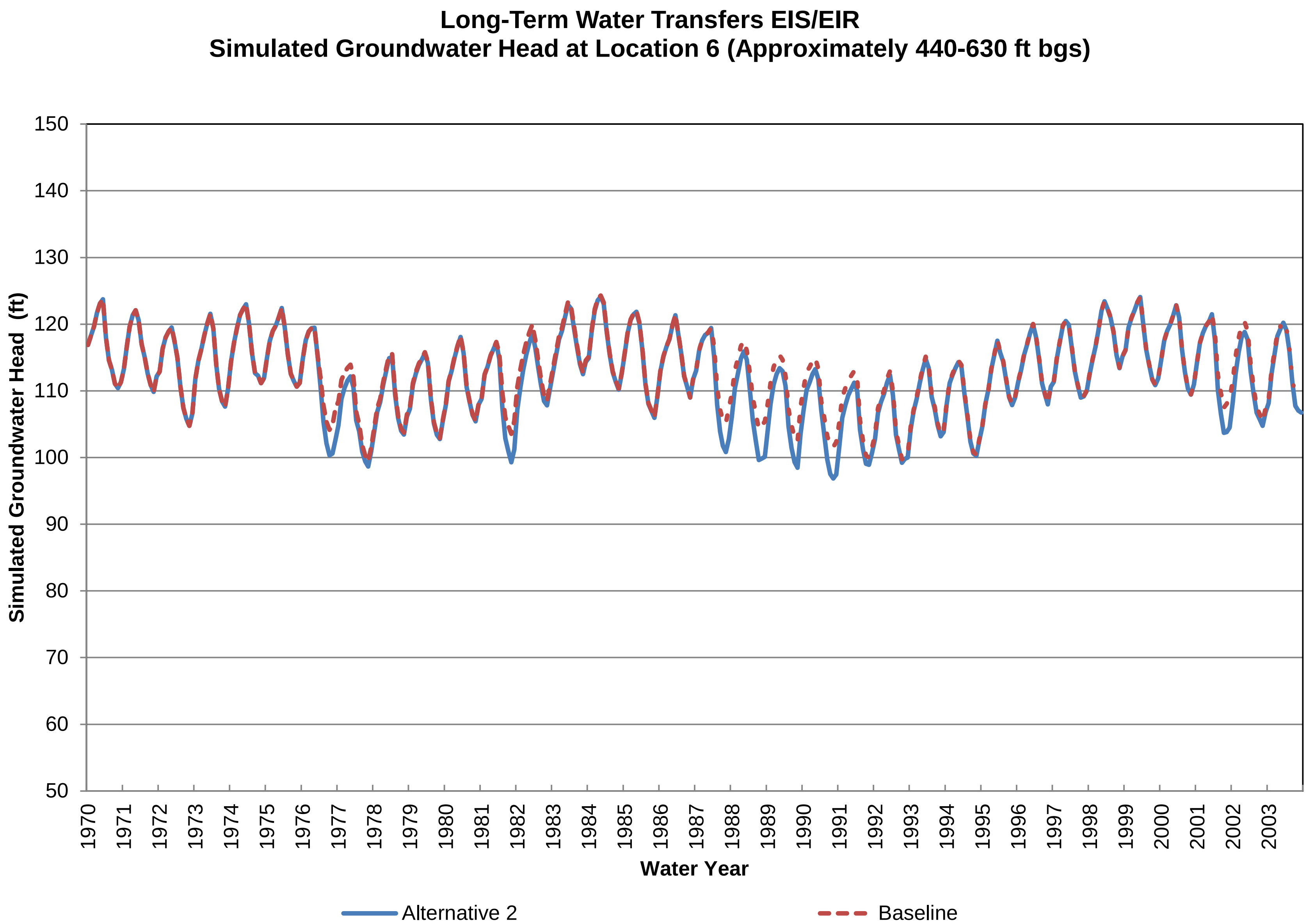
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 320-440 ft bgs)



266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 440-630 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
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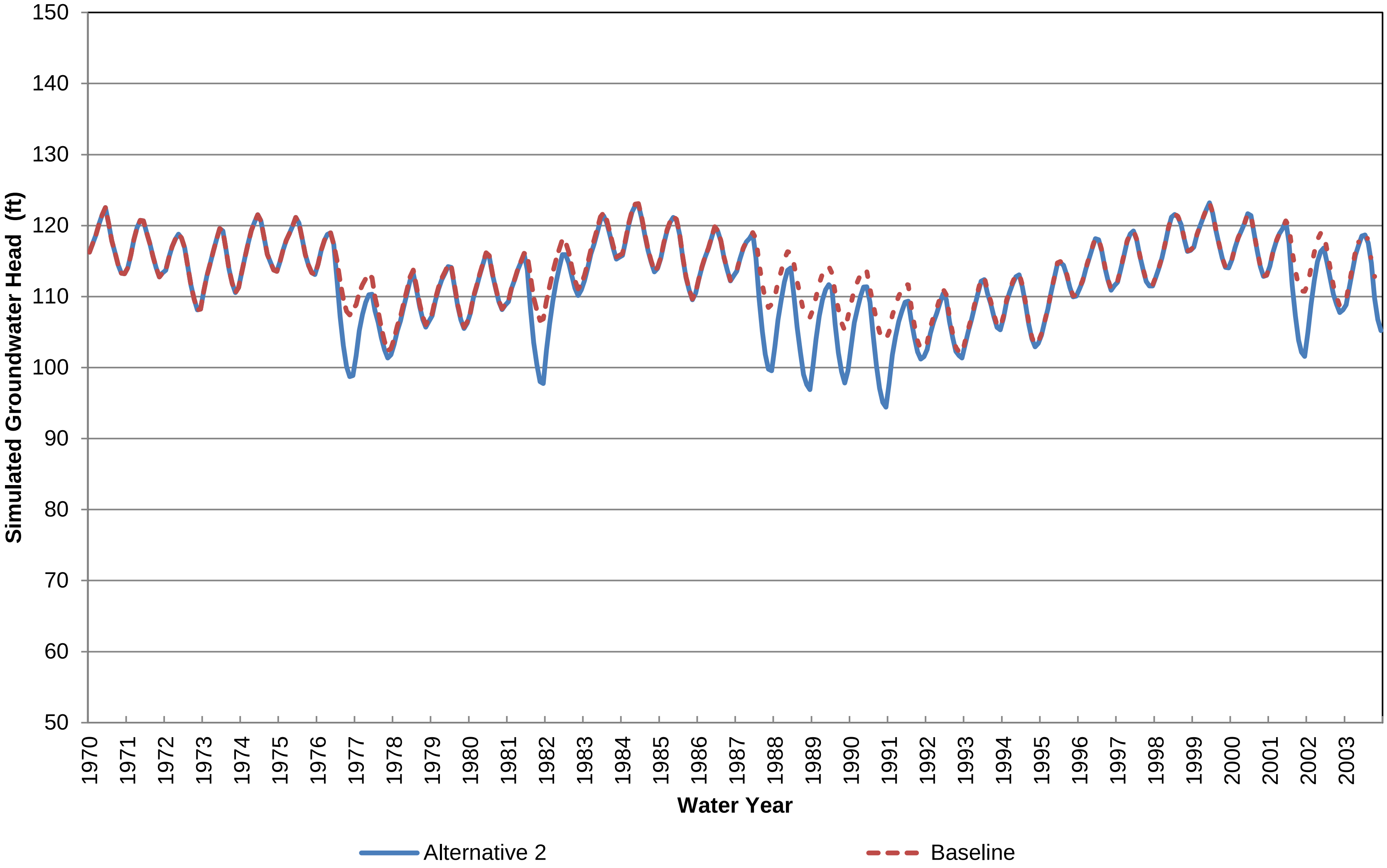
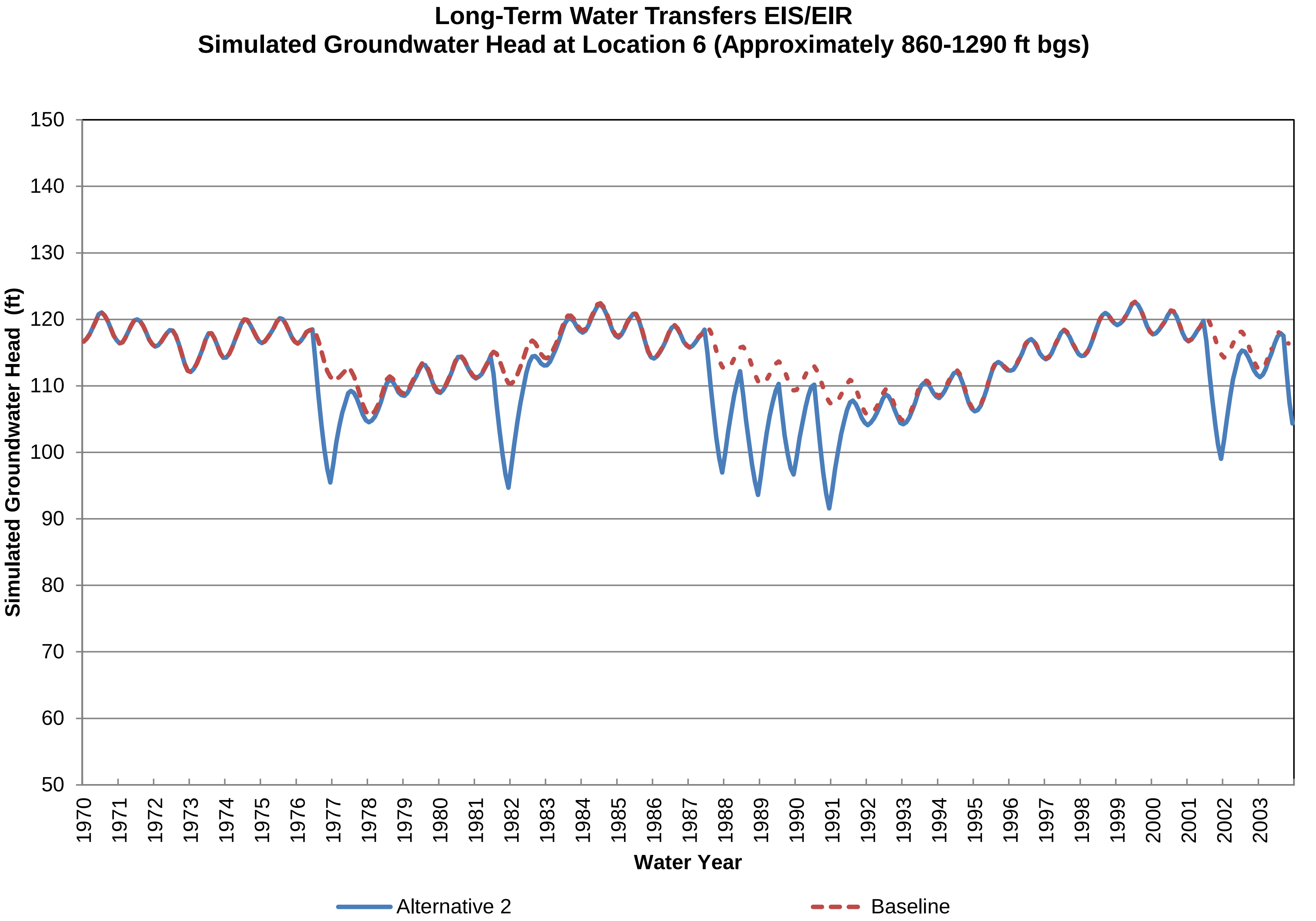
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 630-860 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 6 (Approximately 860-1290 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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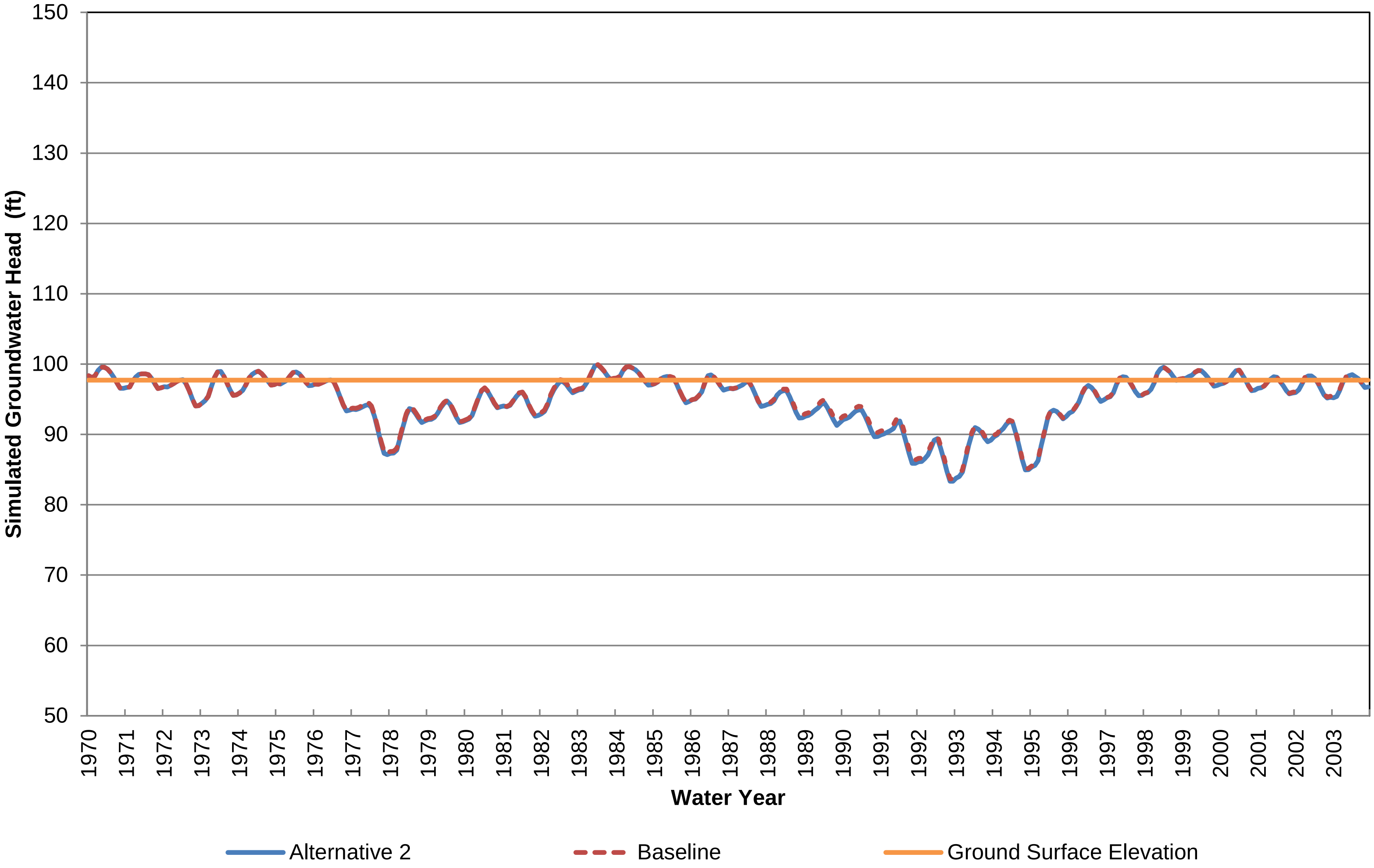
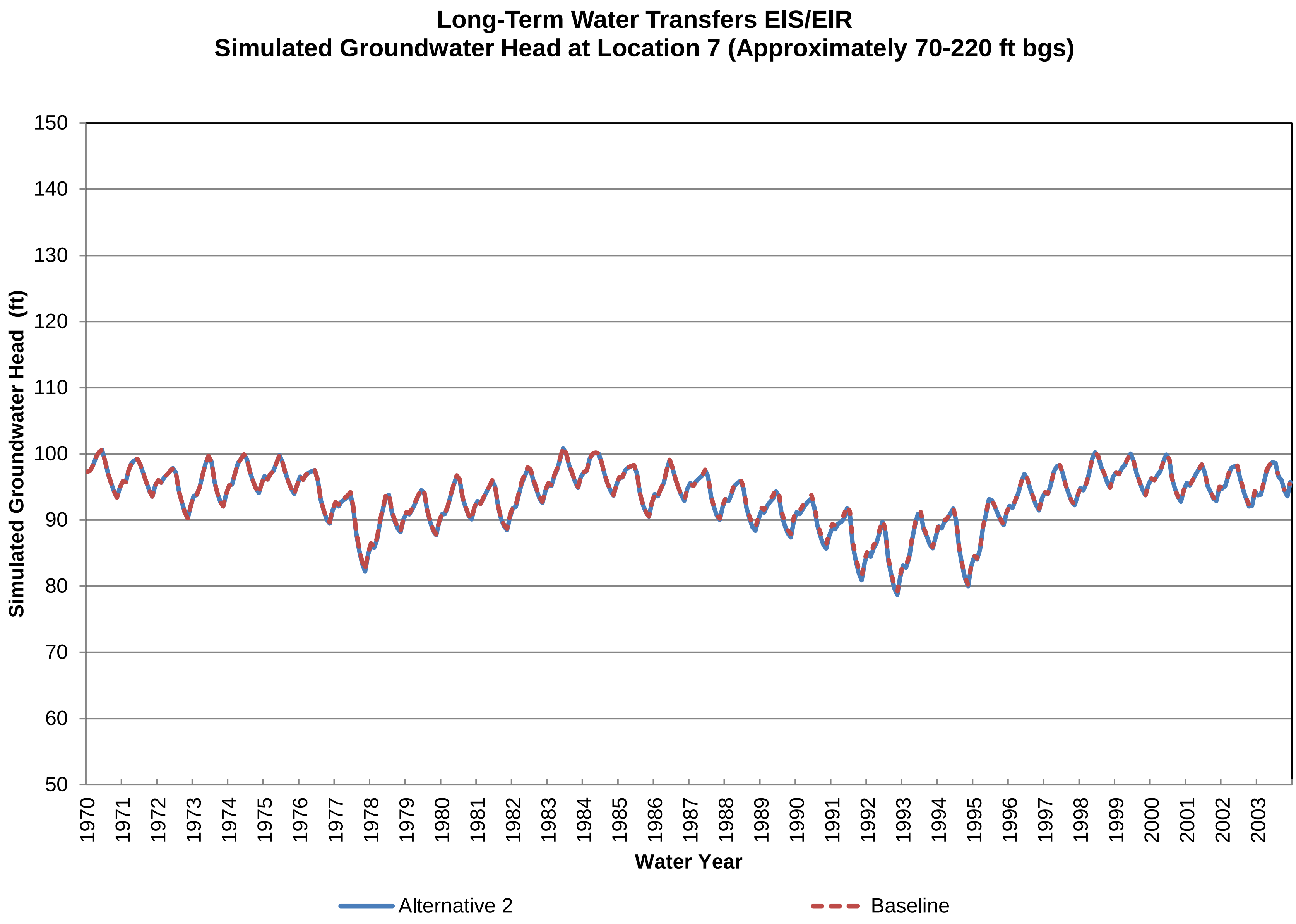
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 7 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 70-220 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1994
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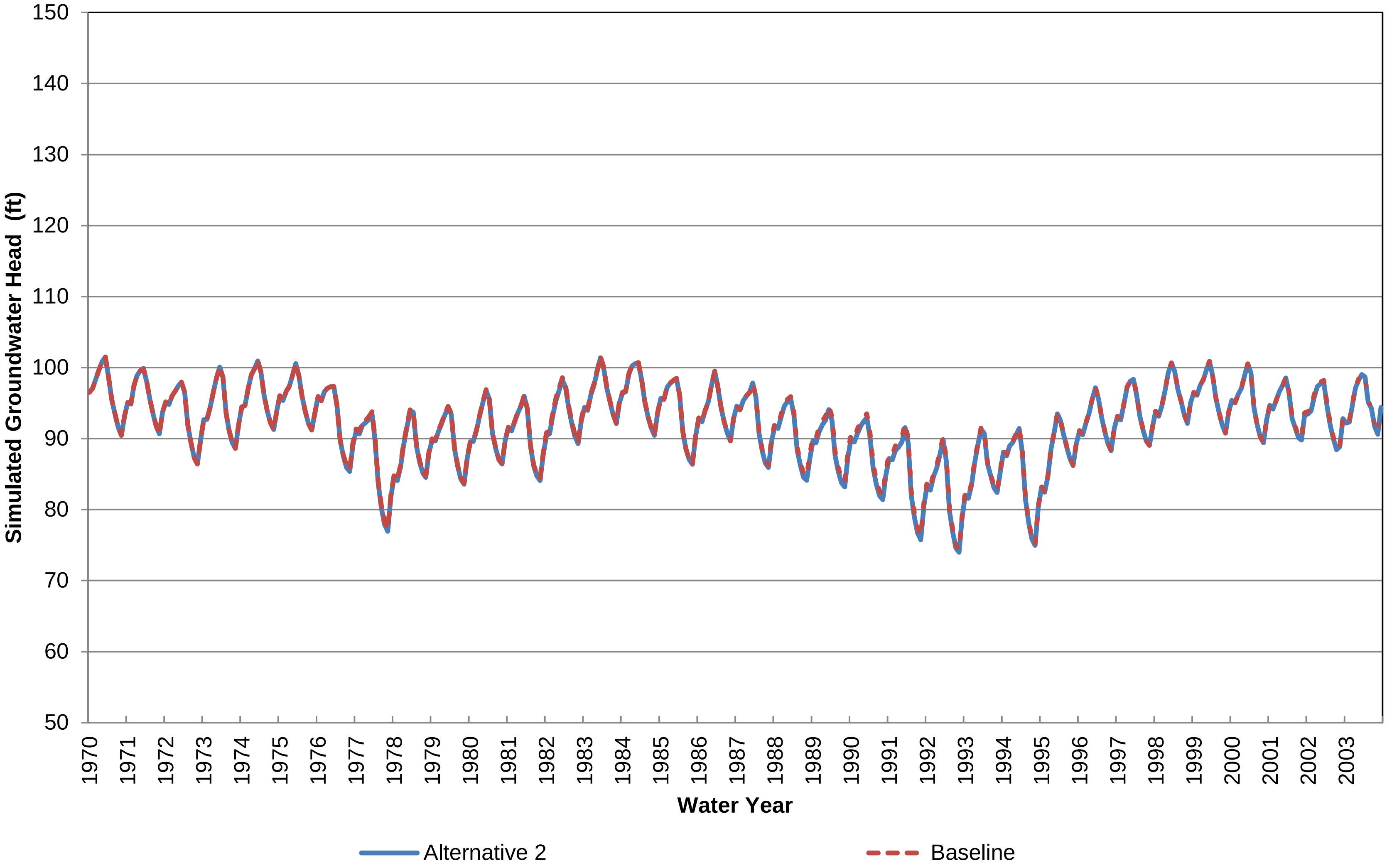
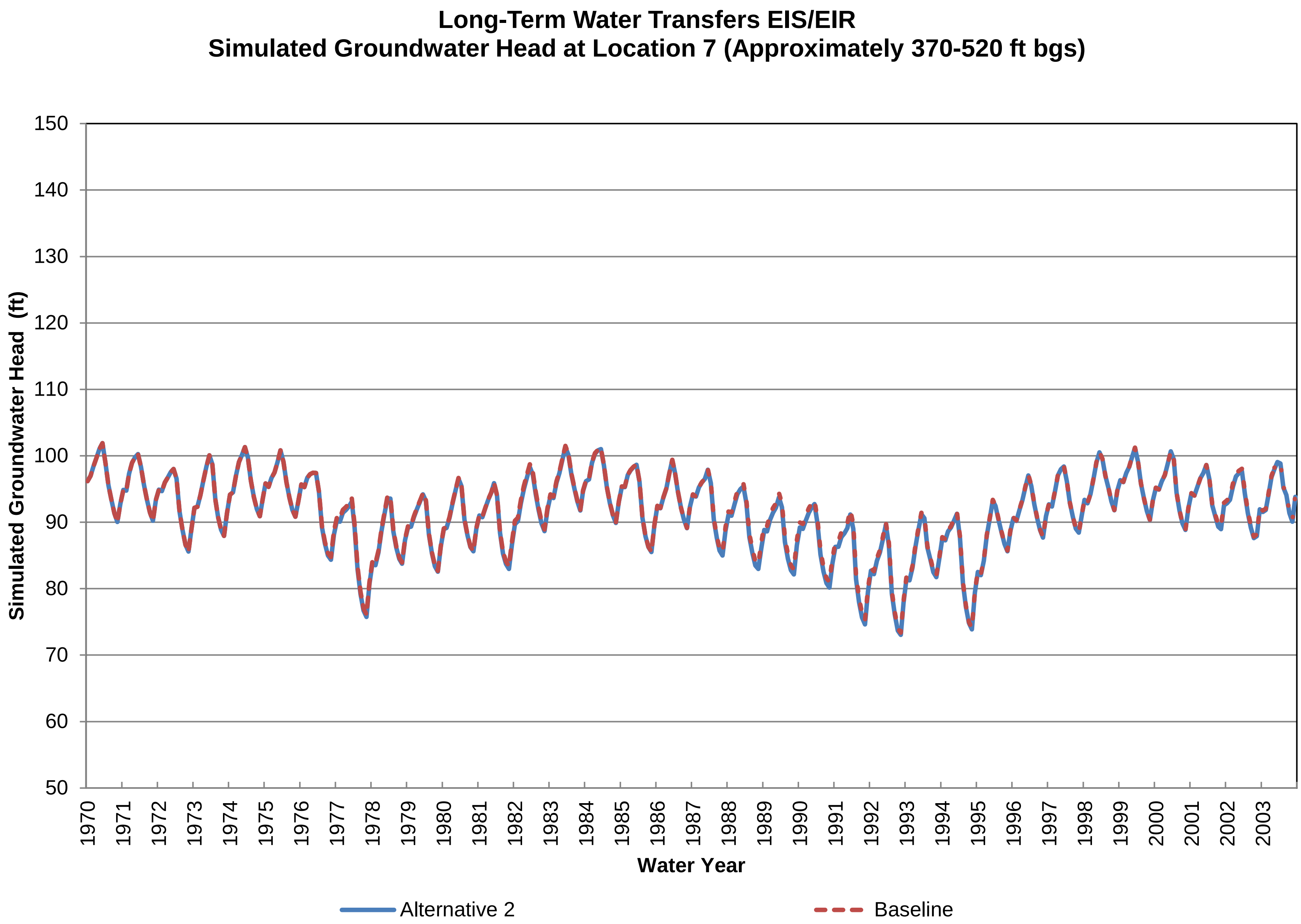
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 220-370 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 370-520 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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1986
1987
1988
1989
1990
1991
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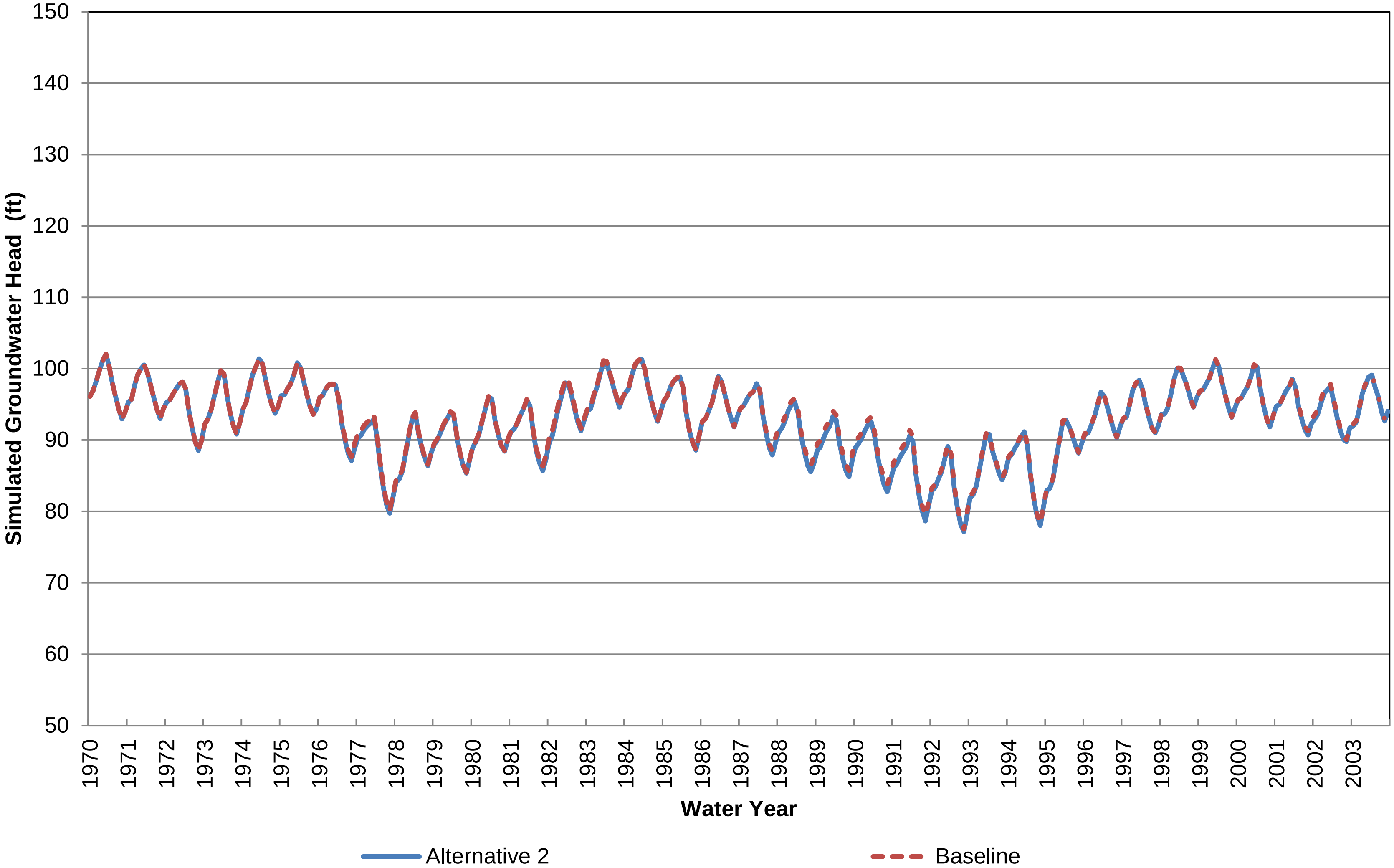
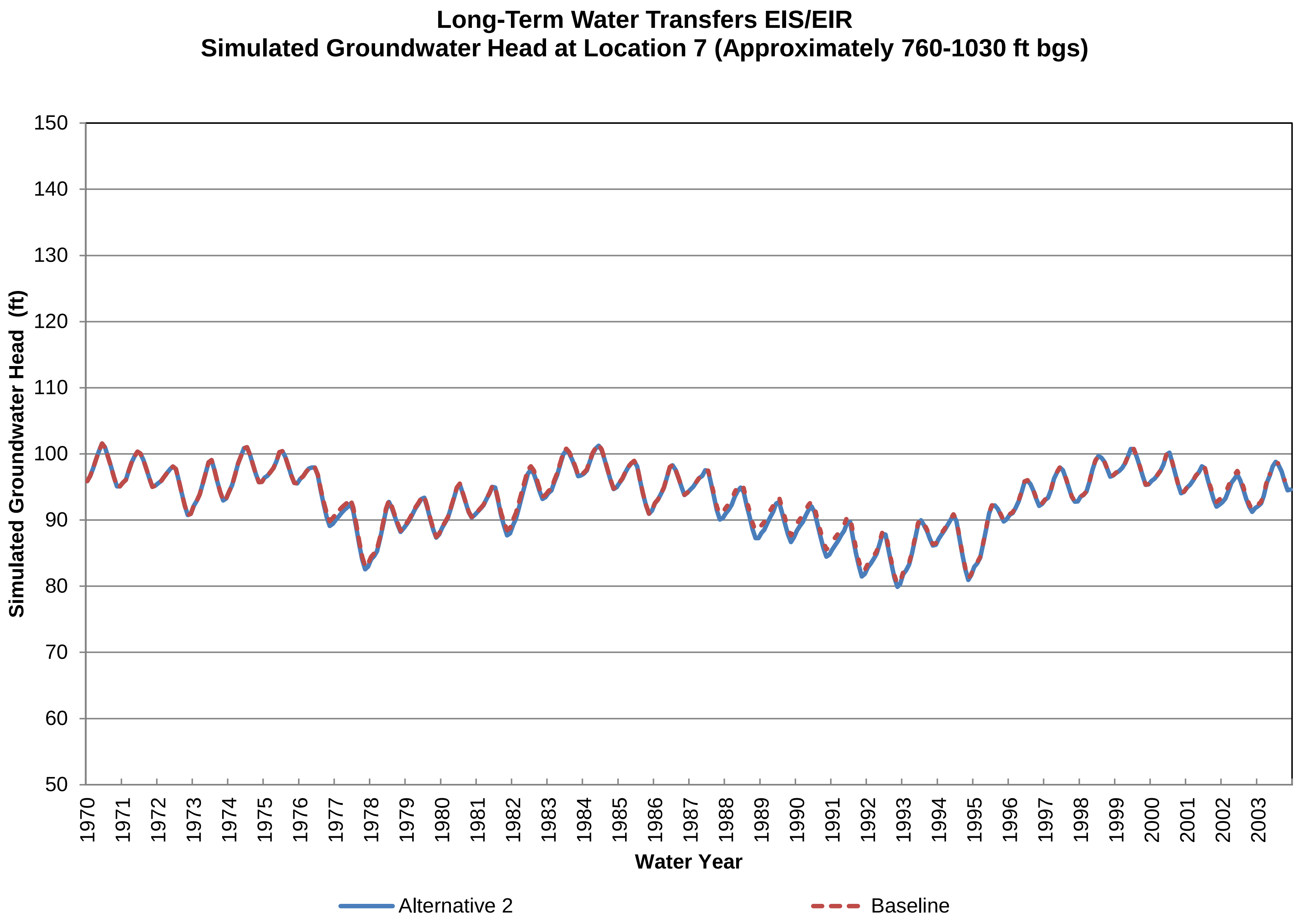
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 520-760 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 760-1030 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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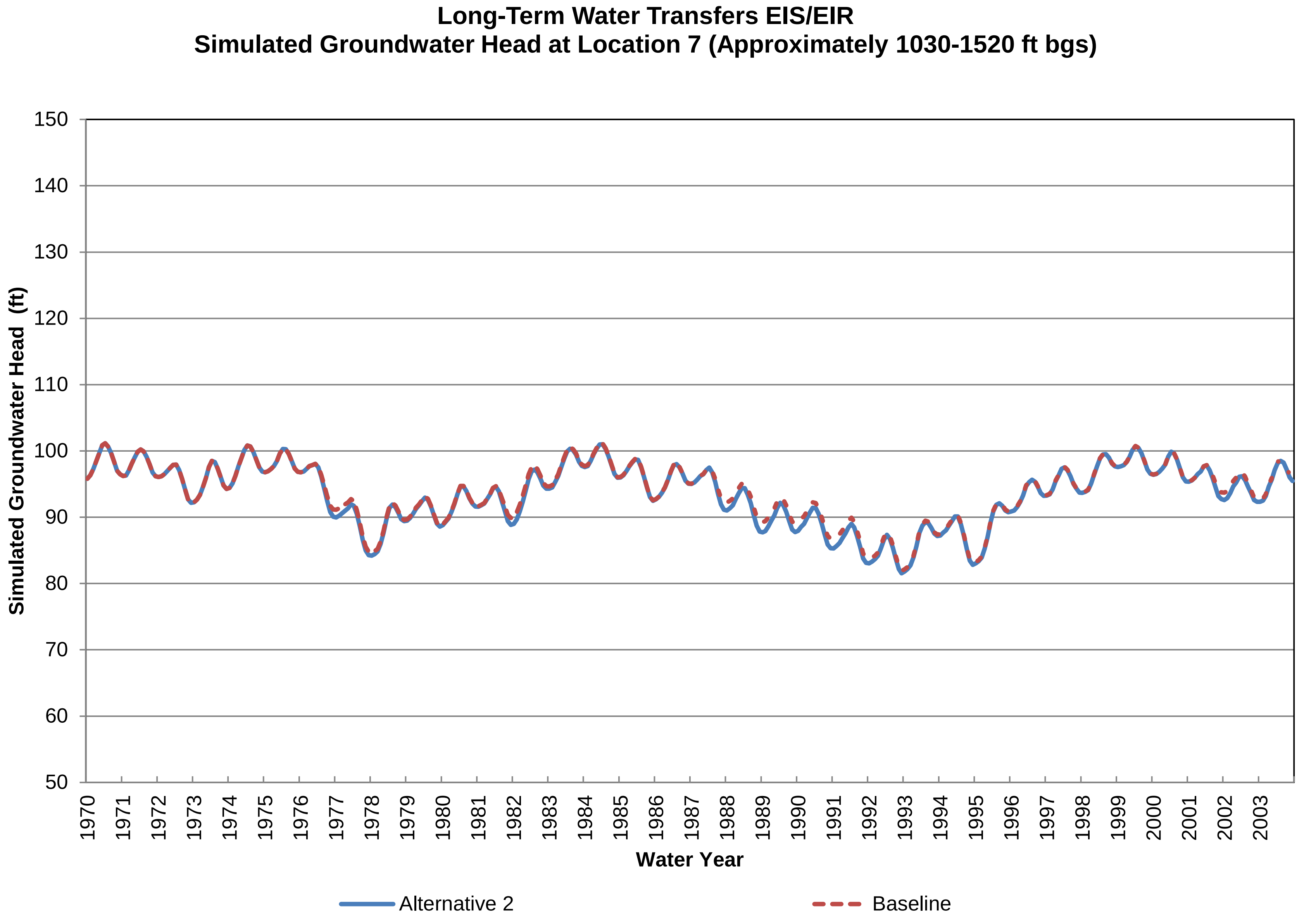
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 7 (Approximately 1030-1520 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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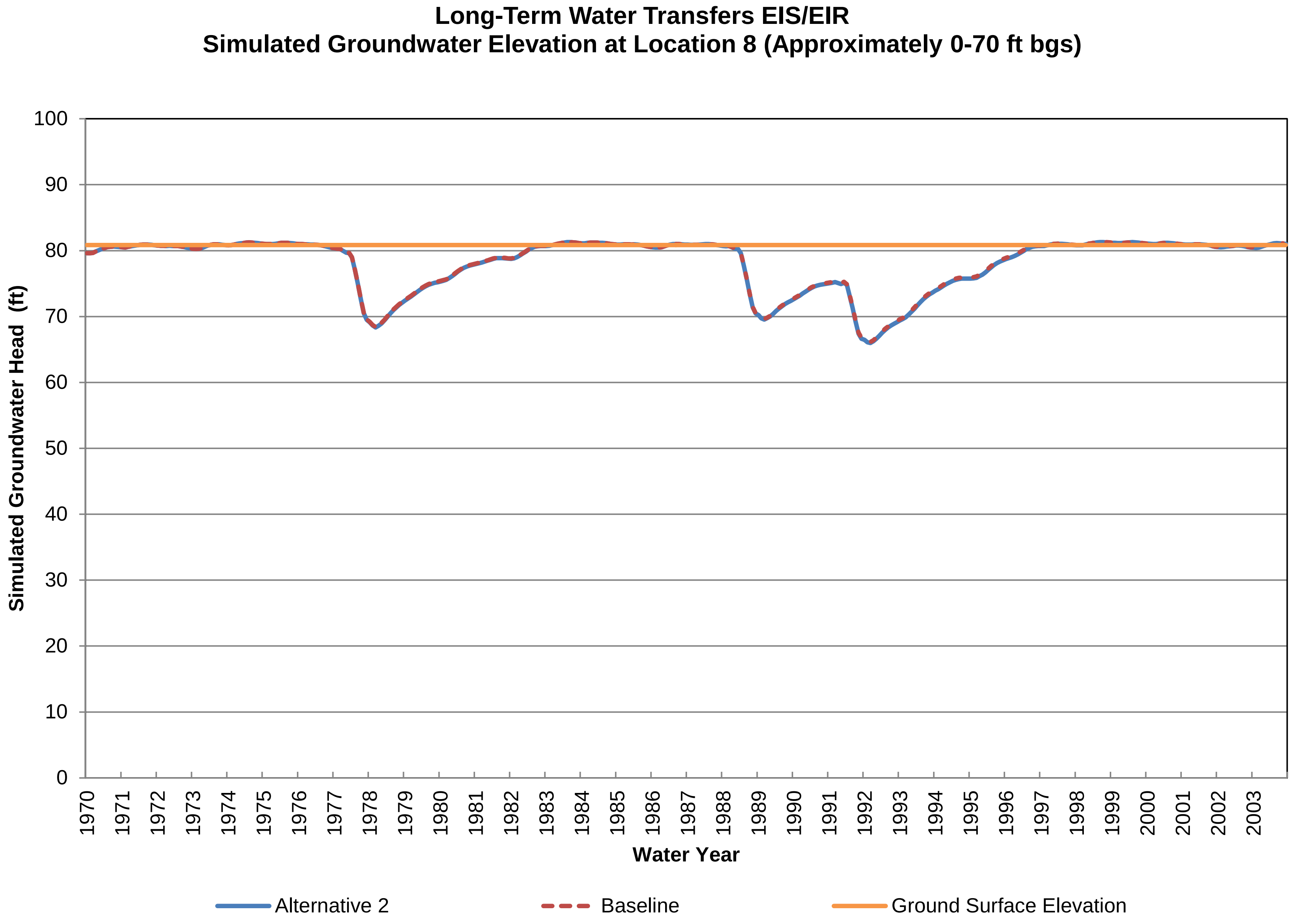
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 8 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
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1988
1989
1990
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1992
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1994
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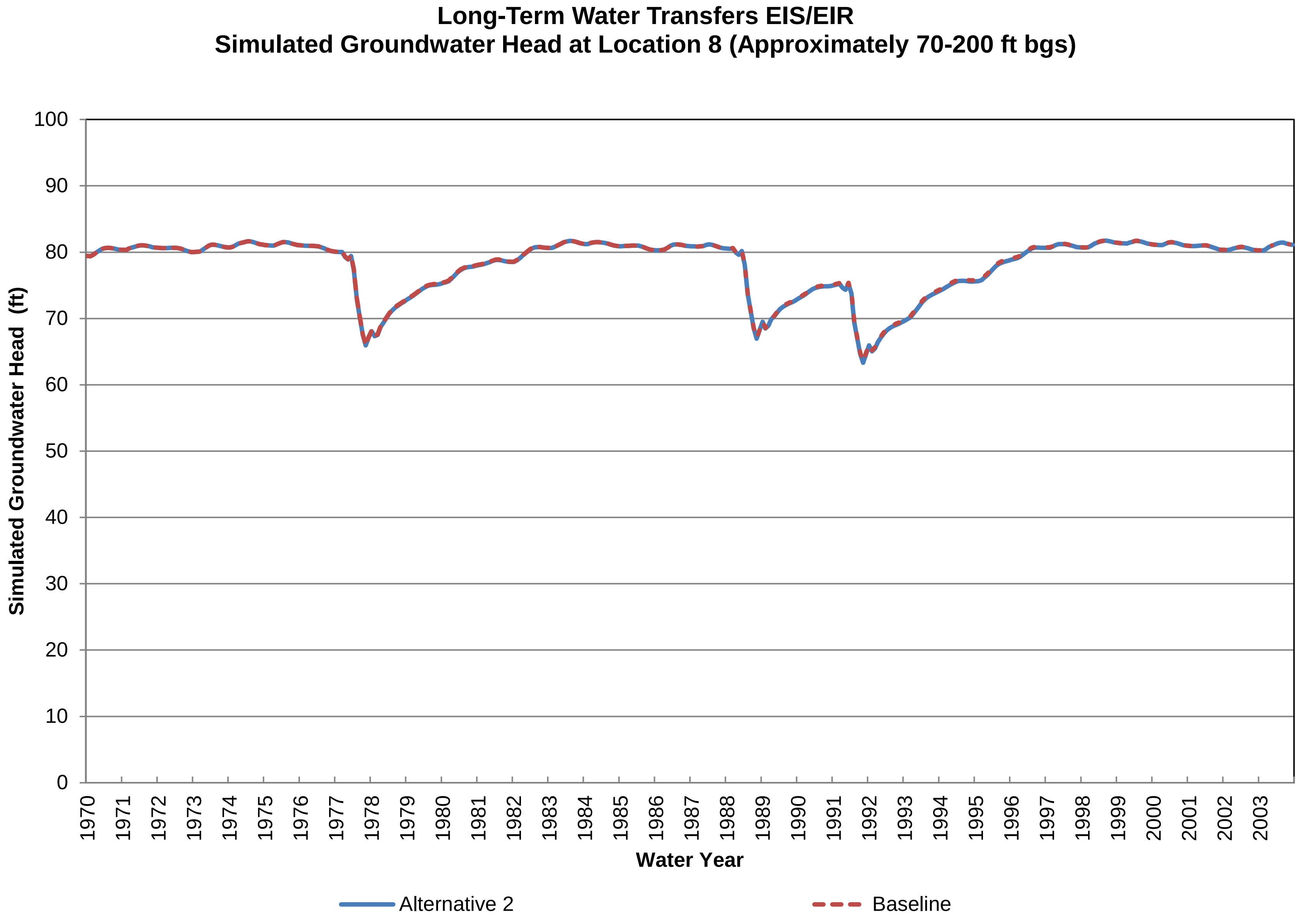
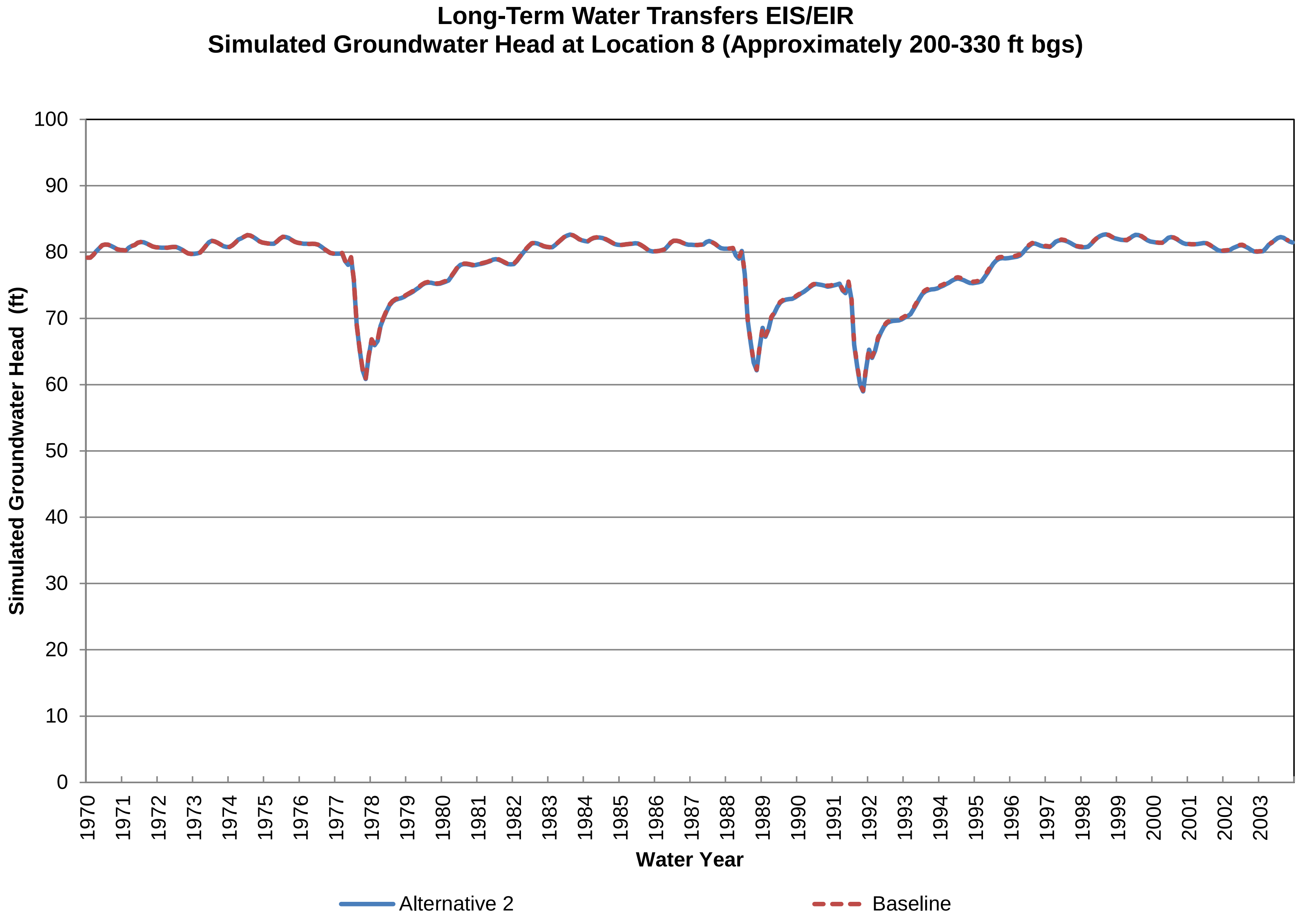
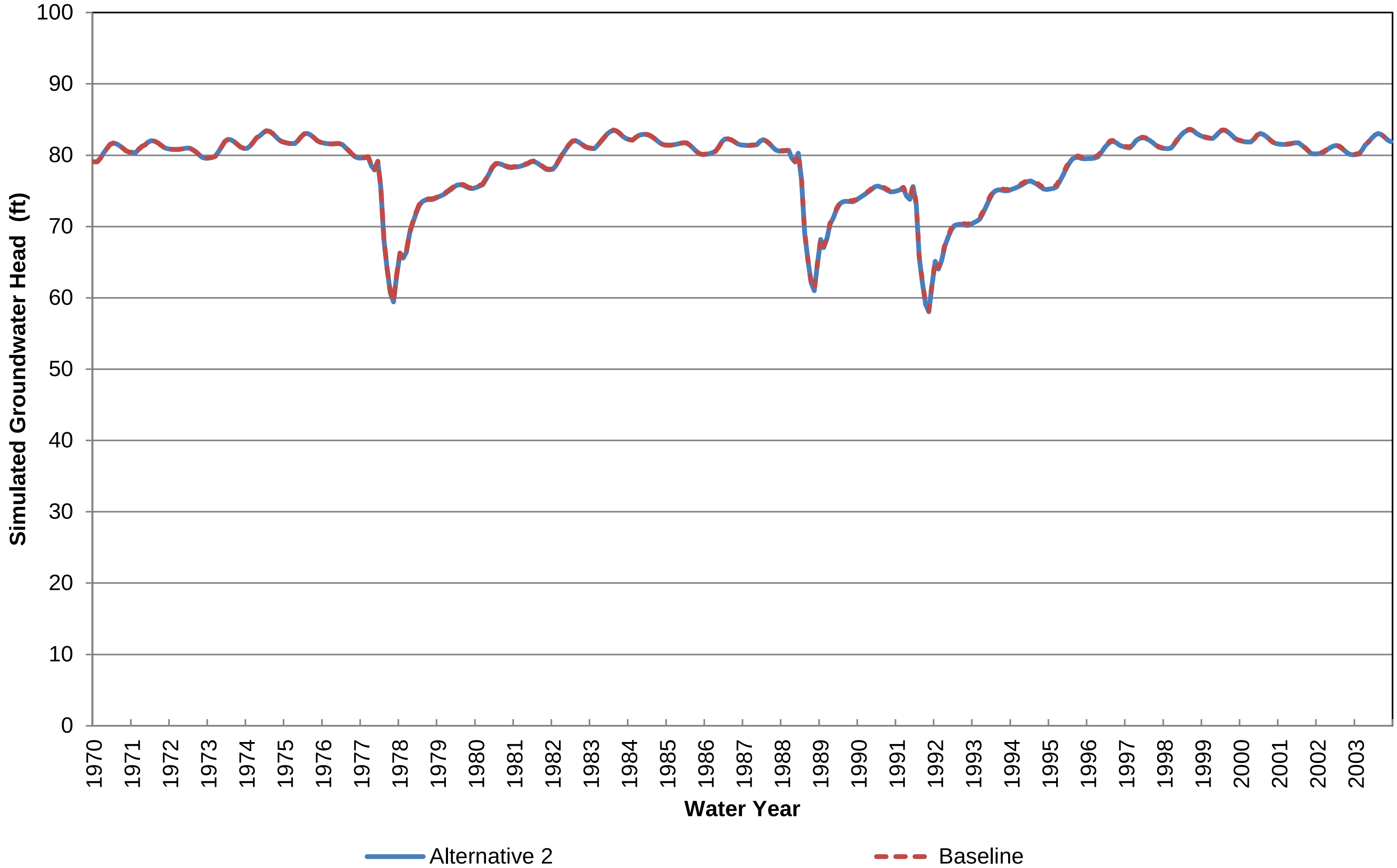
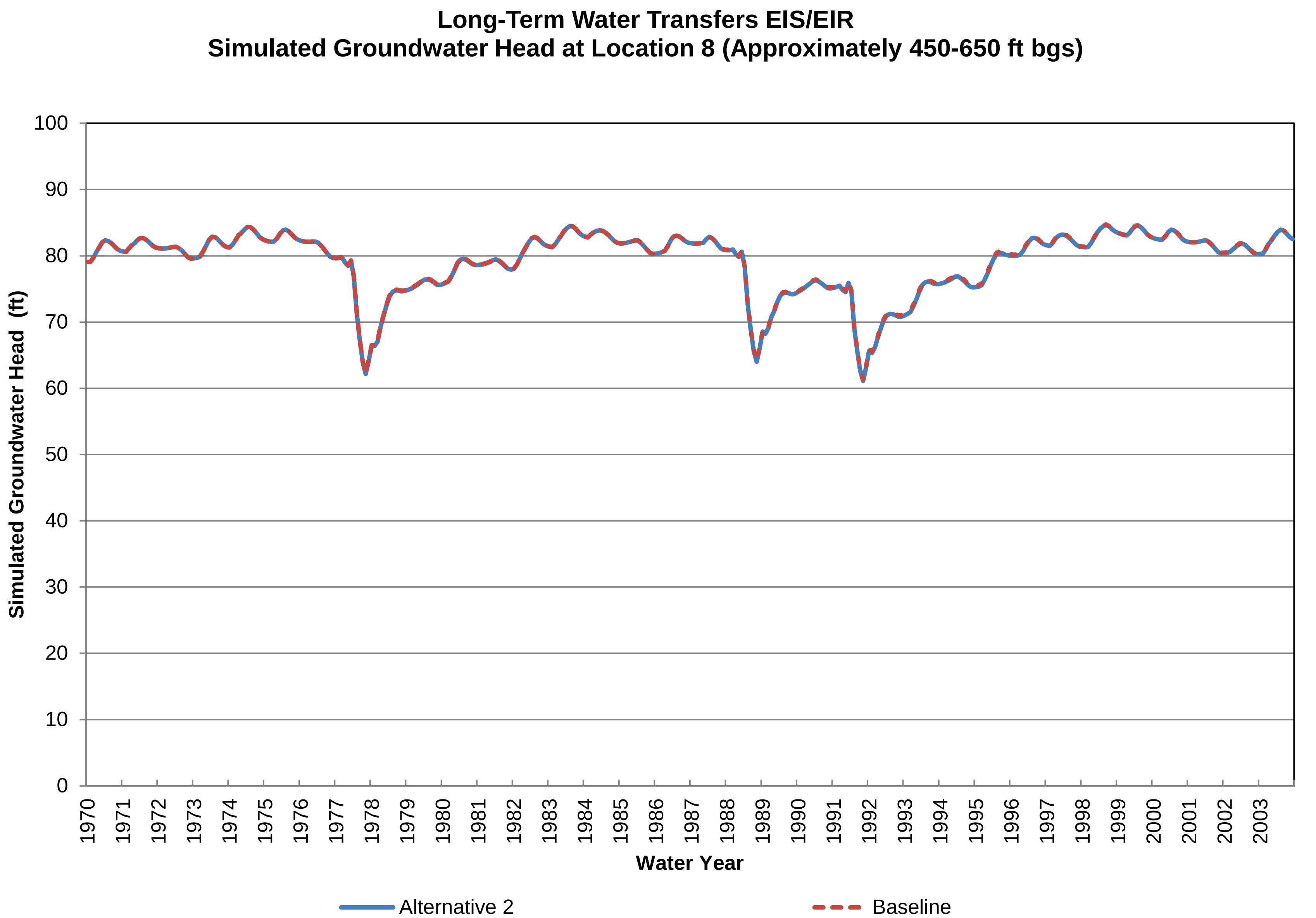
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 200-330 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 330-450 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 450-650 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
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1988
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1990
1991
1992
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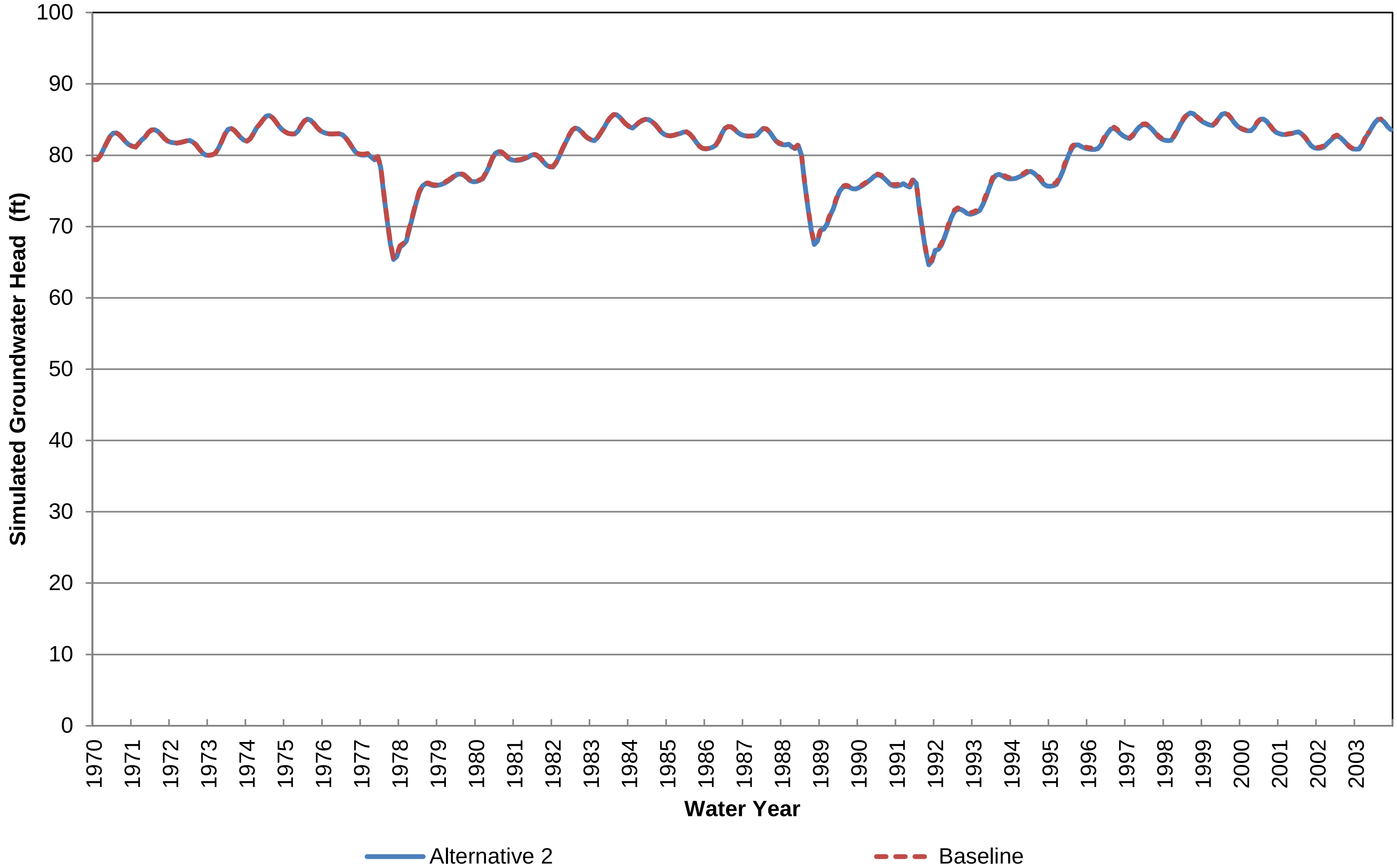
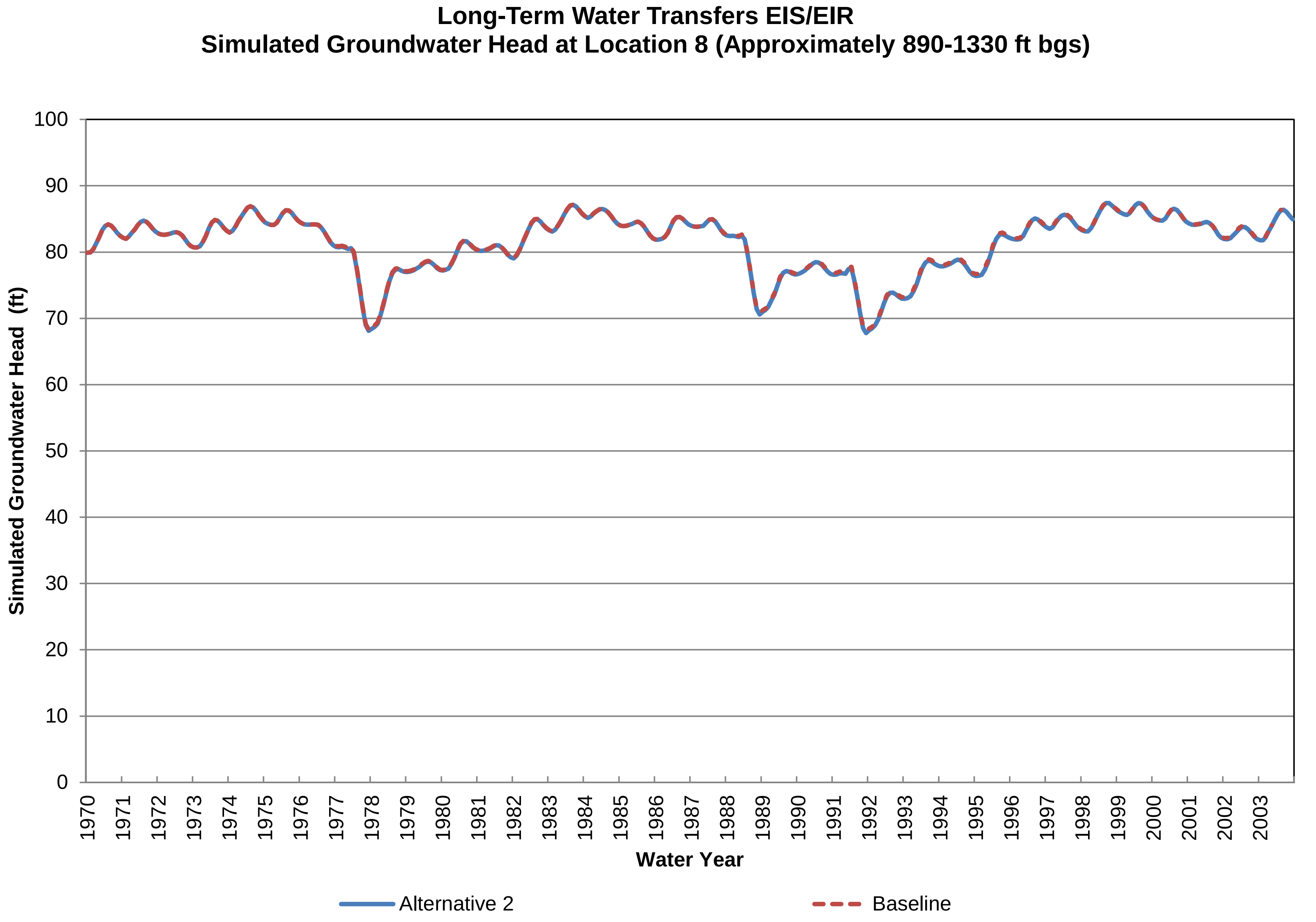
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 650-890 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 8 (Approximately 890-1330 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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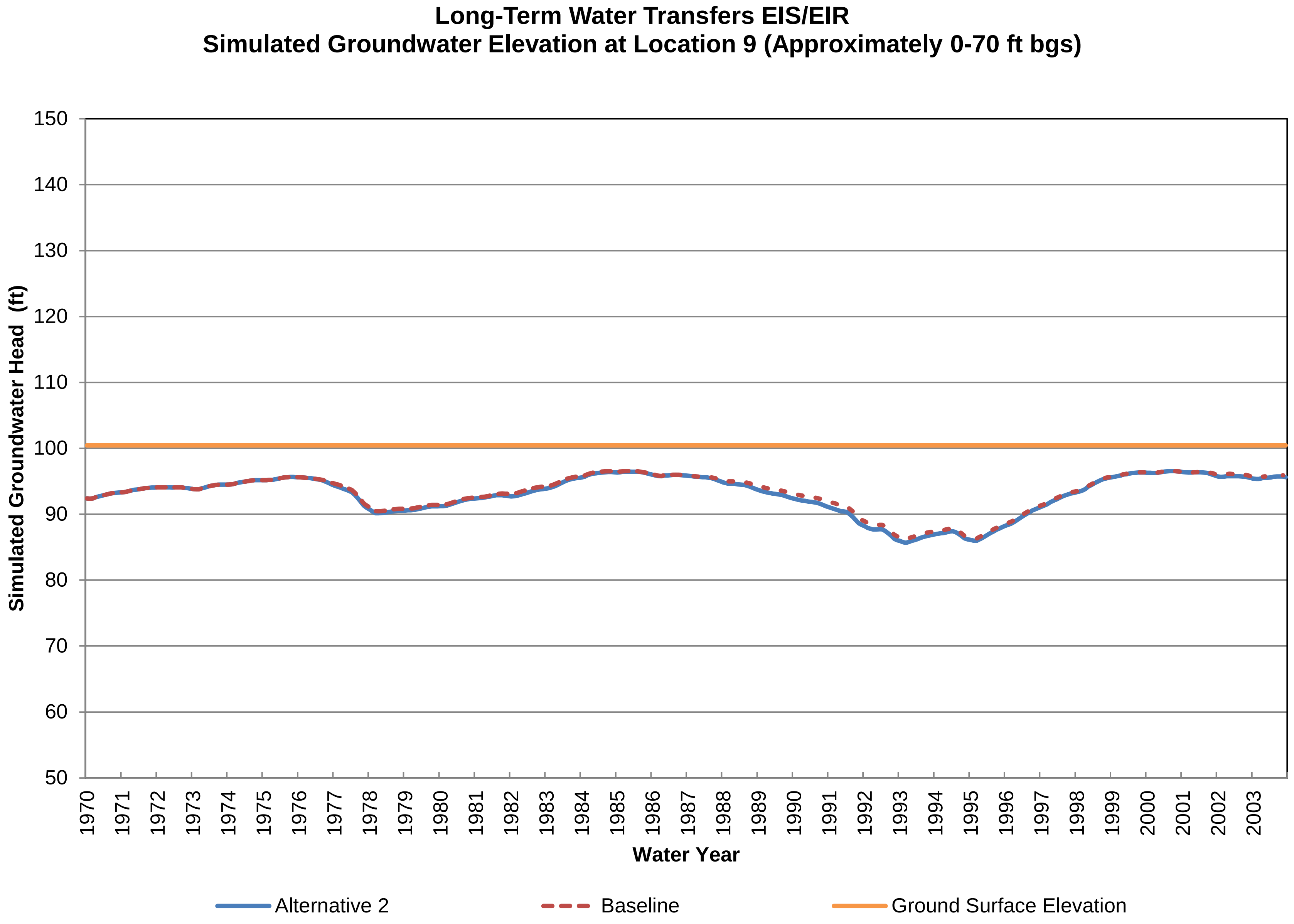
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 9 (Approximately 0-70 ft bgs)
150
140
130
120
110
100
90
80
70
60
50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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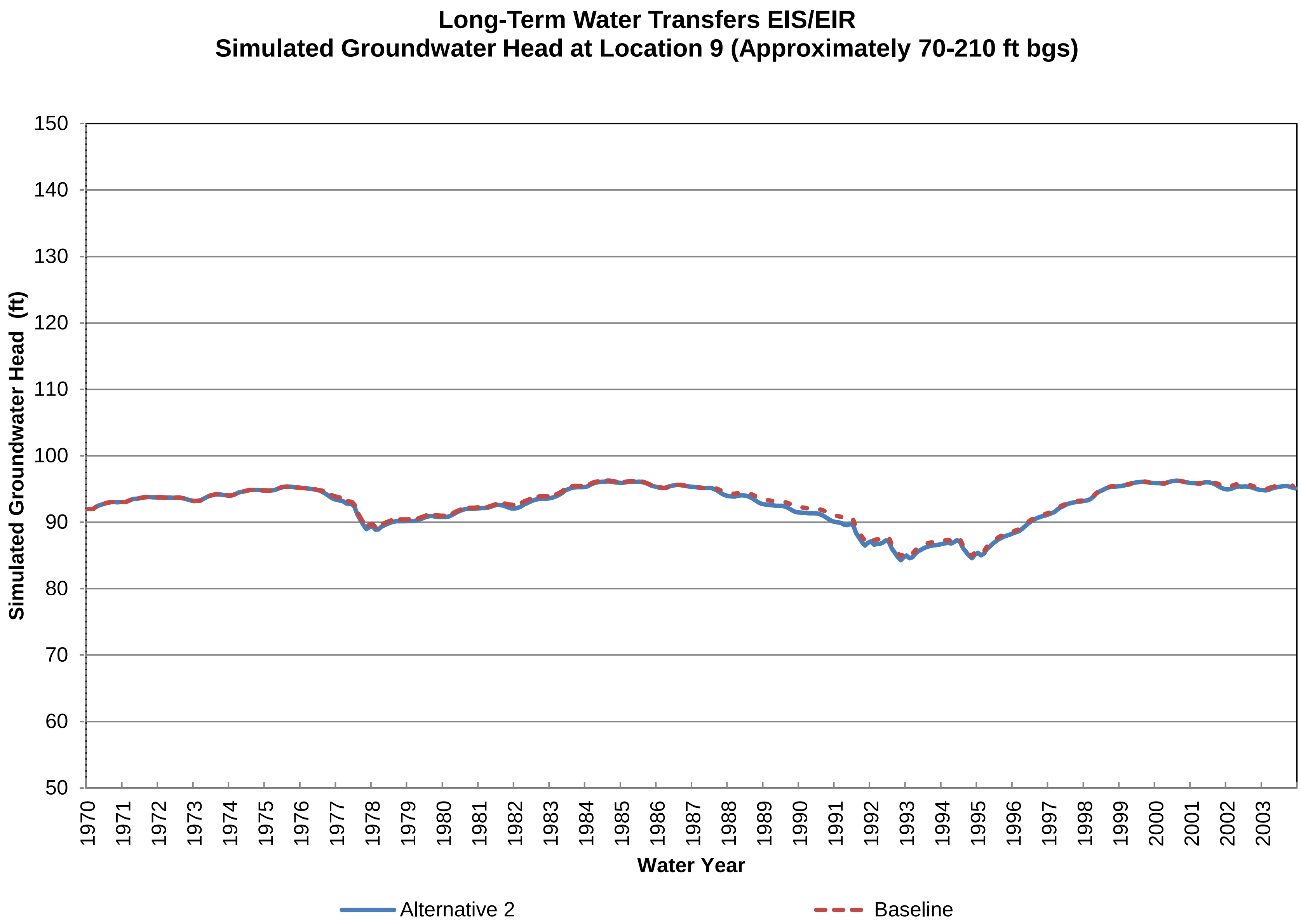
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1983
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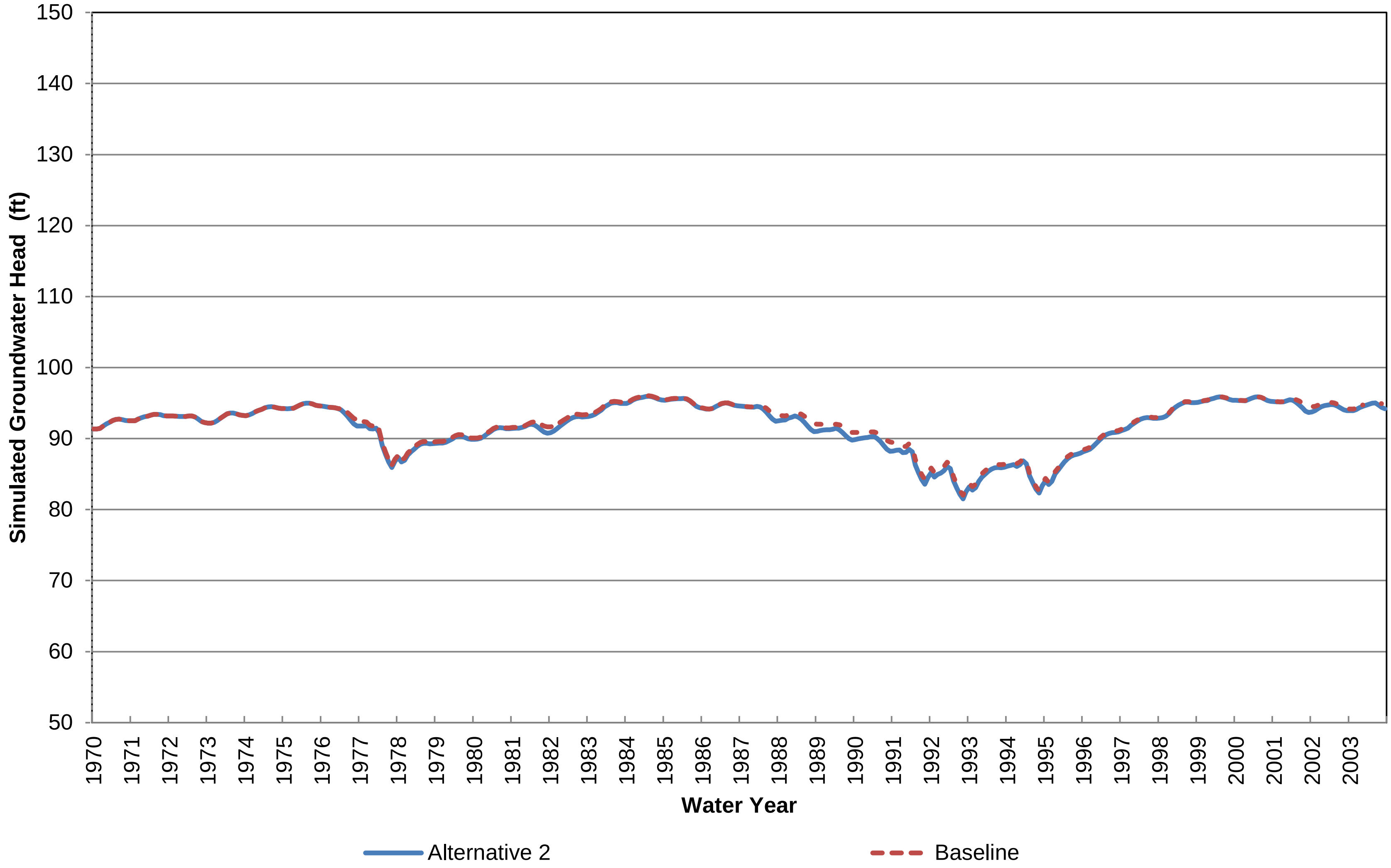
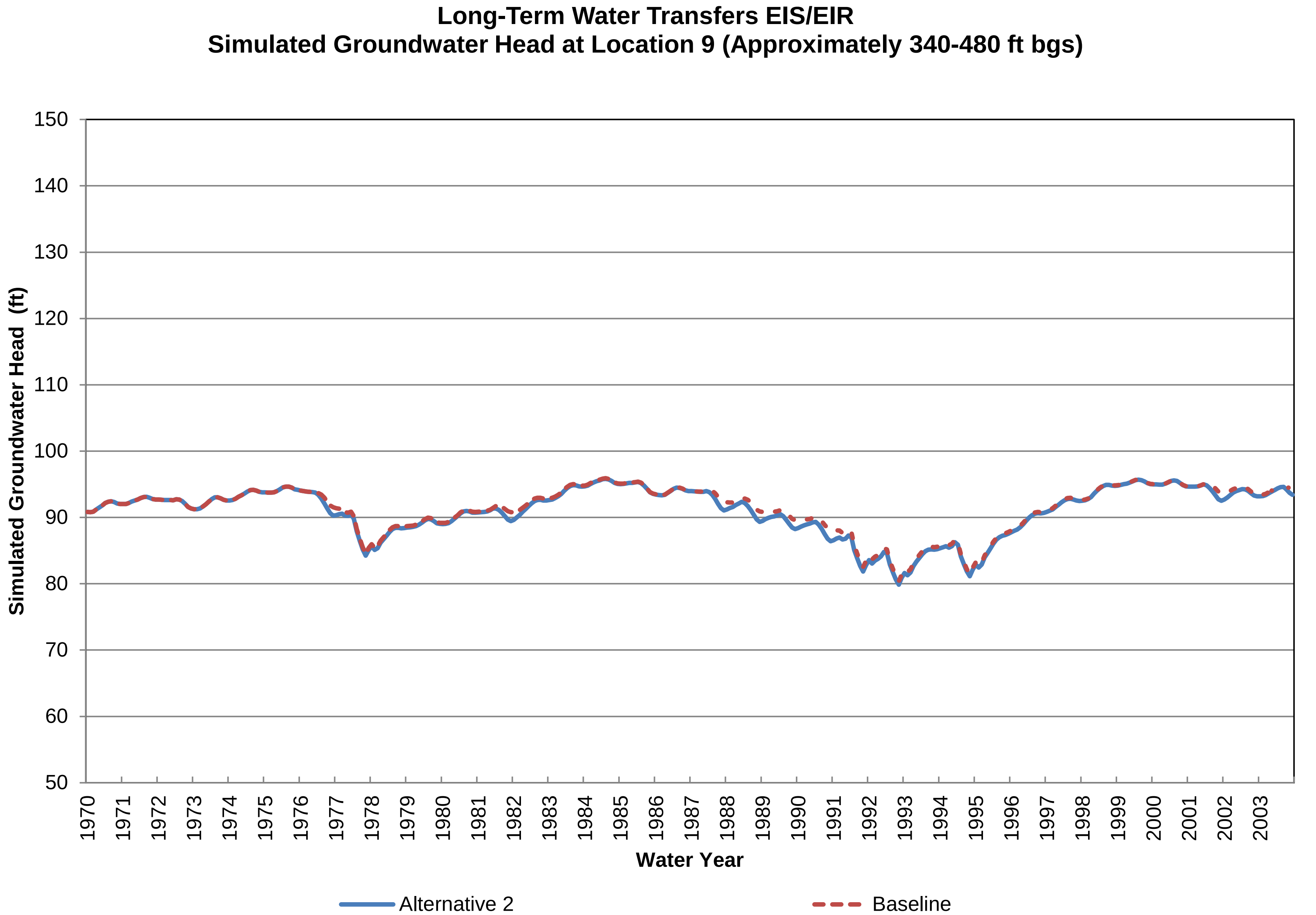
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 210-340 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 340-480 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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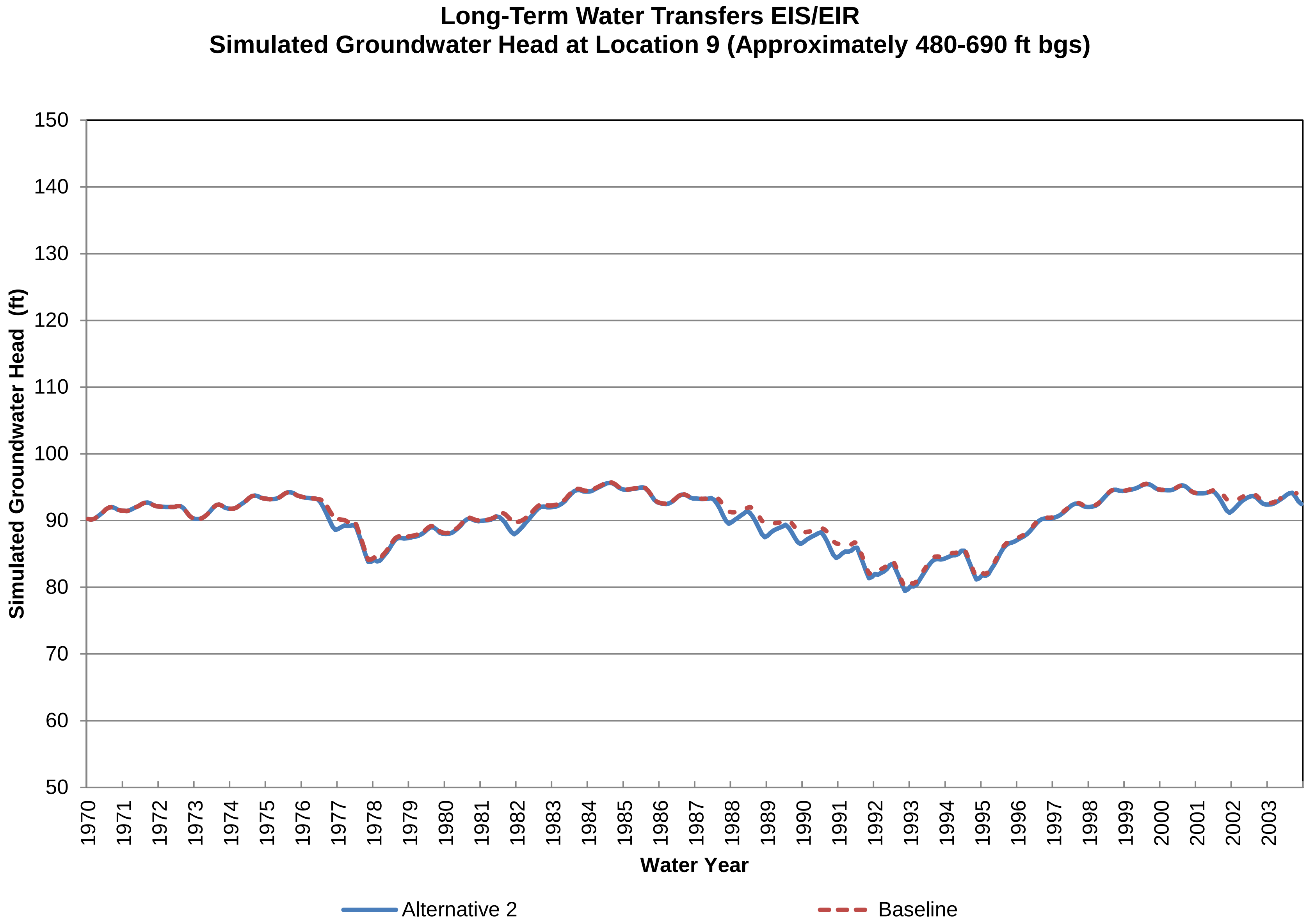
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 480-690 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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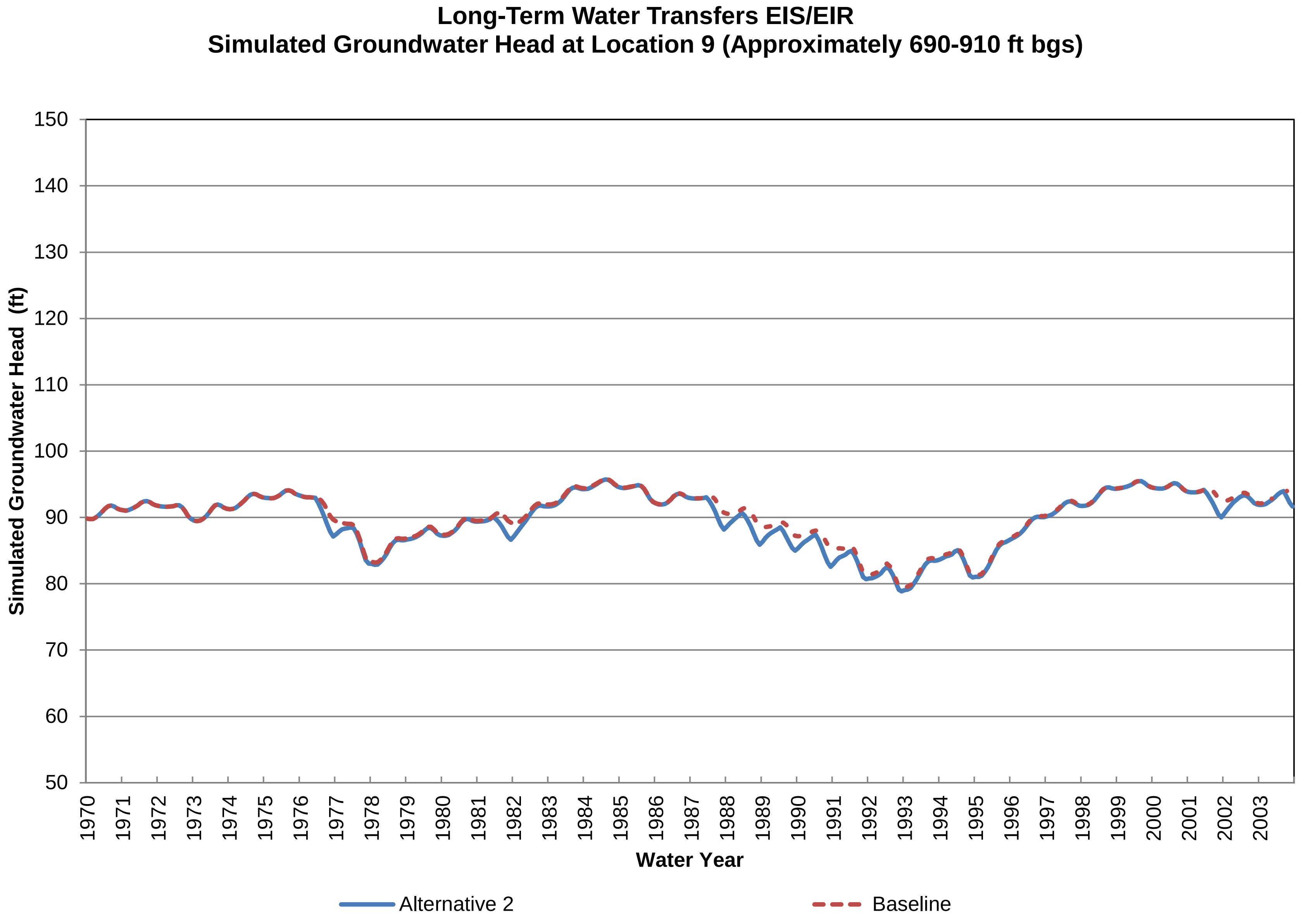
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 690-910 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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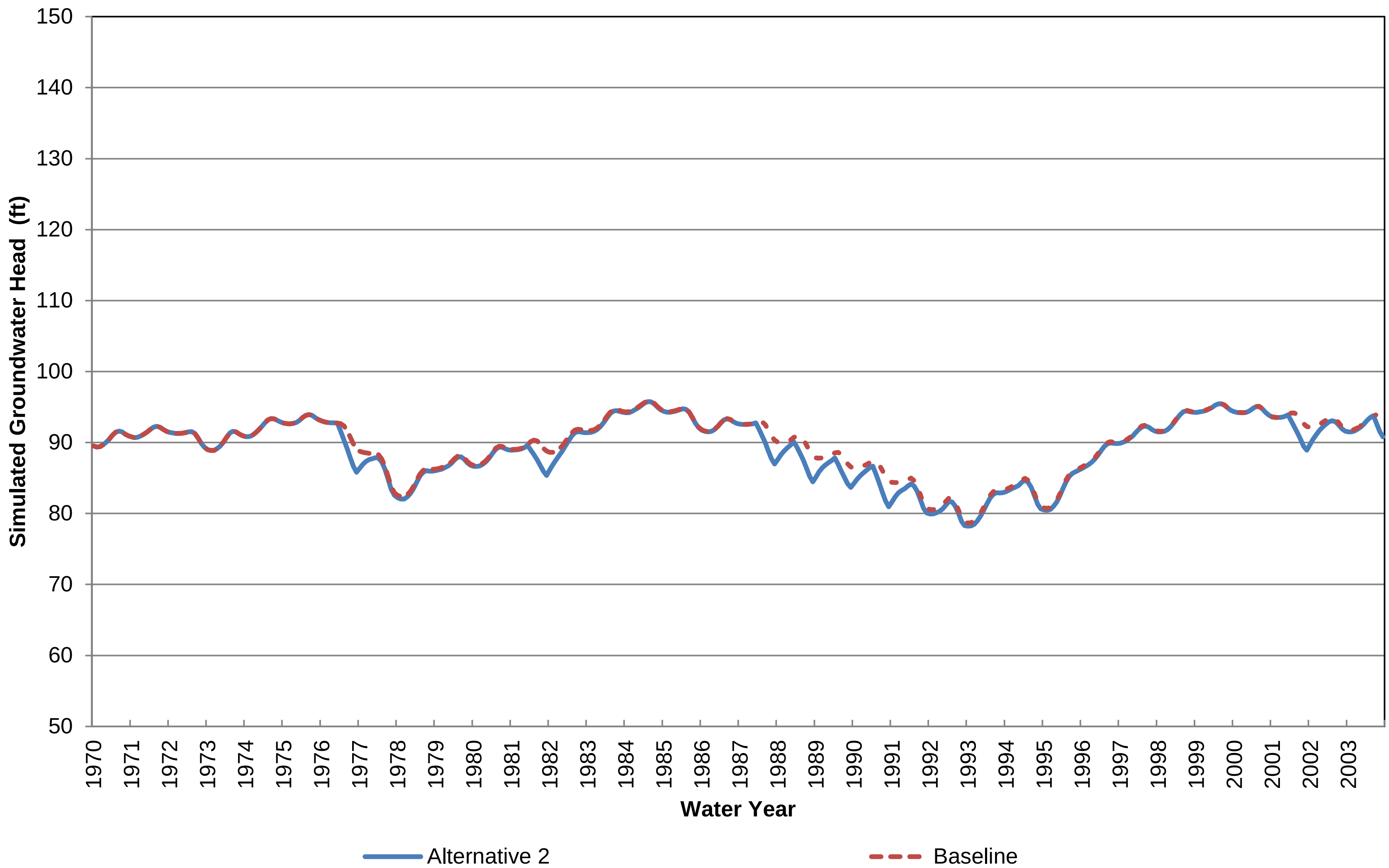
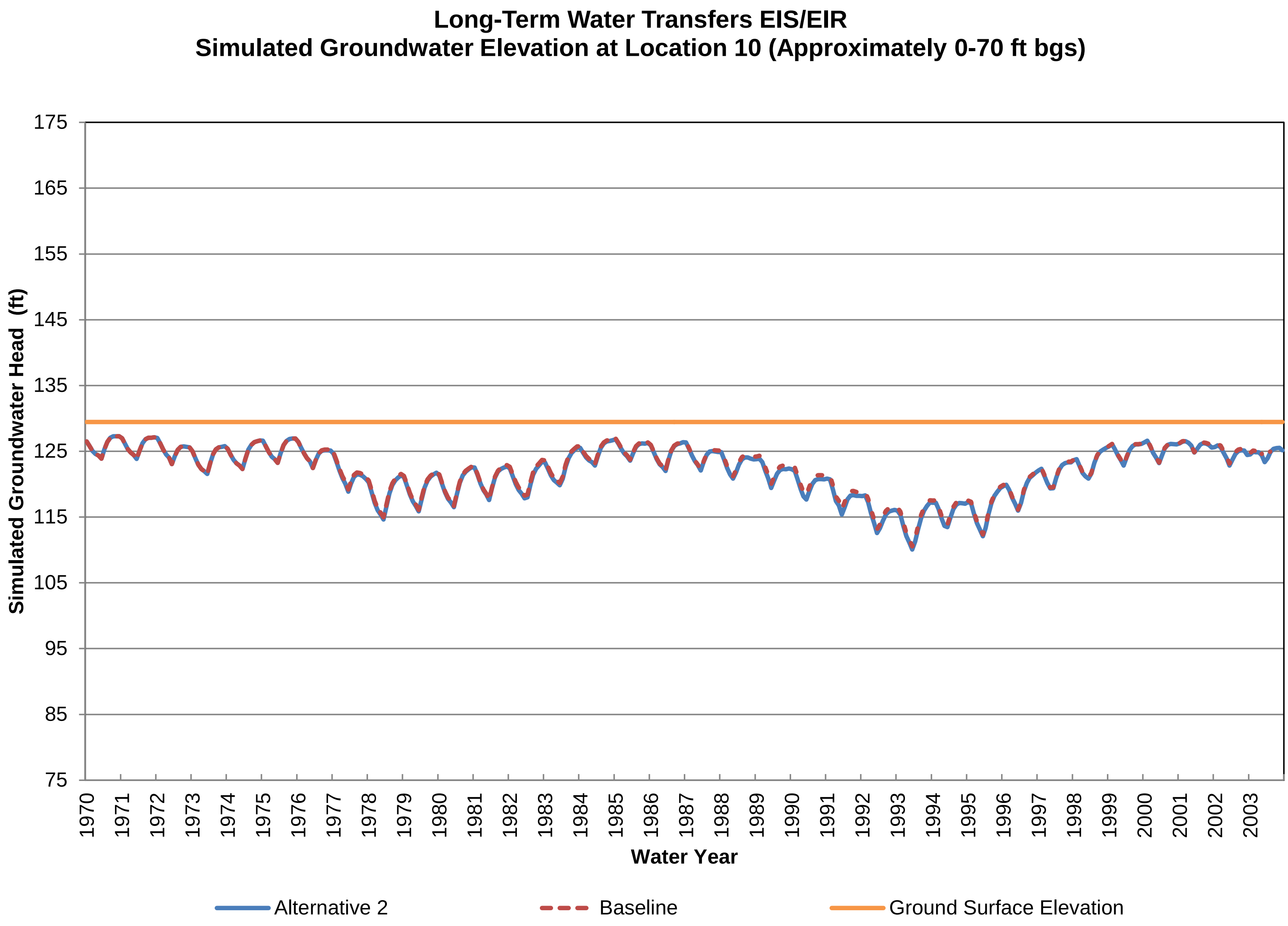
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 9 (Approximately 910-1250 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 10 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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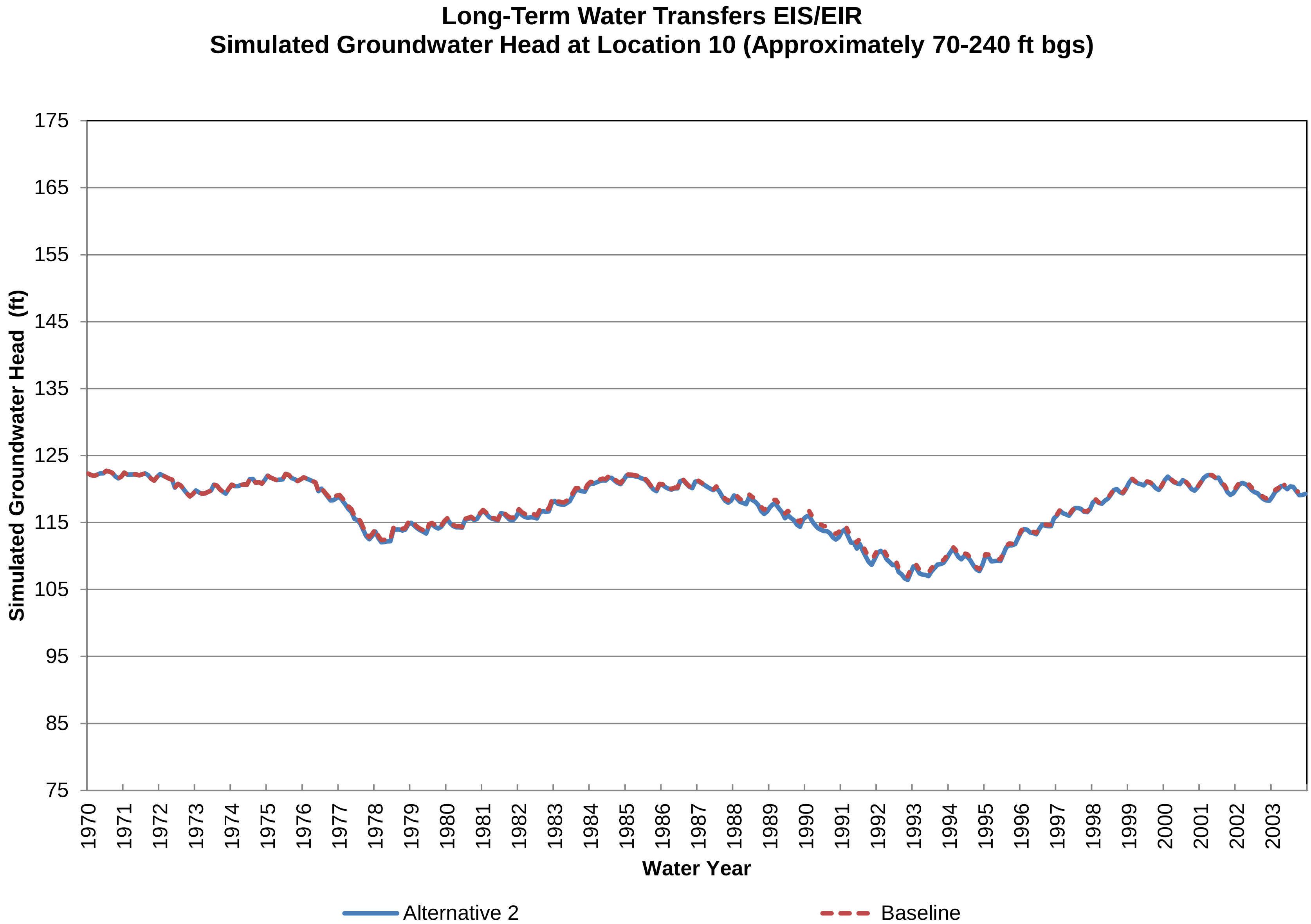
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 70-240 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
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1987
1988
1989
1990
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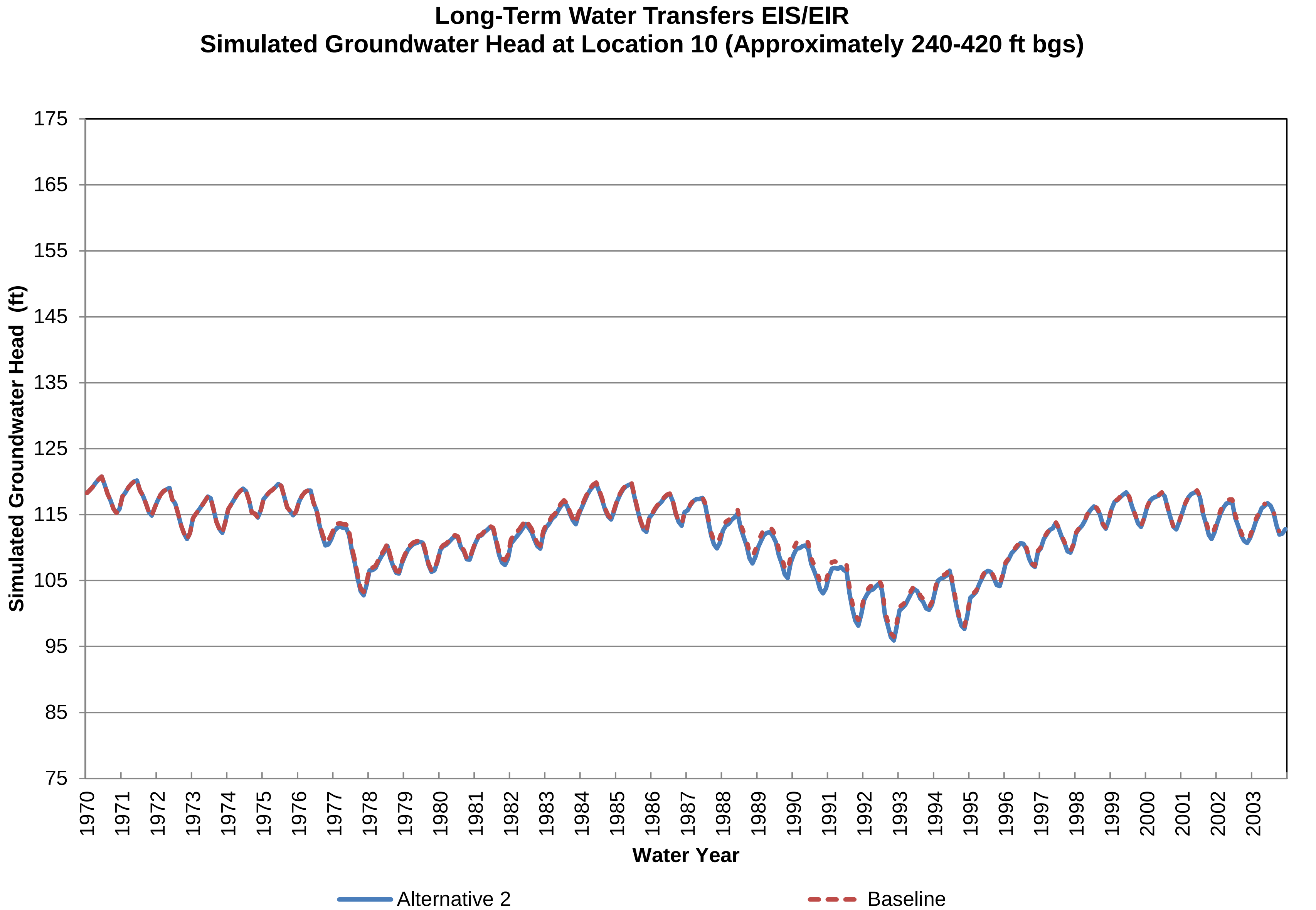
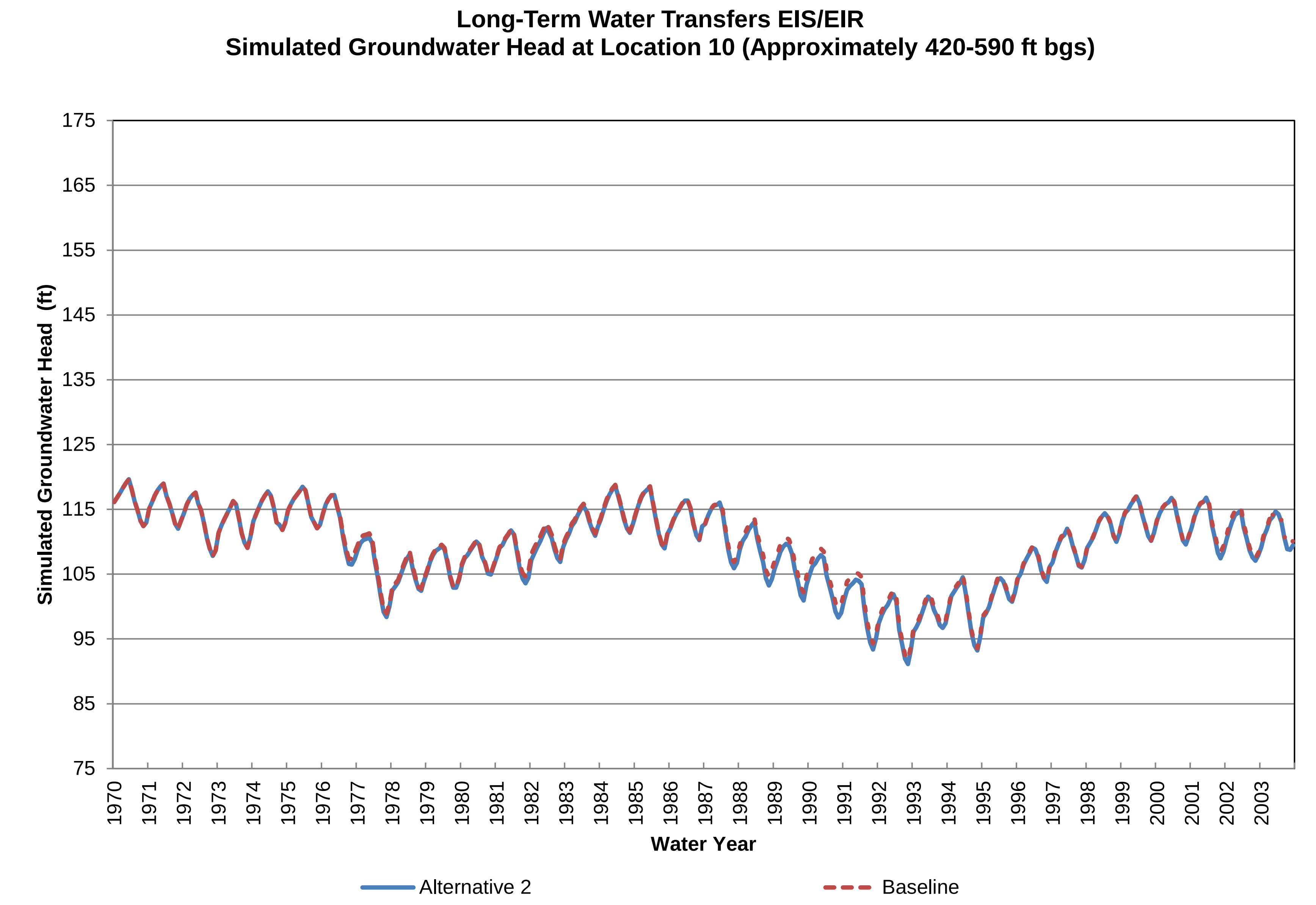
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 240-420 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 420-590 ft bgs)
175
165
155
145
135
125
115
105
95
85
75
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
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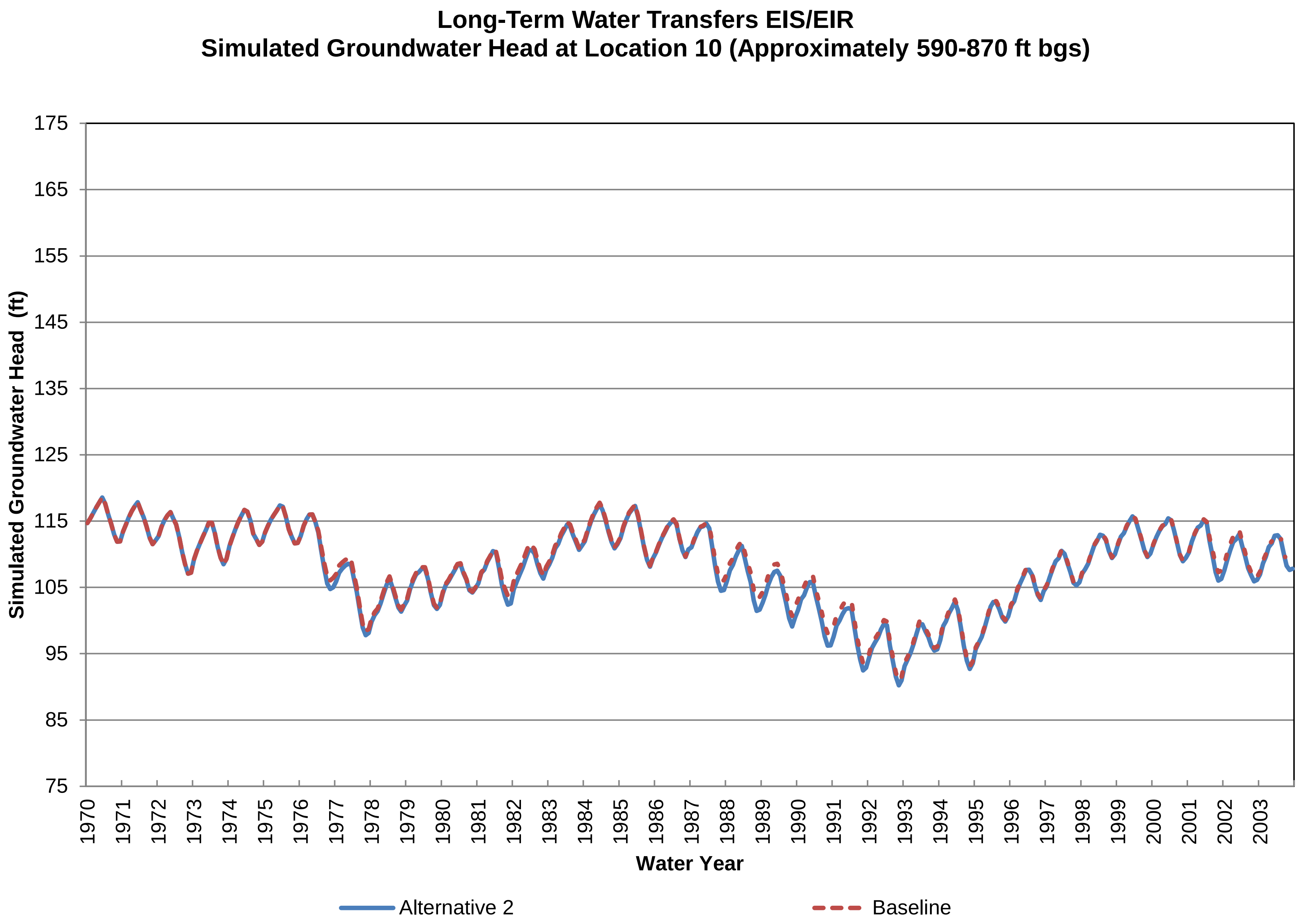
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 590-870 ft bgs)
Simulated Groundwater Head (ft)
175
165
155
145
135
125
115
105
95
85
75
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1992
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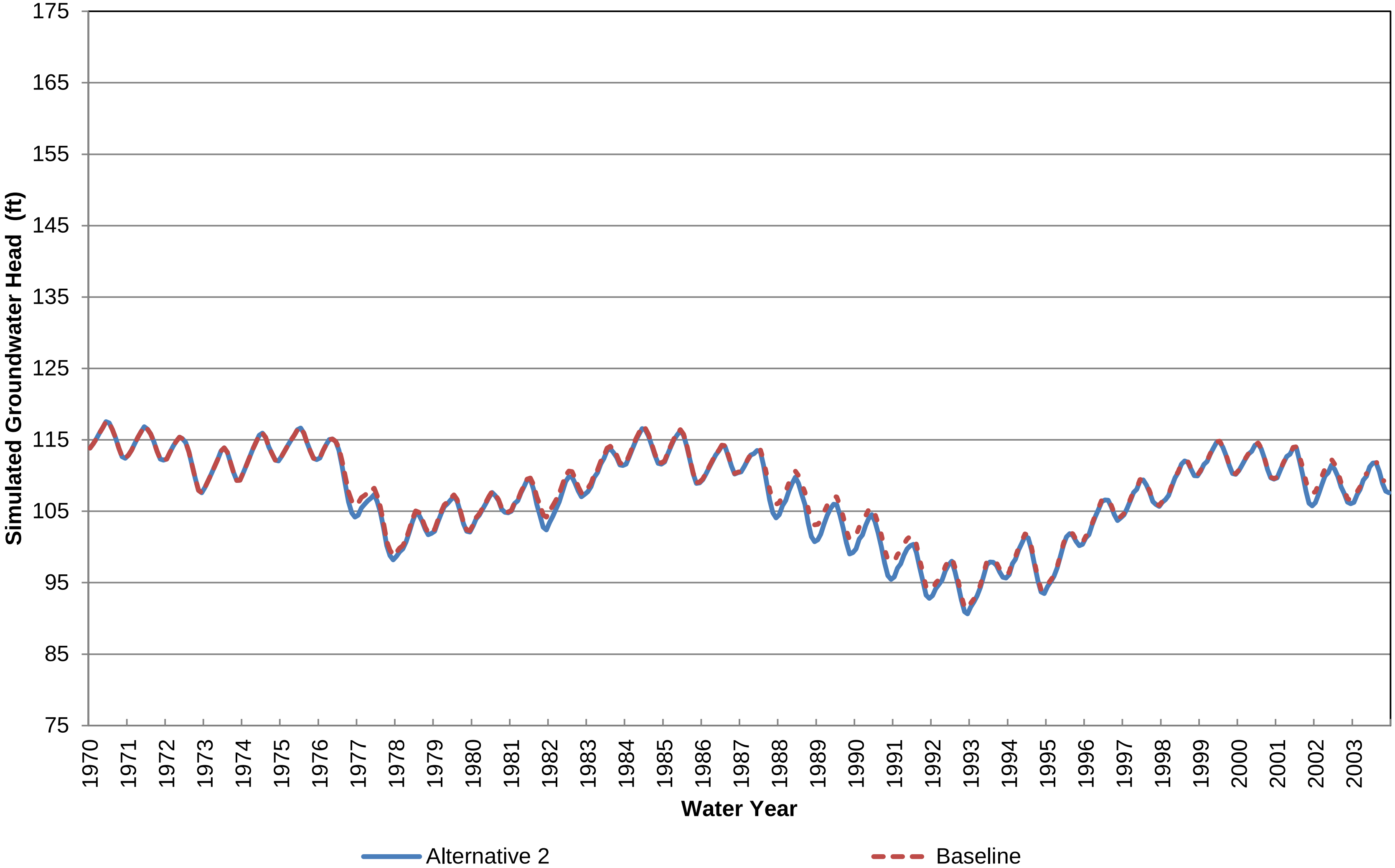
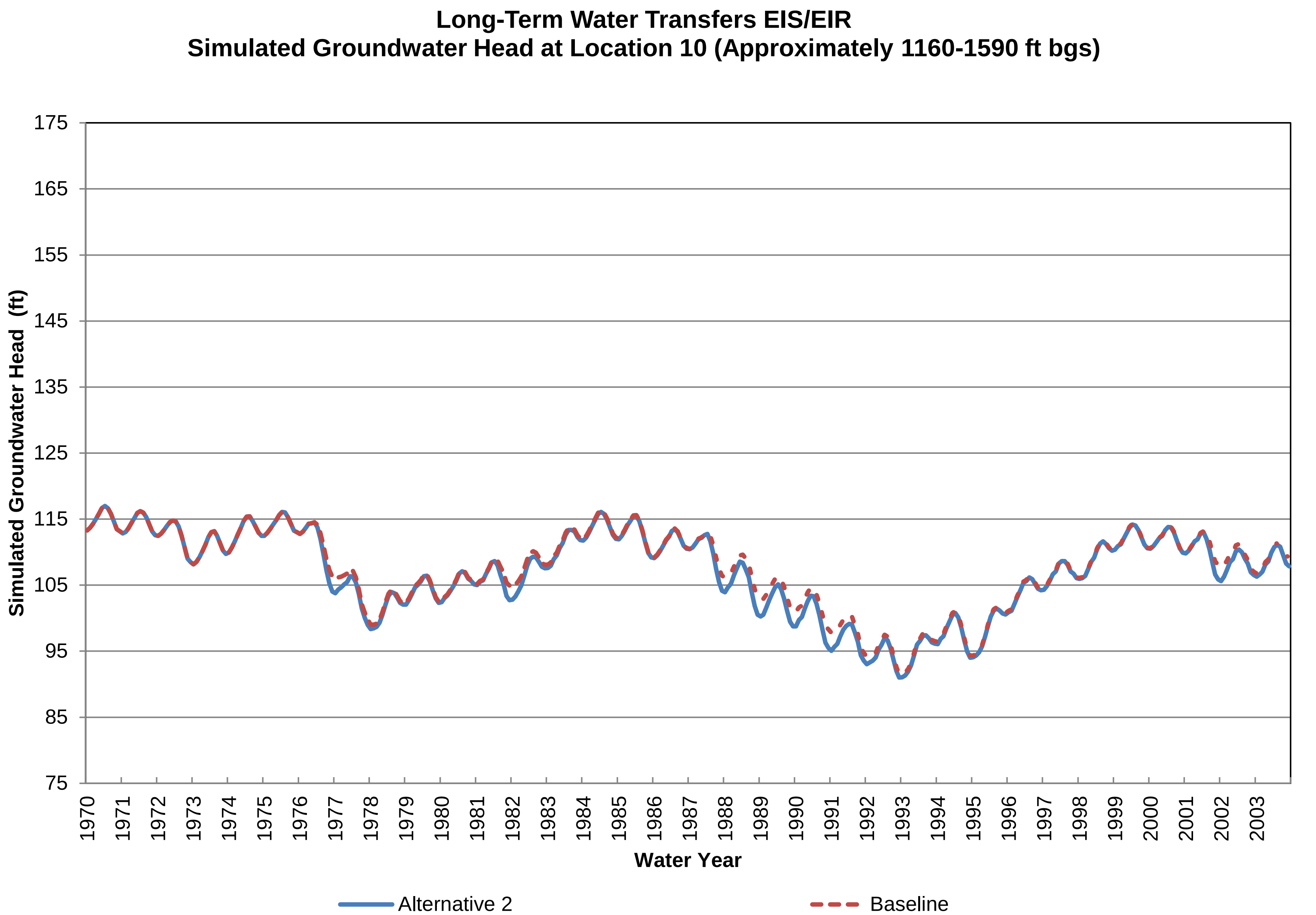
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 870-1160 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 10 (Approximately 1160-1590 ft bgs)
175
165
155
145
135
125
115
105
95
85
75
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1986
1987
1988
1989
1990
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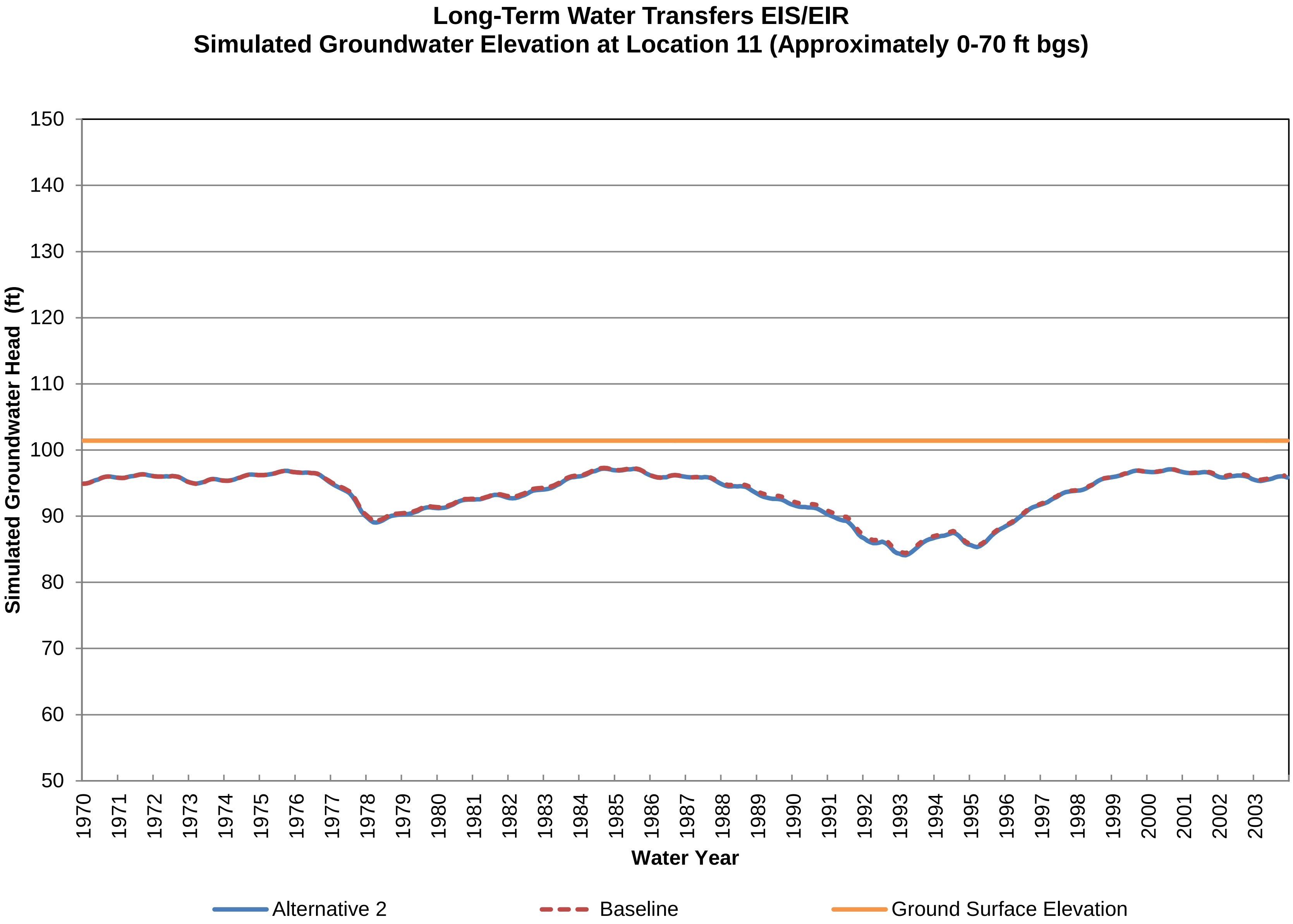
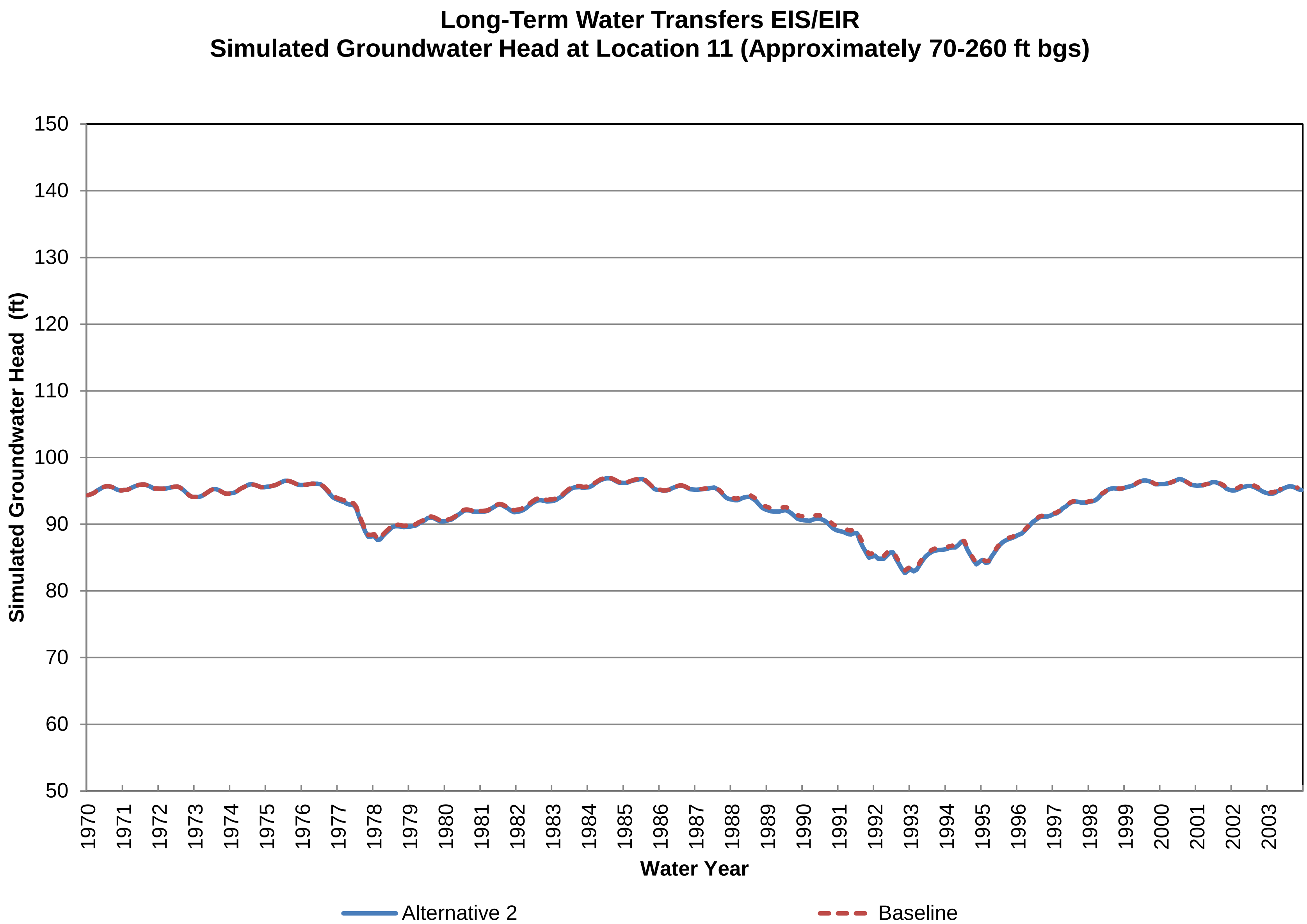
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 11 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 70-260 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1987
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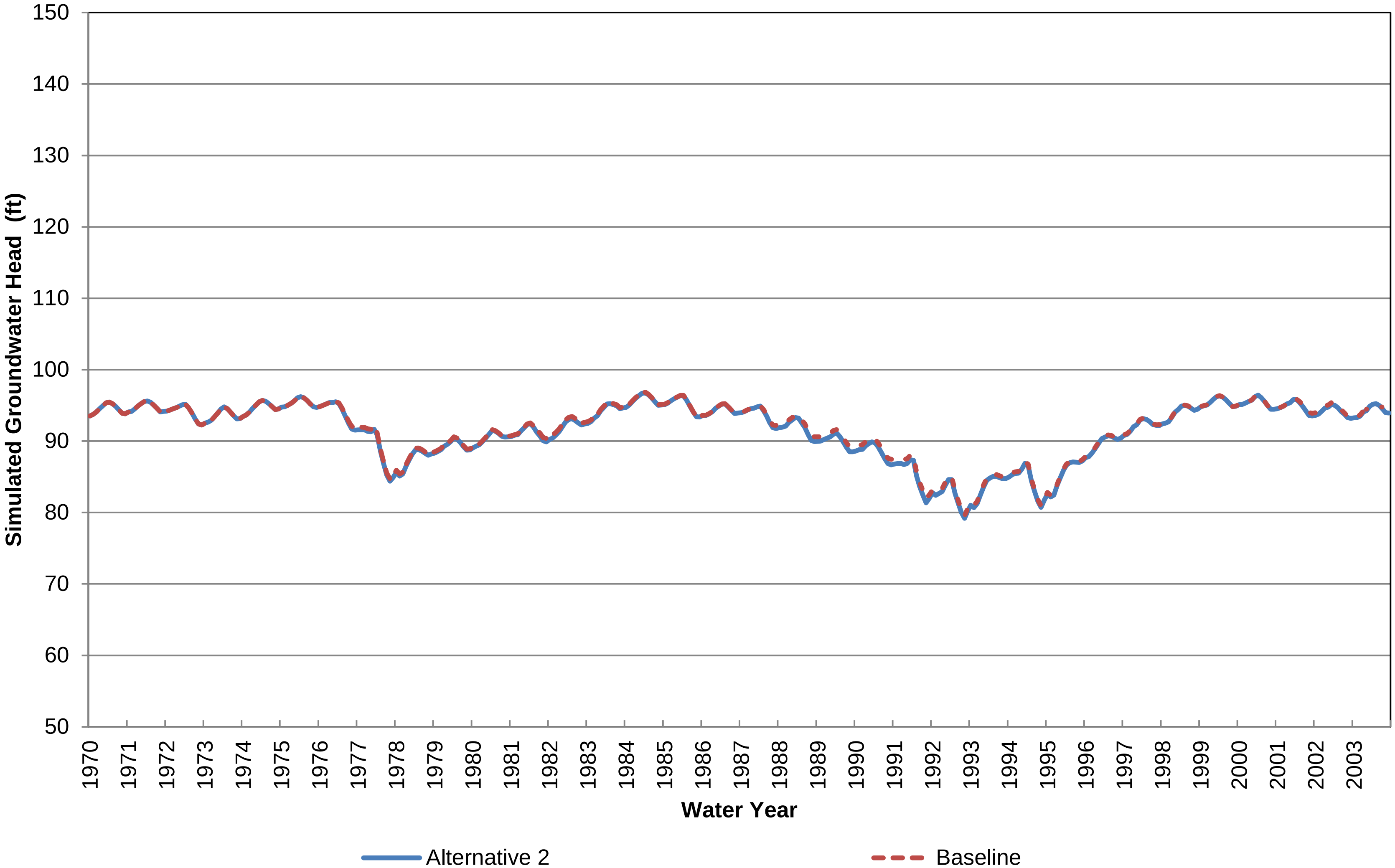
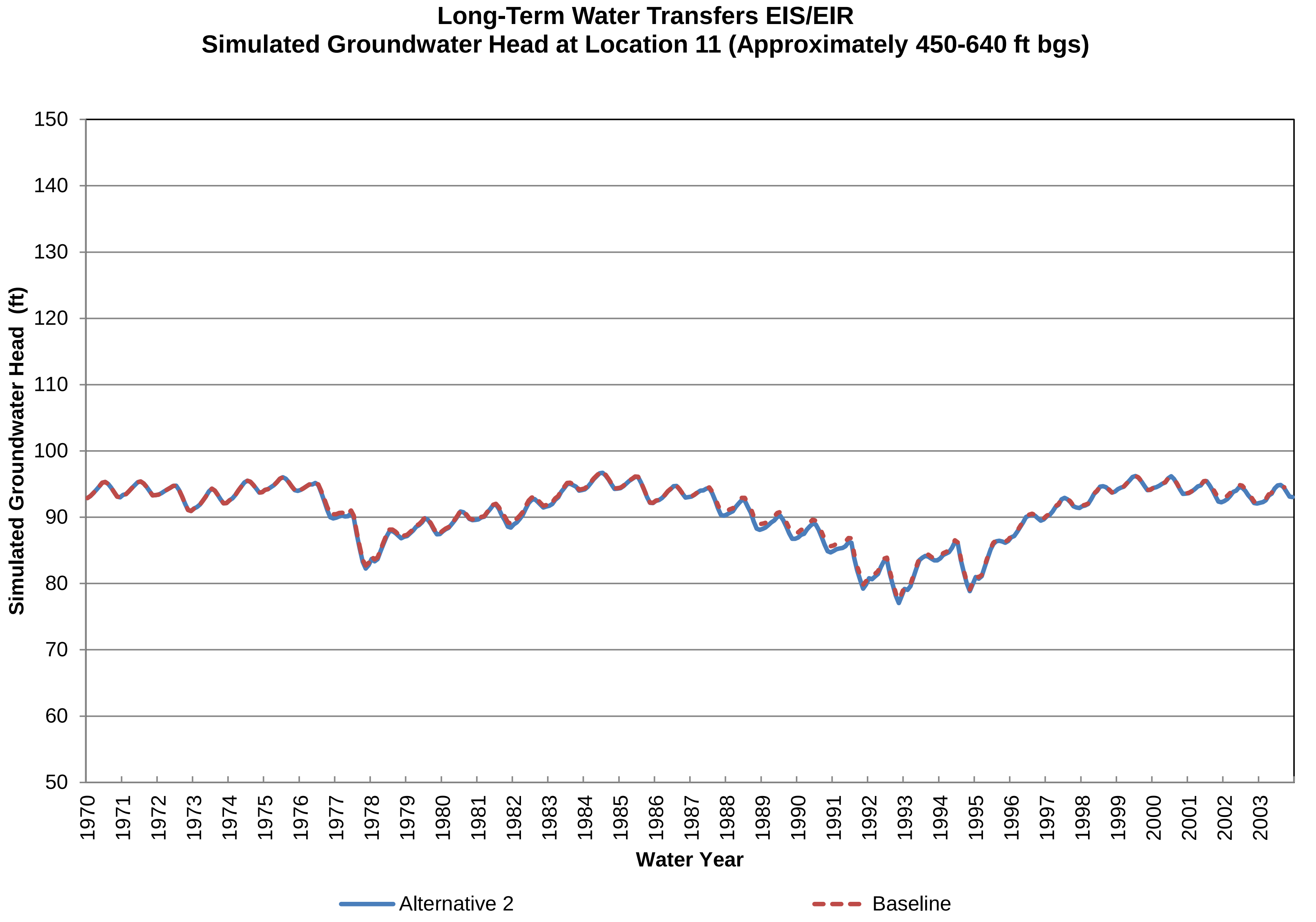
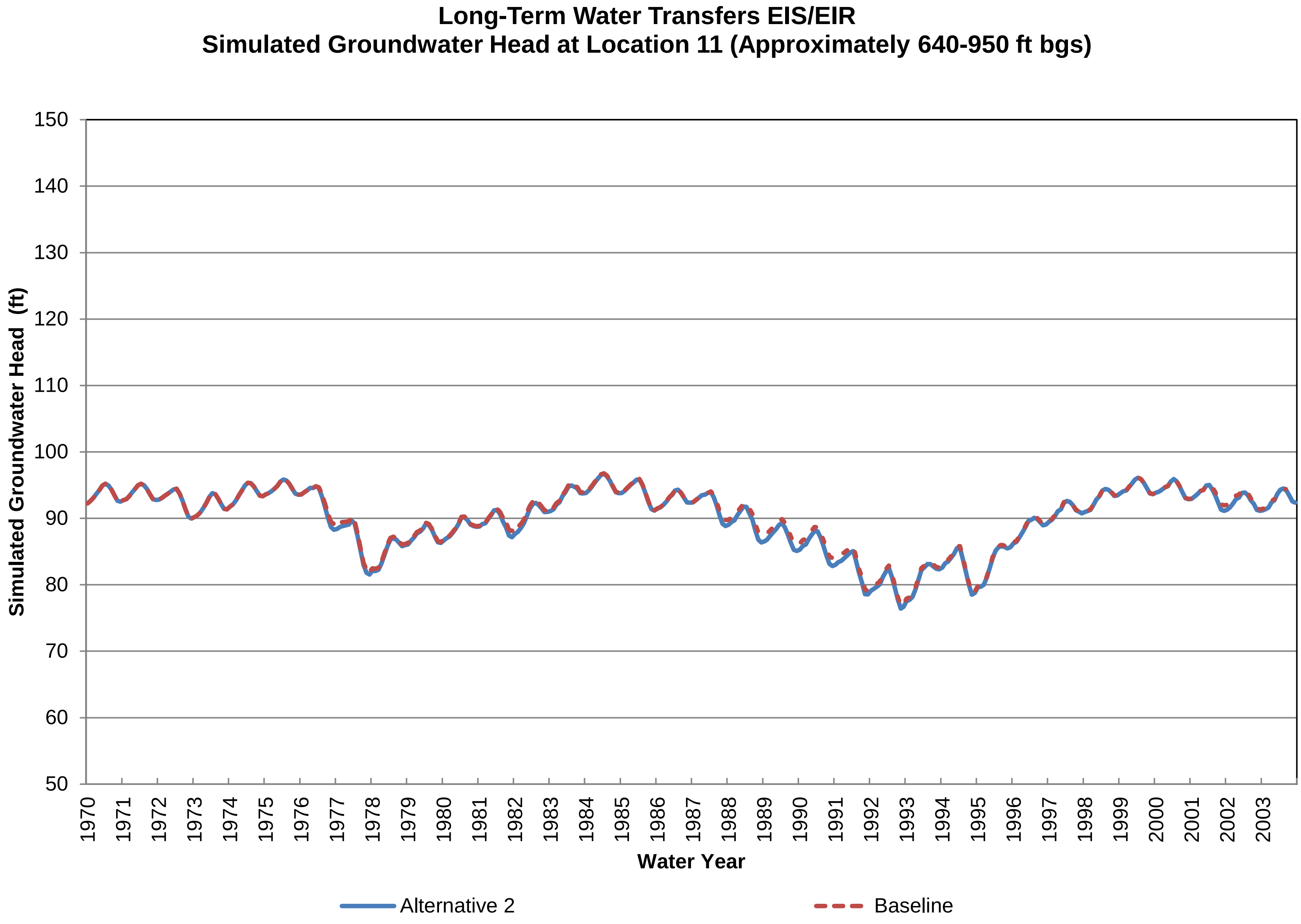
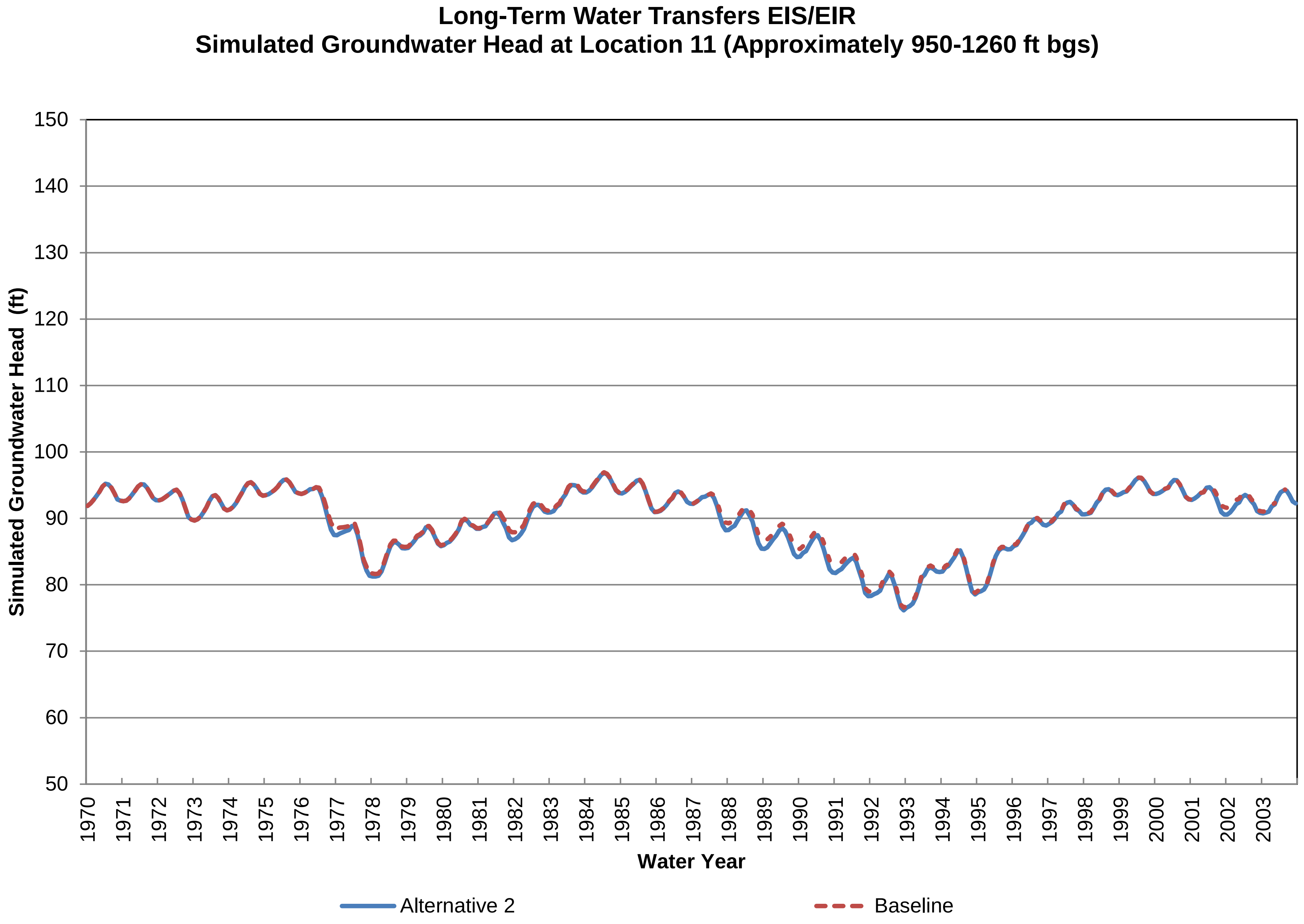
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 260-450 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 450-640 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 640-950 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 950-1260 ft bgs)
Simulated Groundwater Head (ft)
150
140
130
120
110
100
90
80
70
60
50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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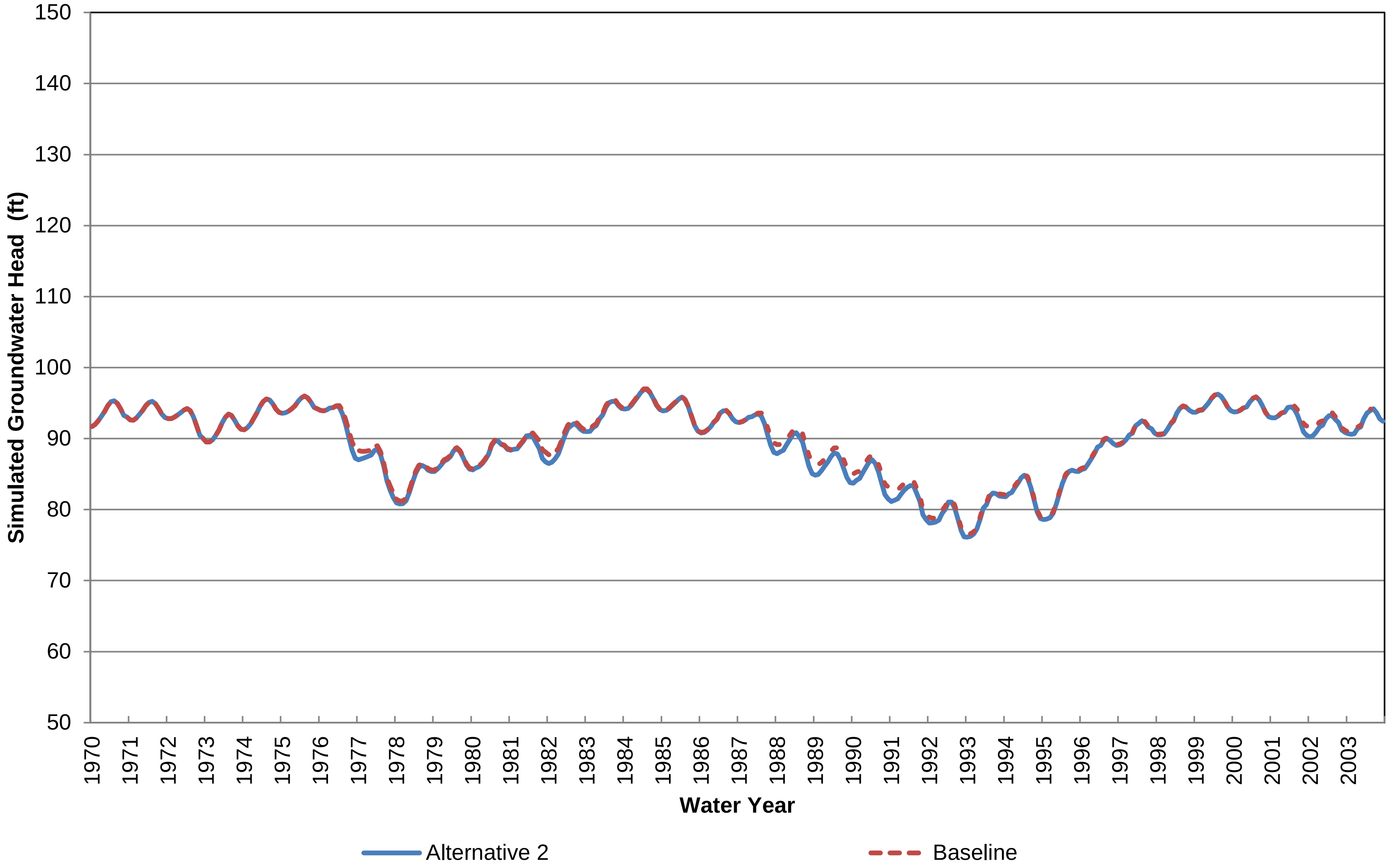
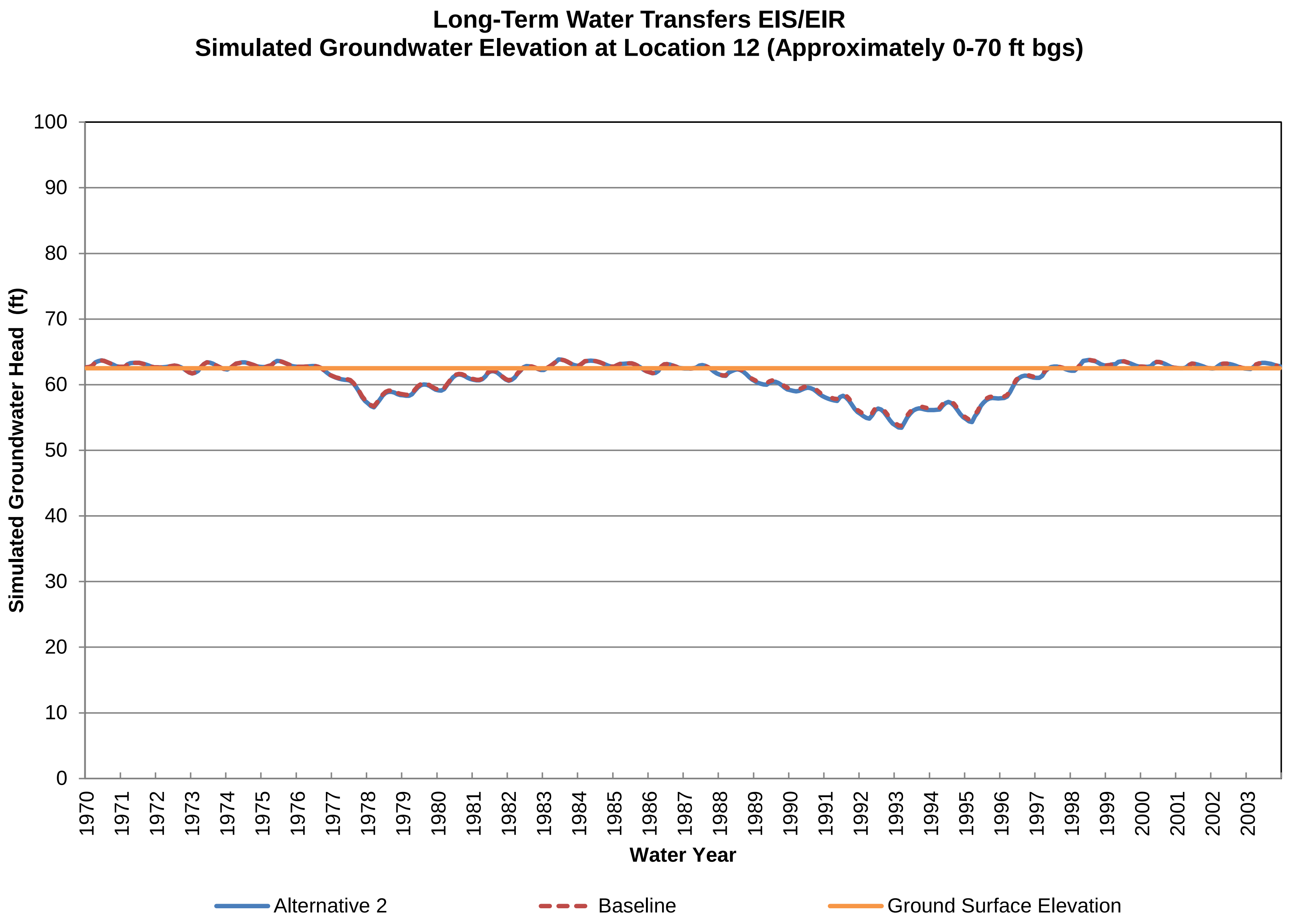
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

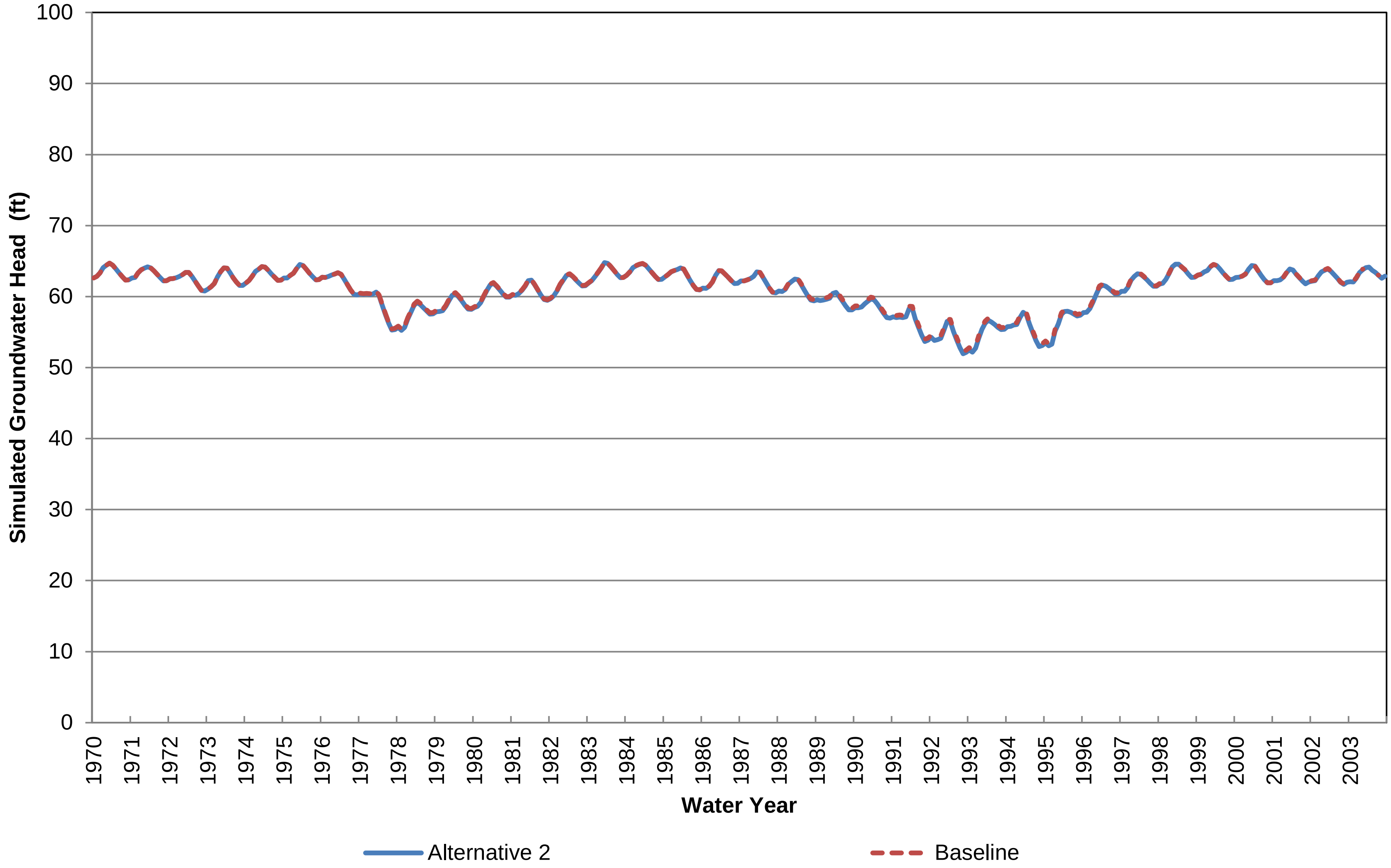
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 11 (Approximately 1260-1740 ft bgs)

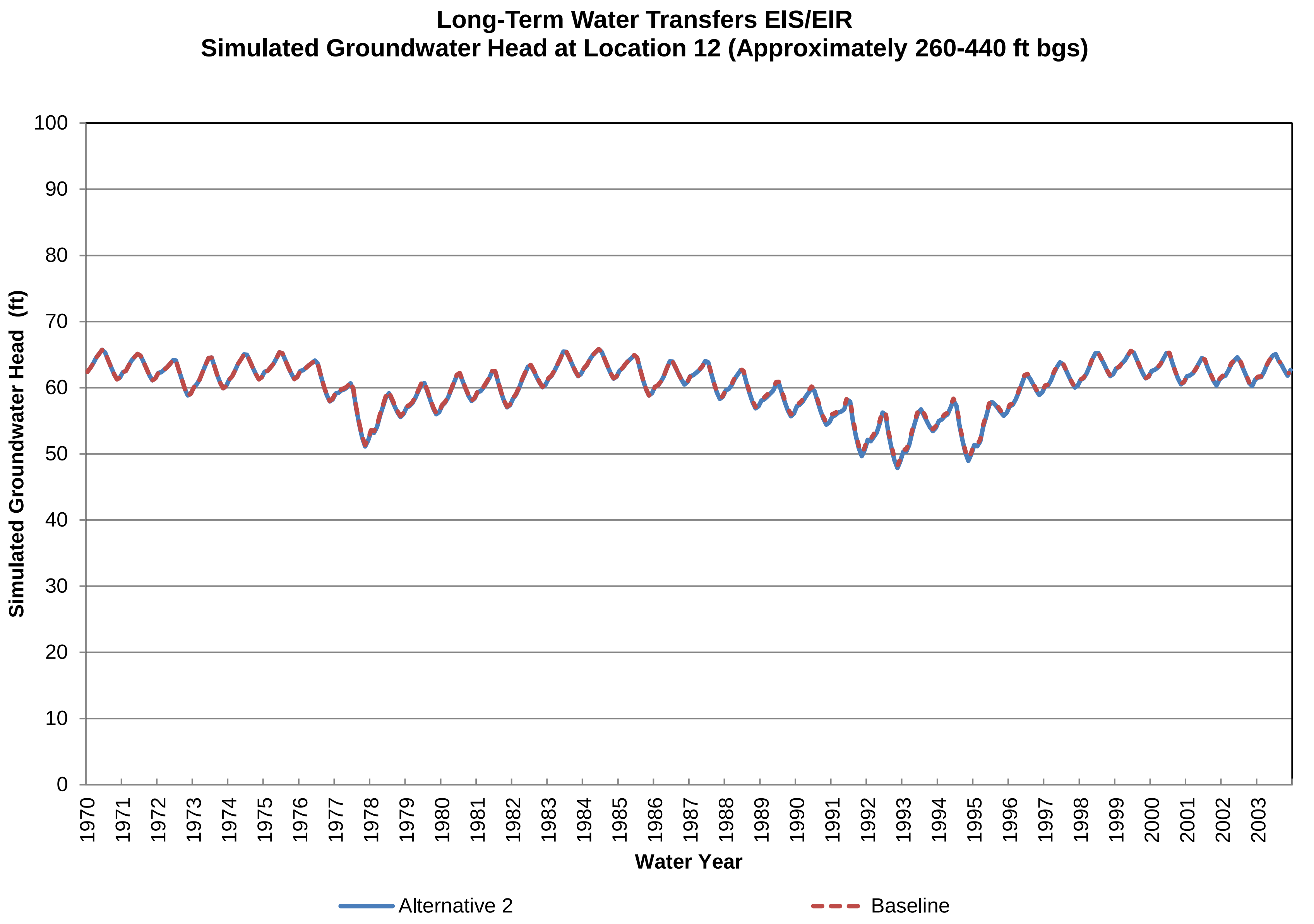



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 12 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

266B

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 70-260 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 260-440 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1989
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1994
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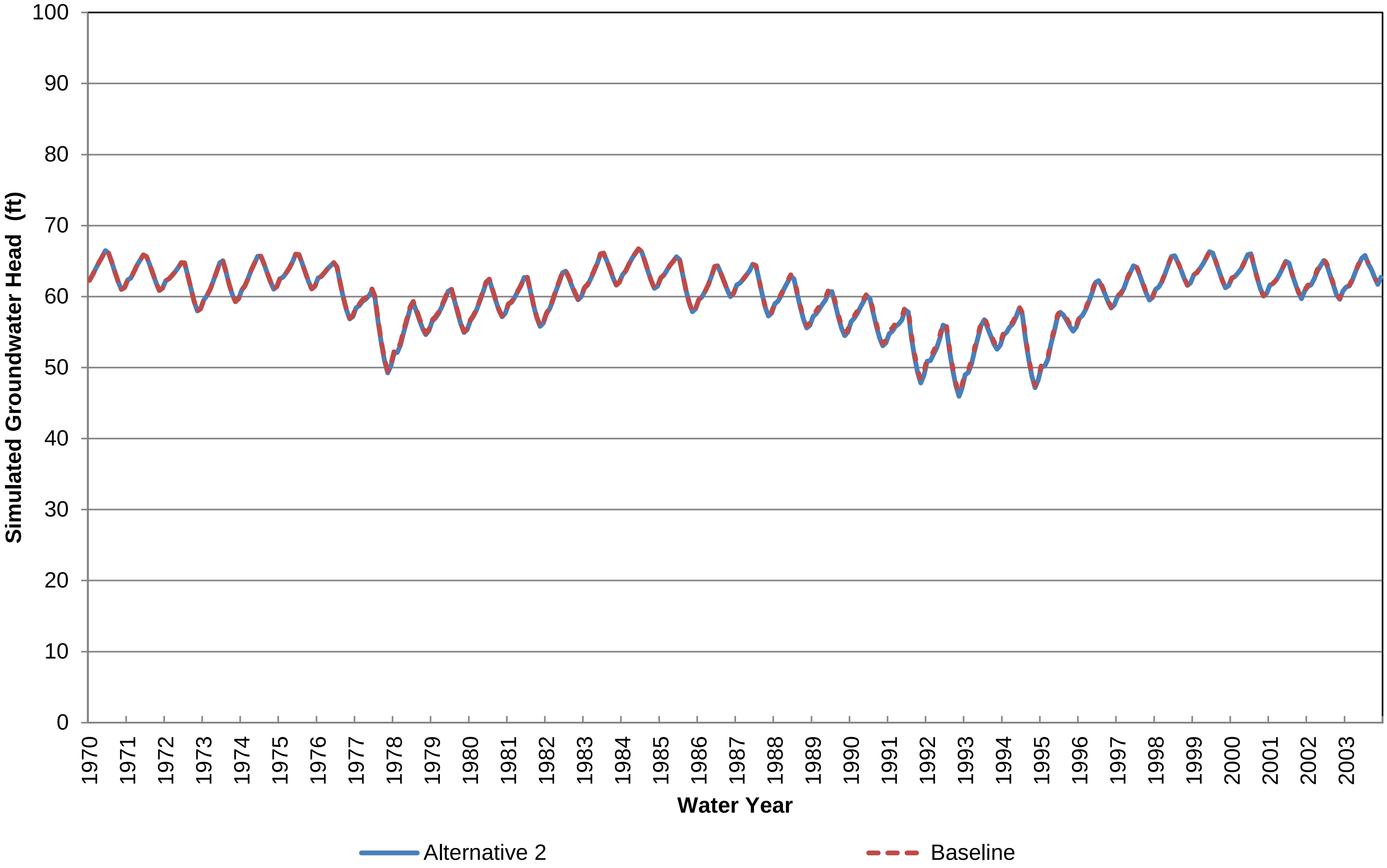
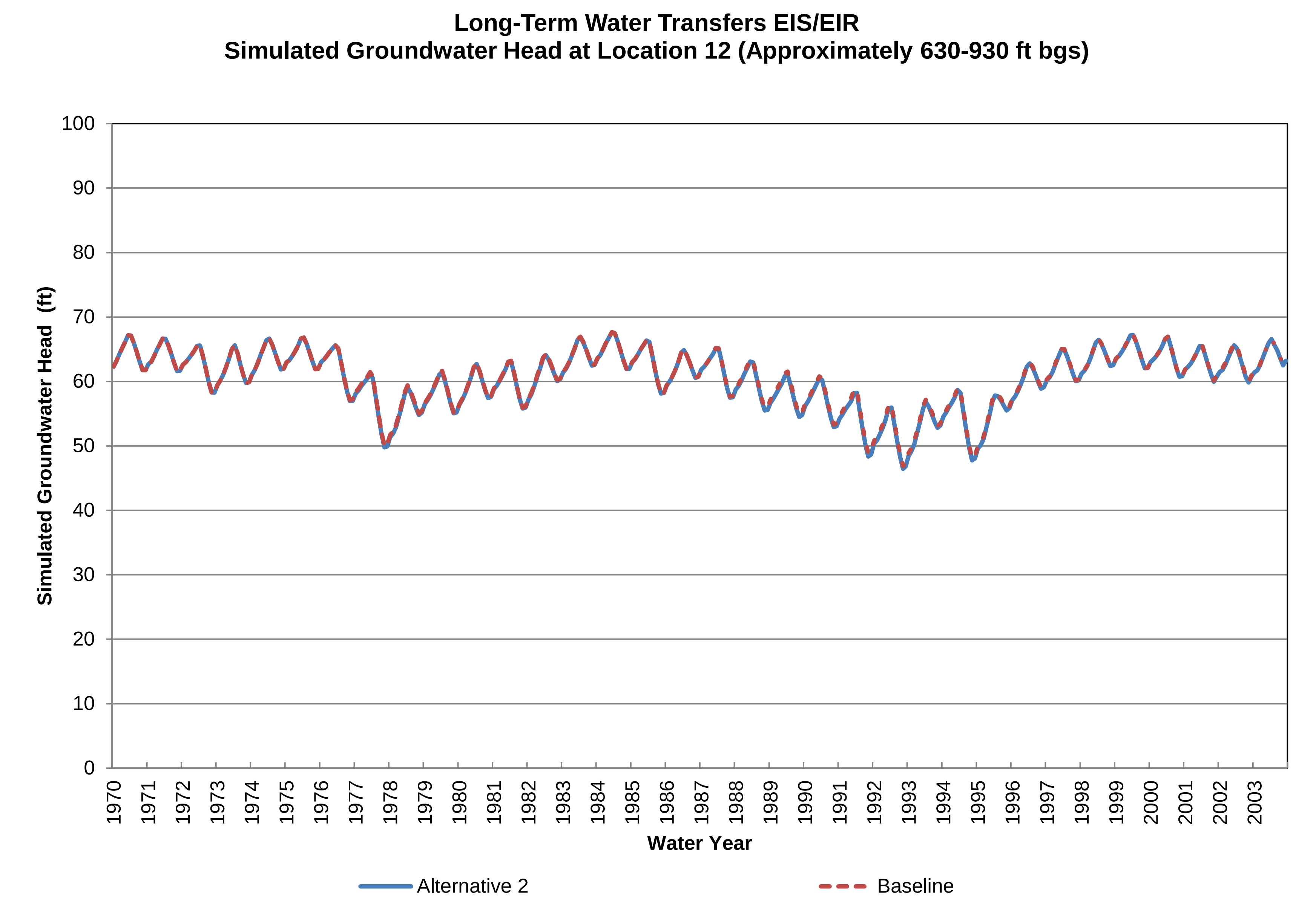
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 440-630 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 630-930 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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1994
1995
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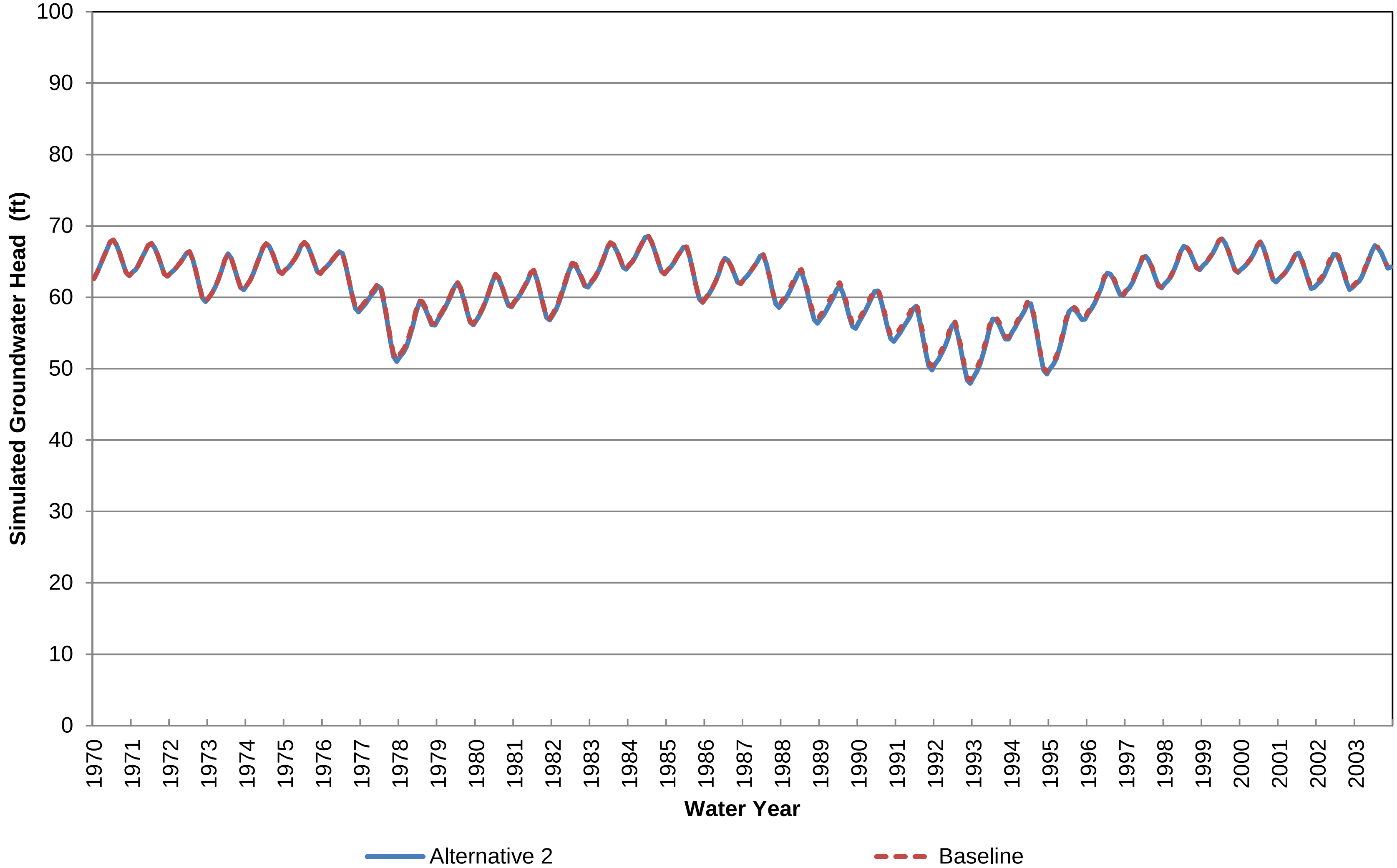
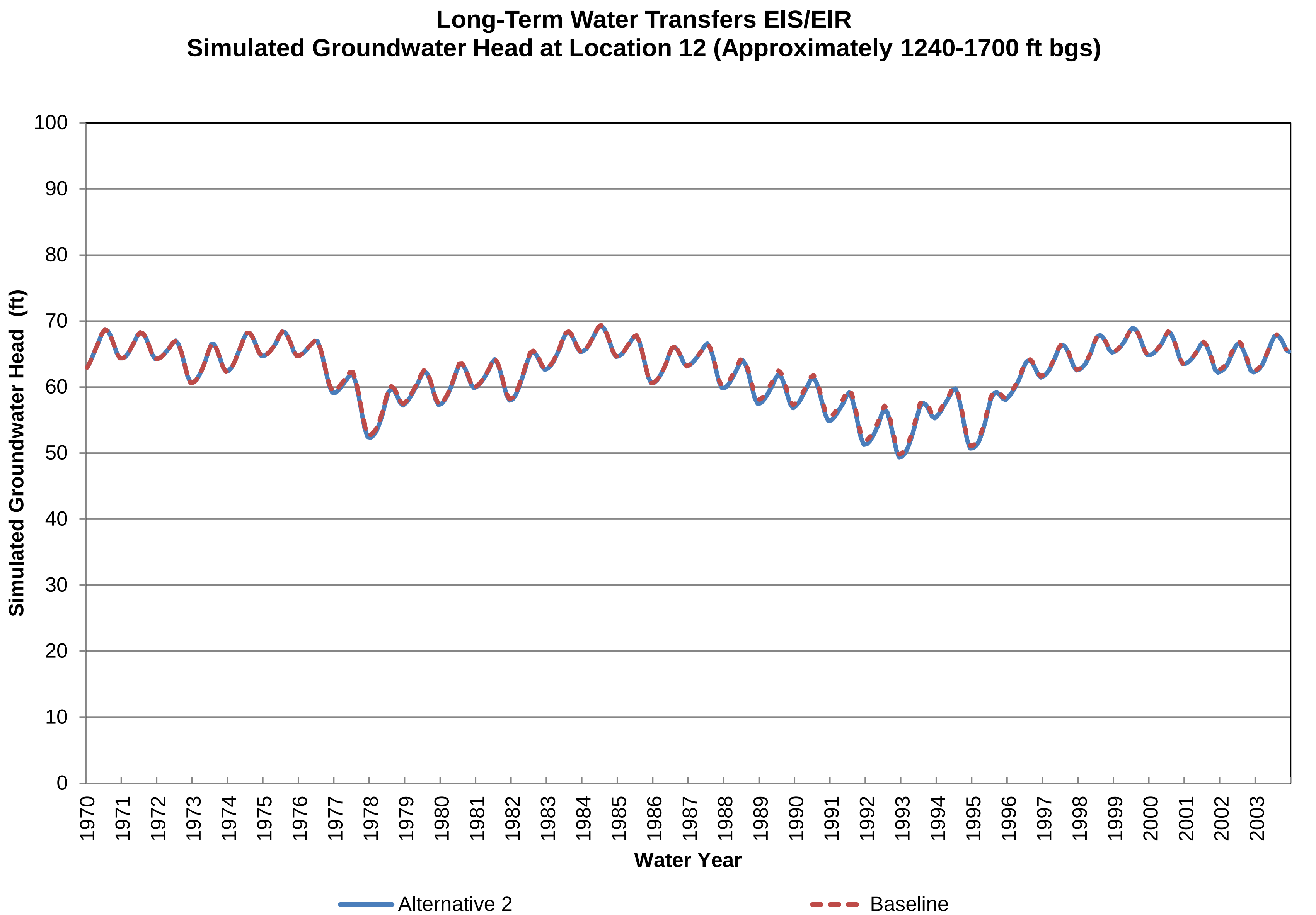
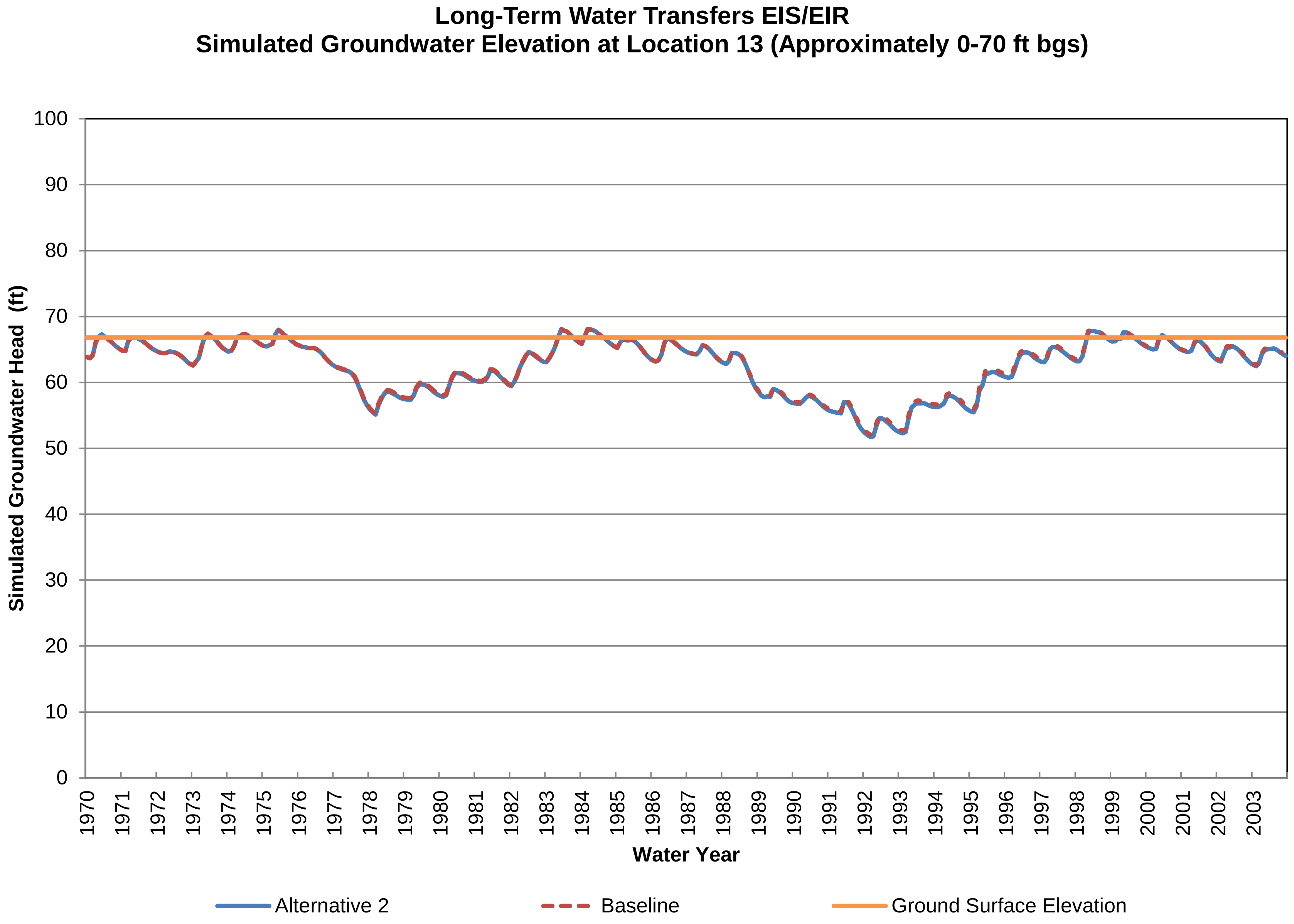
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 930-1240 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 12 (Approximately 1240-1700 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 13 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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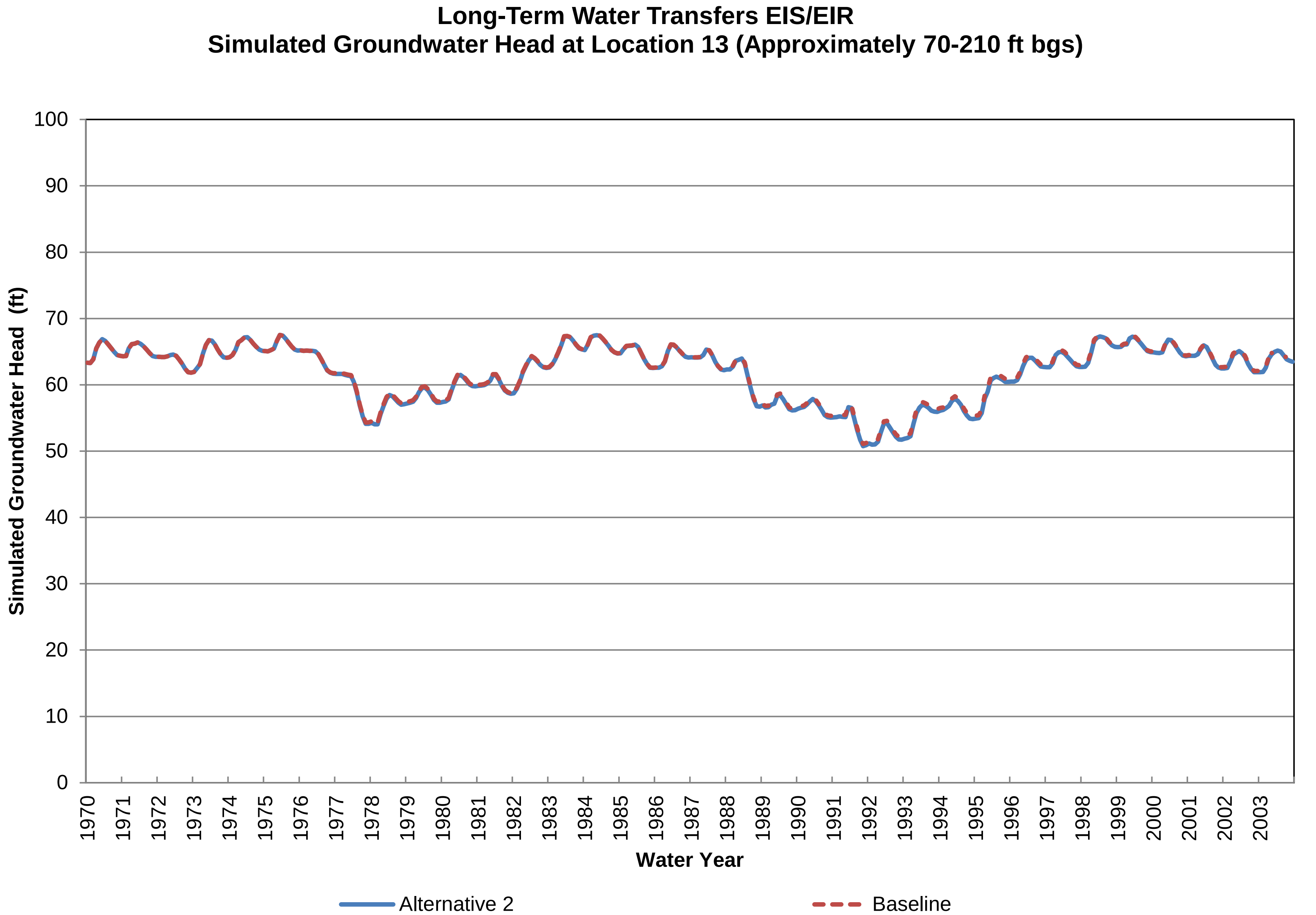
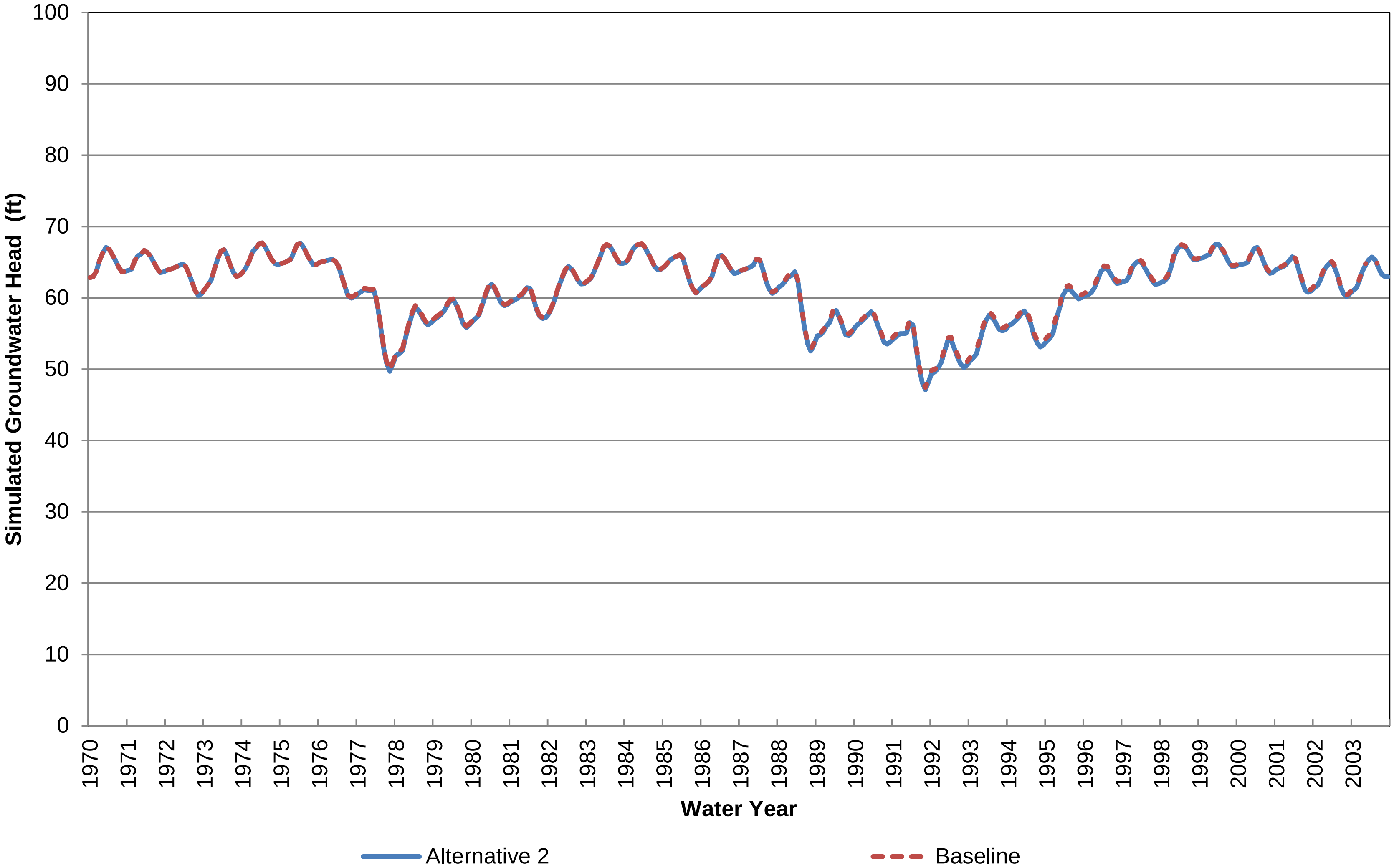
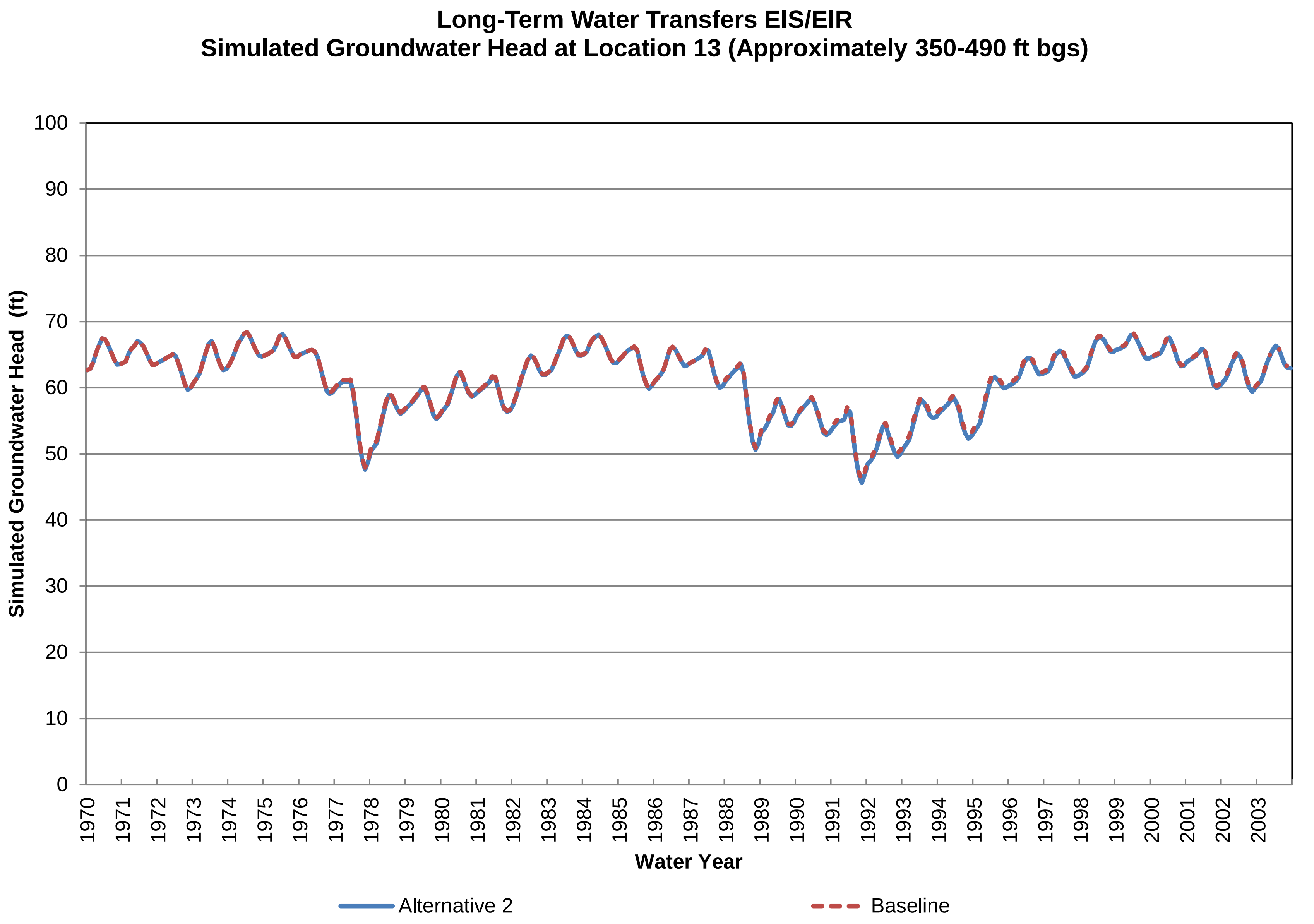
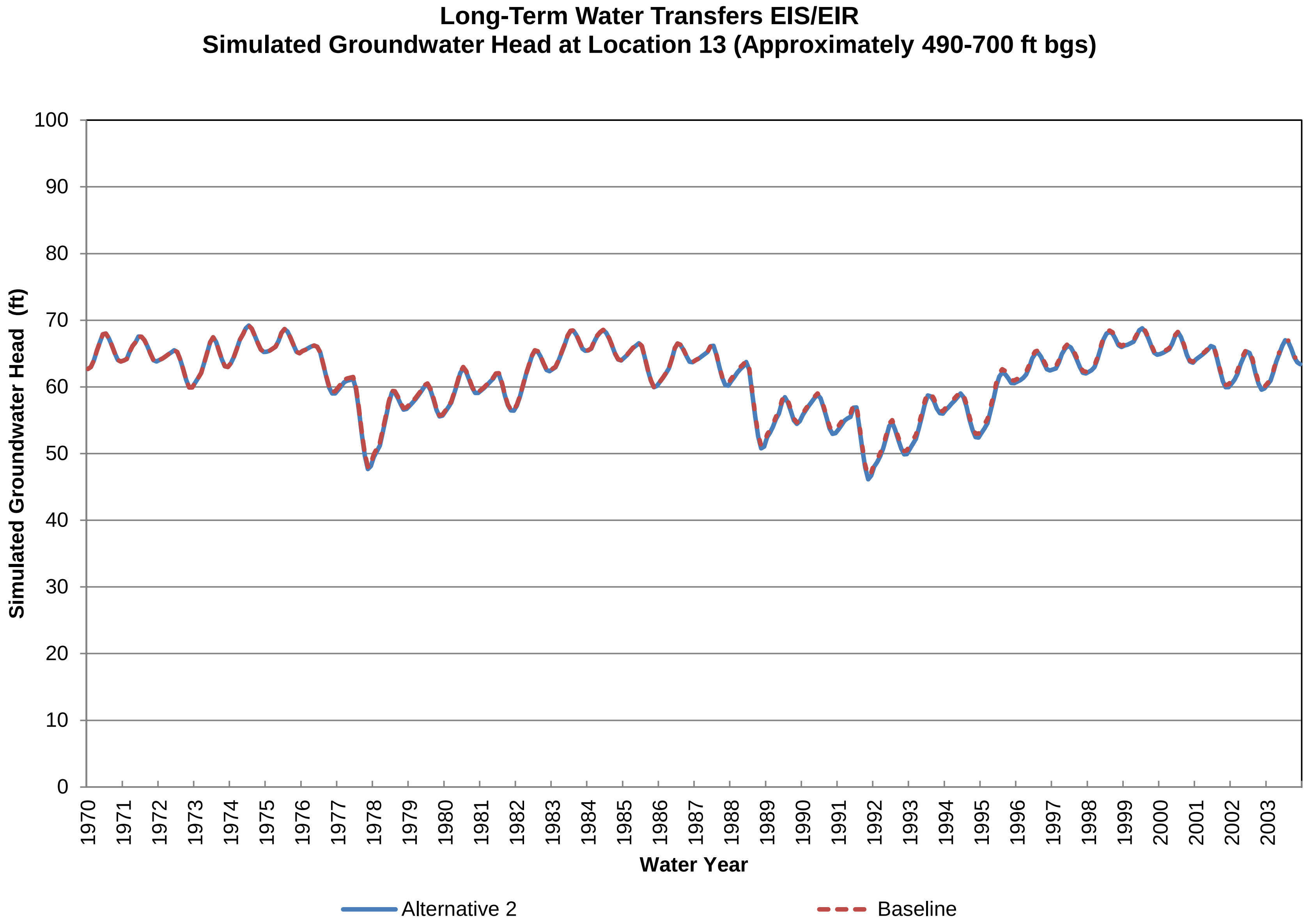
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

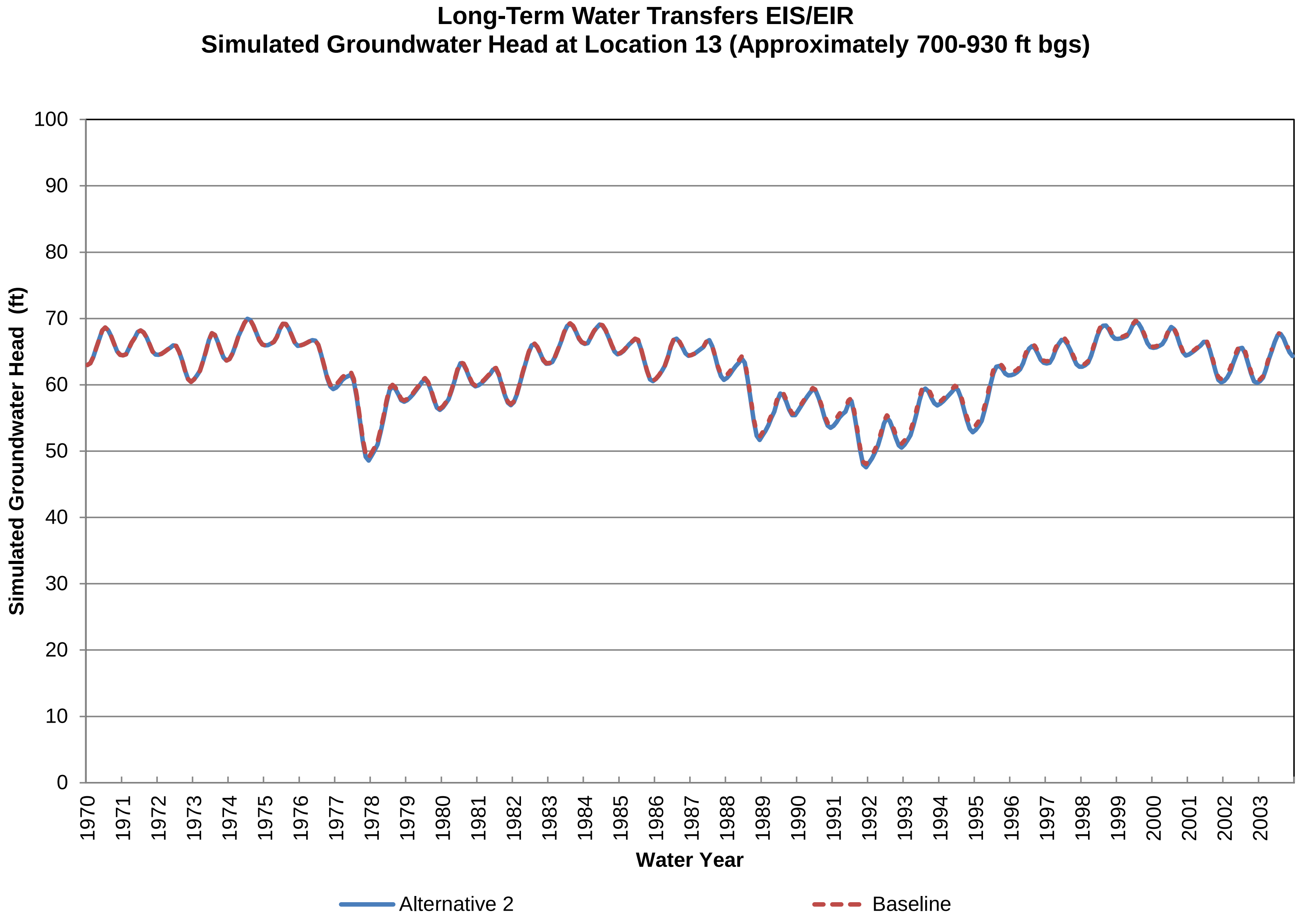

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 210-350 ft bgs)

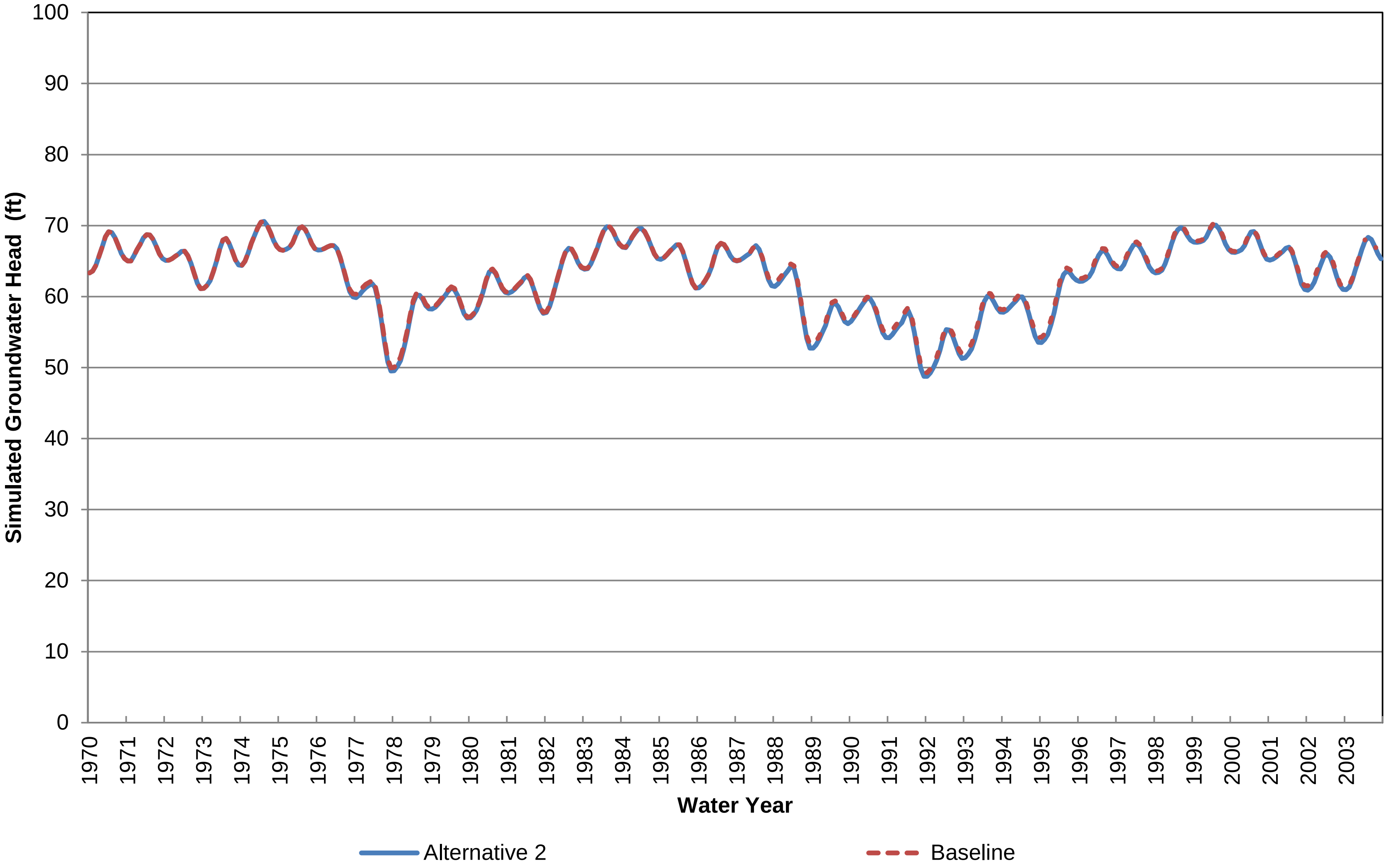


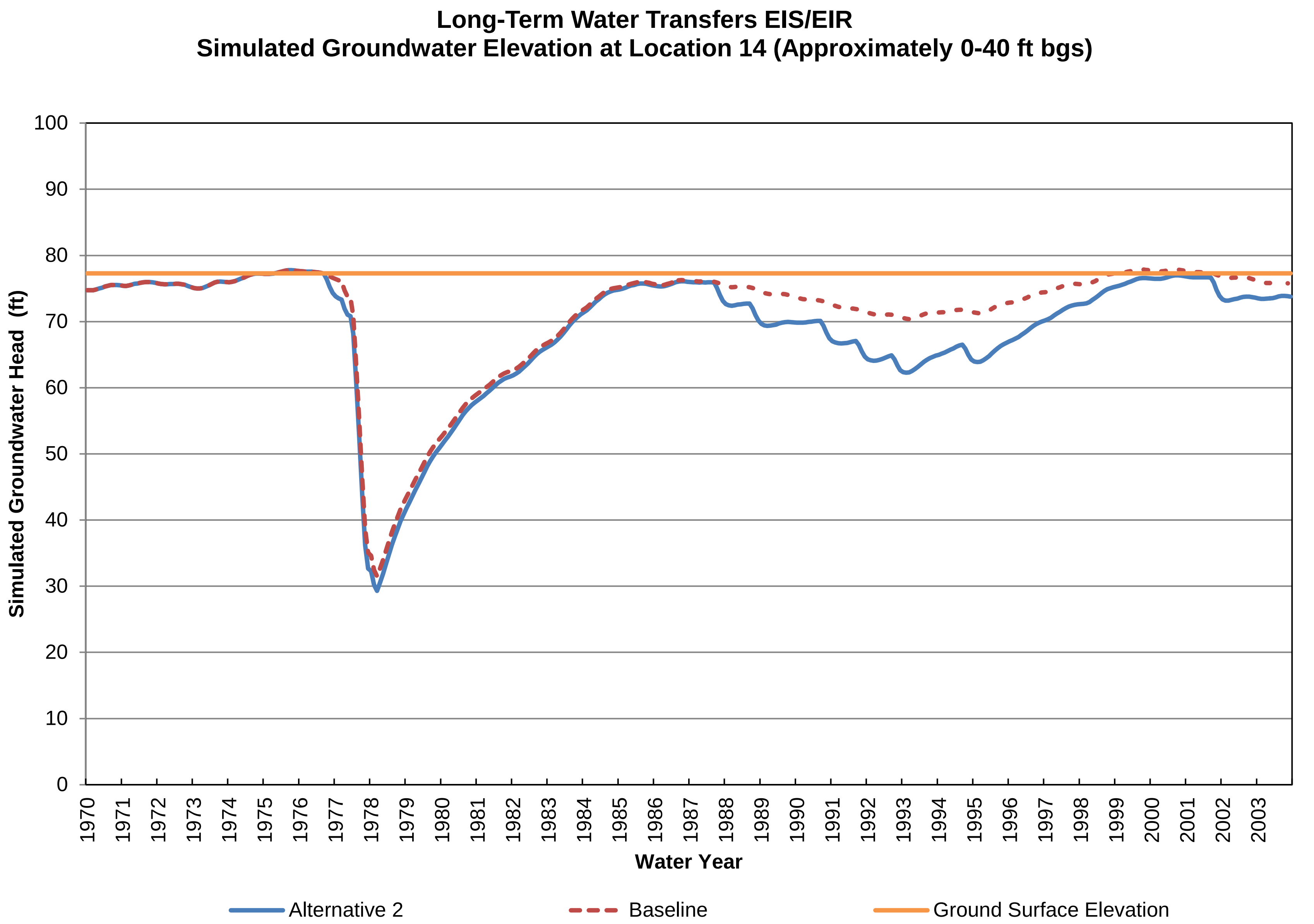

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 350-490 ft bgs)
Simulated Groundwater Head (ft)
0
10
20
30
40
50
60
70
80
90
100
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

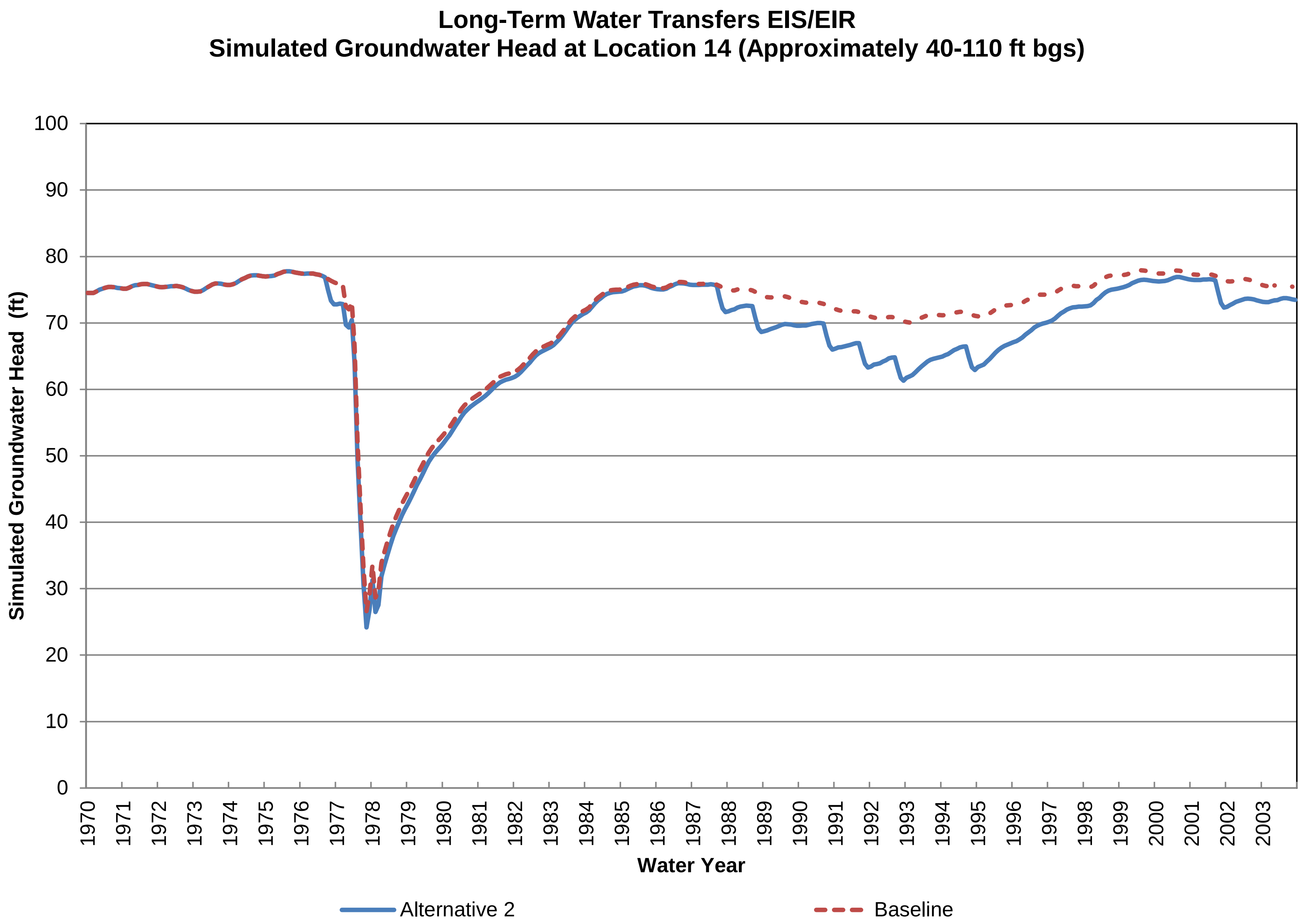

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 490-700 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

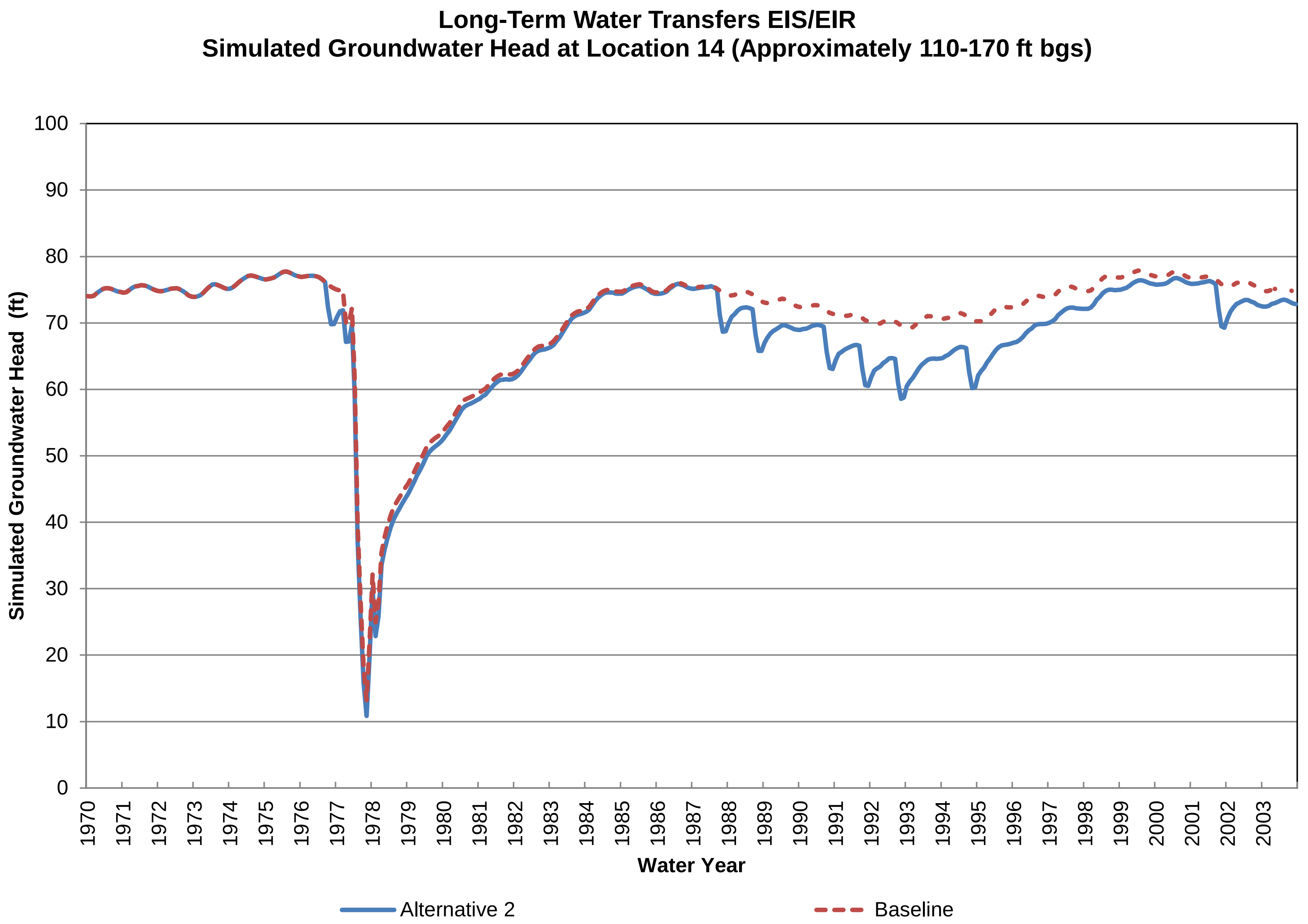

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 700-930 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 13 (Approximately 930-1280 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 14 (Approximately 0-40 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 40-110 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 110-170 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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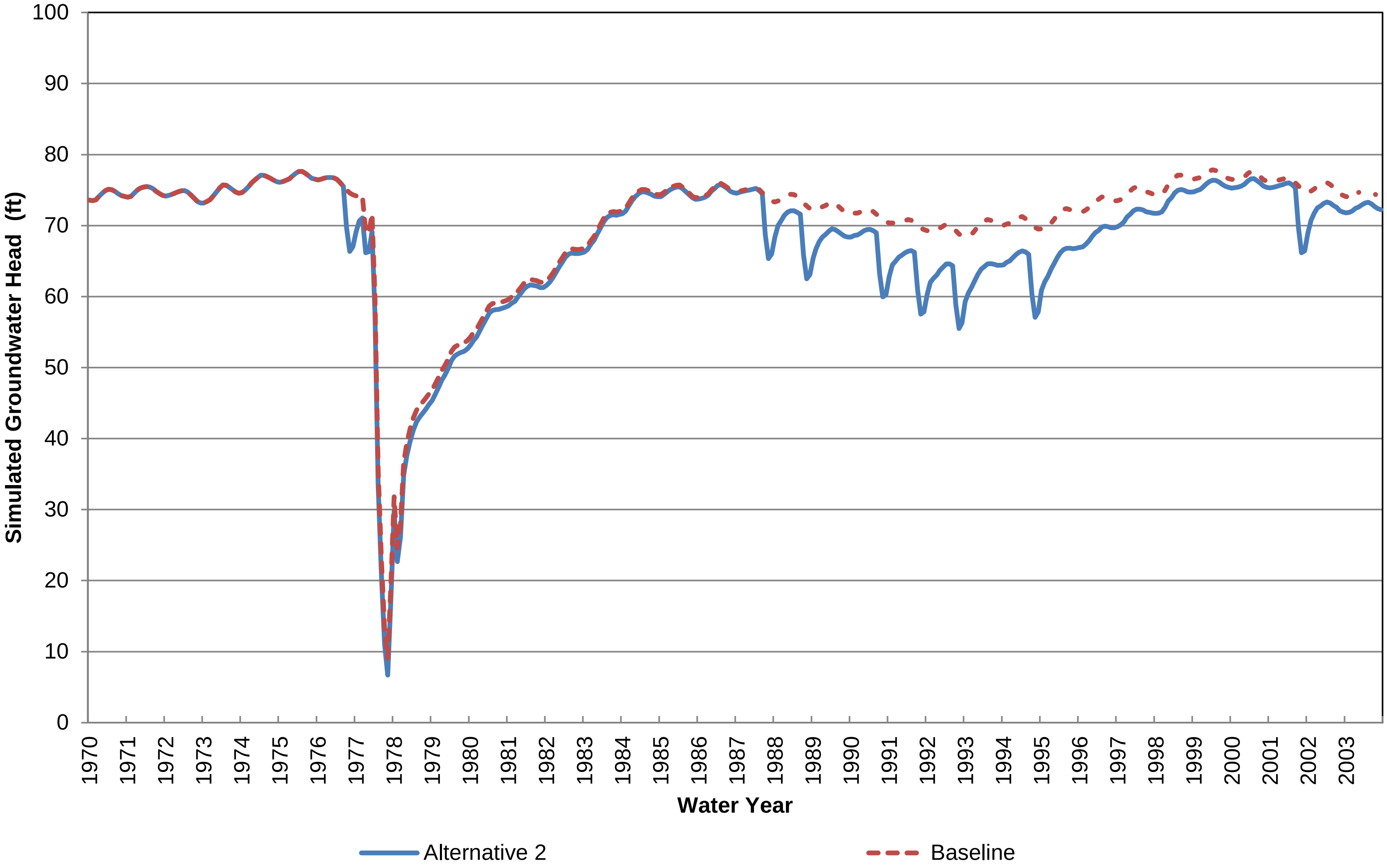
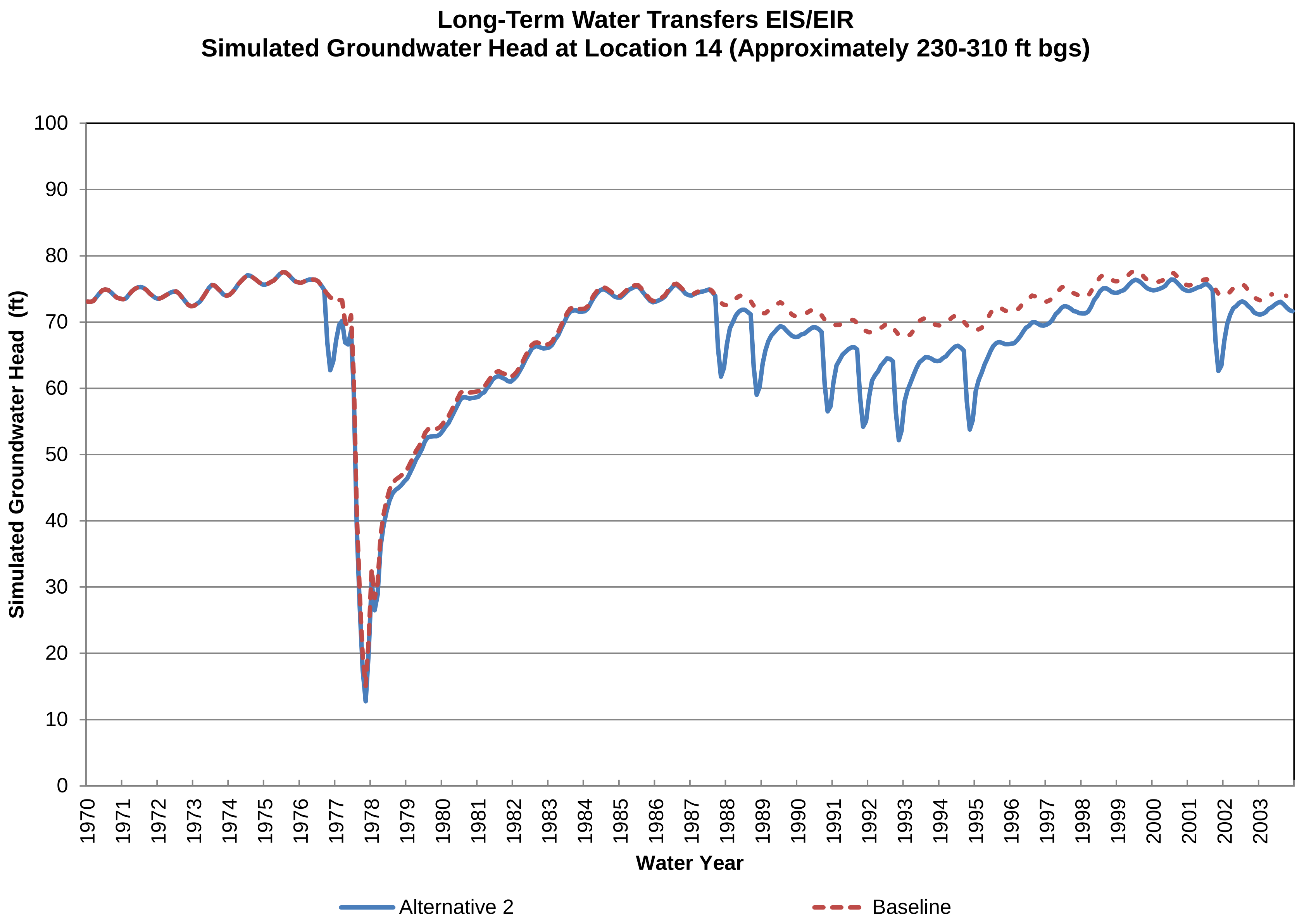
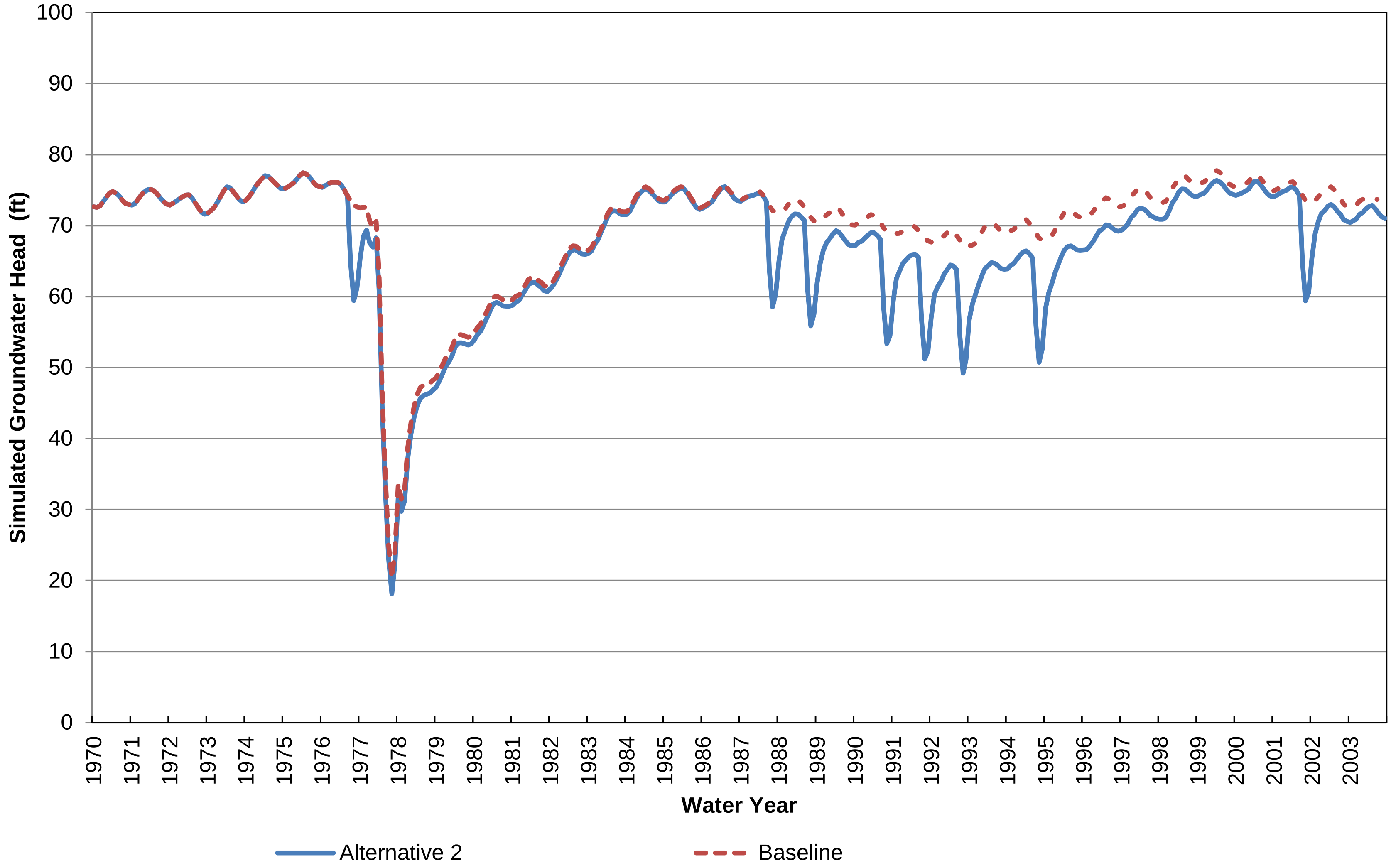
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

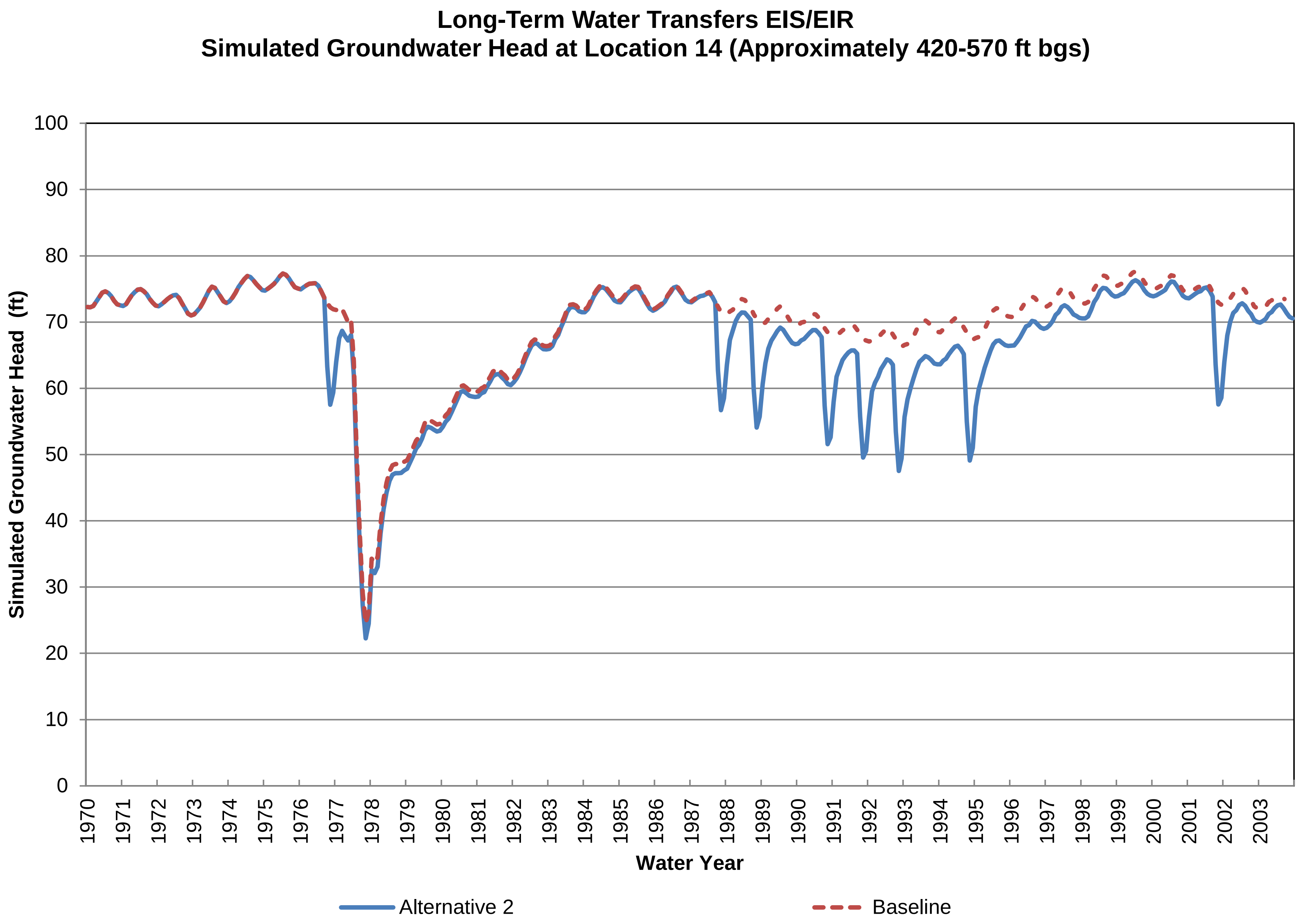
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 170-230 ft bgs)



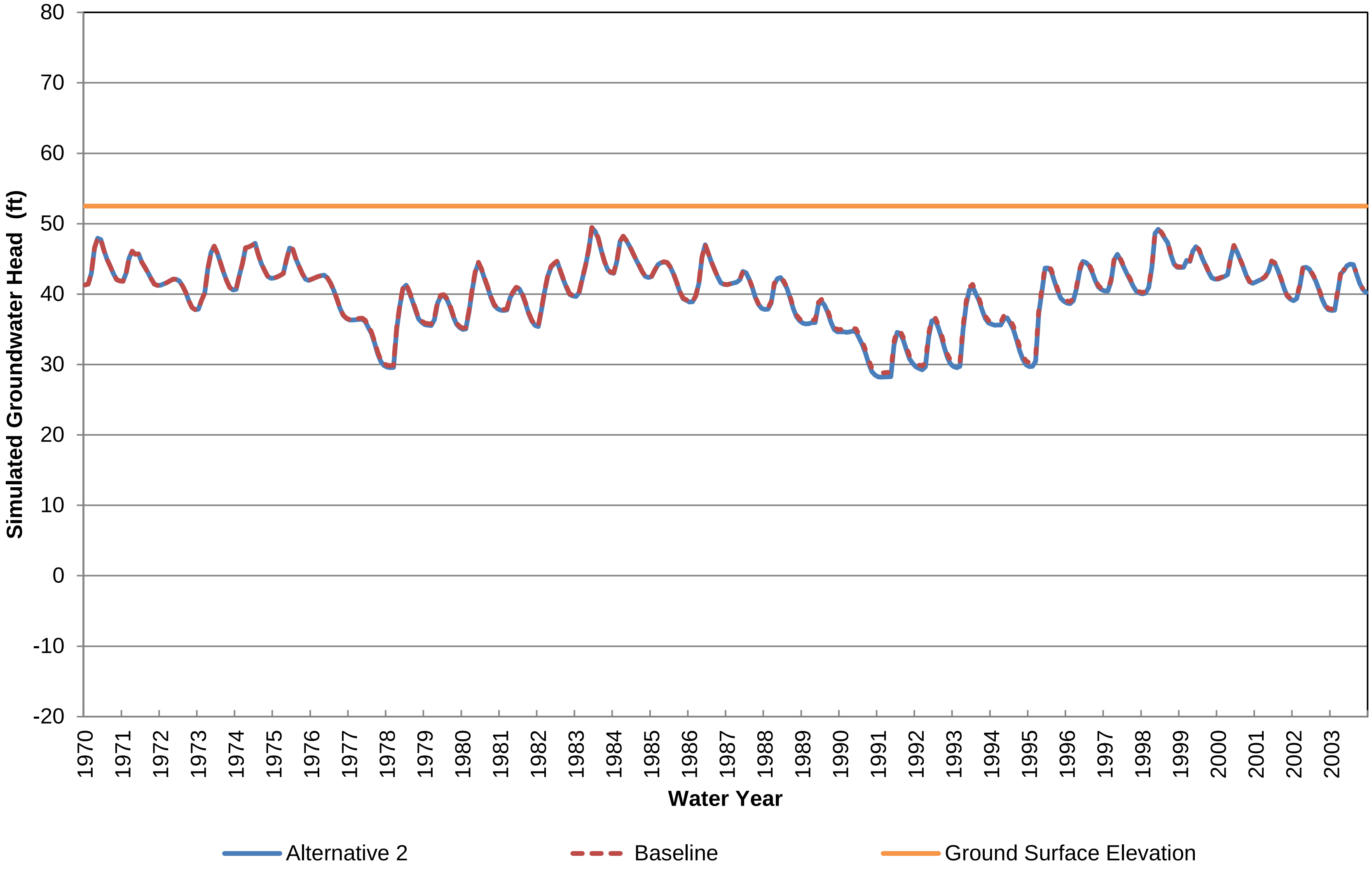

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 230-310 ft bgs)
100
90
80
70
60
50
40
30
20
10
0
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

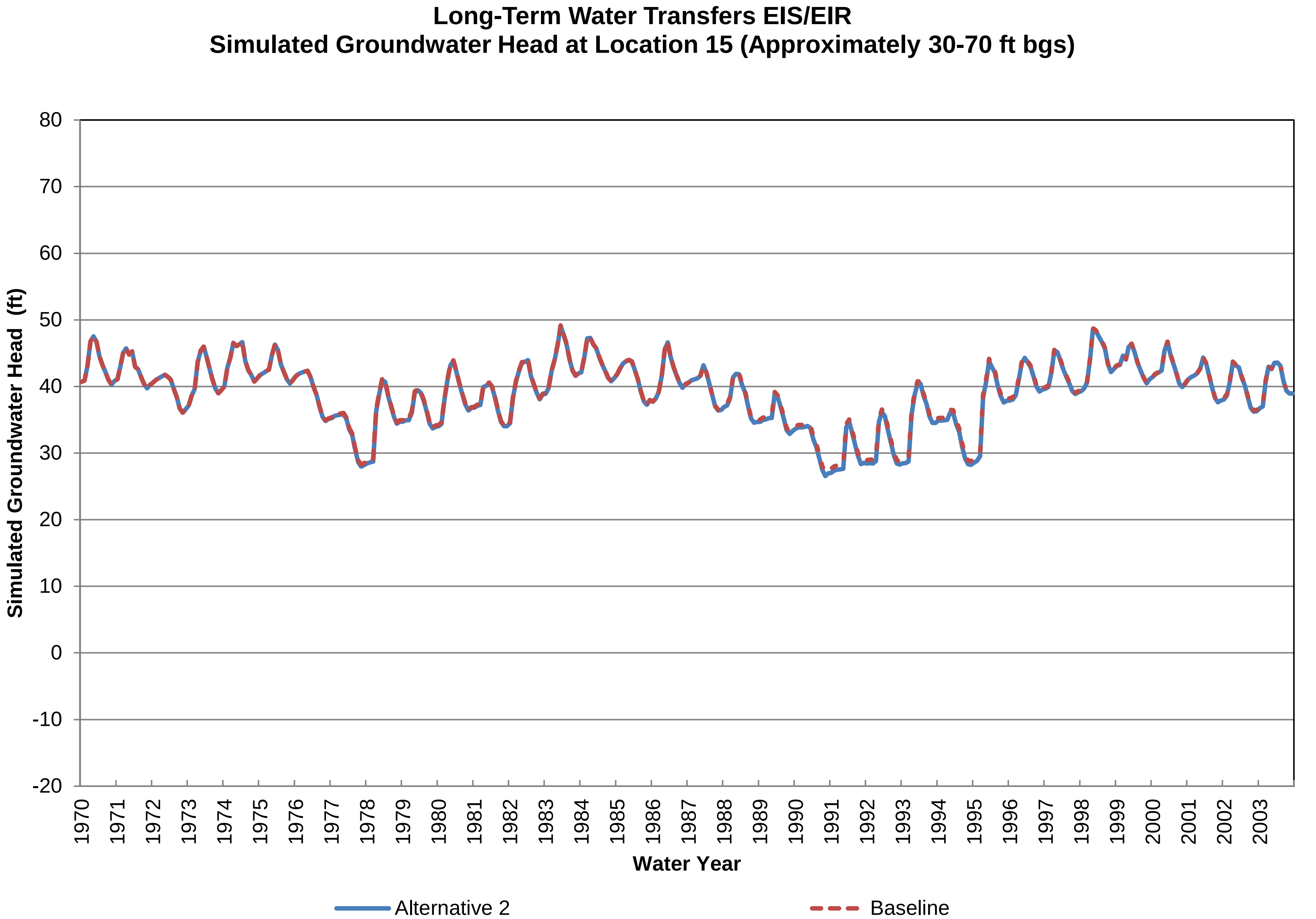
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 310-420 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 14 (Approximately 420-570 ft bgs)
Simulated Groundwater Head (ft)
100
90
80
70
60
50
40
30
20
10
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 15 (Approximately 0-30 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 30-70 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

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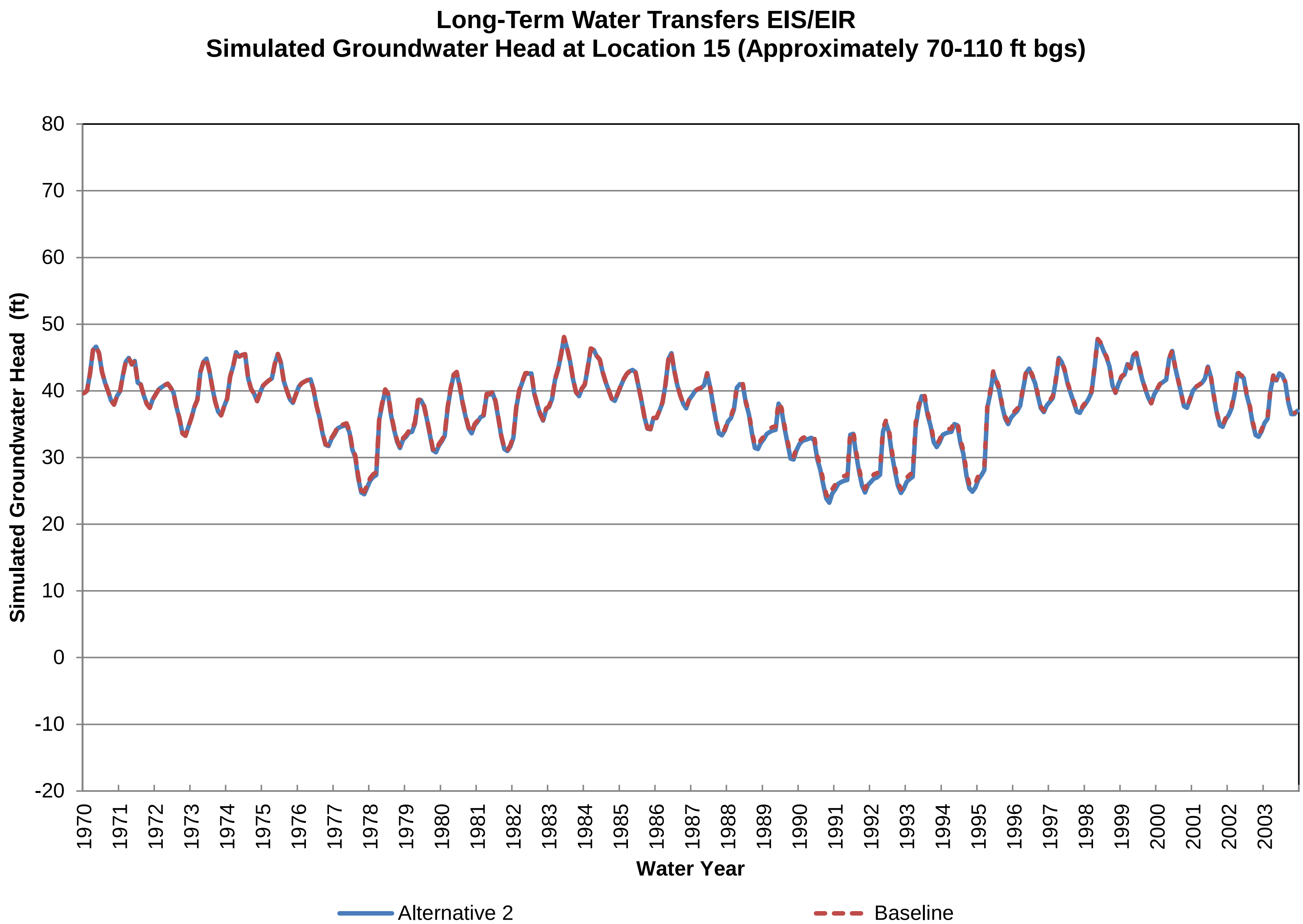
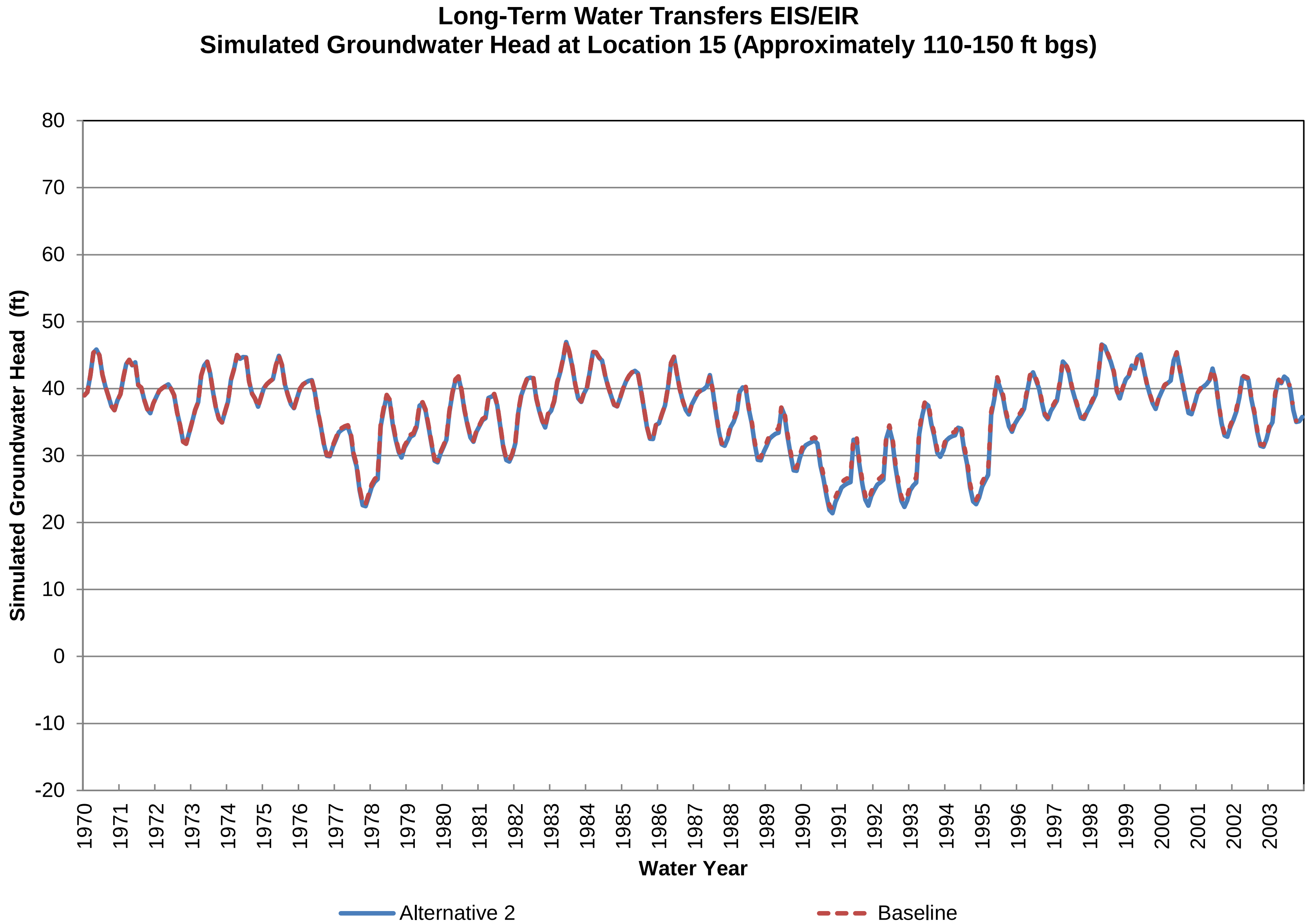
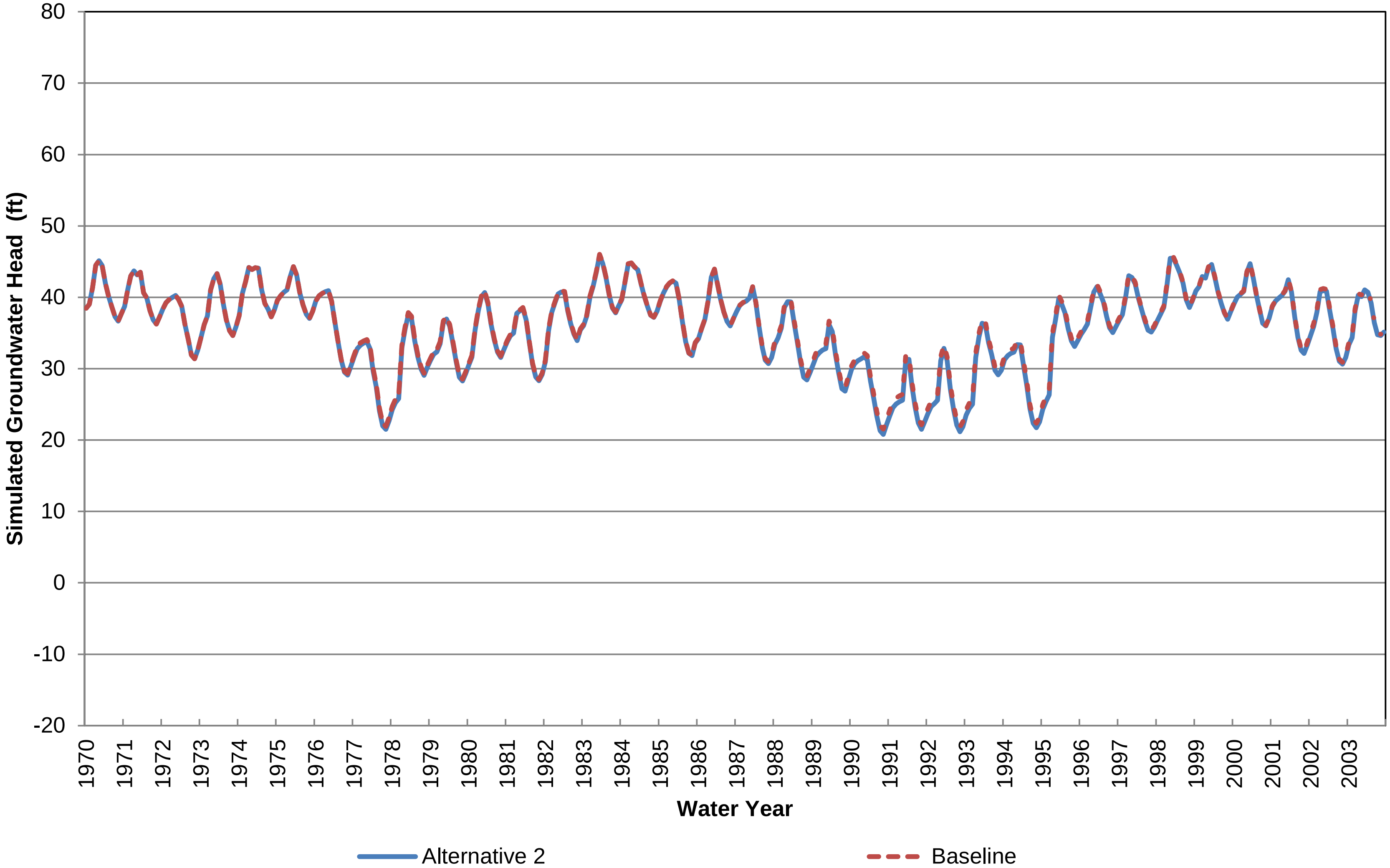
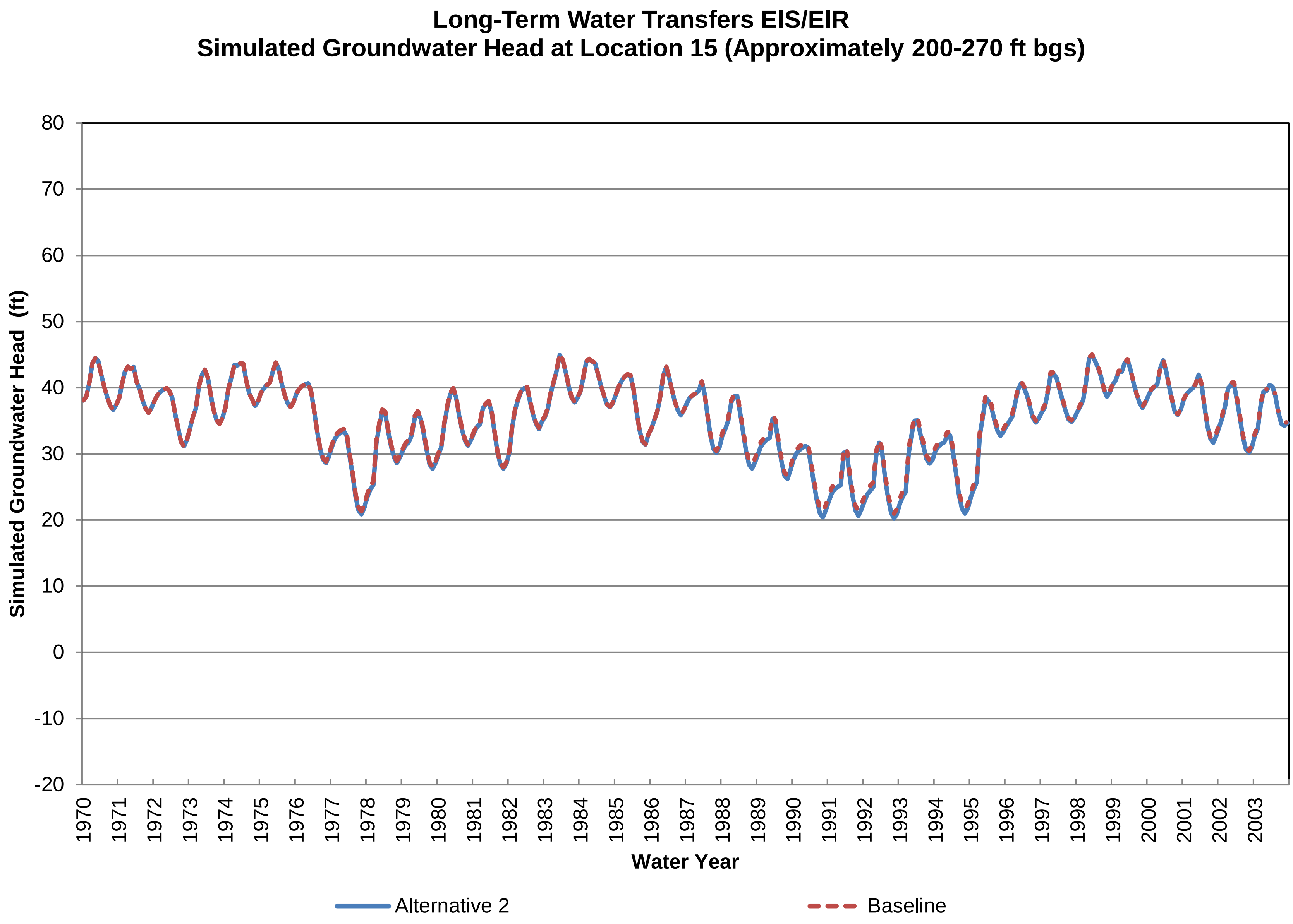

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 70-110 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

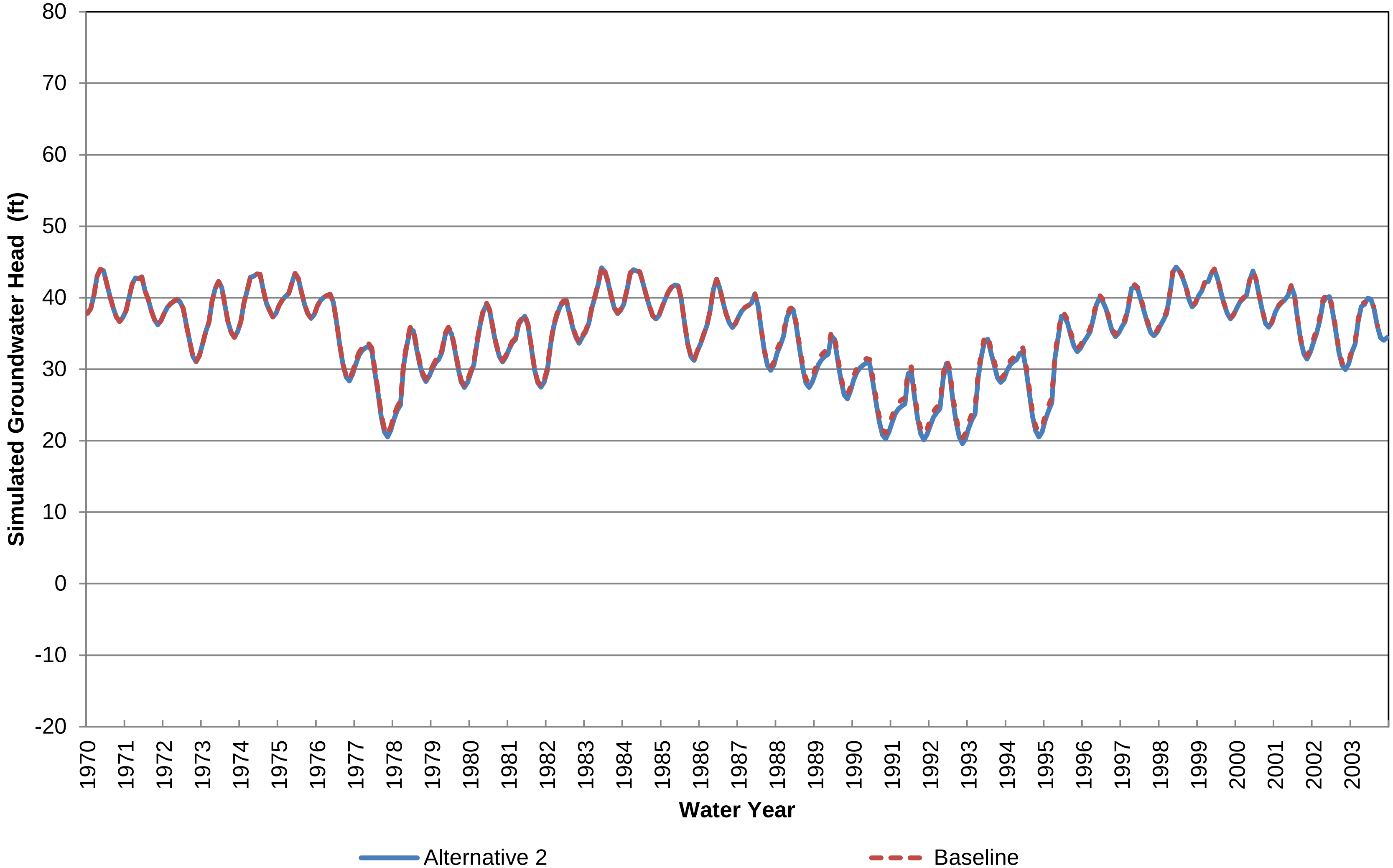

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 110-150 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

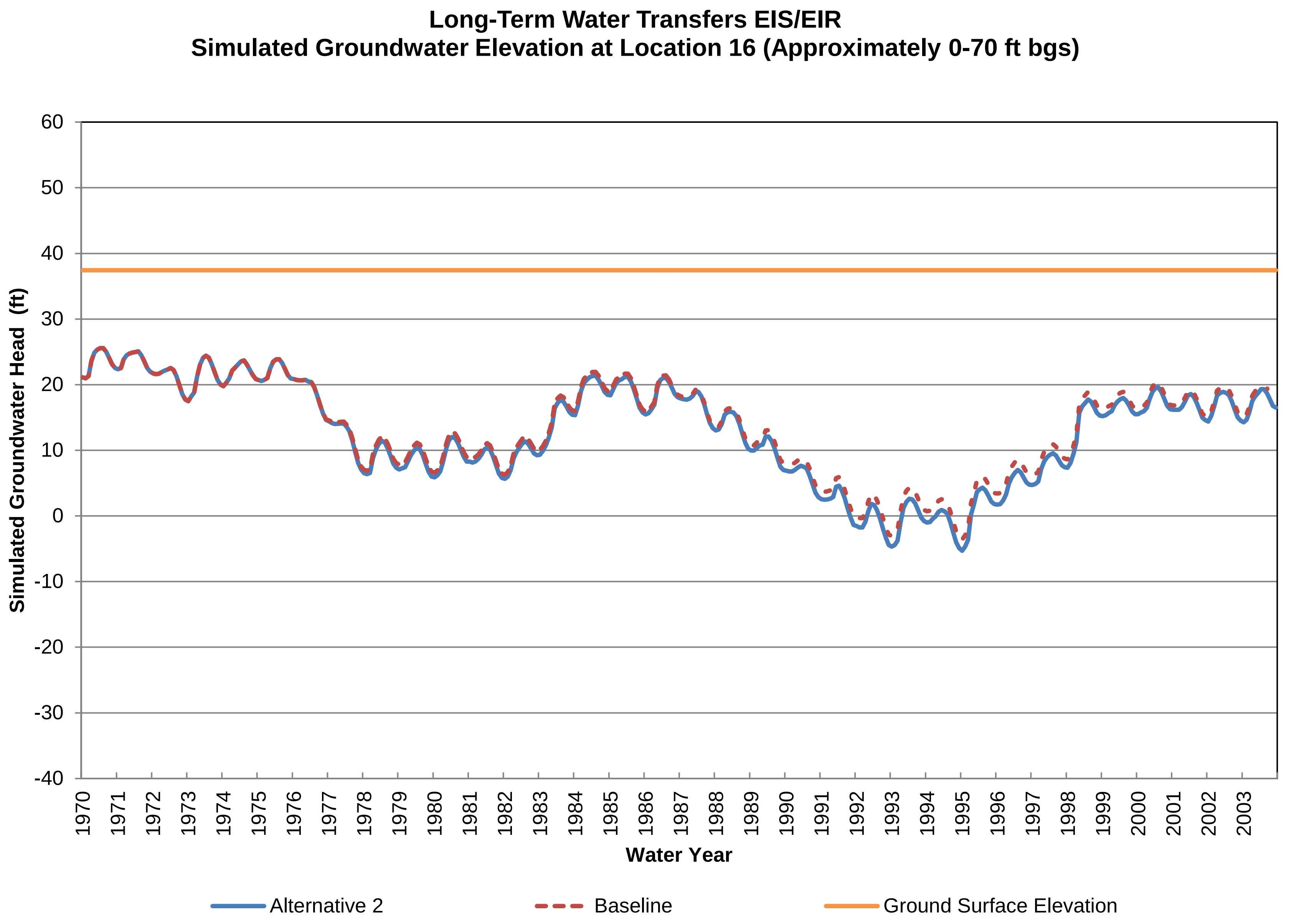
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 150-200 ft bgs)



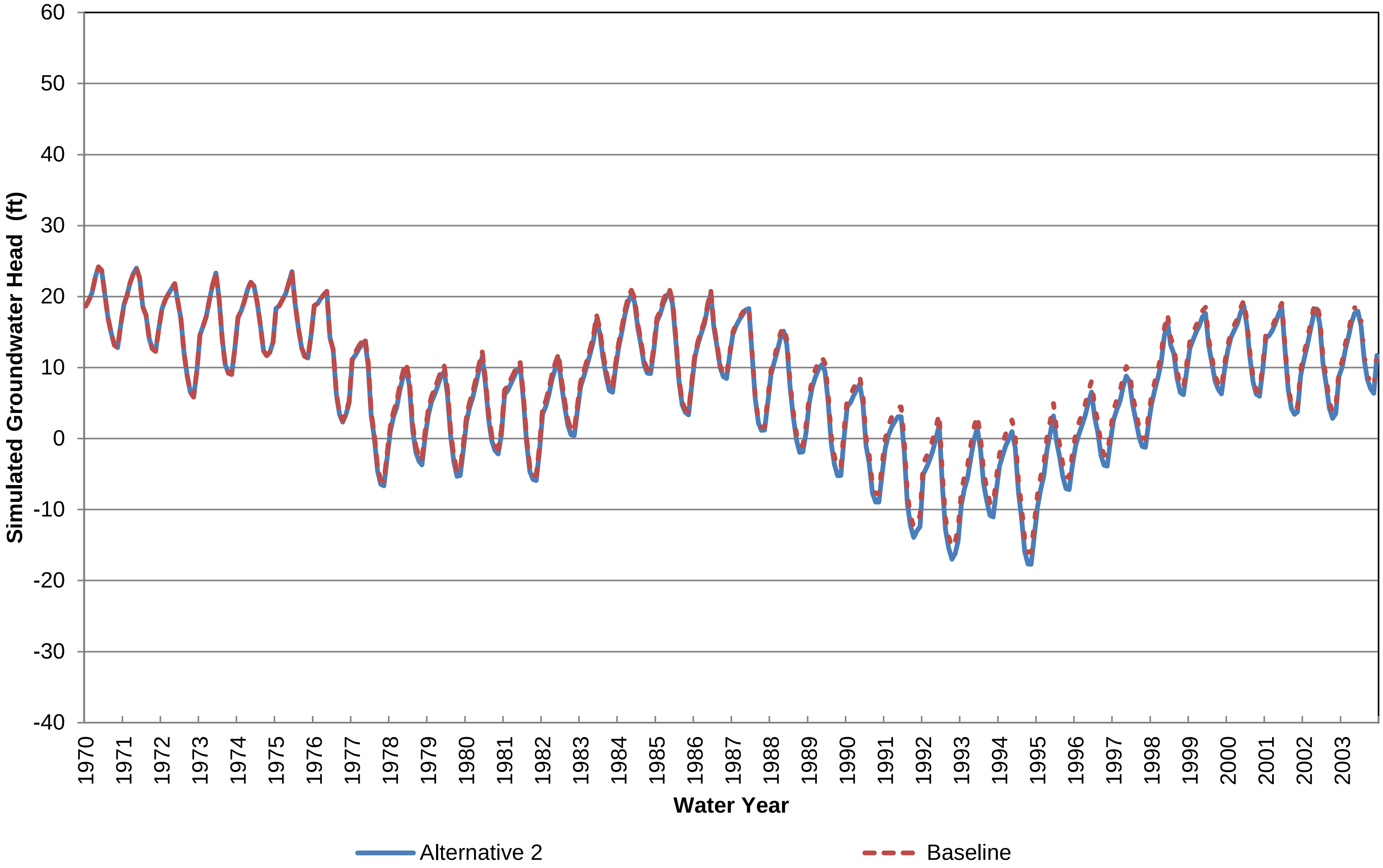

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 200-270 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

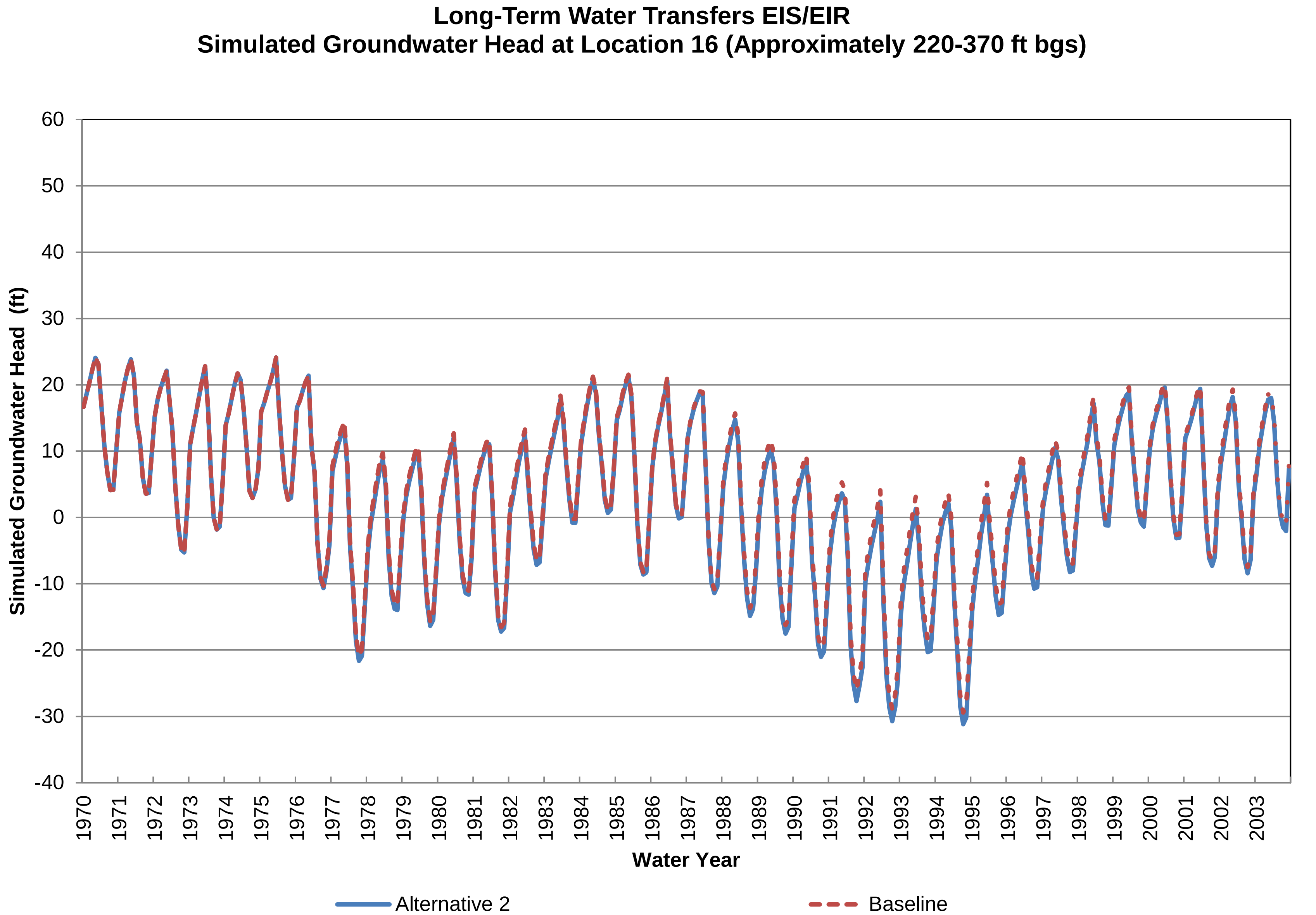
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 15 (Approximately 270-360 ft bgs)



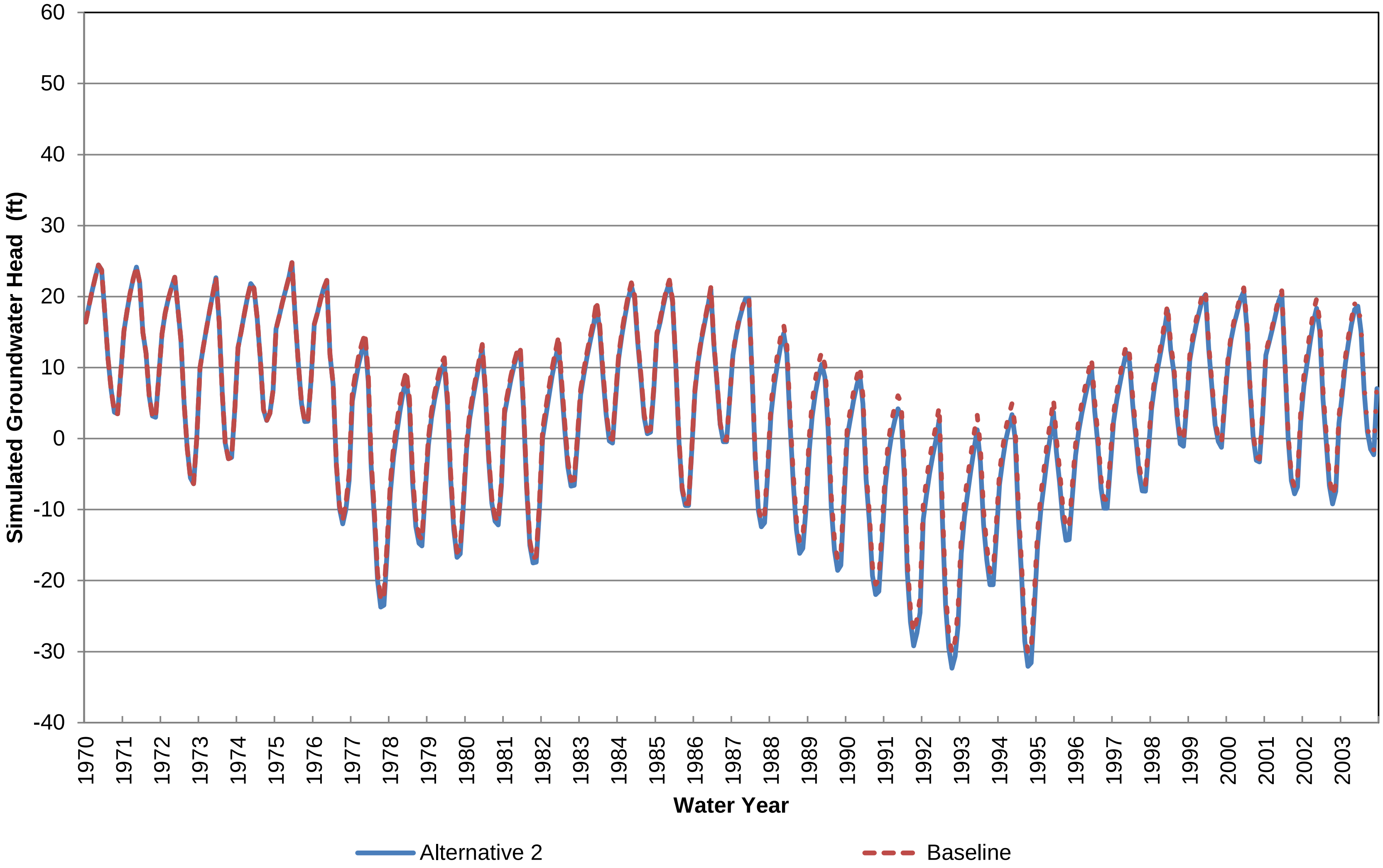

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 16 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

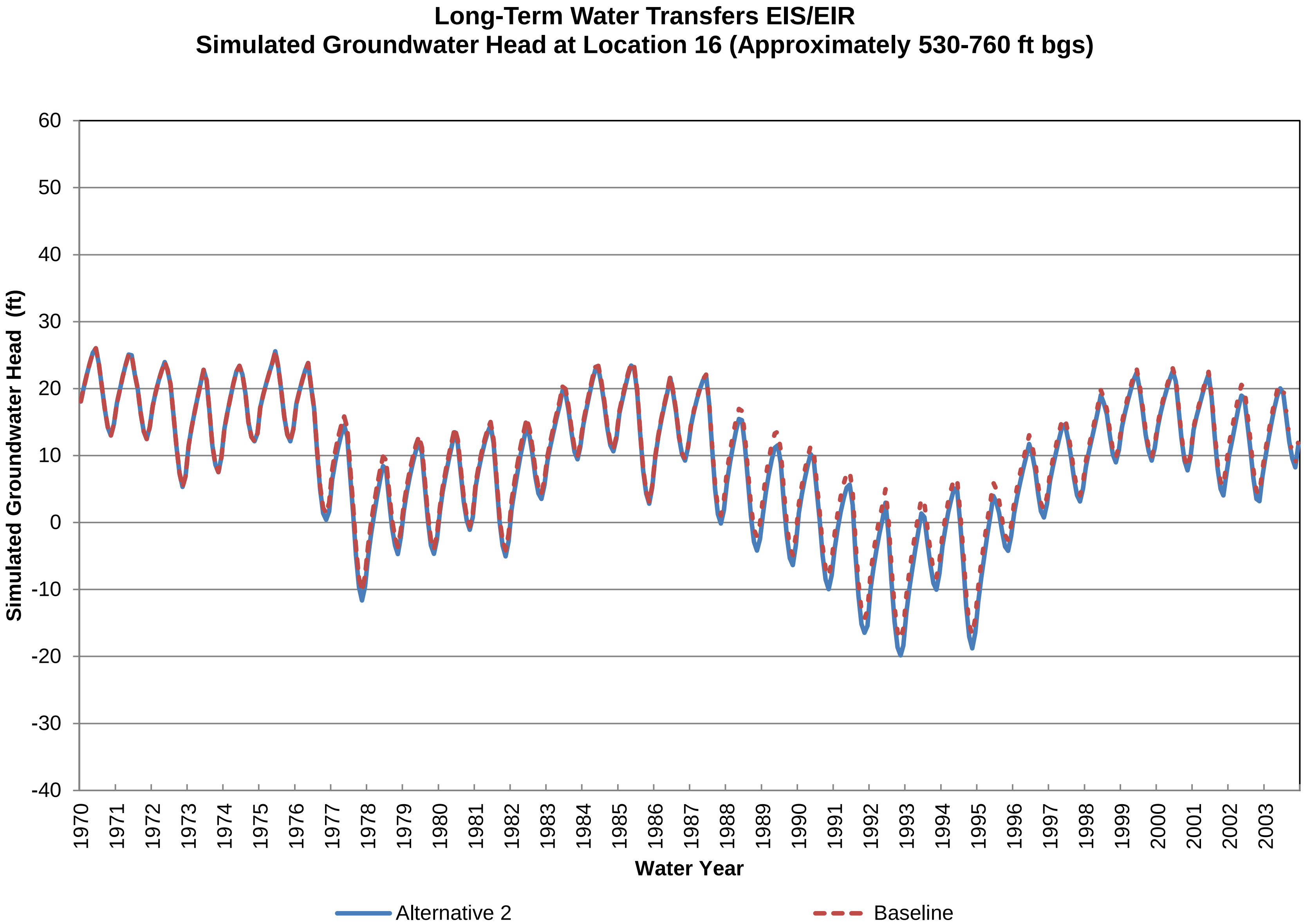
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 70-220 ft bgs)



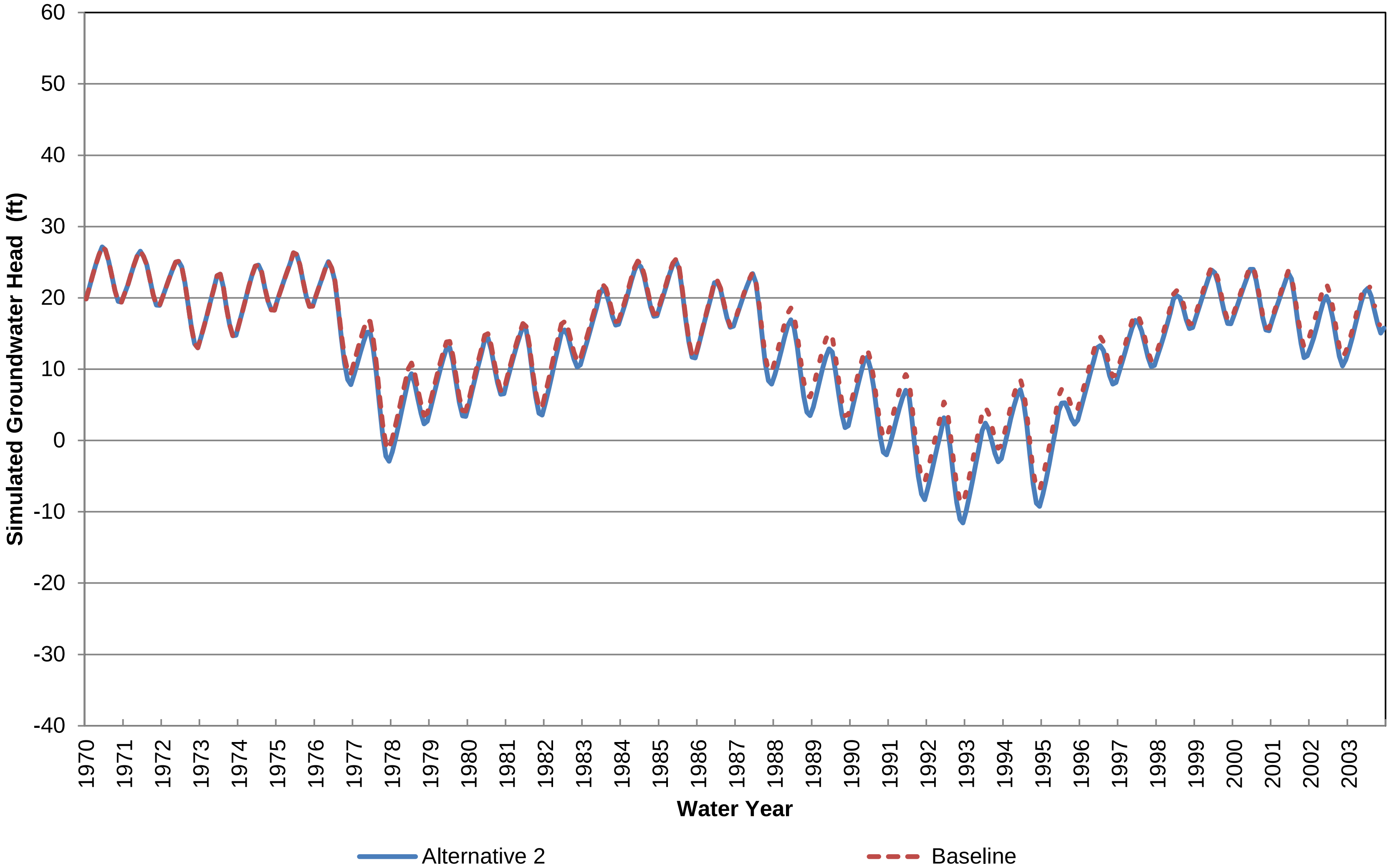

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 220-370 ft bgs)
60
50
40
30
20
10
0
-10
-20
-30
-40
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

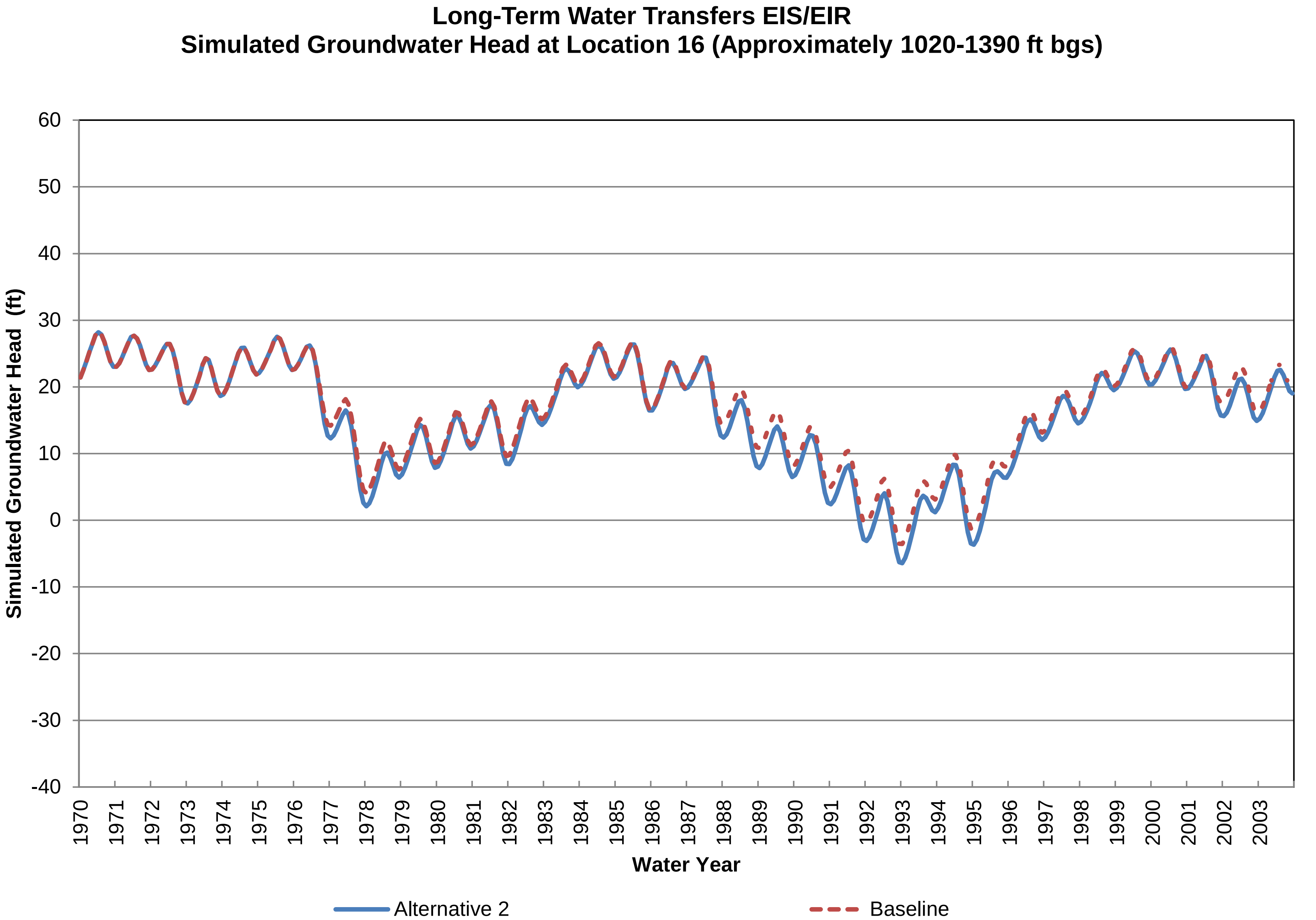
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 370-530 ft bgs)



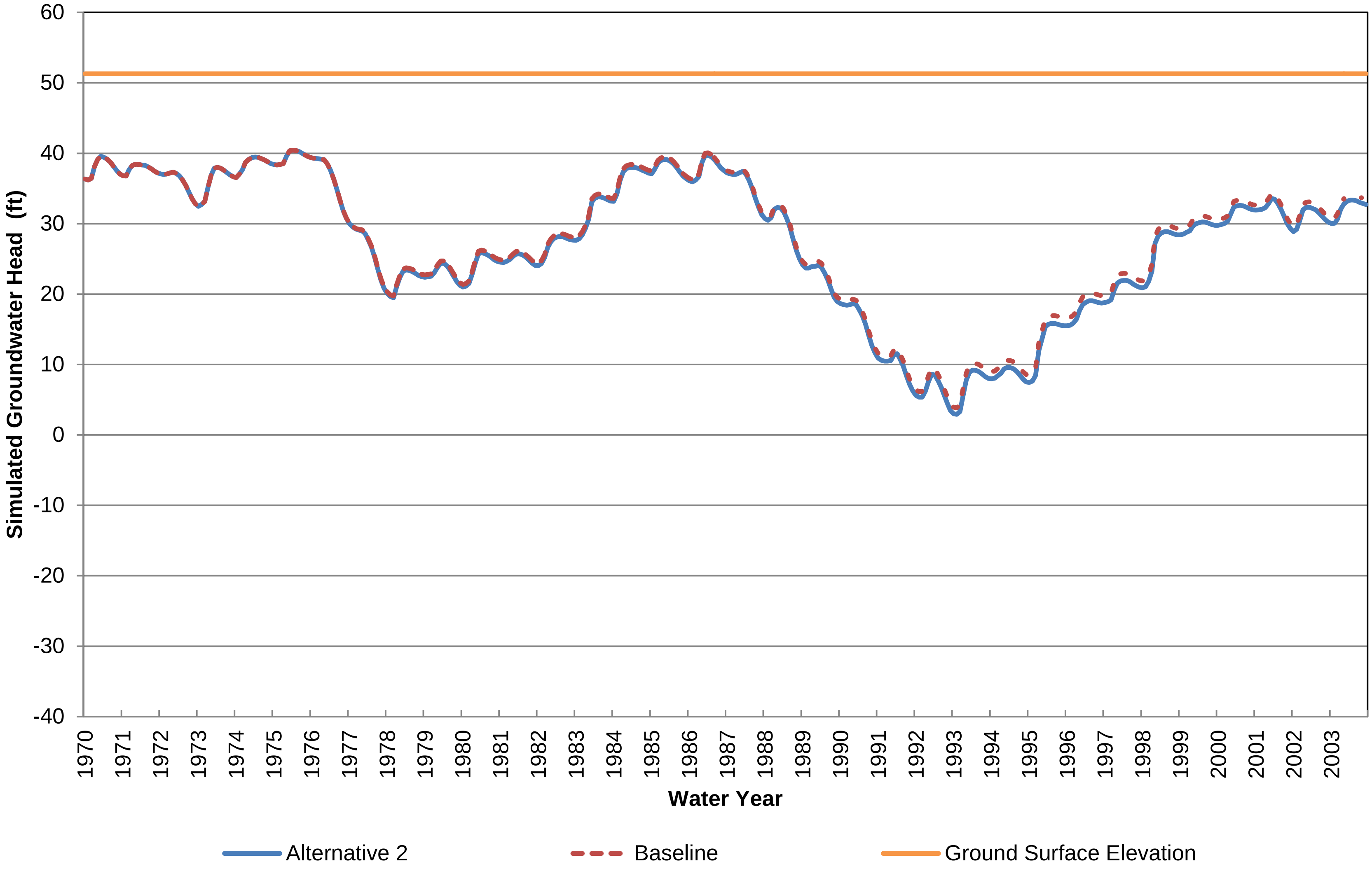

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 530-760 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

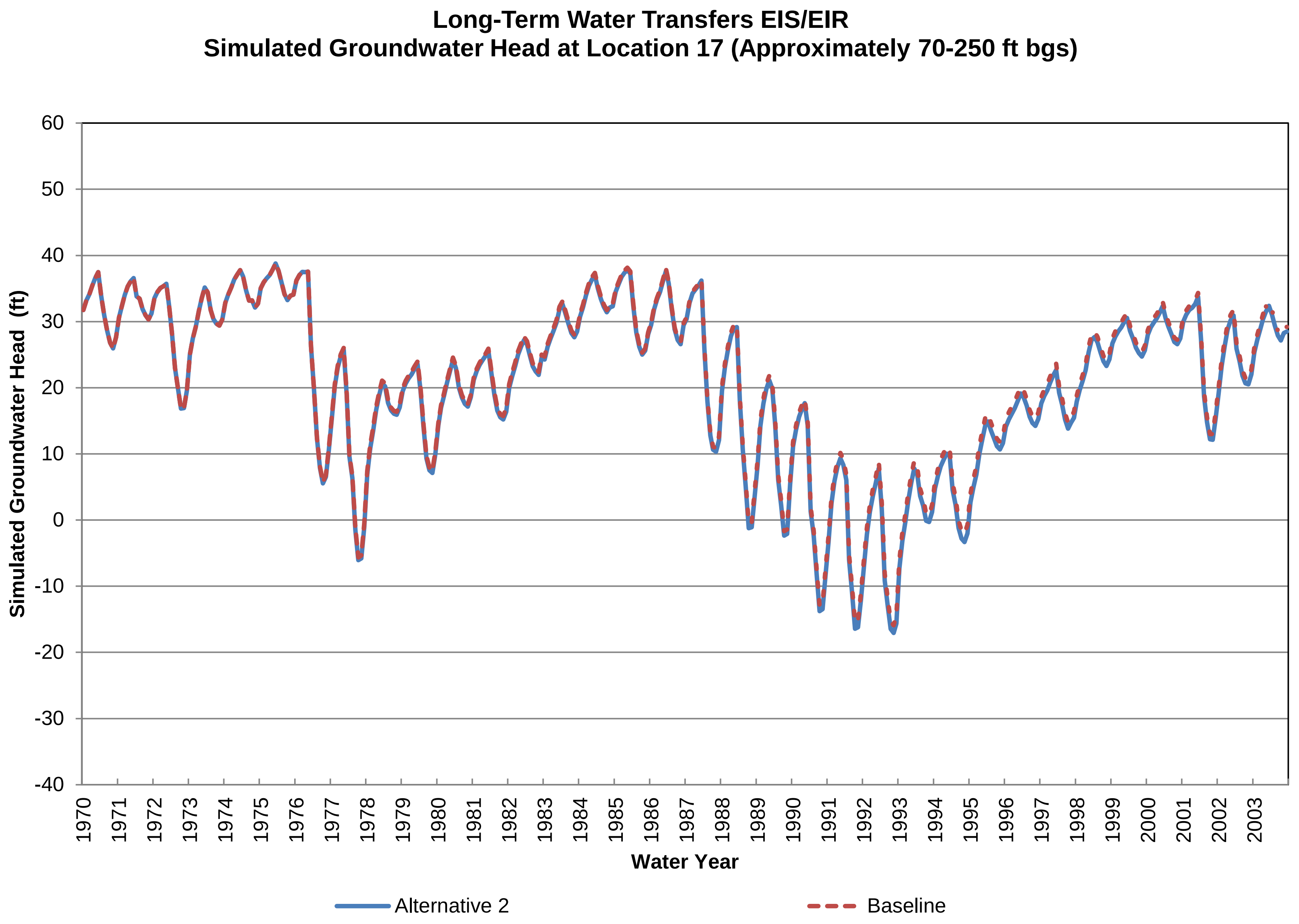
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 760-1020 ft bgs)

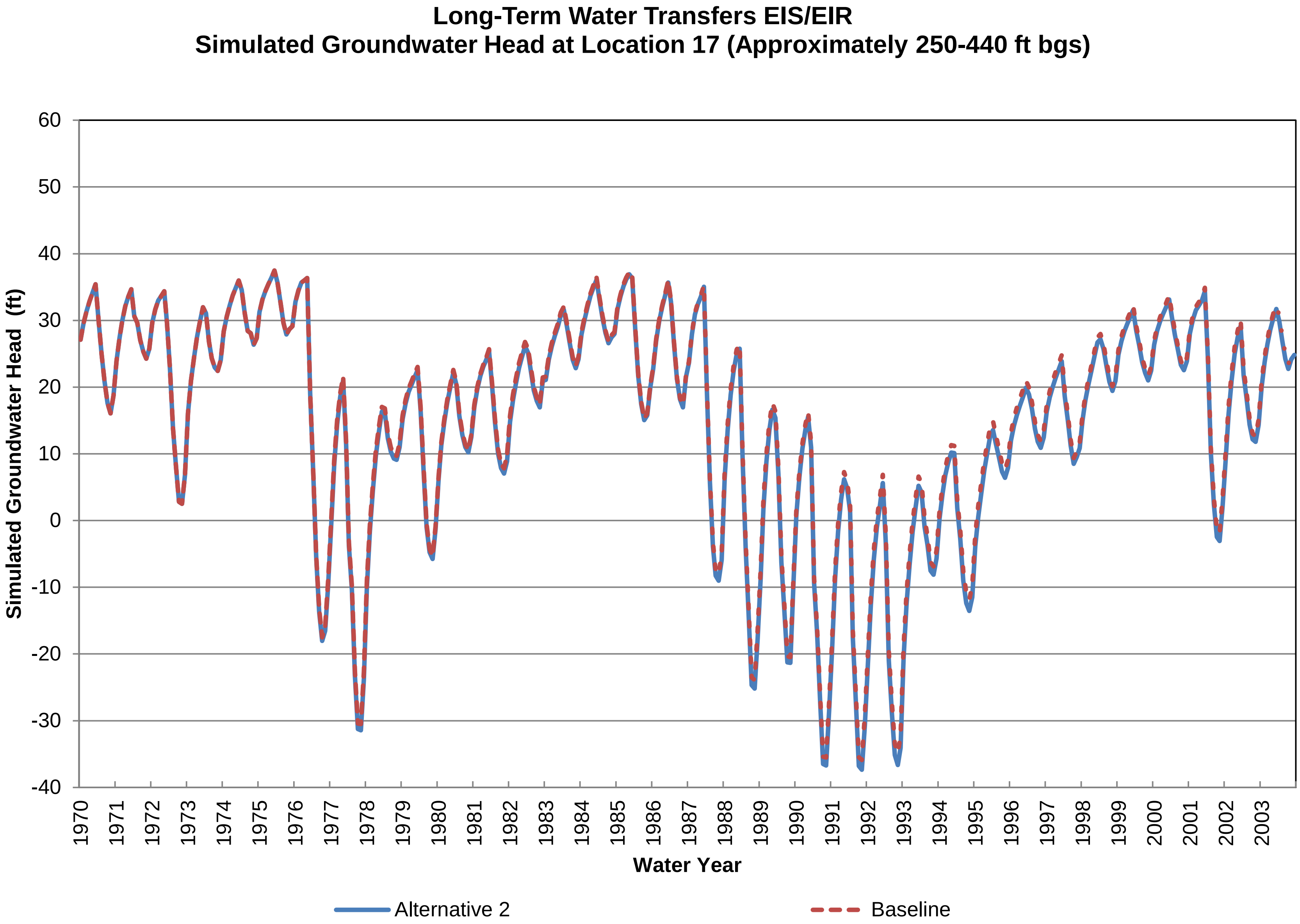



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 16 (Approximately 1020-1390 ft bgs)
60
50
40
30
20
10
0
-10
-20
-30
-40
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 17 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 70-250 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 250-440 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
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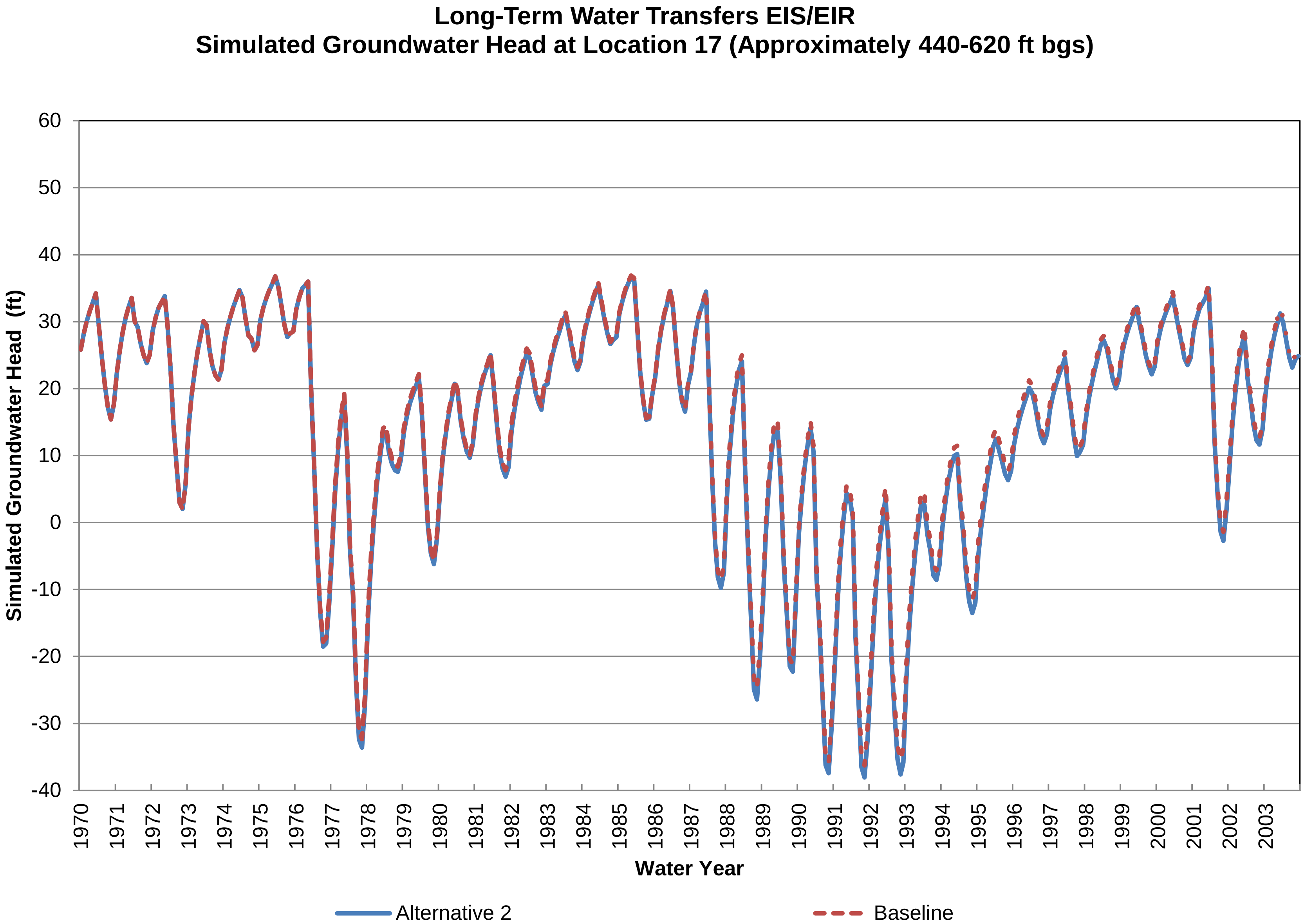
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 440-620 ft bgs)
60
50
40
30
20
10
0
-10
-20
-30
-40
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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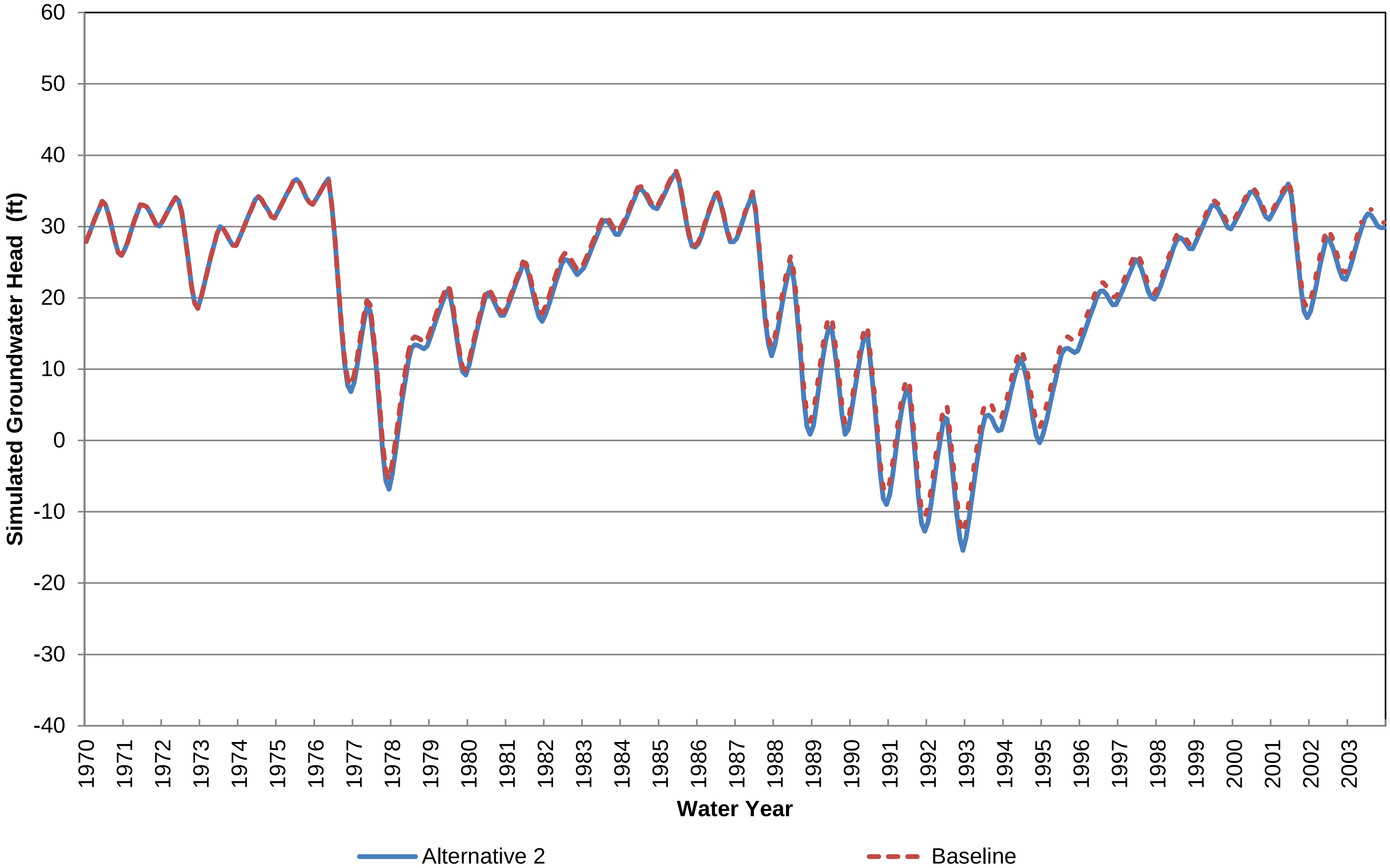
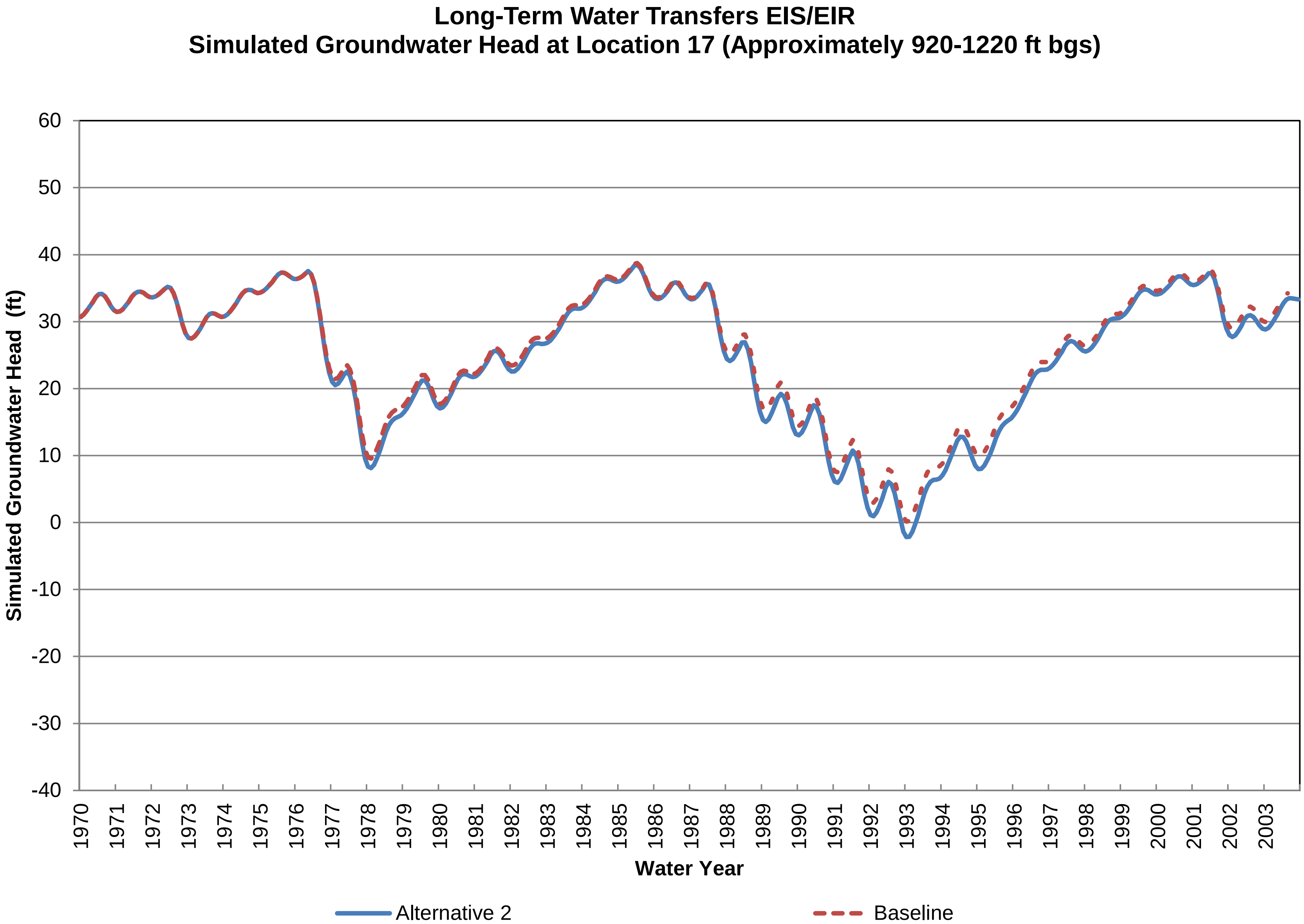
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 620-920 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 920-1220 ft bgs)
60
50
40
30
20
10
0
-10
-20
-30
-40
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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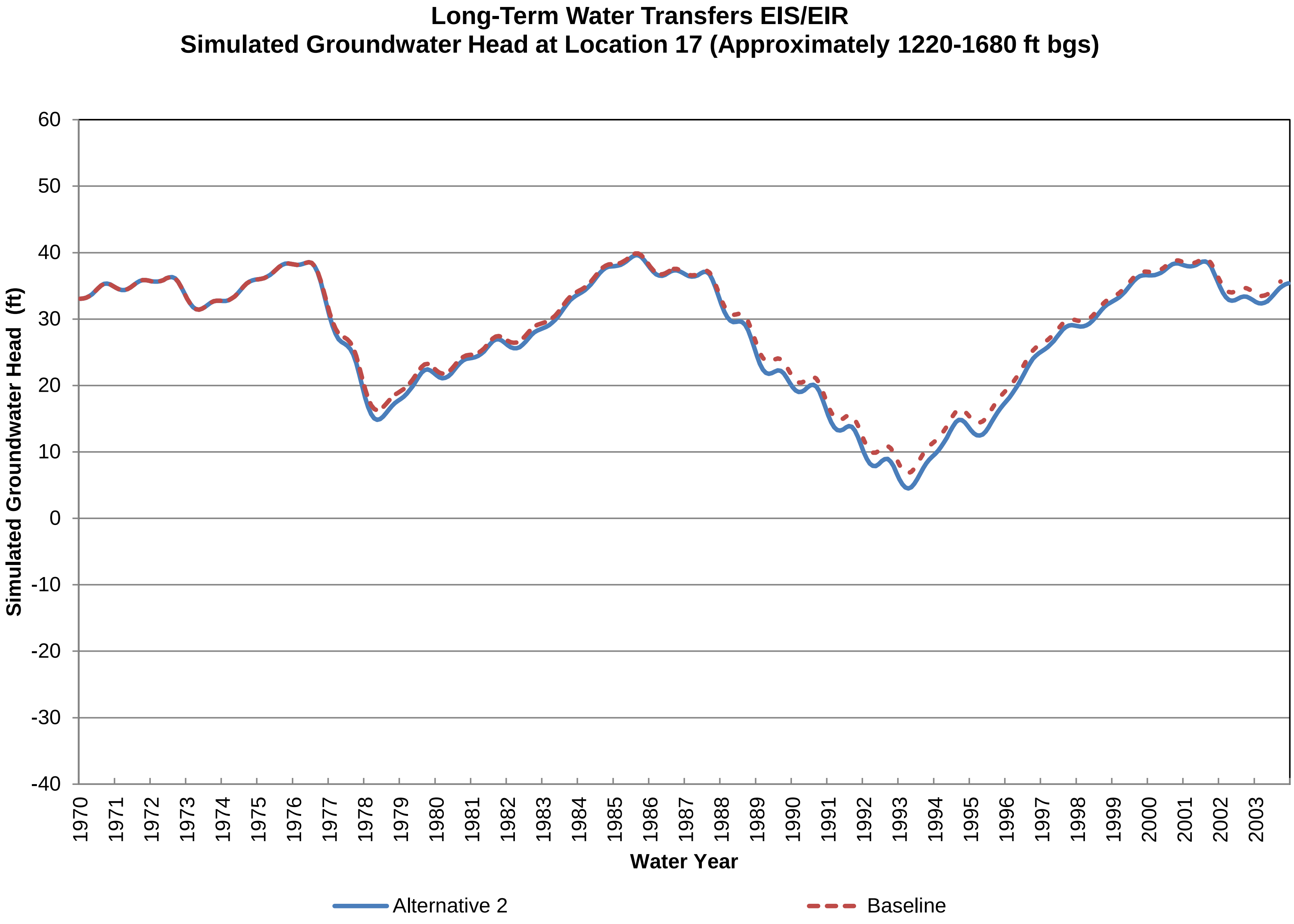
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 17 (Approximately 1220-1680 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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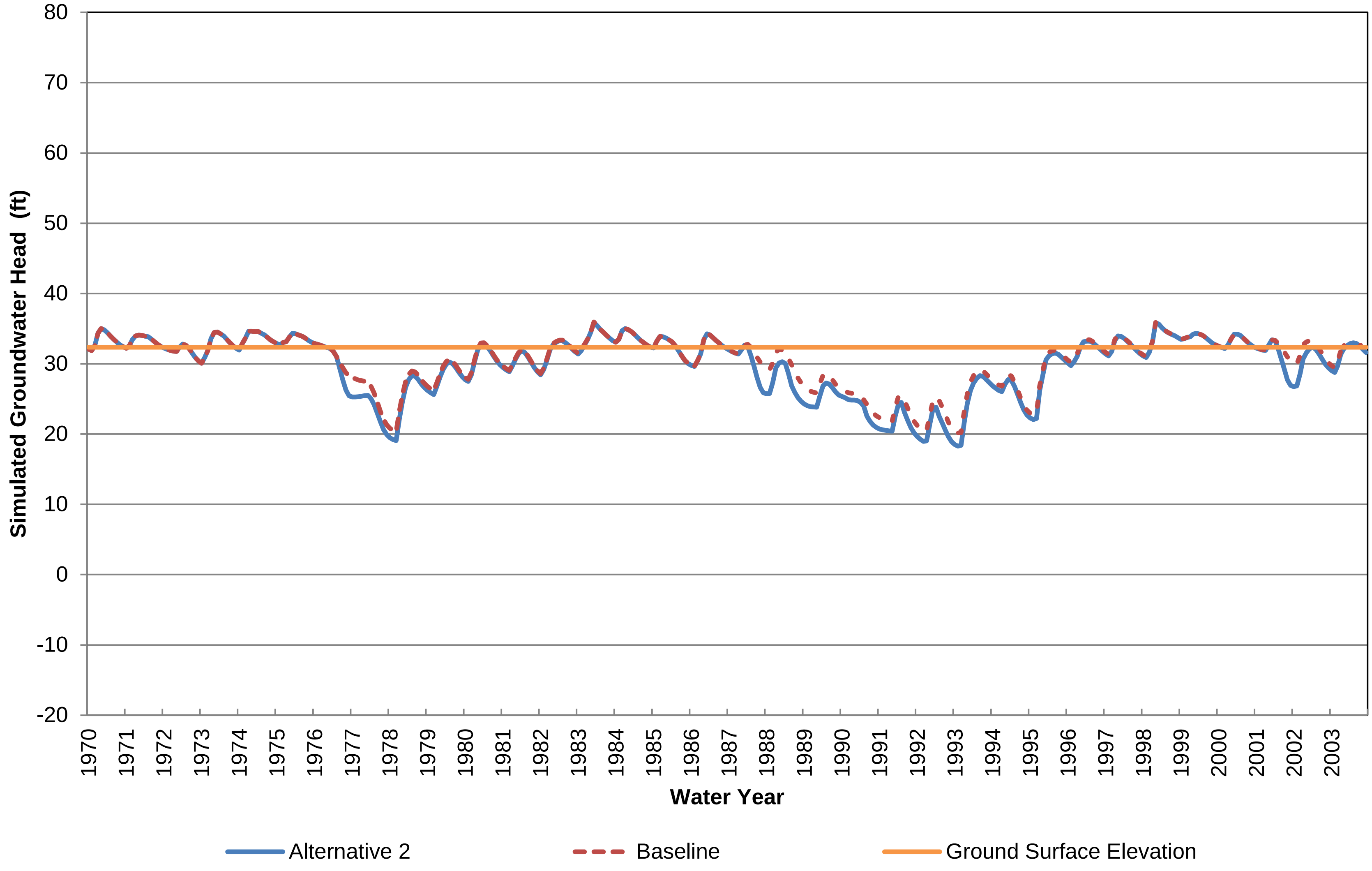
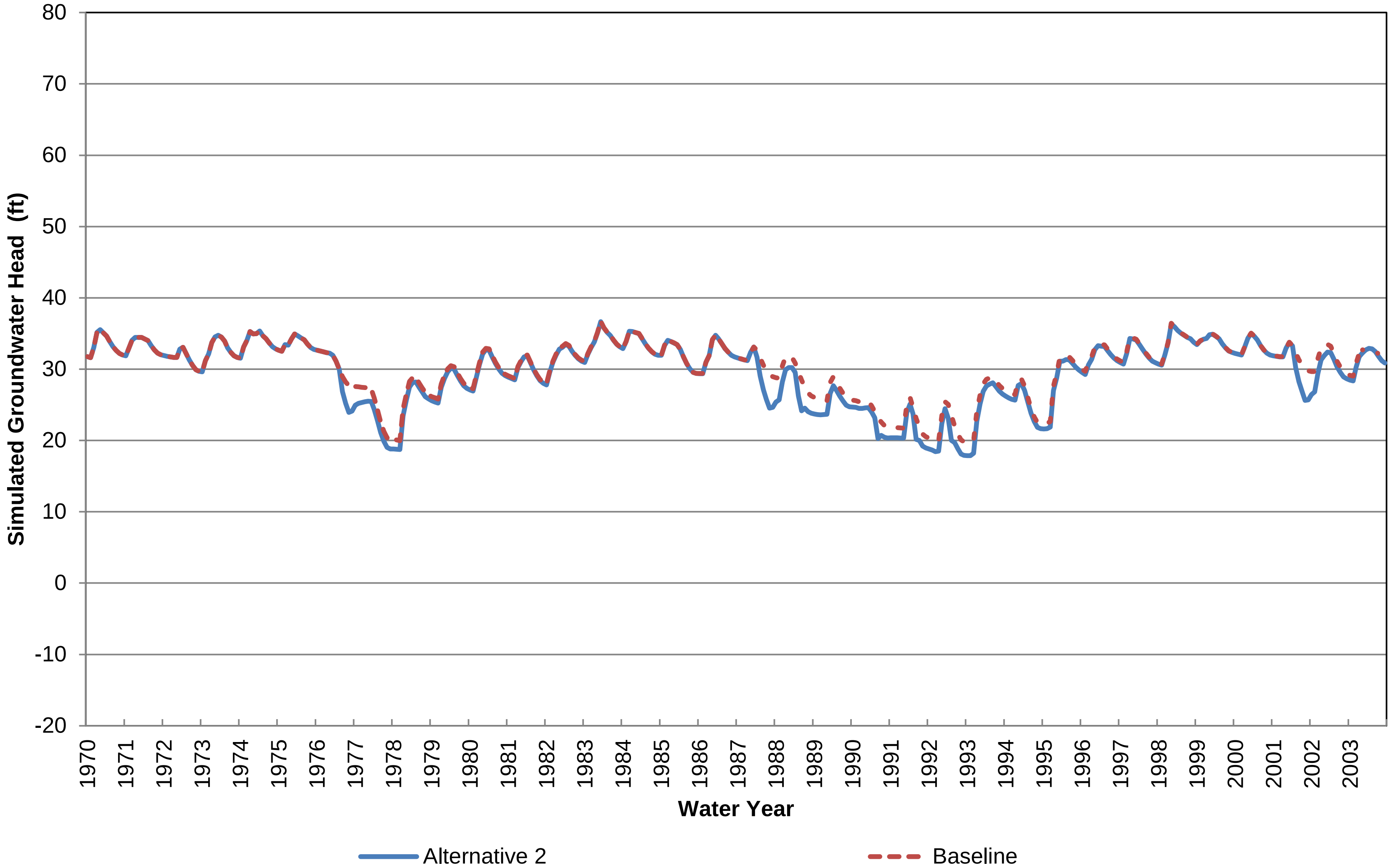
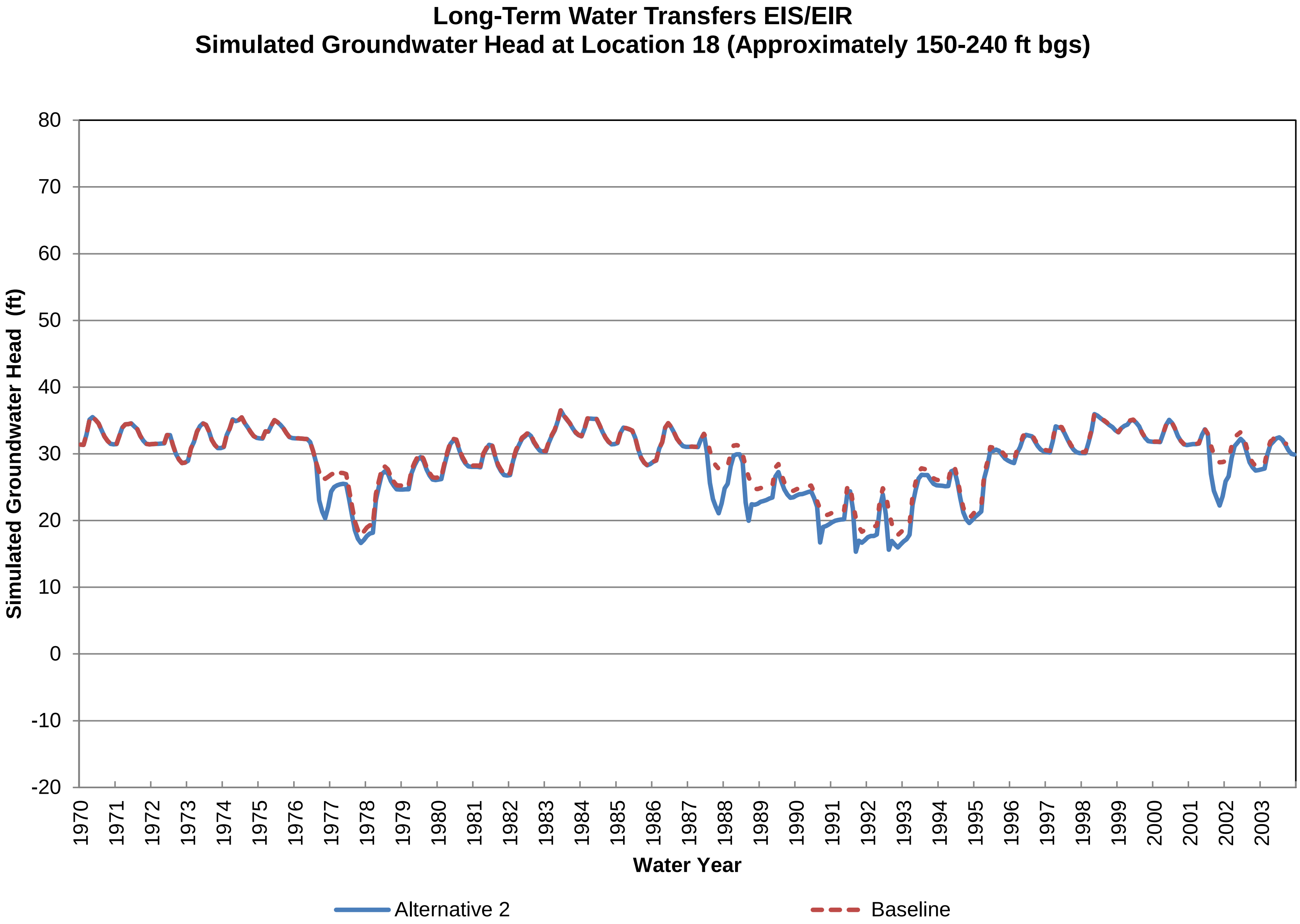
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 18 (Approximately 0-60 ft bgs)



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 60-150 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 150-240 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
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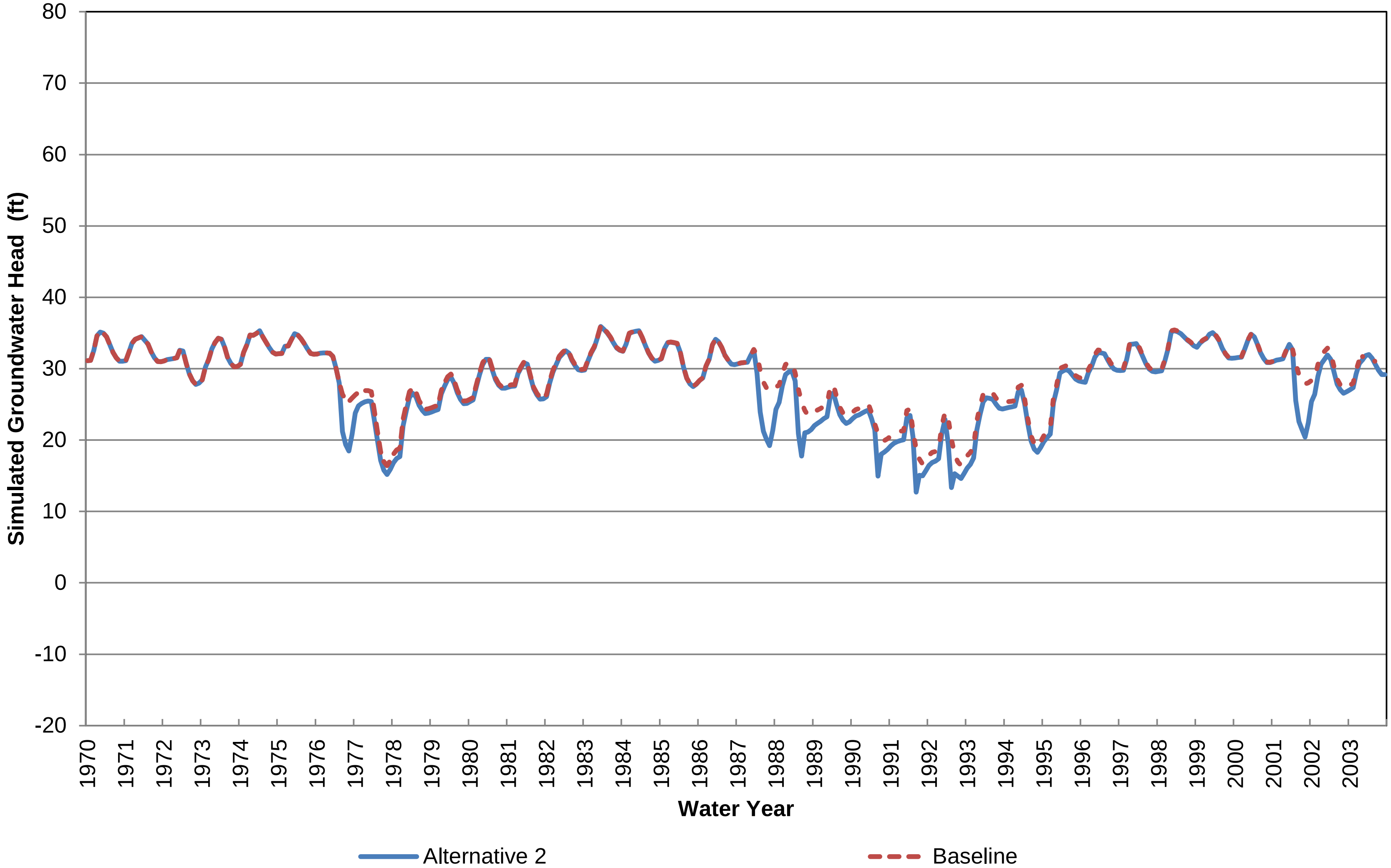
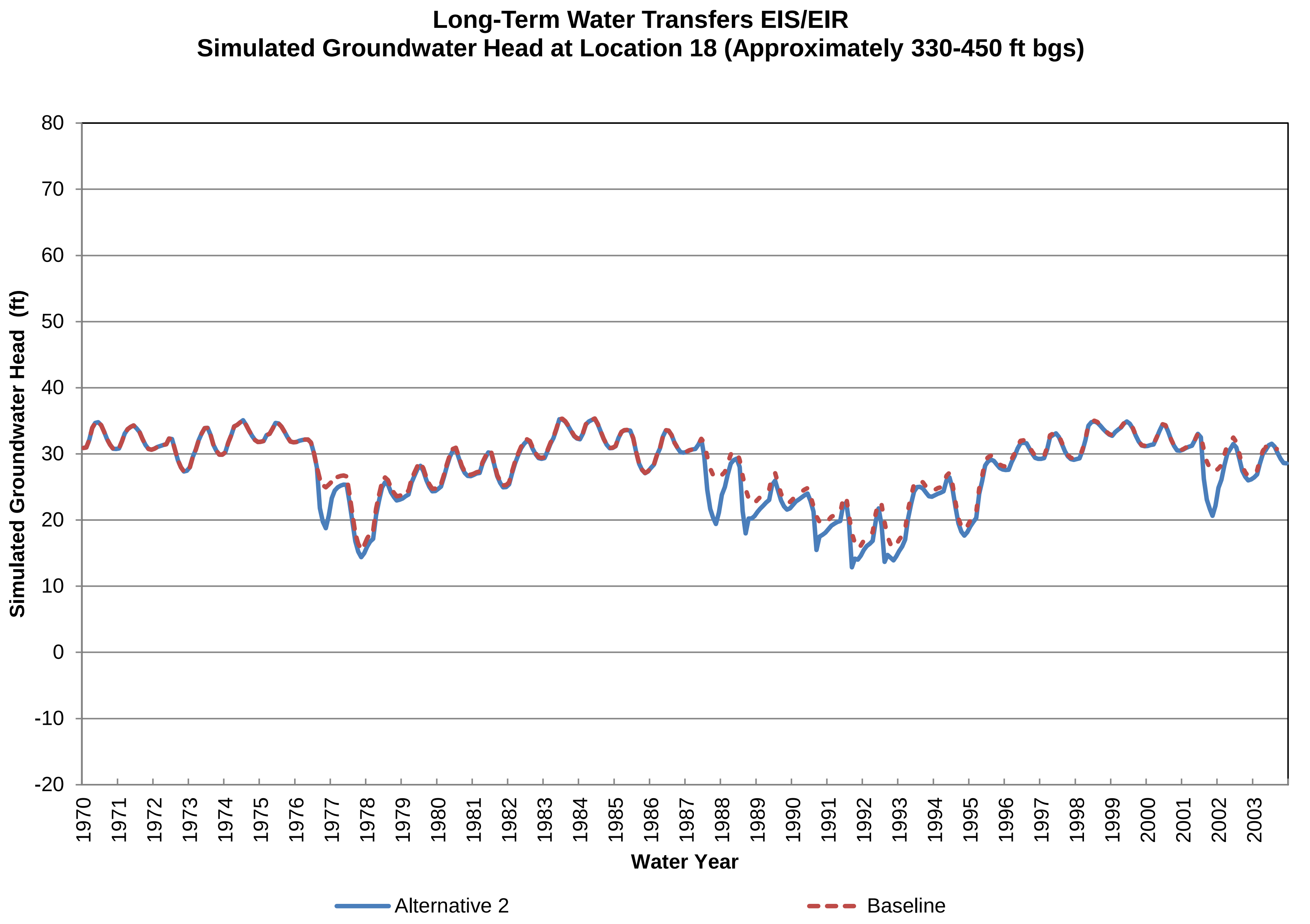
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 240-330 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 330-450 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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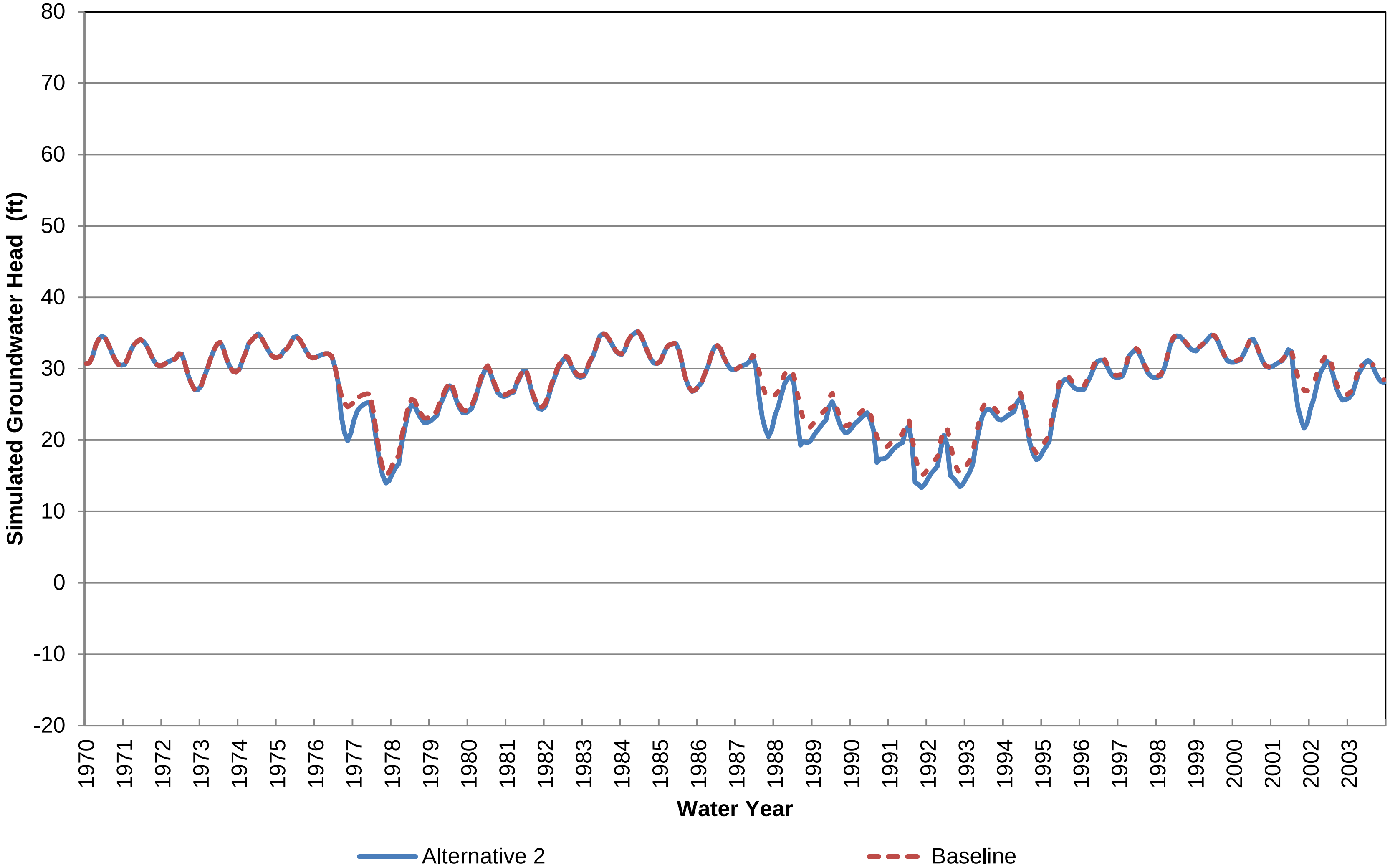
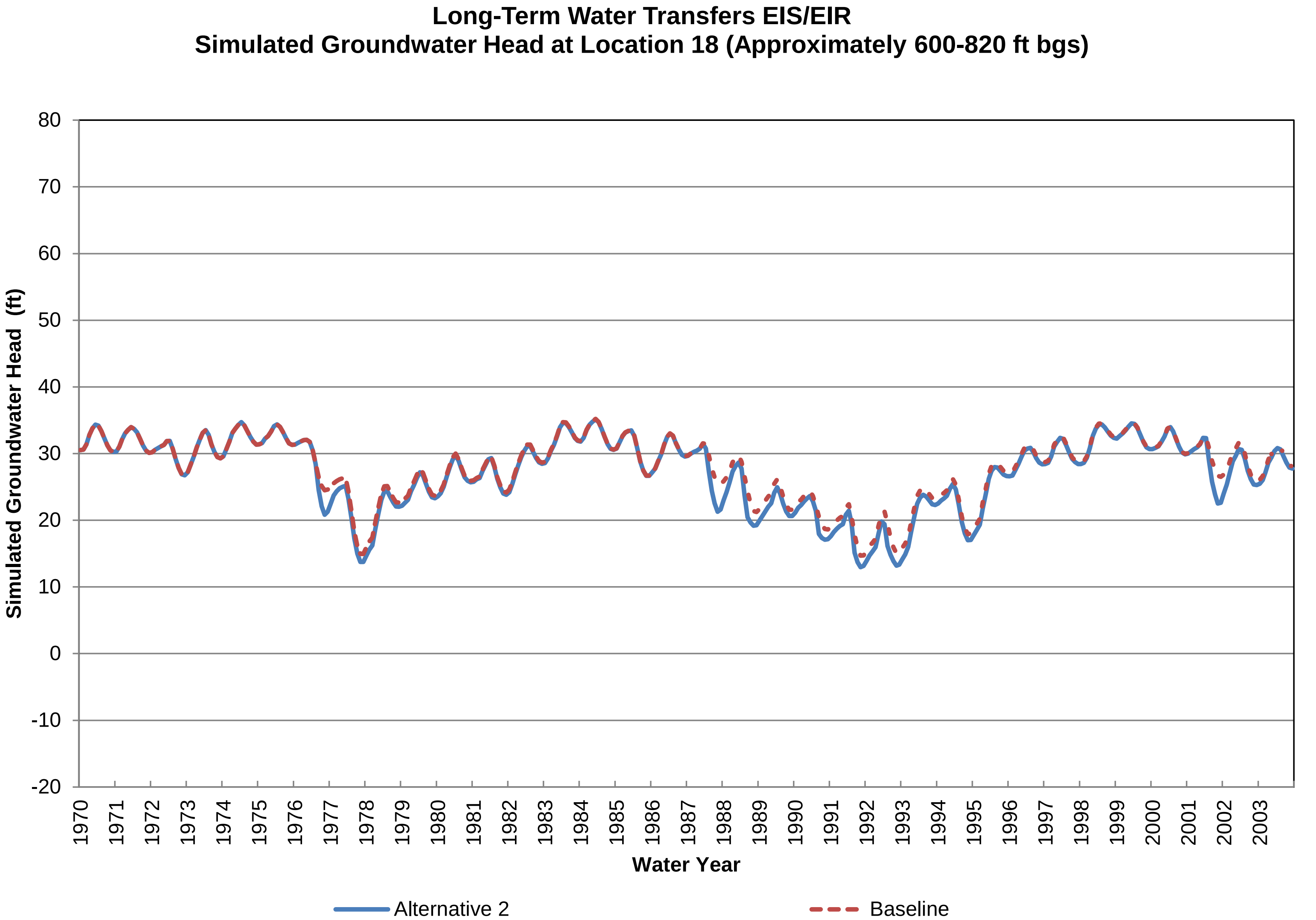
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 450-600 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 18 (Approximately 600-820 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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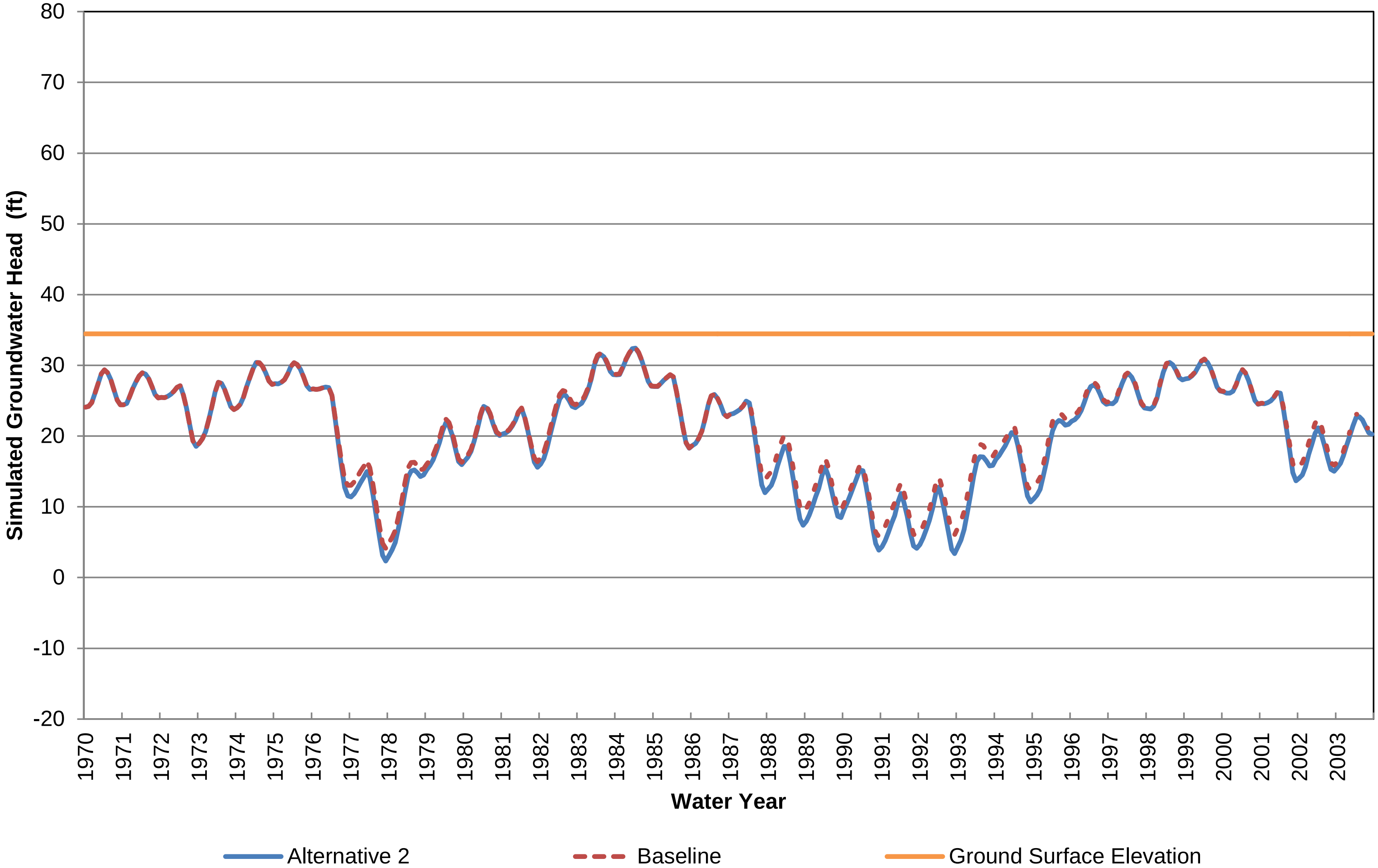
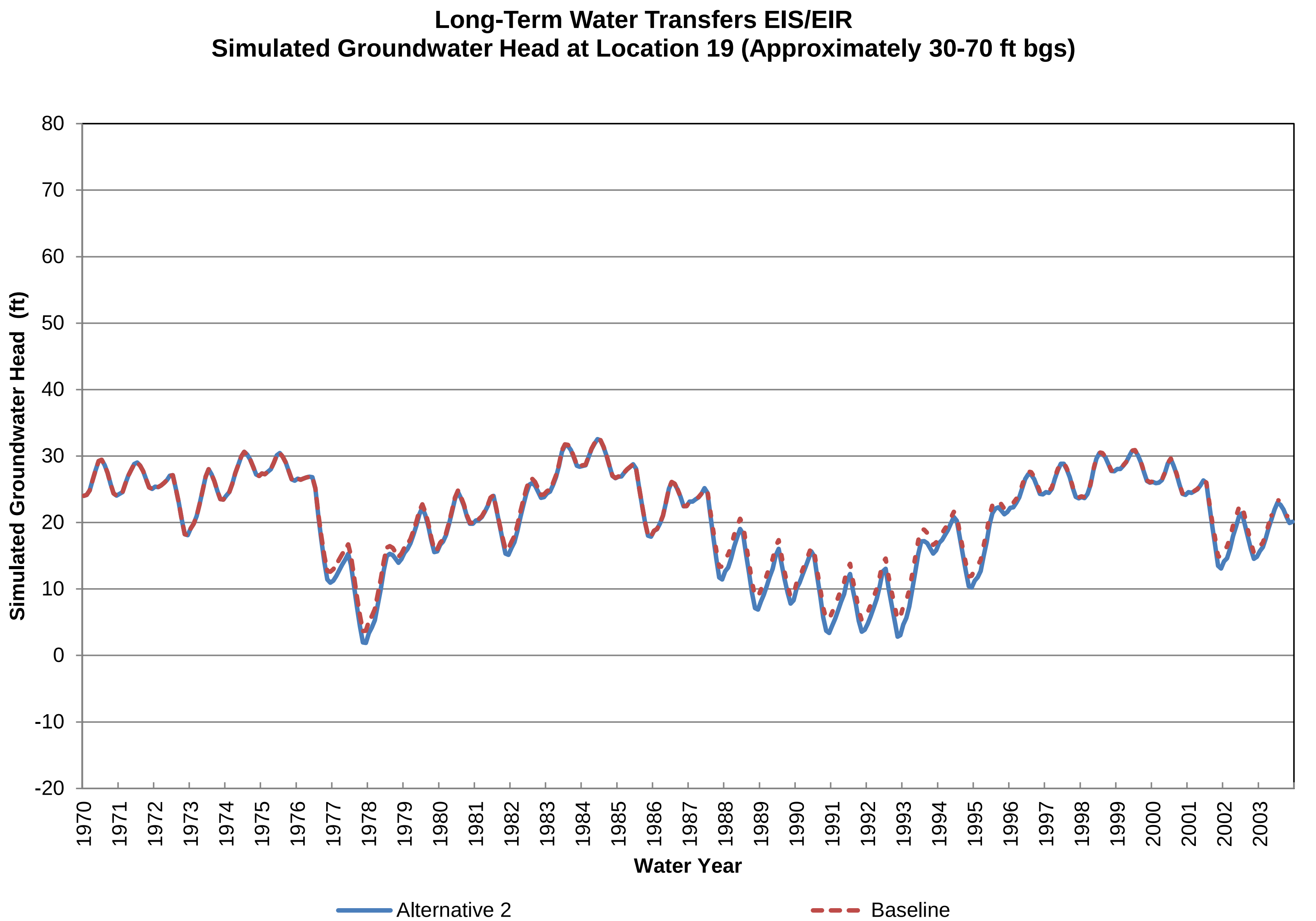
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 19 (Approximately 0-30 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 30-70 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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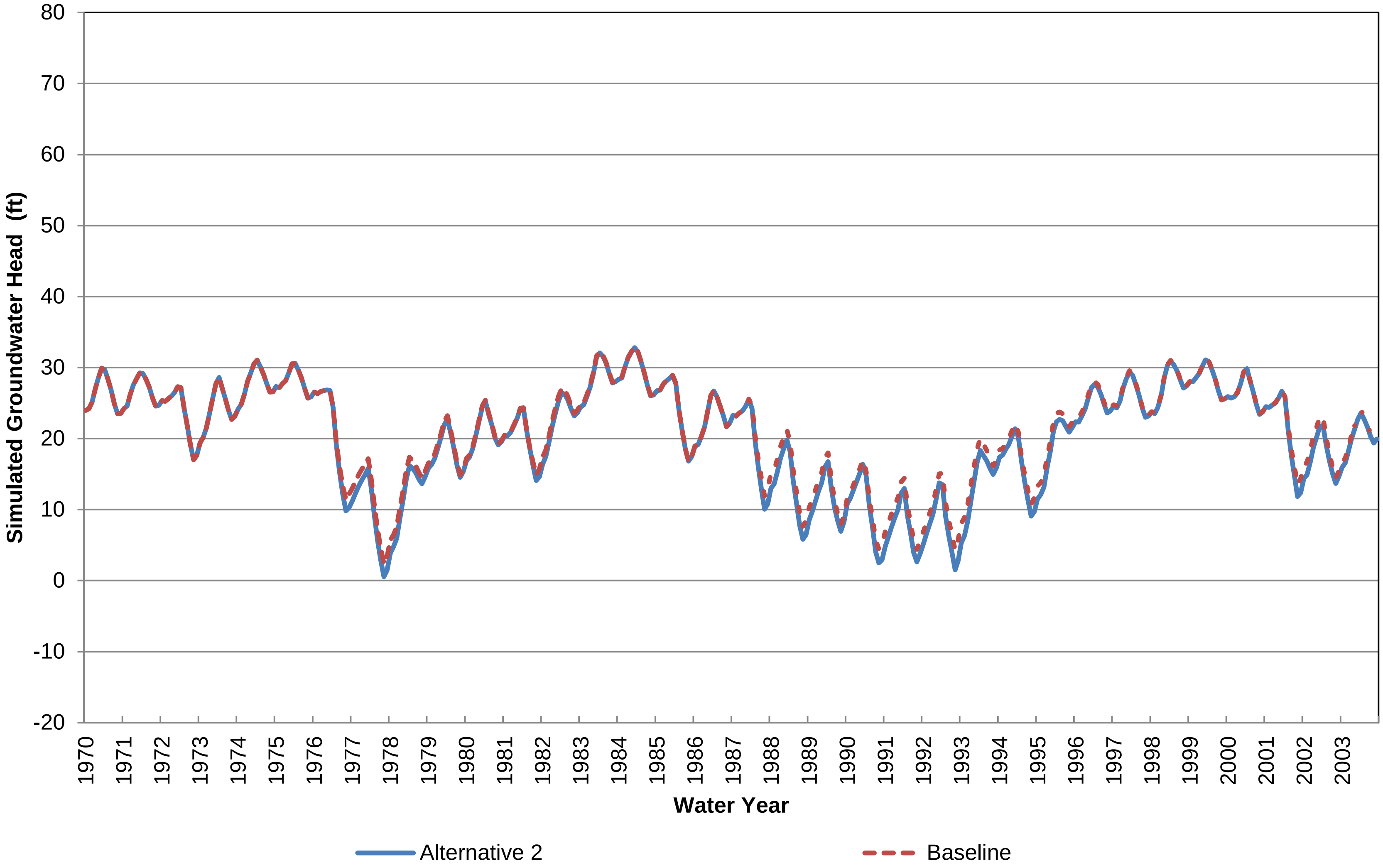
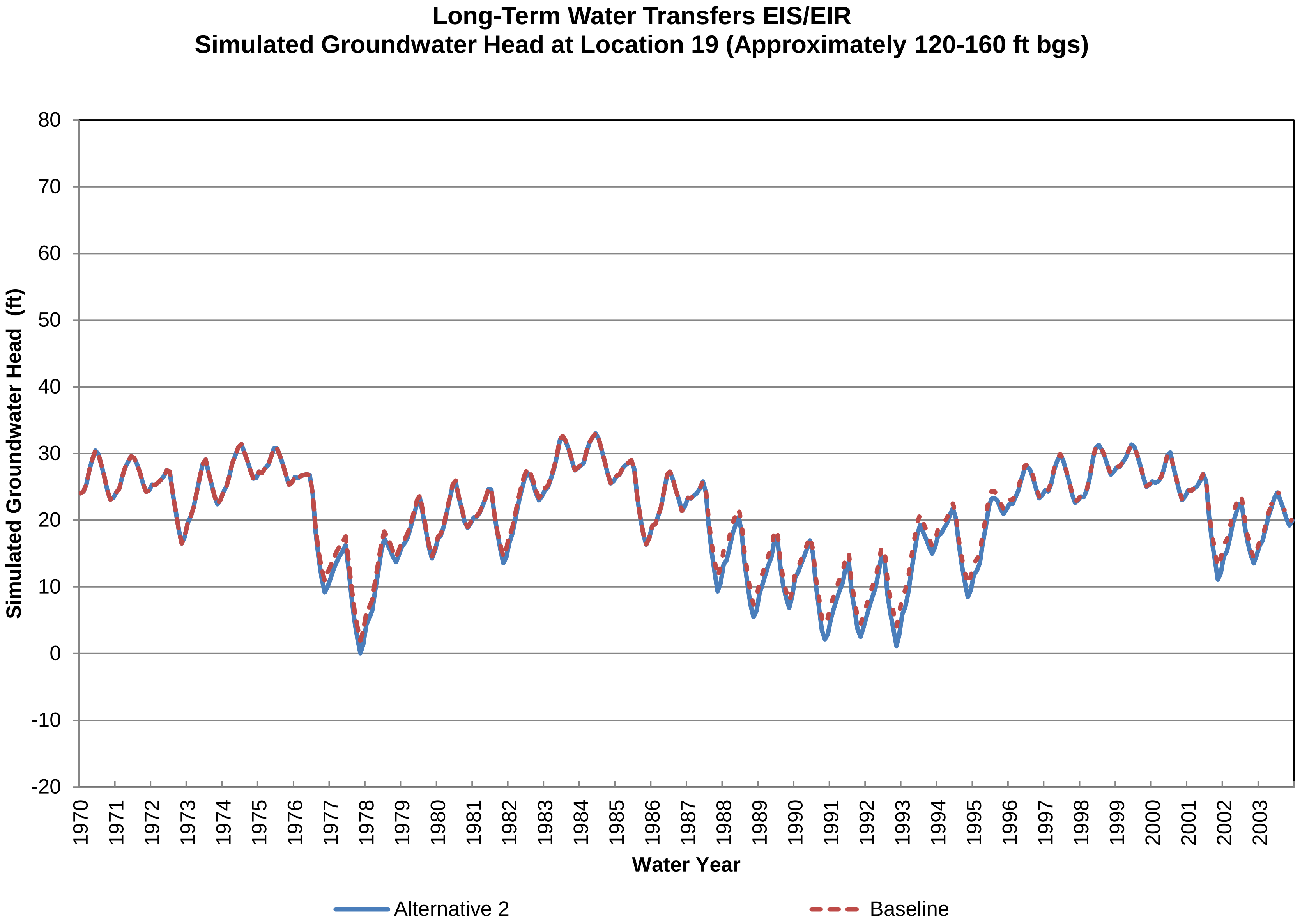
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 70-120 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 120-160 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1999
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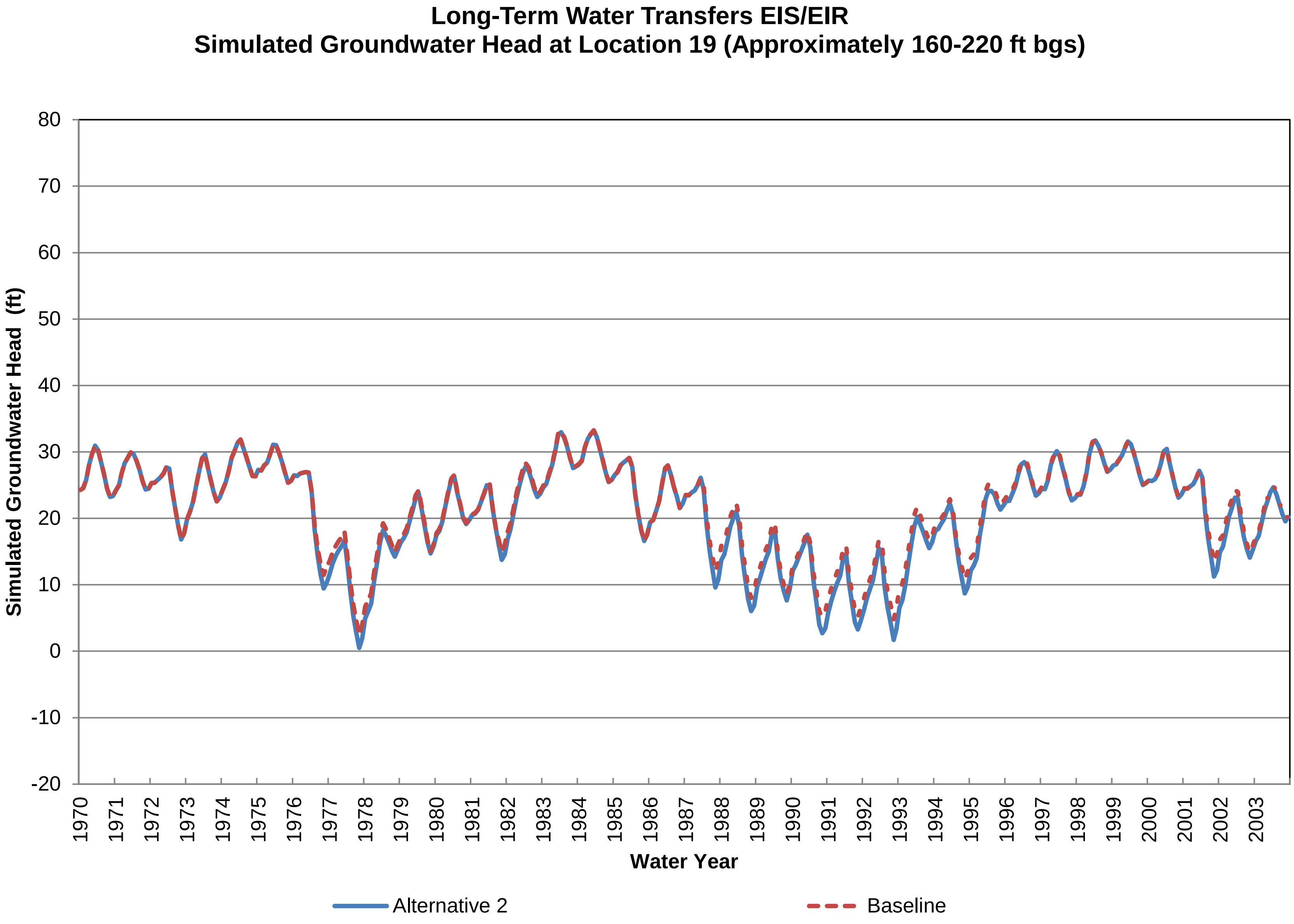
2001
2002
2003
Water Year
Alternative 2
Baseline

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 160-220 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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1990
1991
1992
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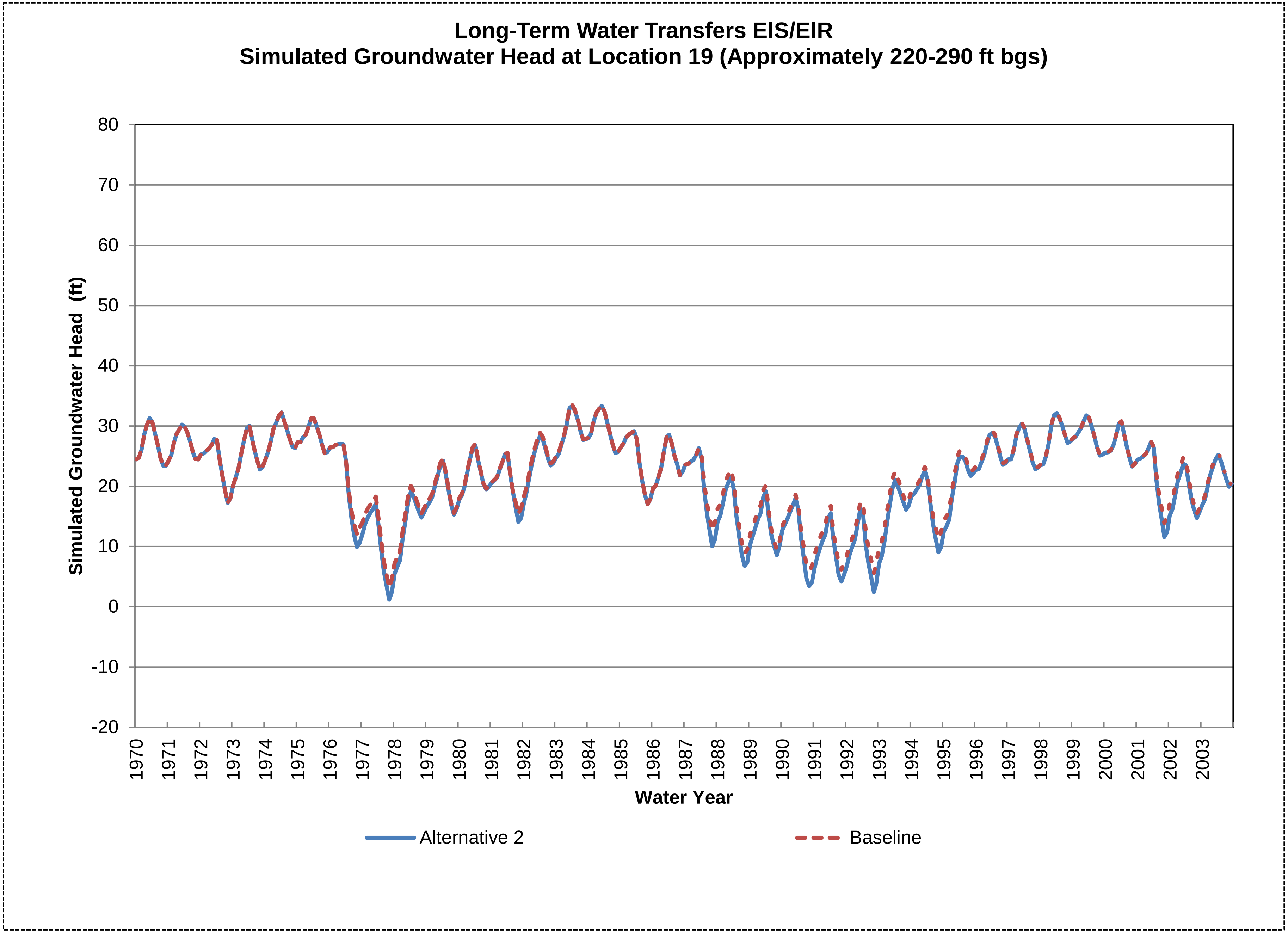
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 220-290 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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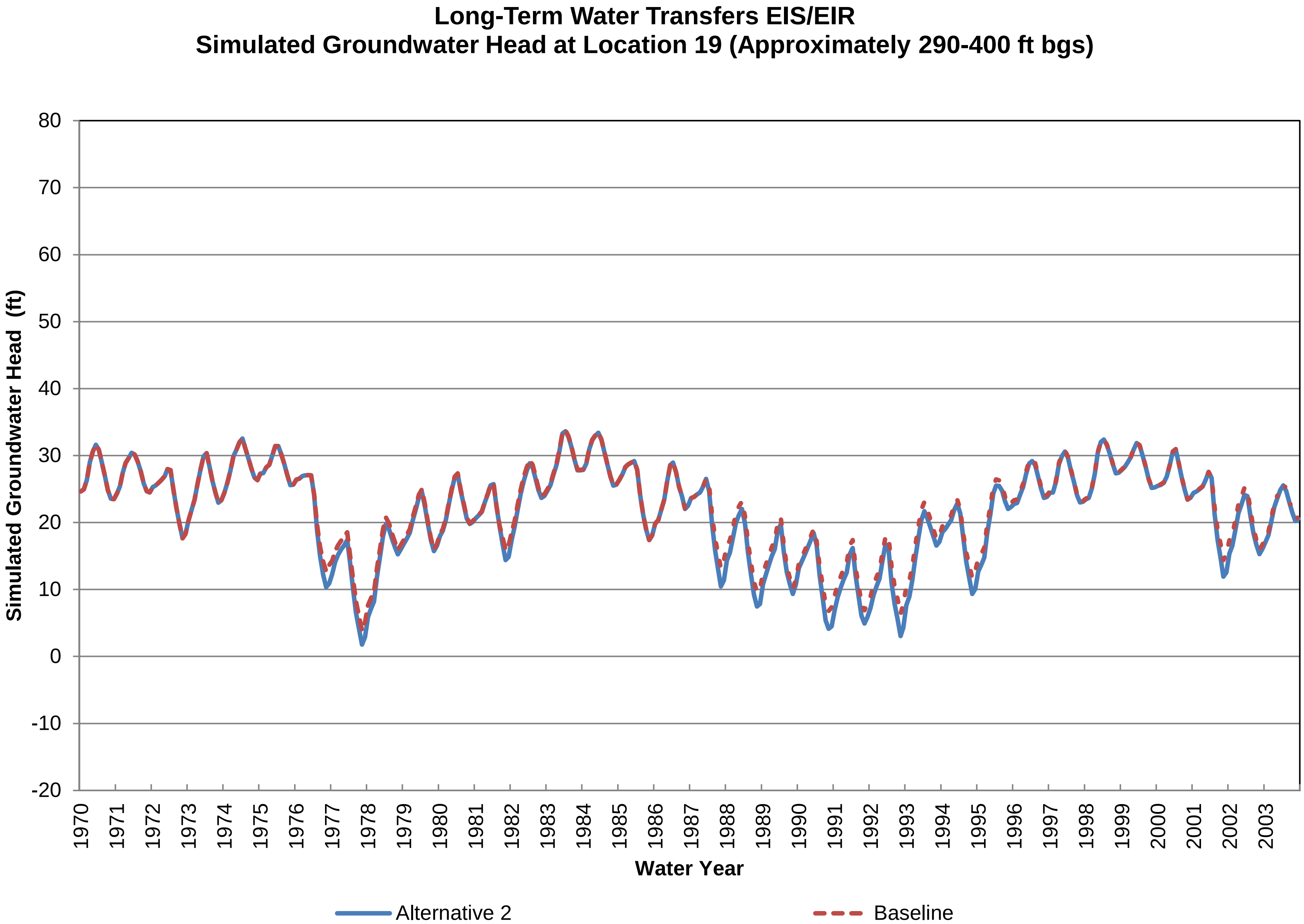
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 19 (Approximately 290-400 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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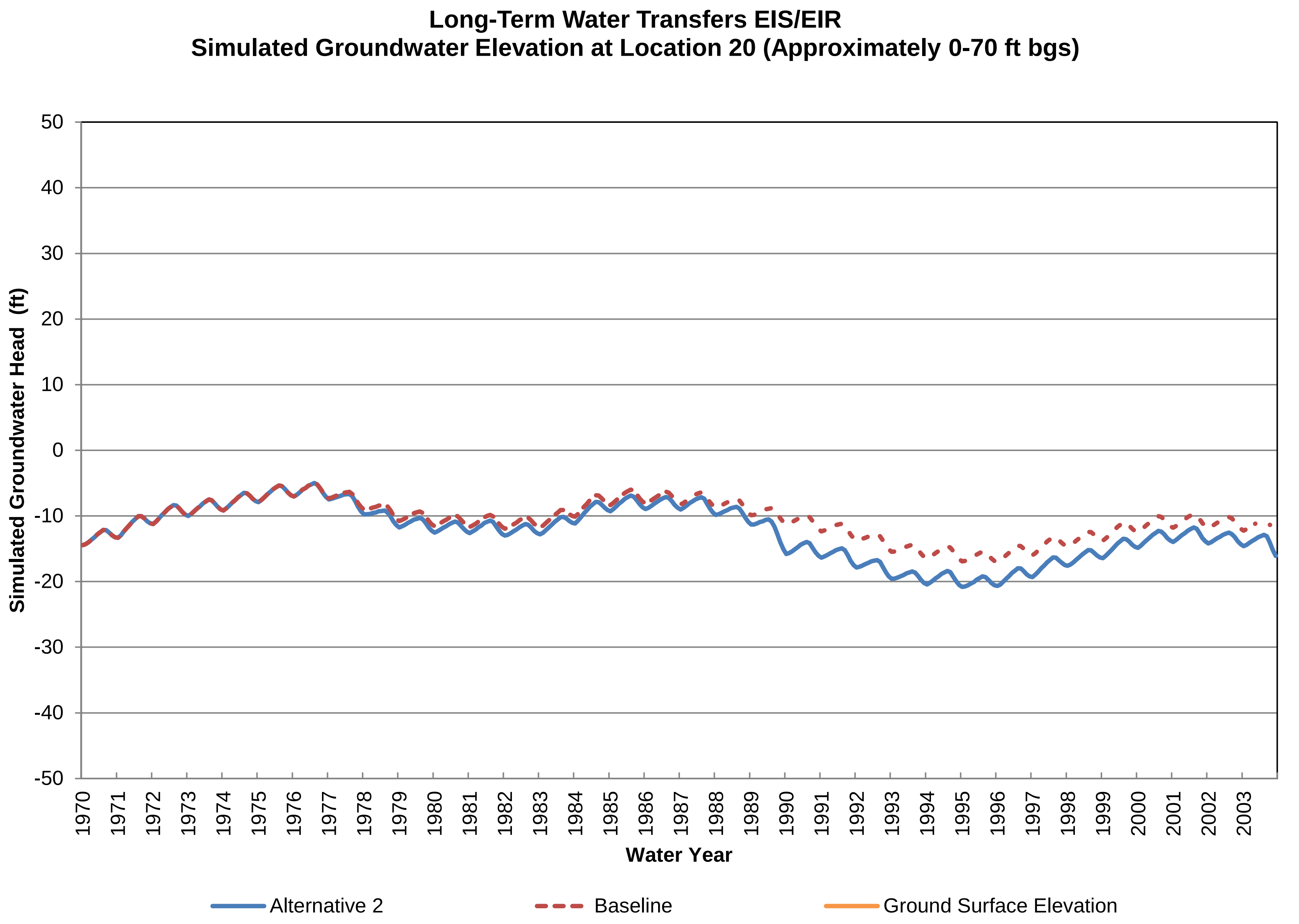
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 20 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
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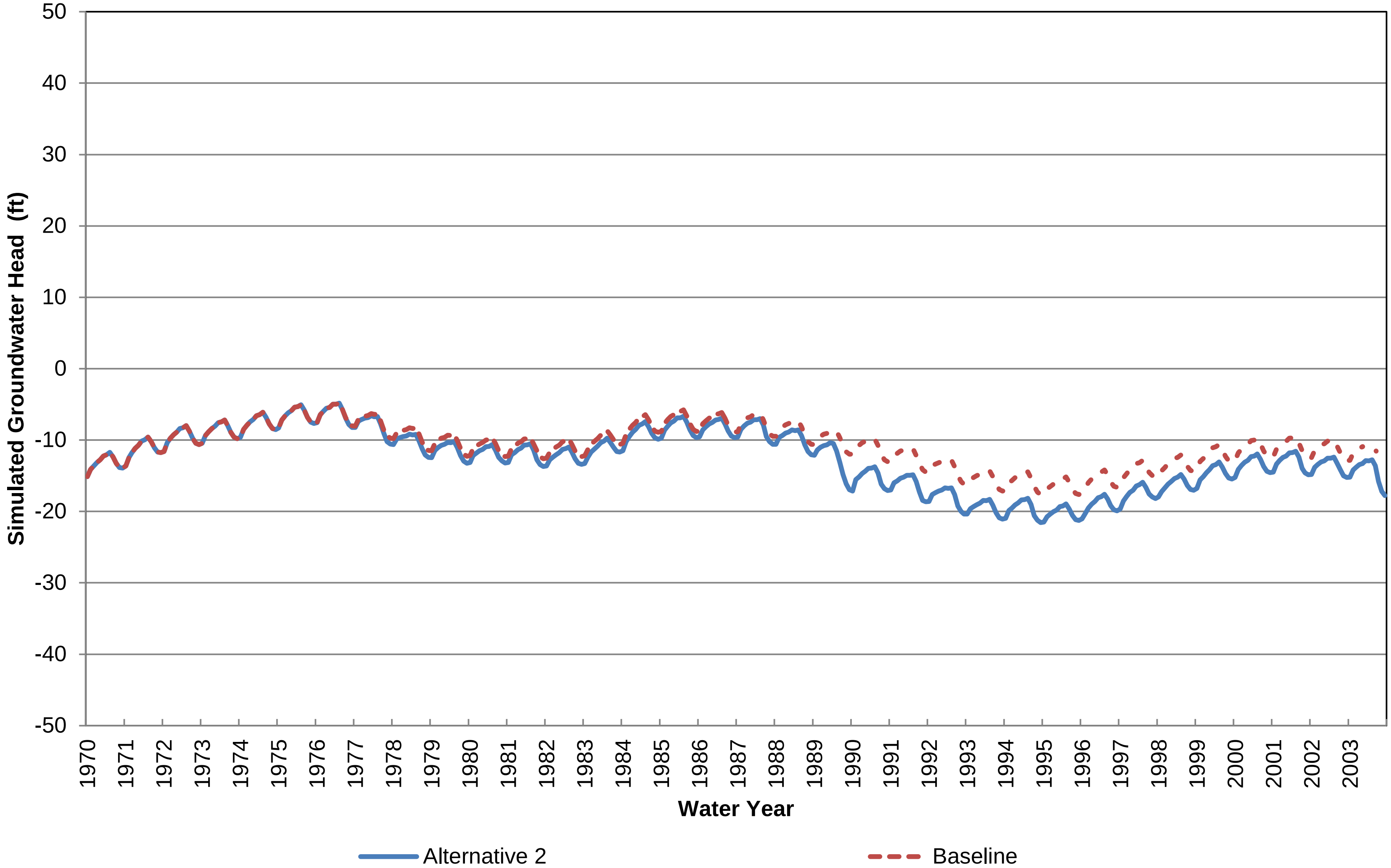
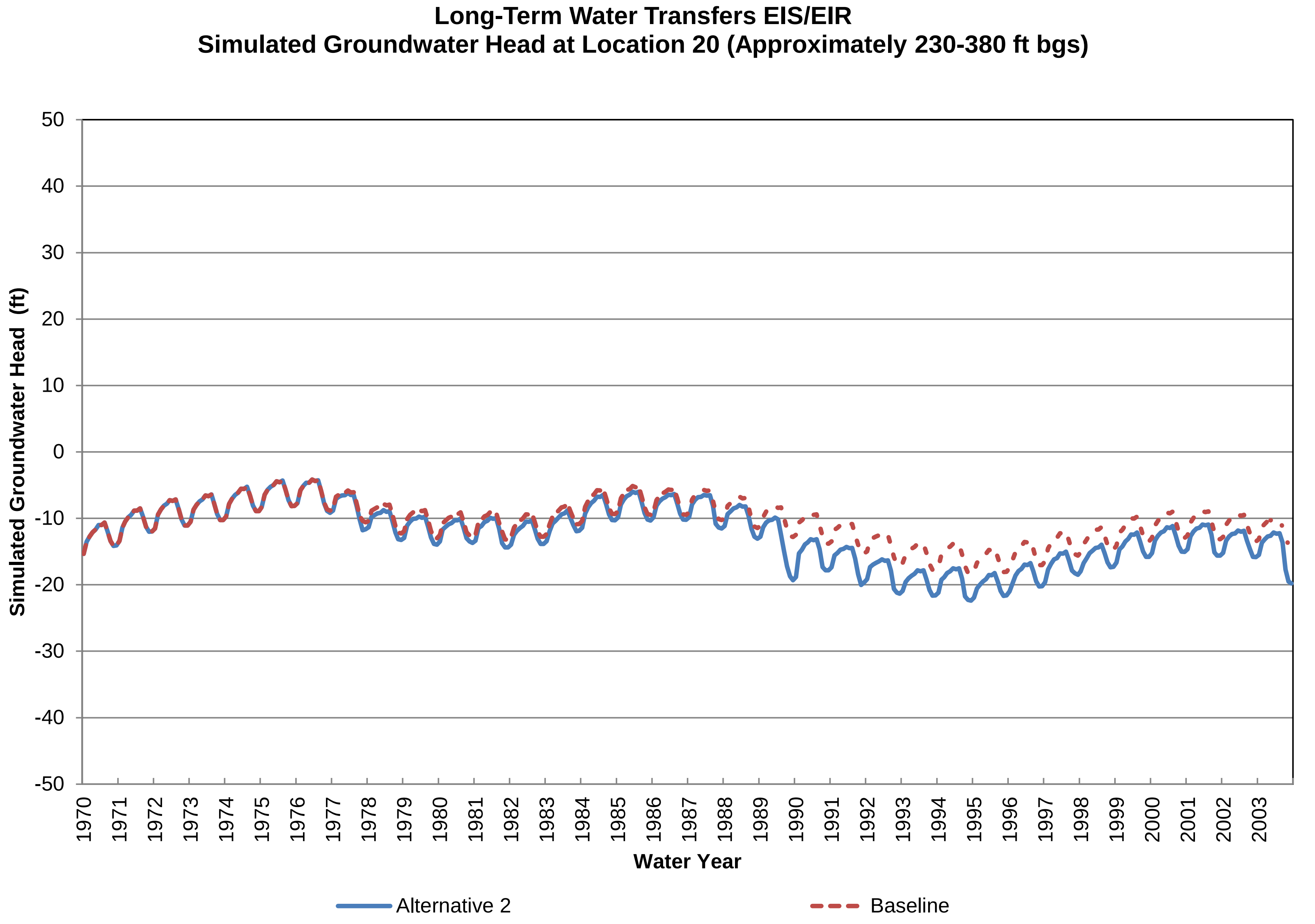
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 70-230 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 230-380 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
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1988
1989
1990
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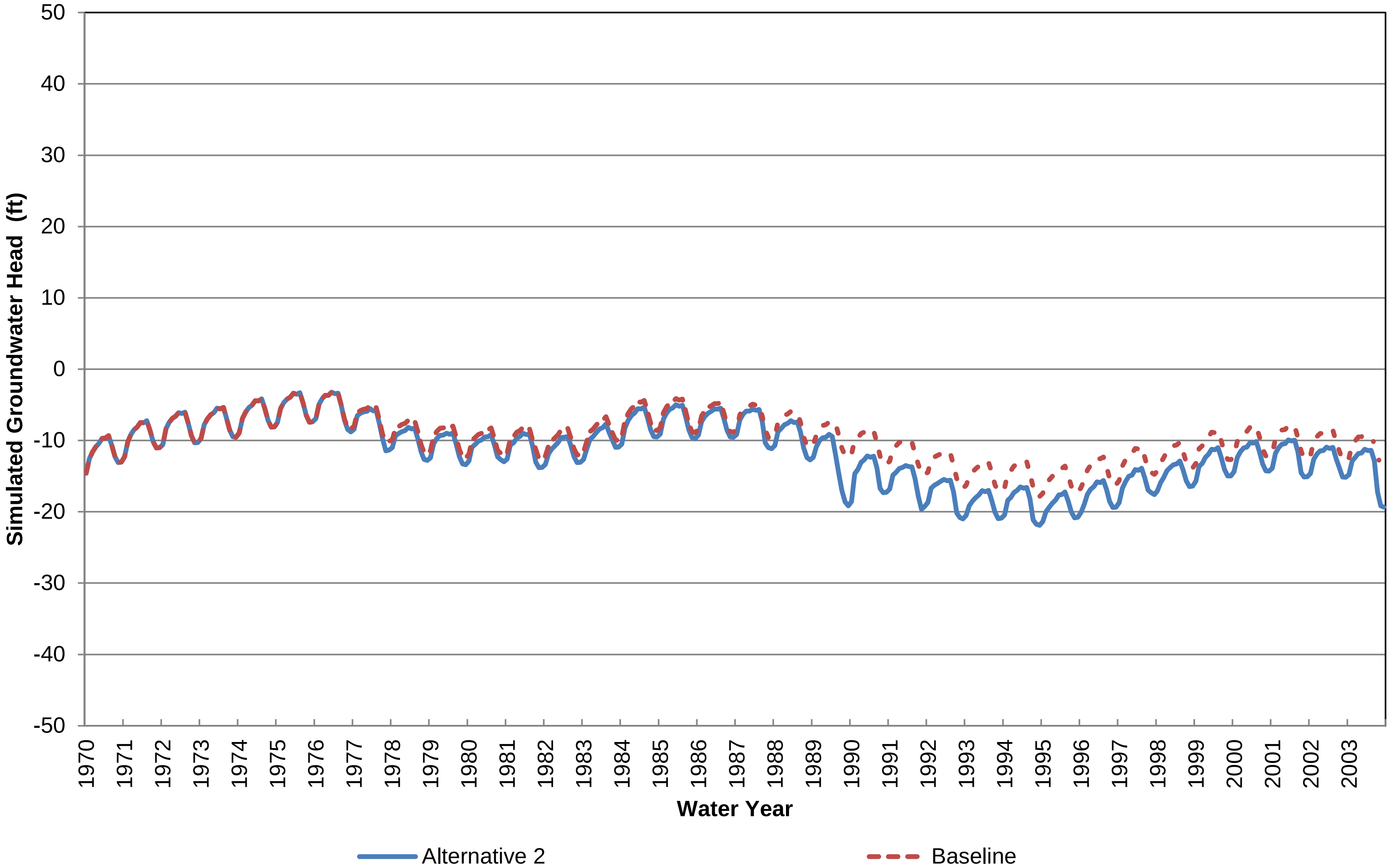
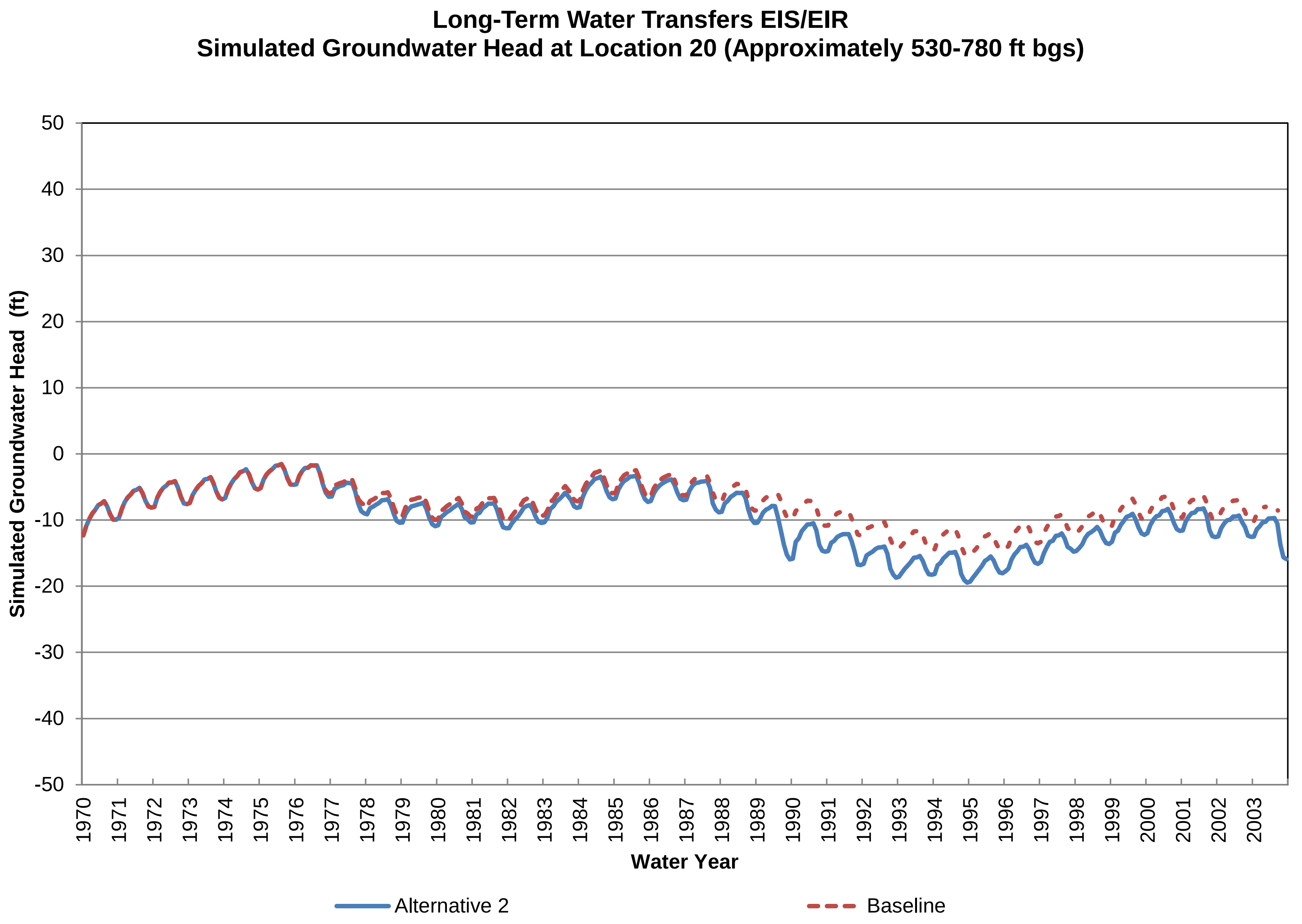
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 380-530 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 530-780 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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1983
1984
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1986
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1988
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1990
1991
1992
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1994
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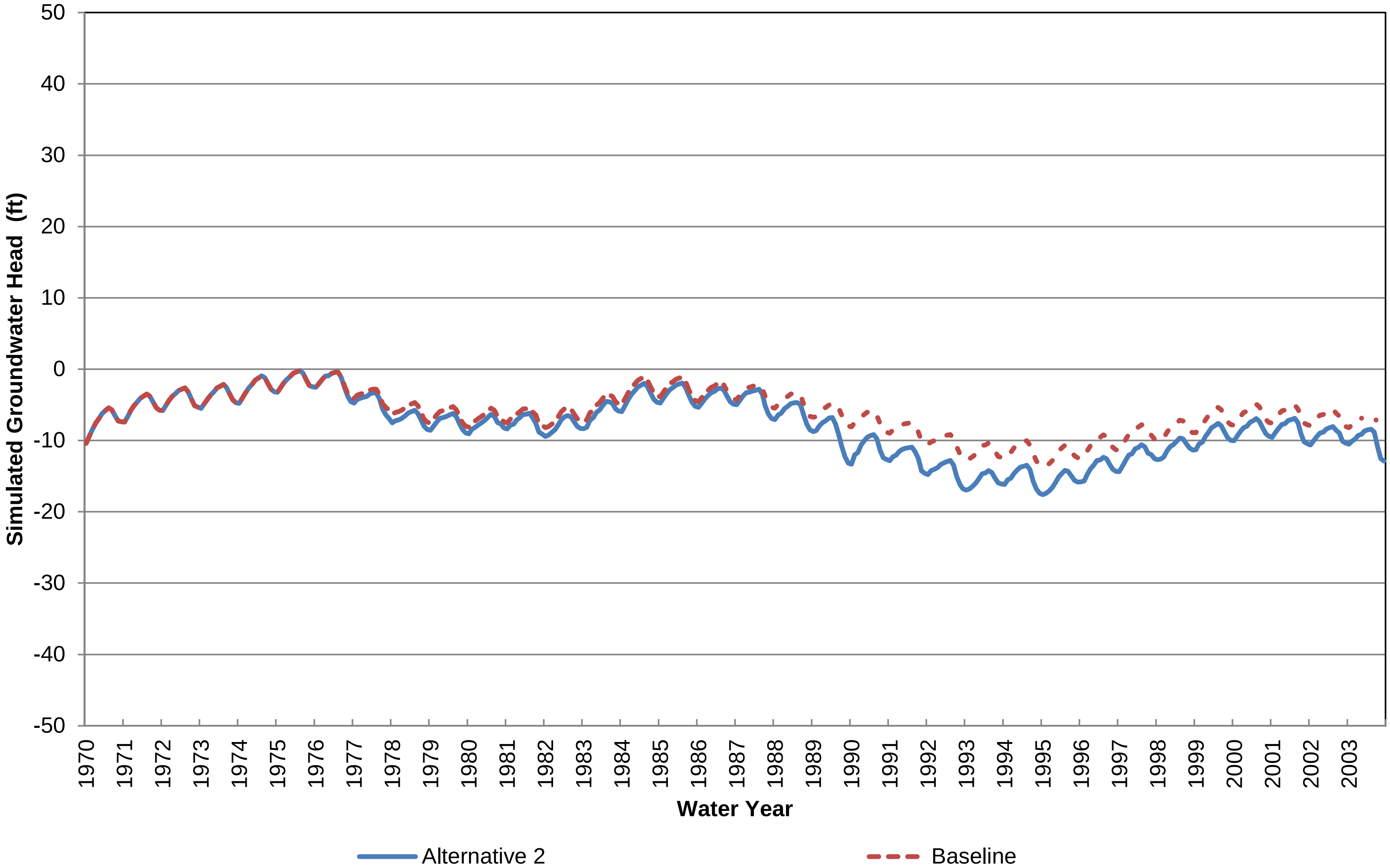
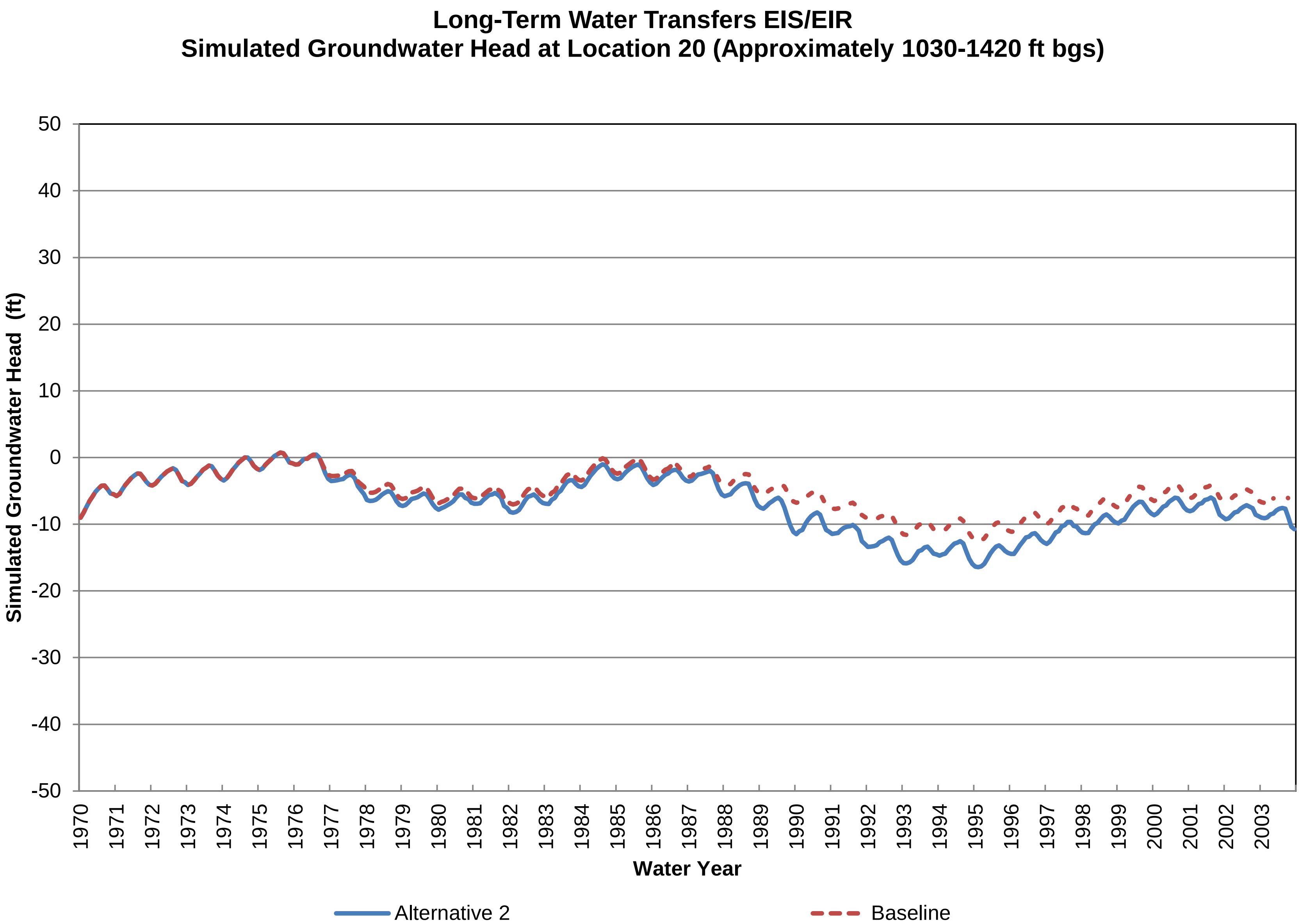
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 780-1030 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 20 (Approximately 1030-1420 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
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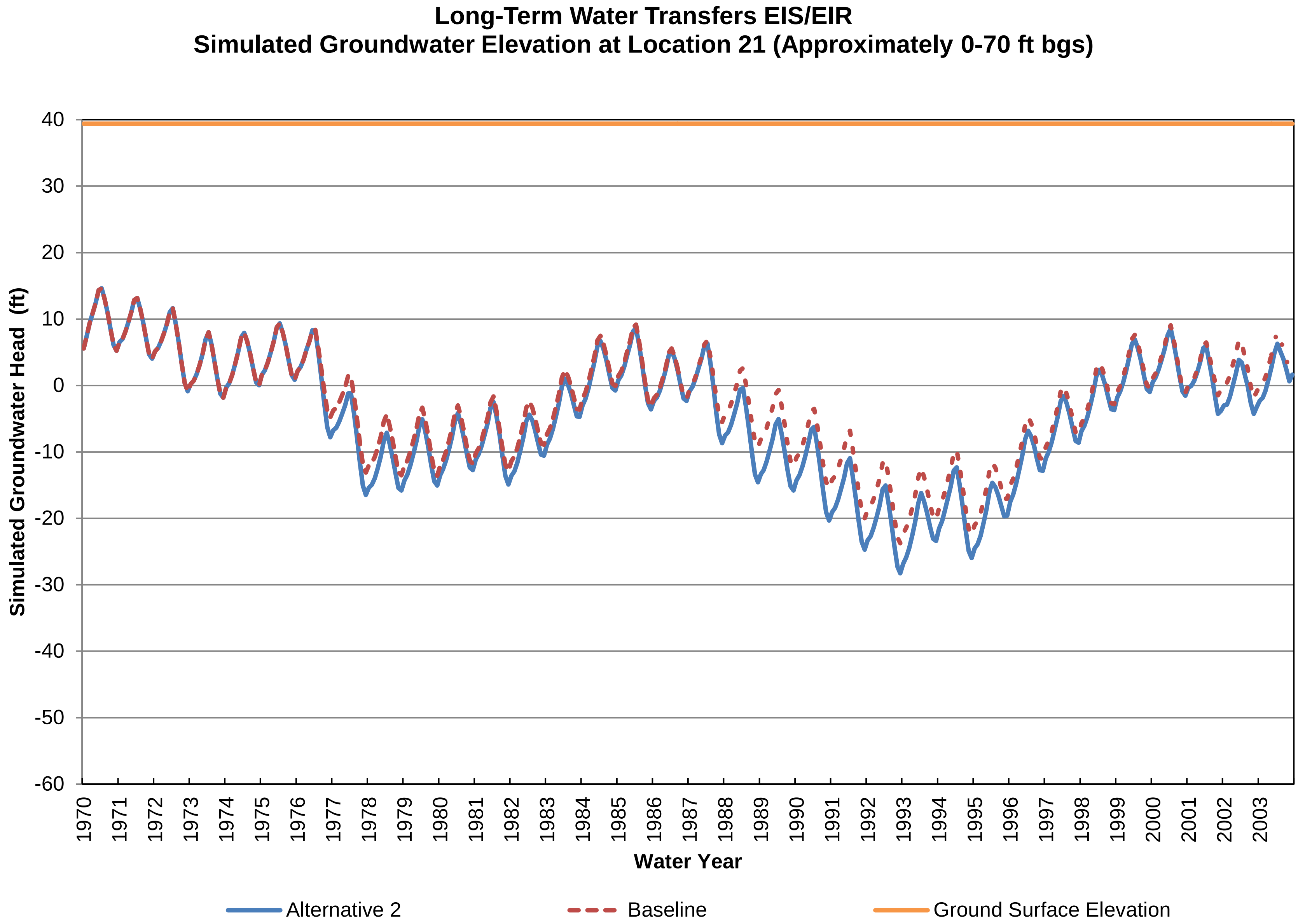
2001
2002
2003
Water Year
Alternative 2
Baseline

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 21 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1984
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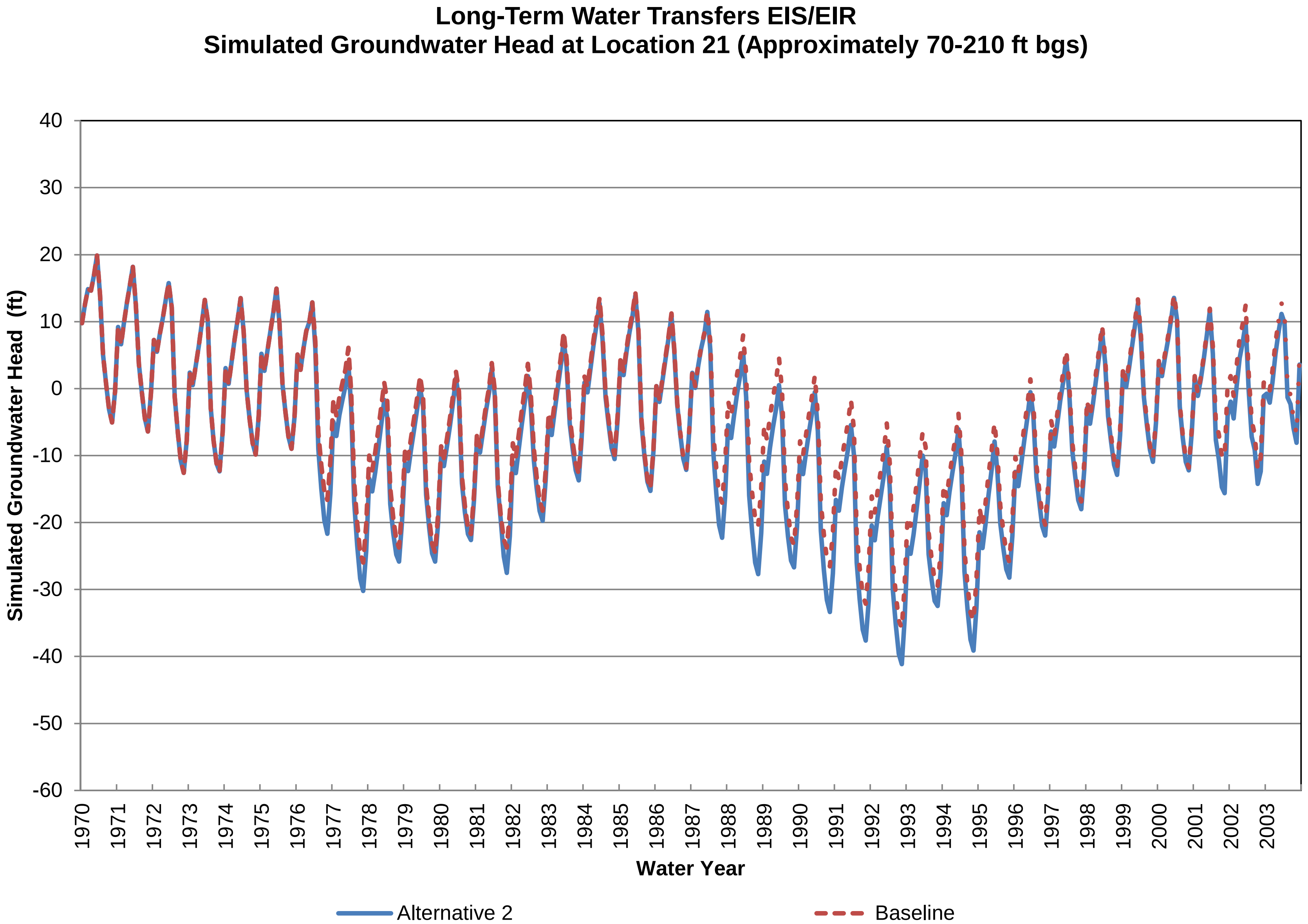
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 70-210 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1994
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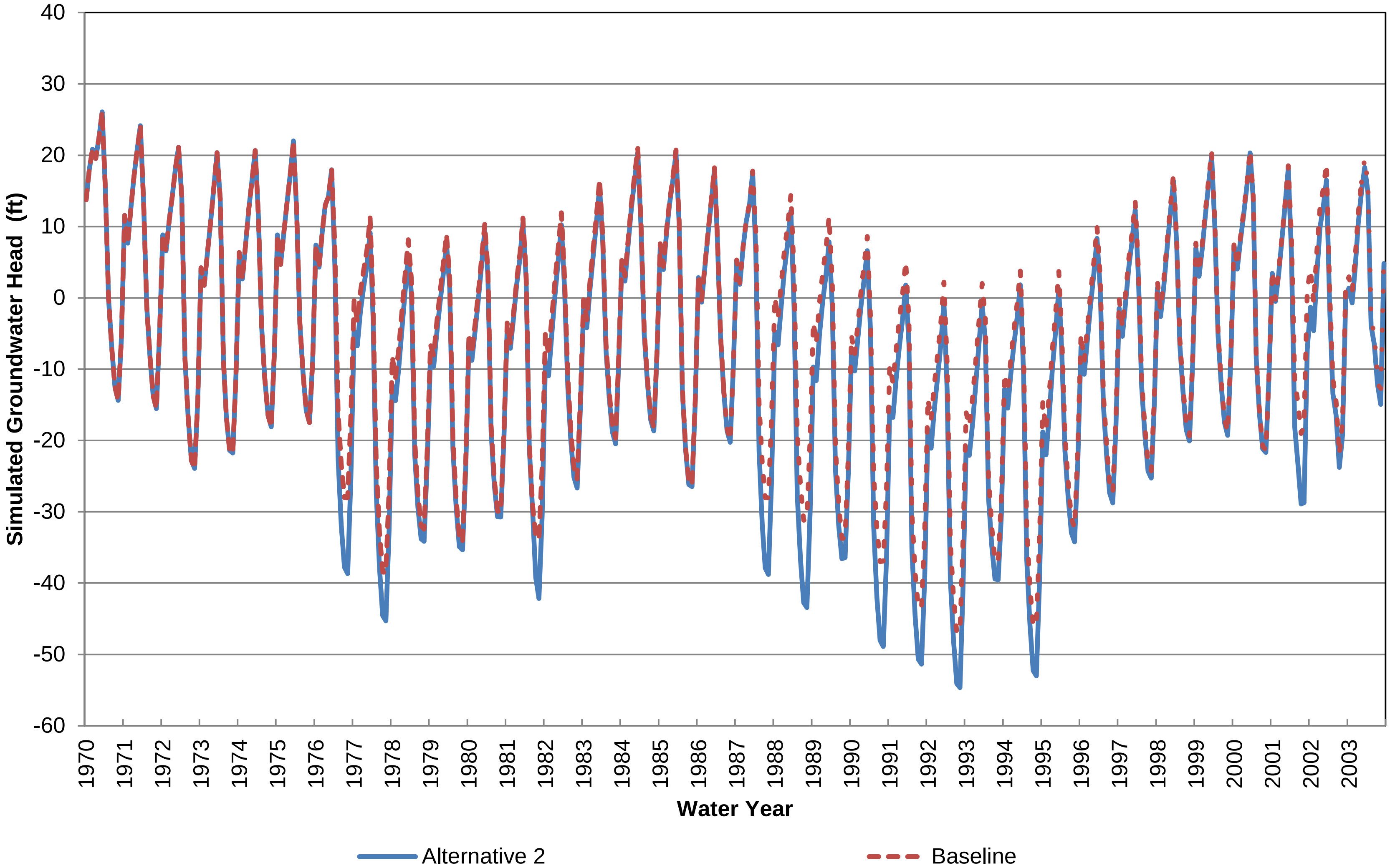
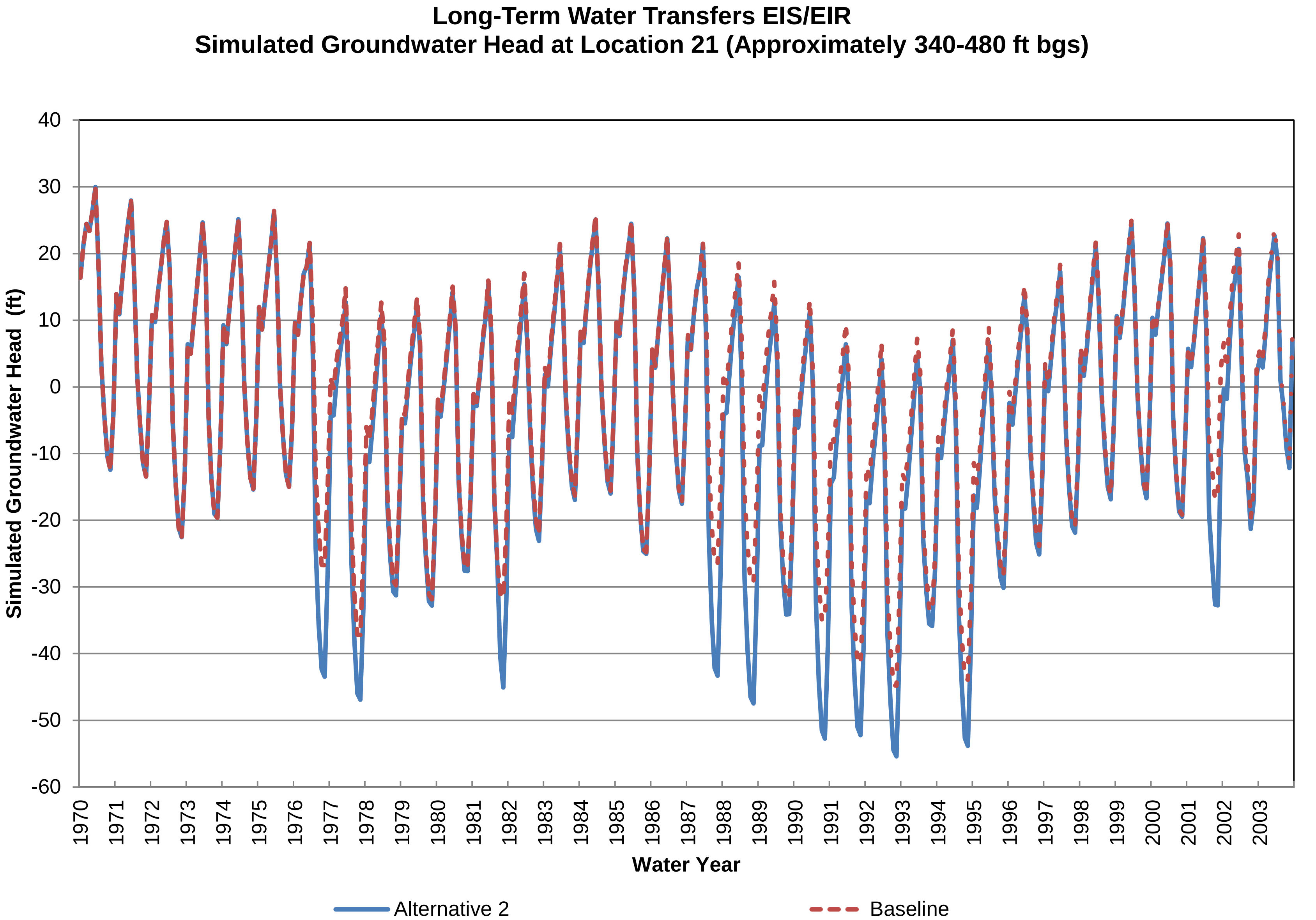
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 210-340 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 340-480 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1981
1982
1983
1984
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1998
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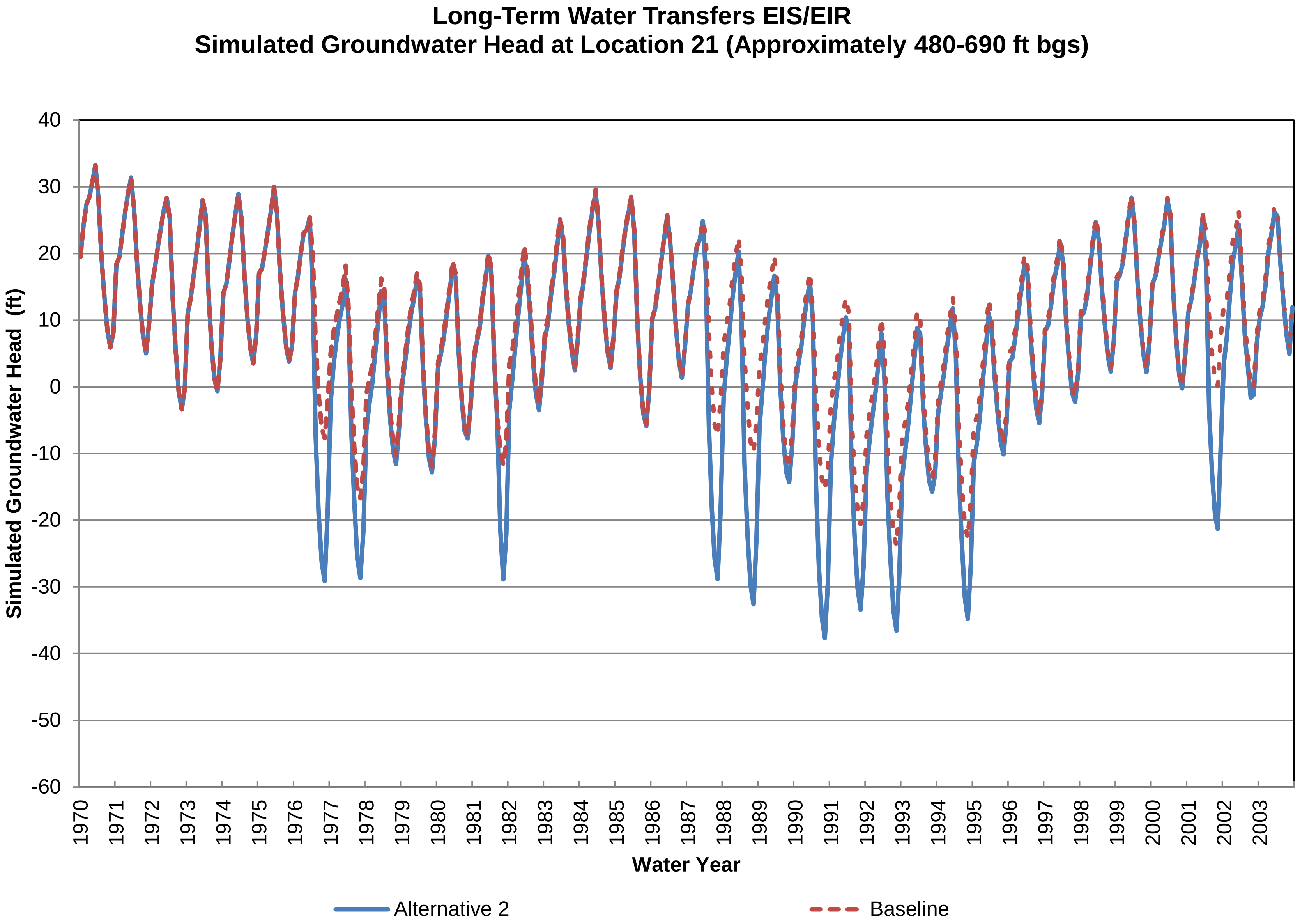
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 480-690 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
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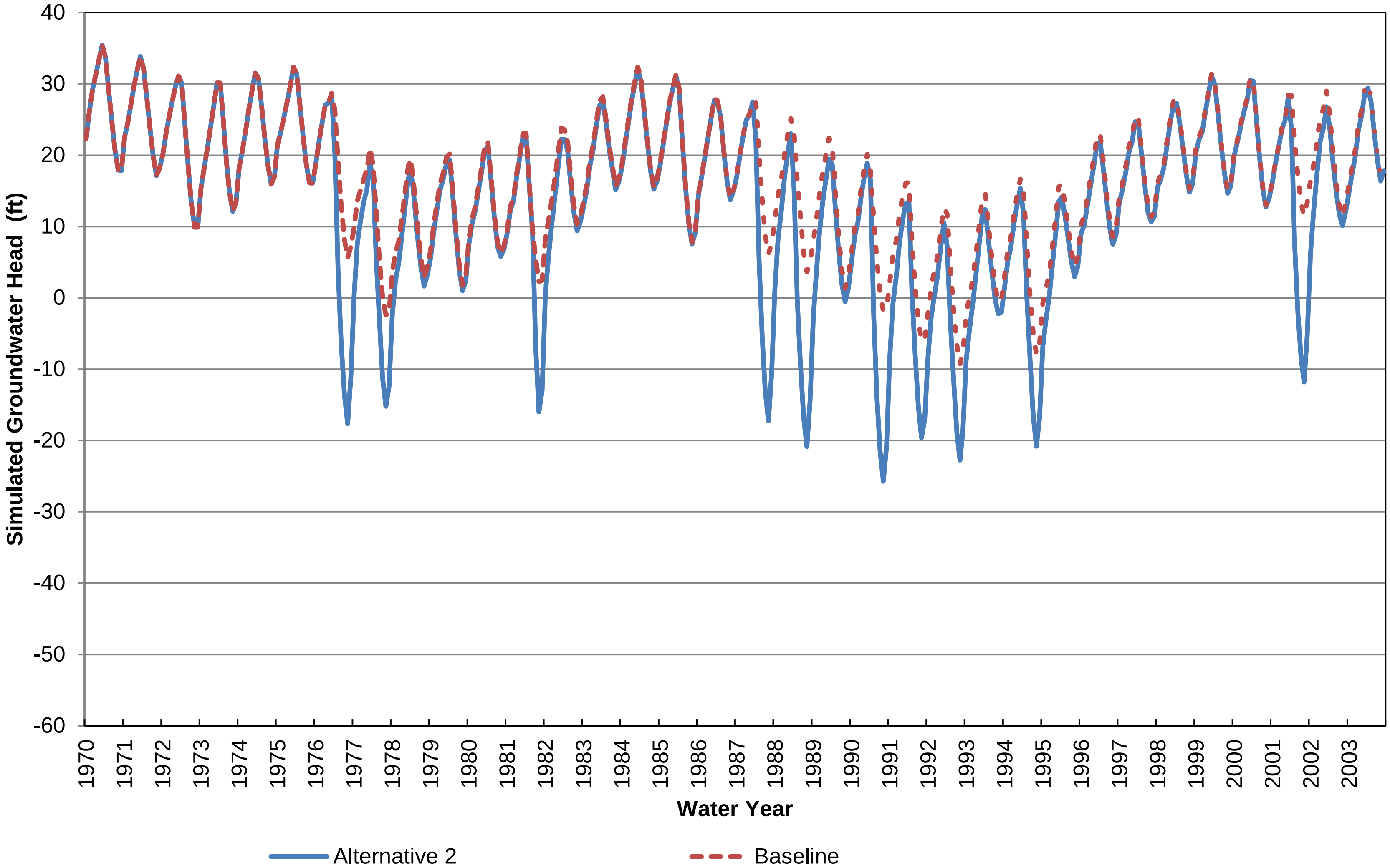
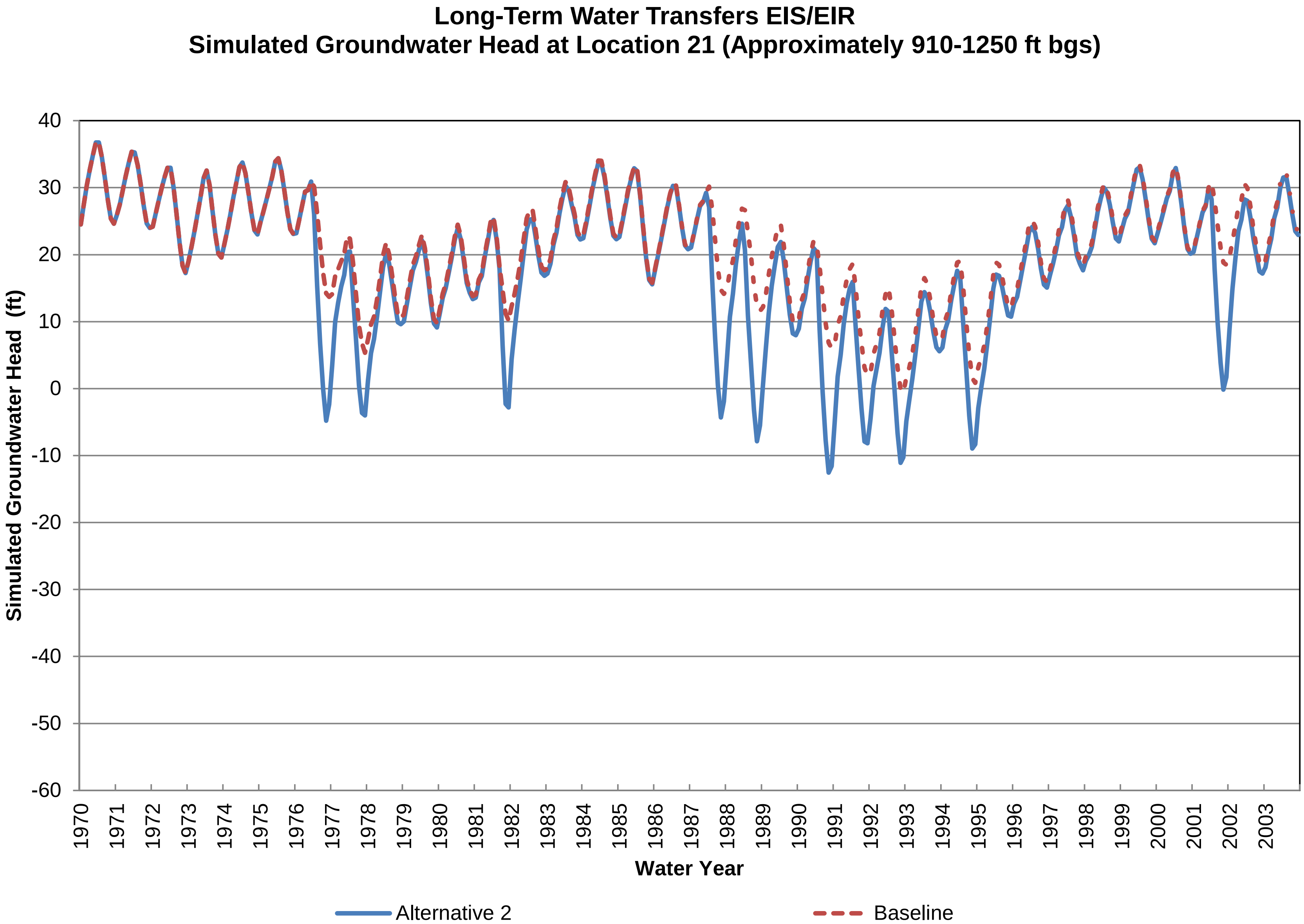
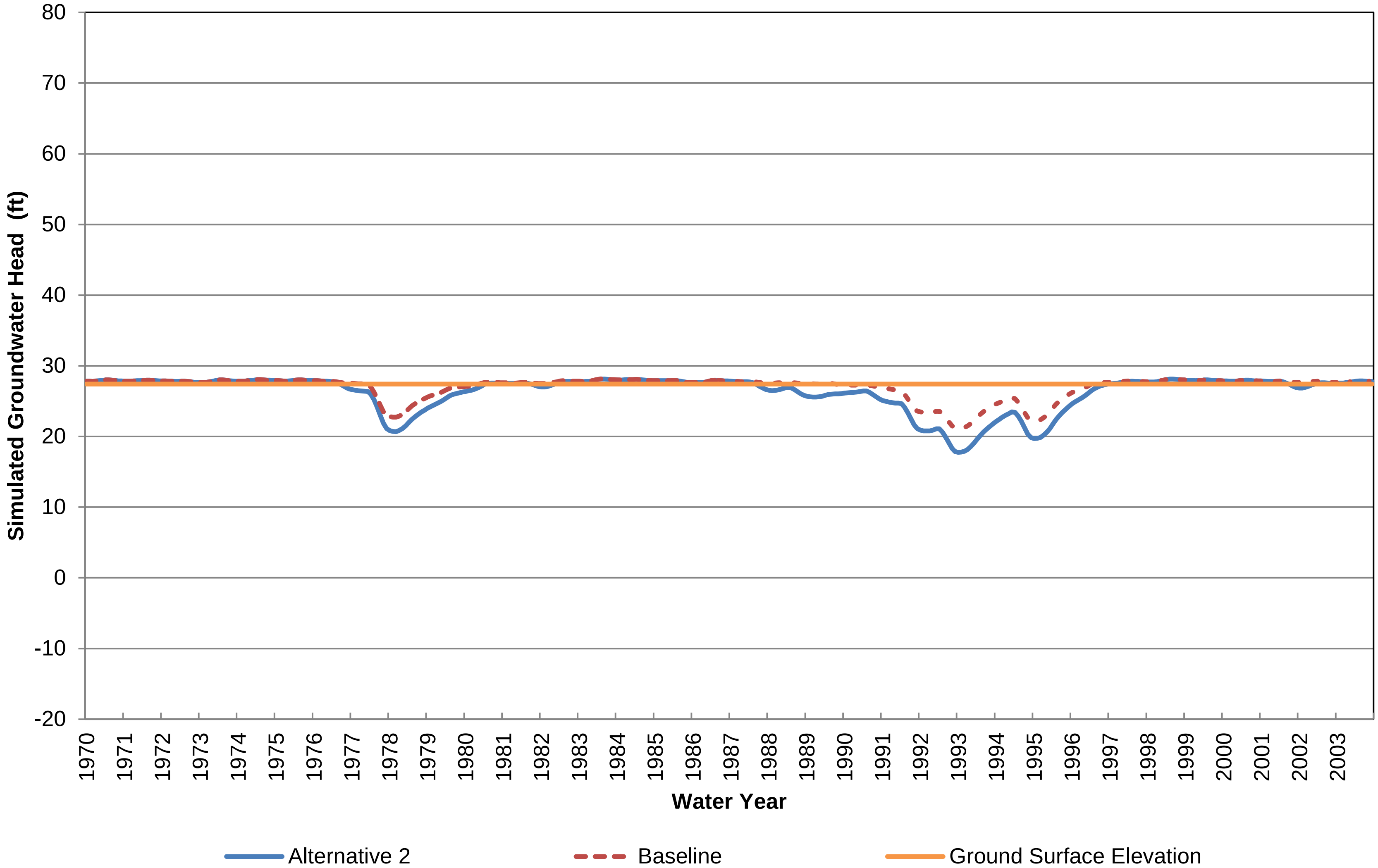
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

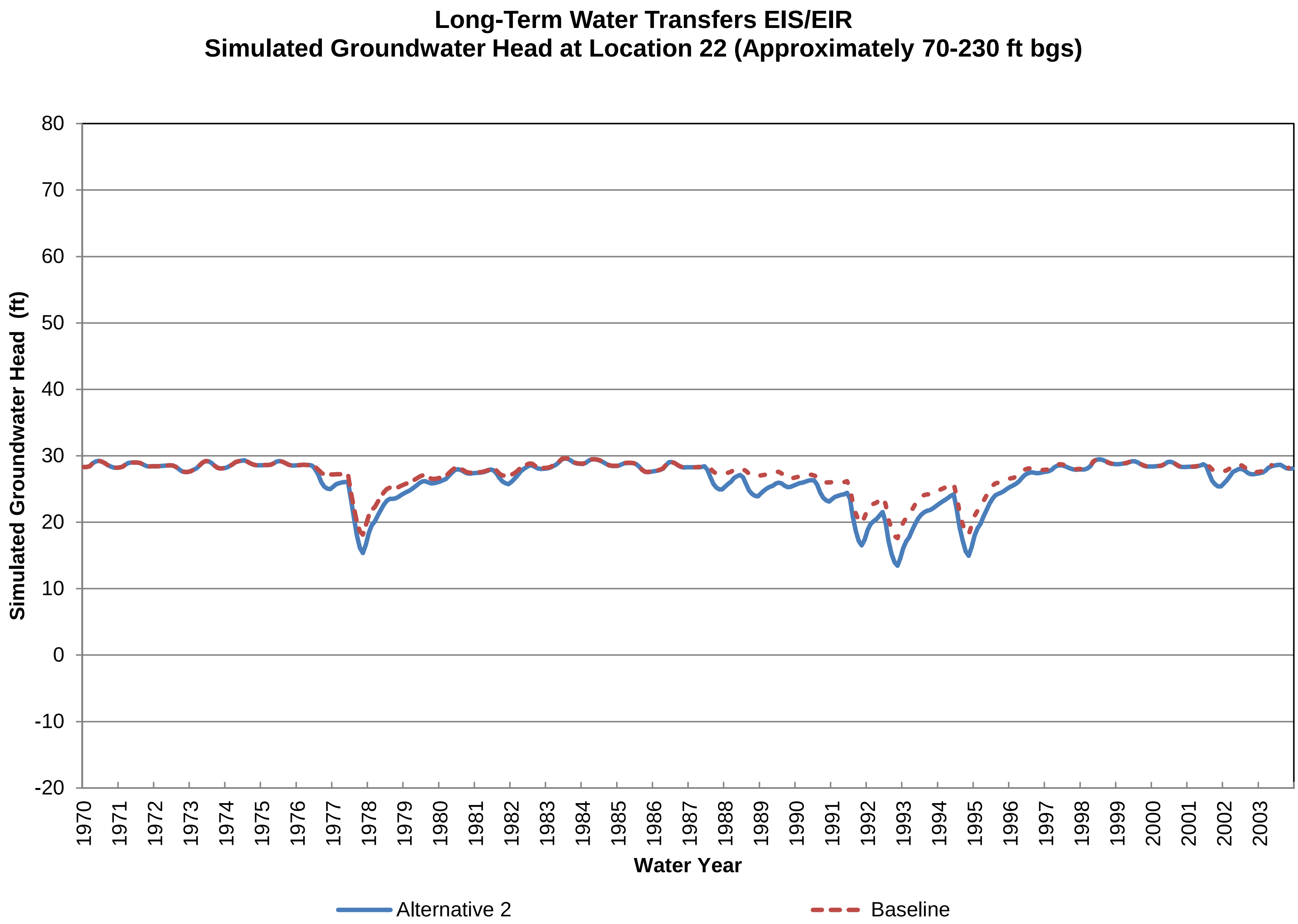
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 690-910 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 21 (Approximately 910-1250 ft bgs)
Simulated Groundwater Head (ft)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 22 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 70-230 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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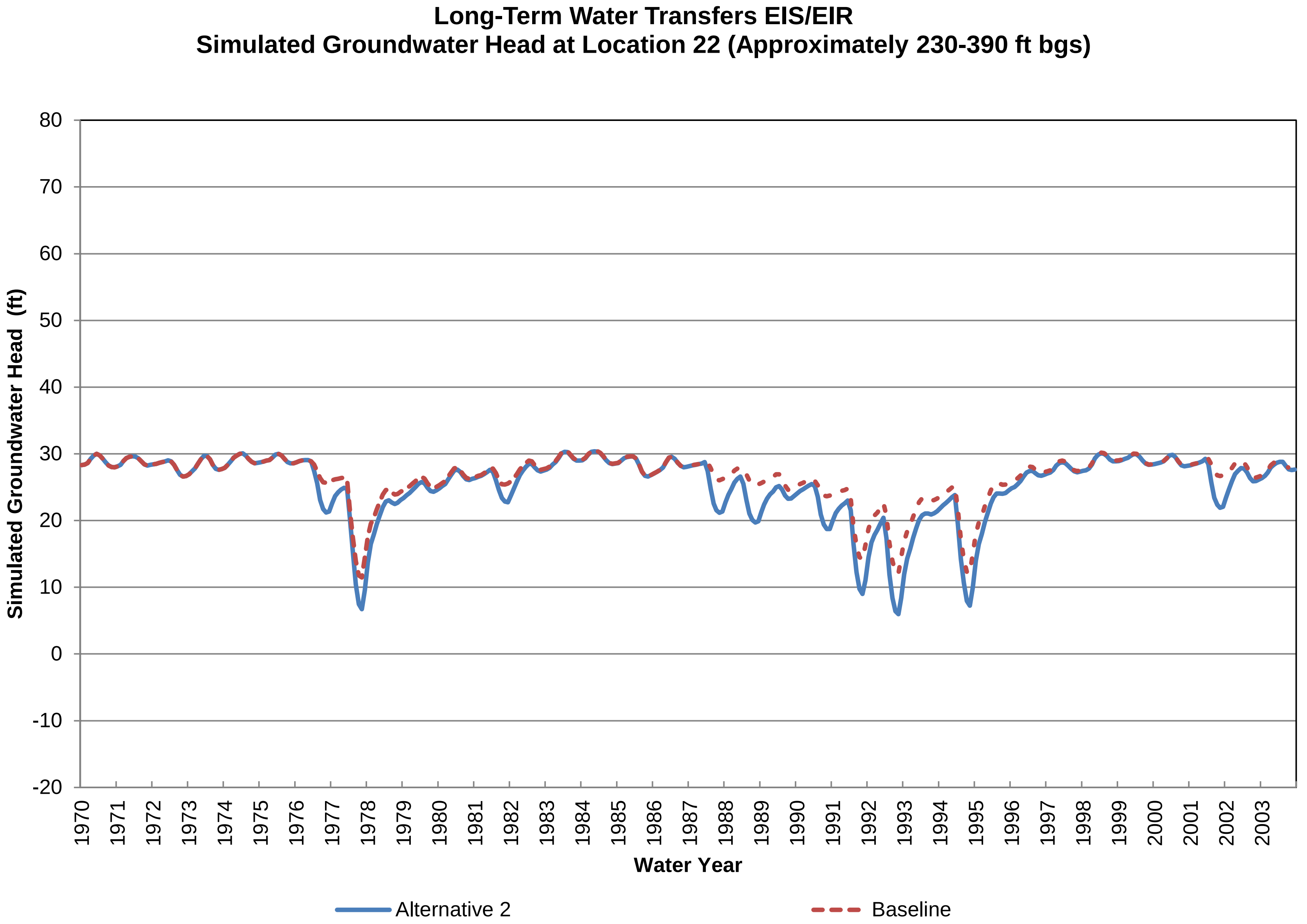
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 230-390 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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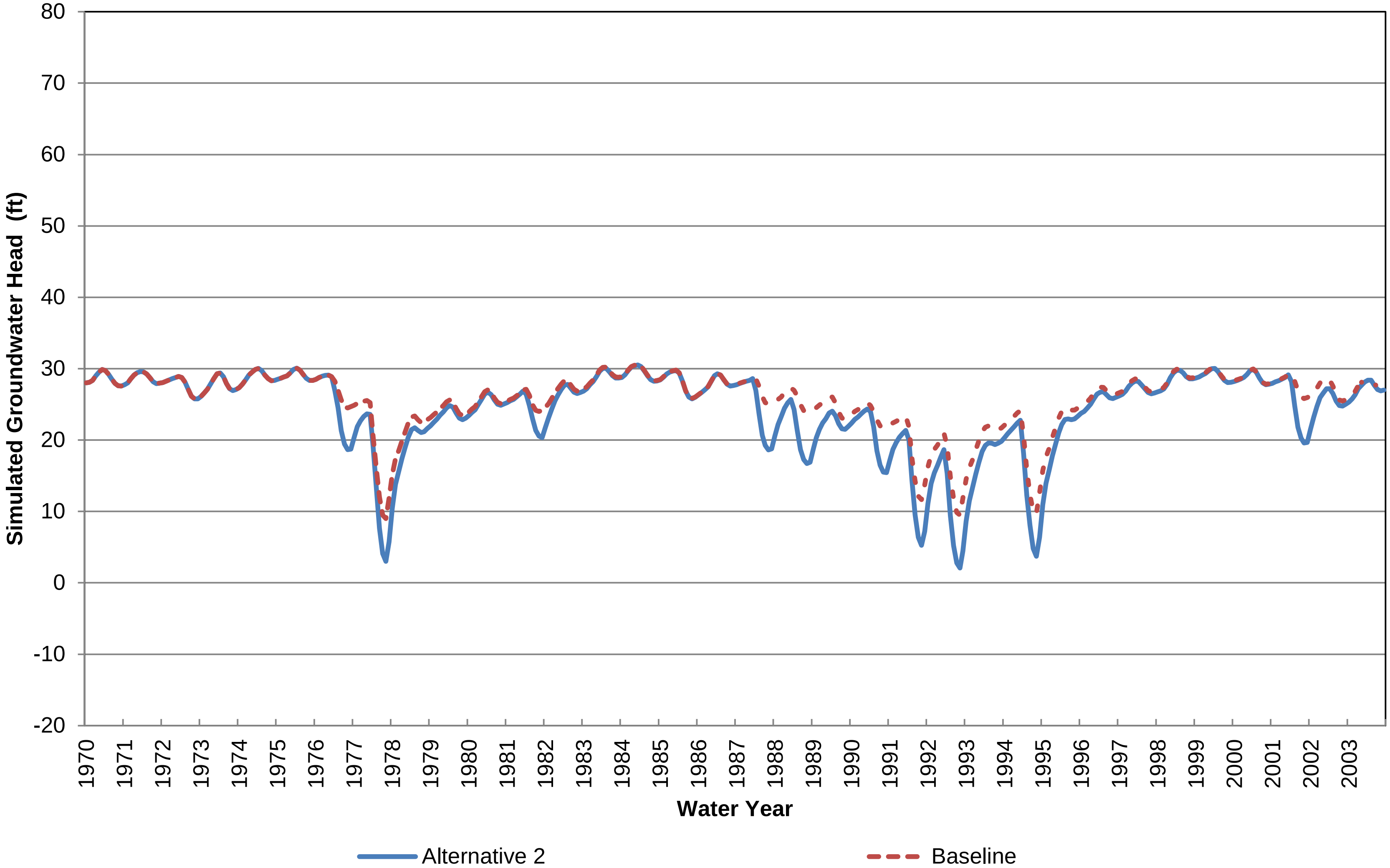
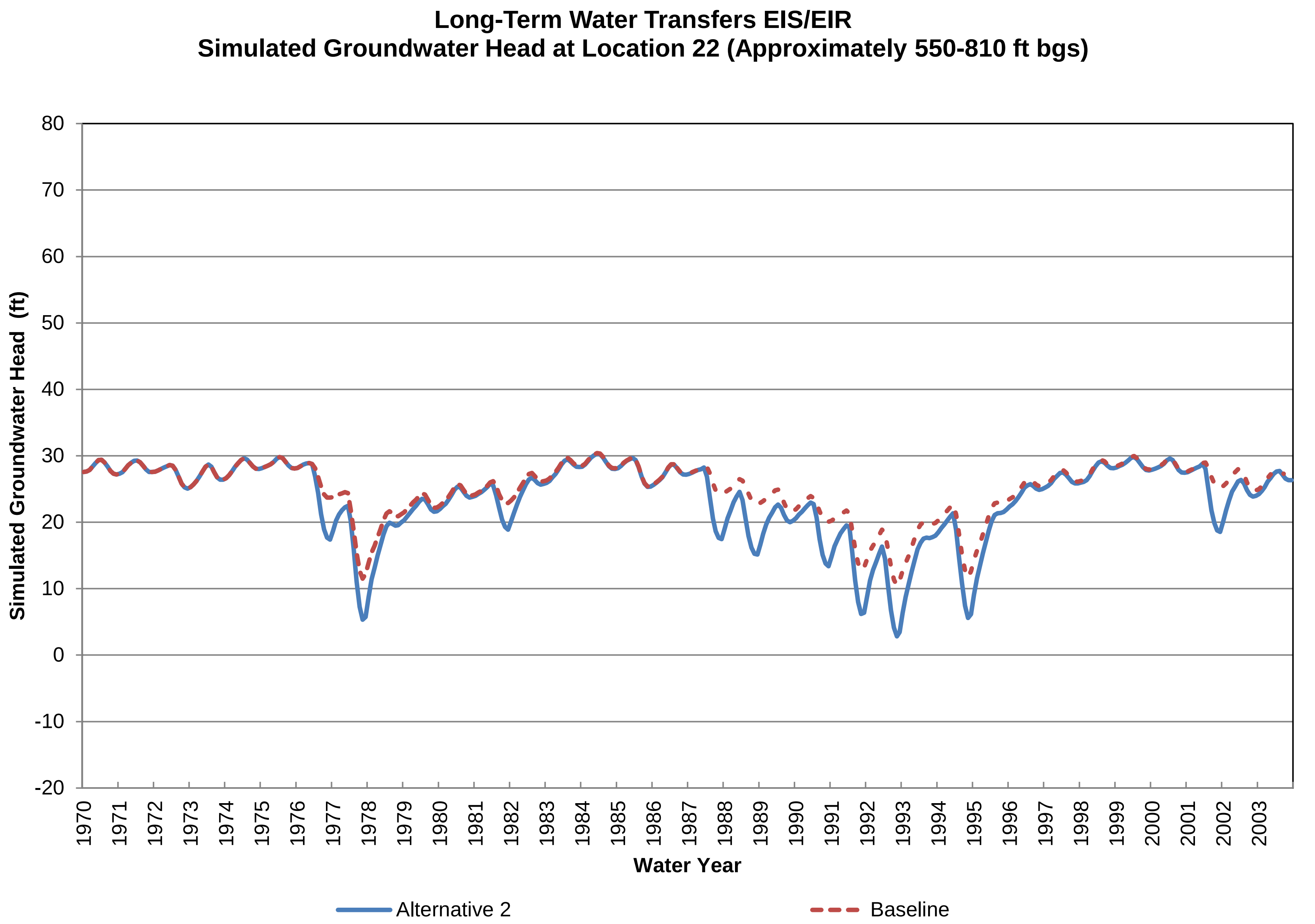
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 390-550 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 550-810 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
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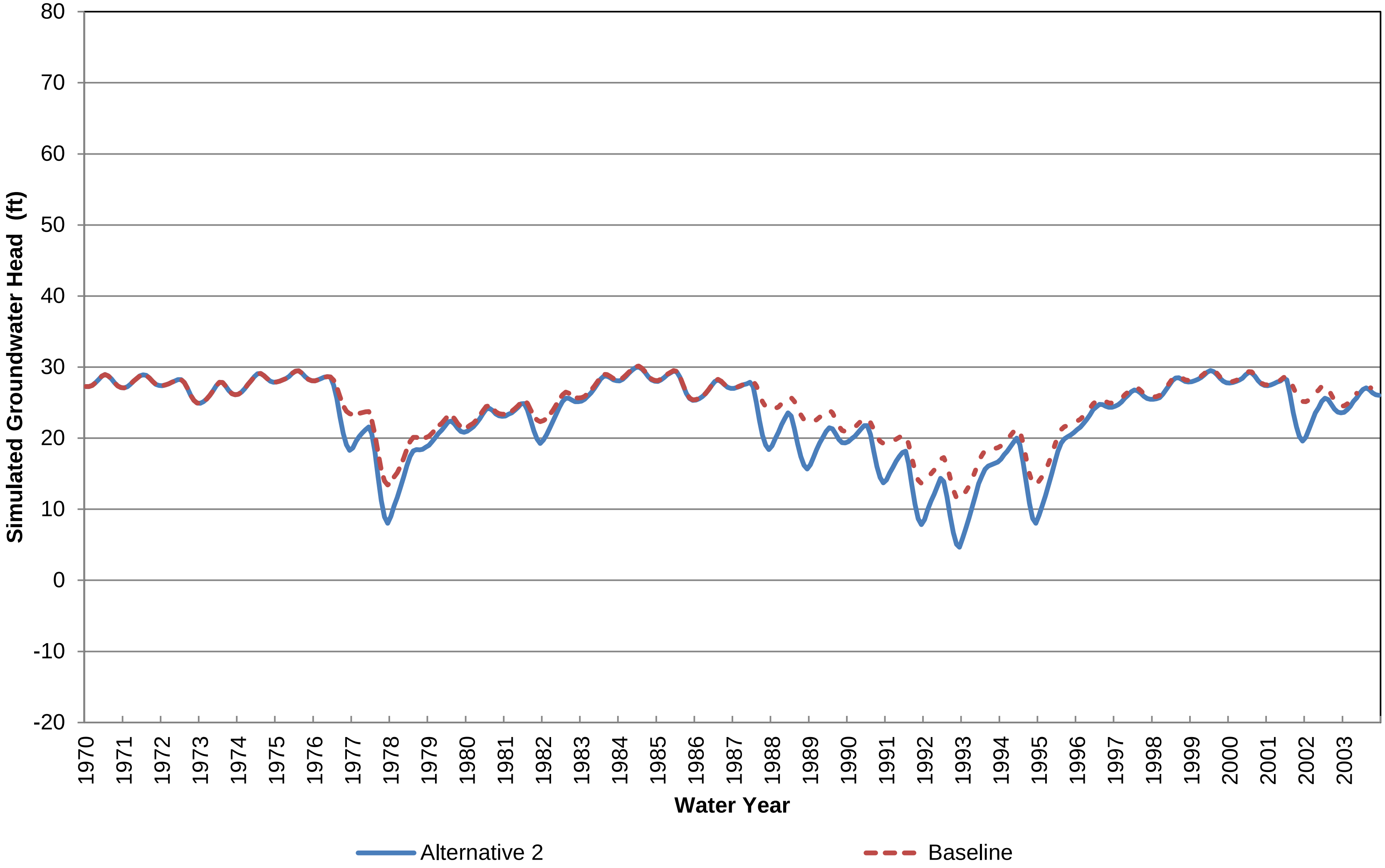
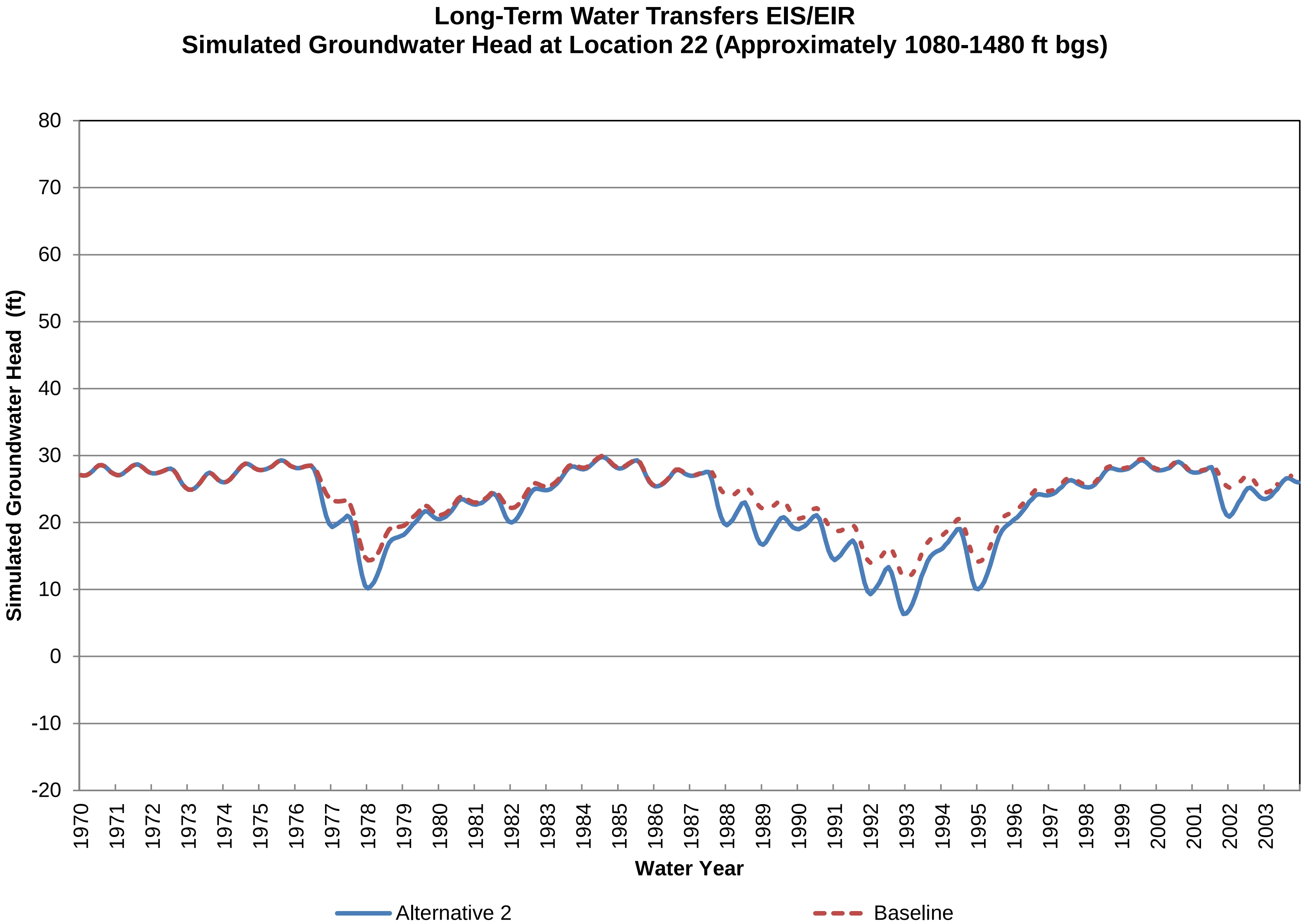
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 810-1080 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 22 (Approximately 1080-1480 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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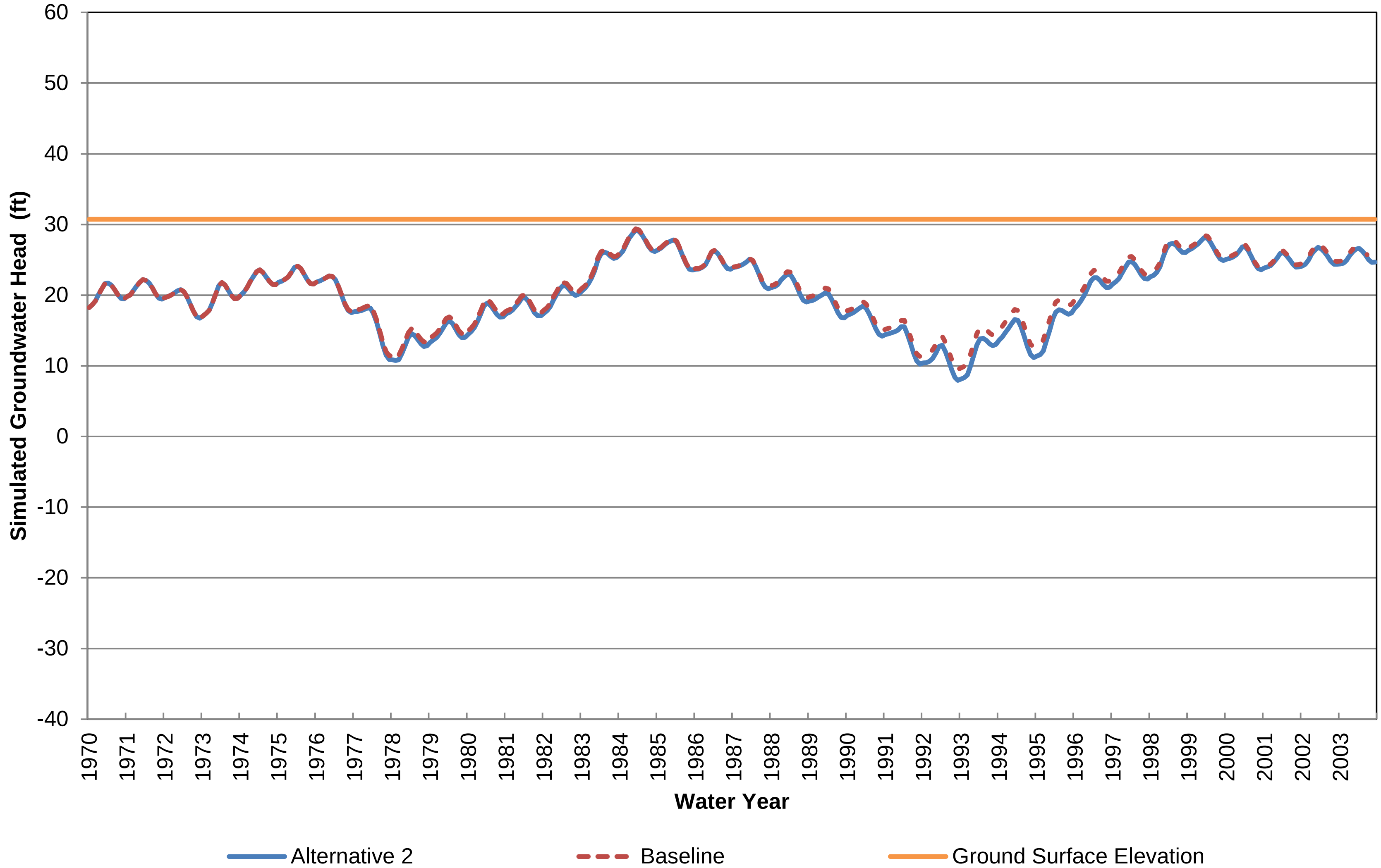
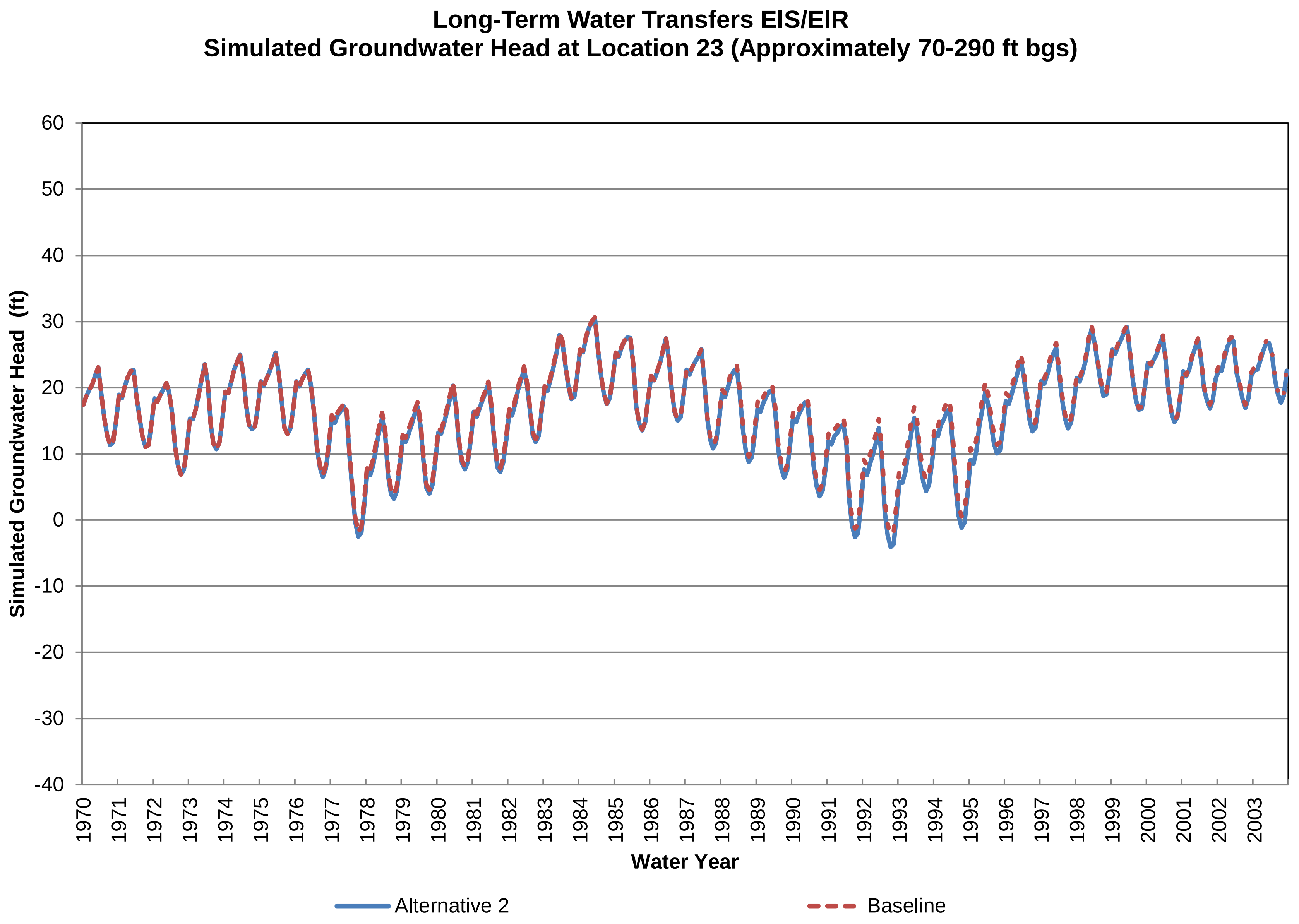
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 23 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 70-290 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1992
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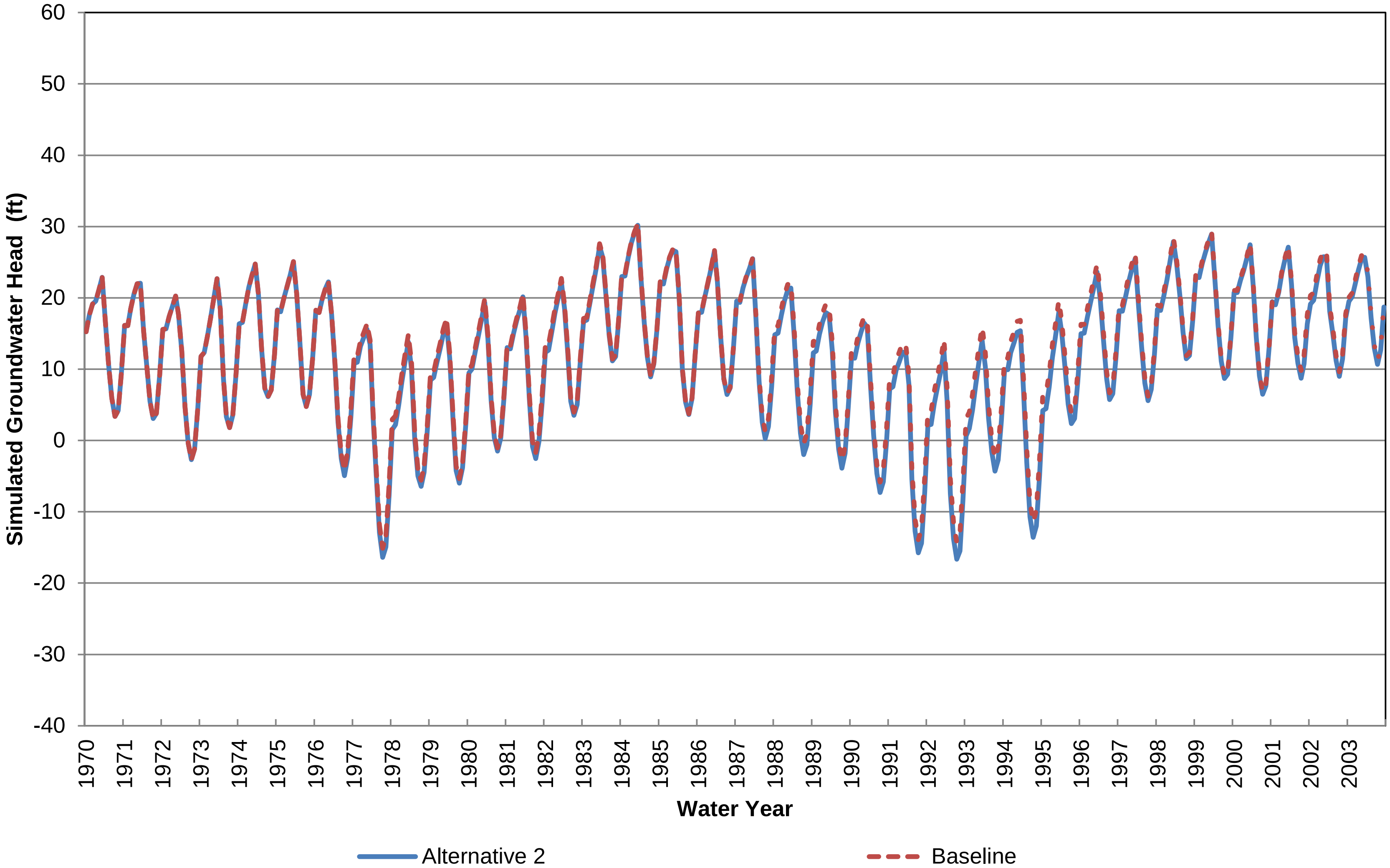
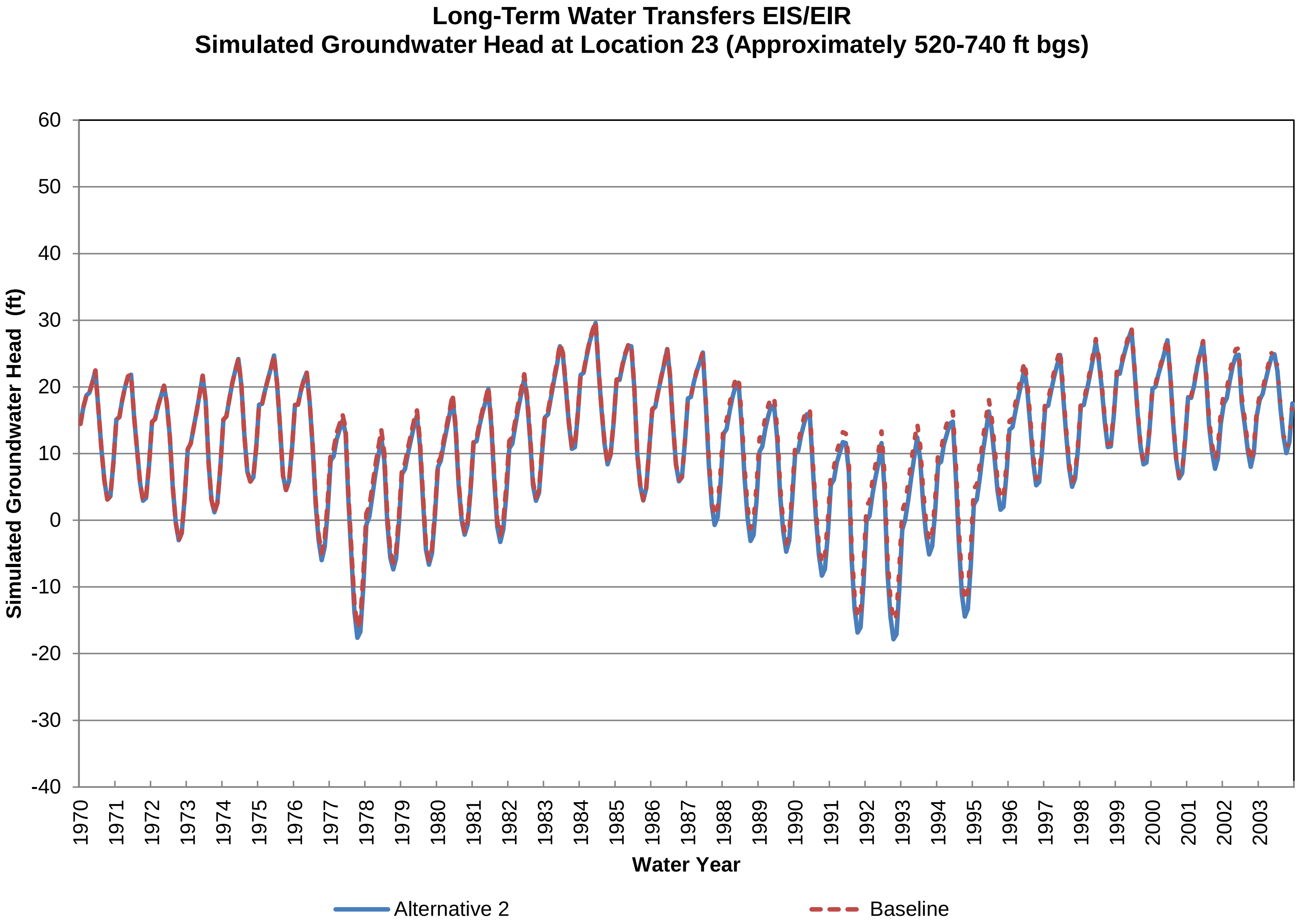
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 290-520 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 520-740 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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1993
1994
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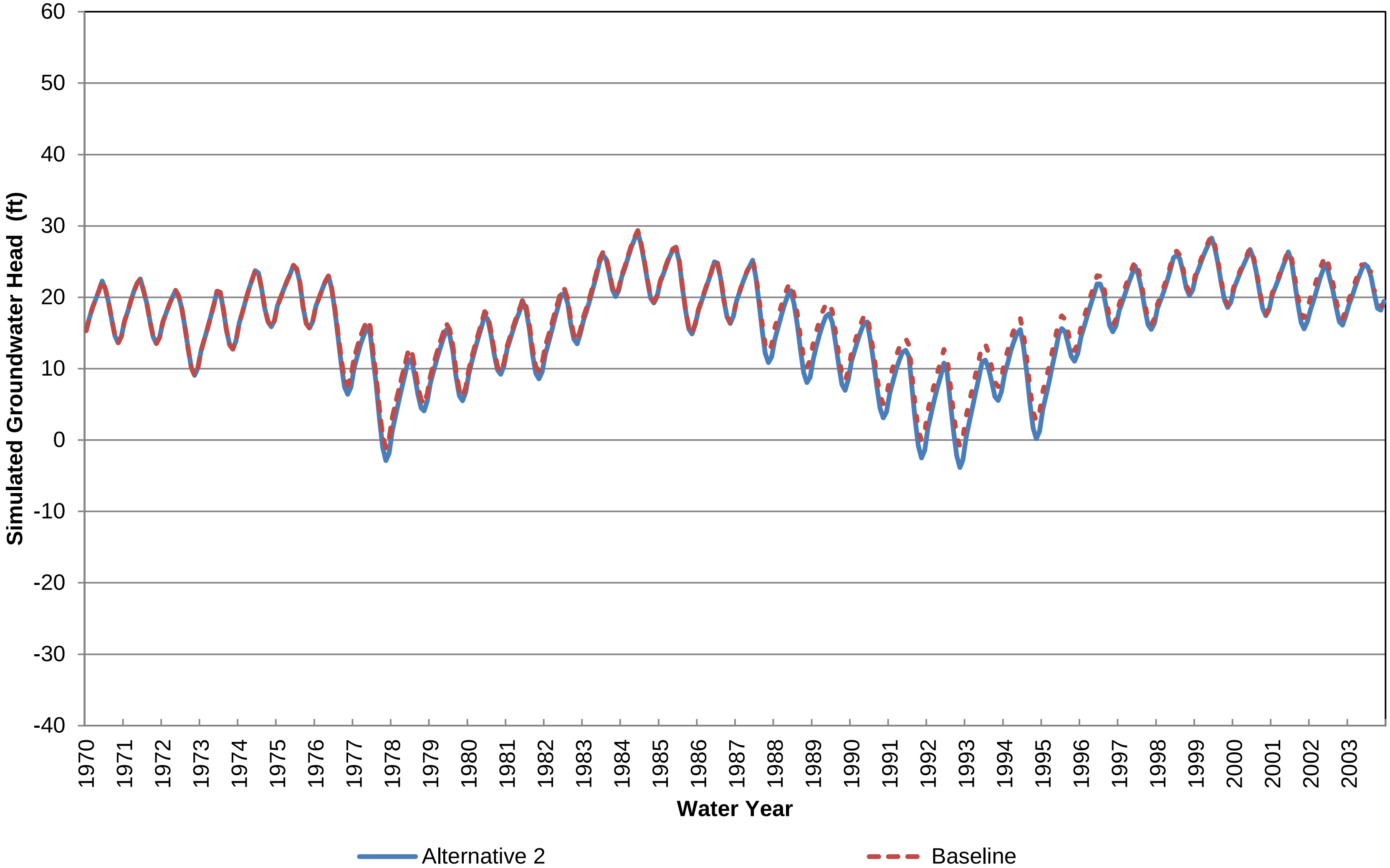
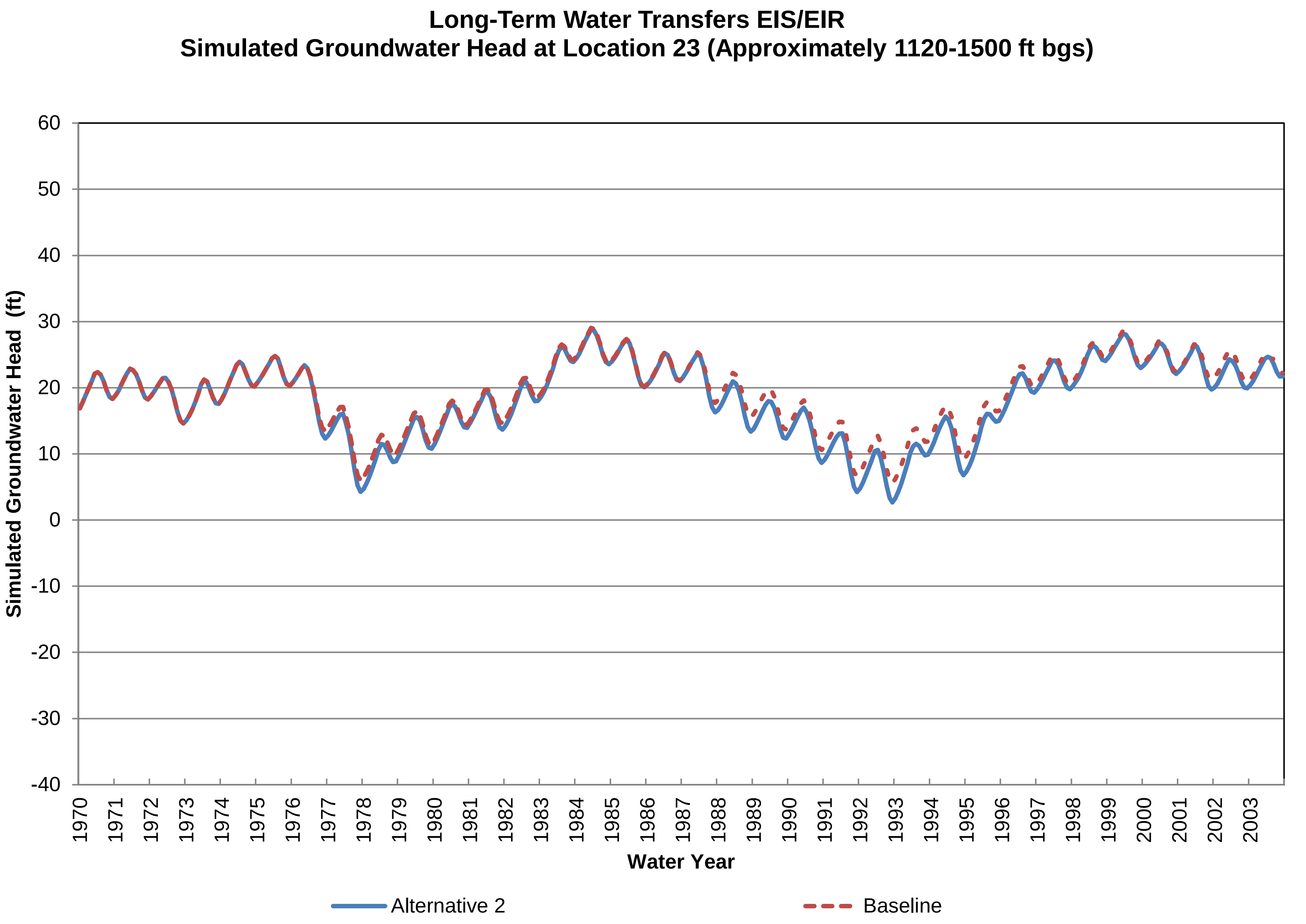
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 740-1120 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 1120-1500 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
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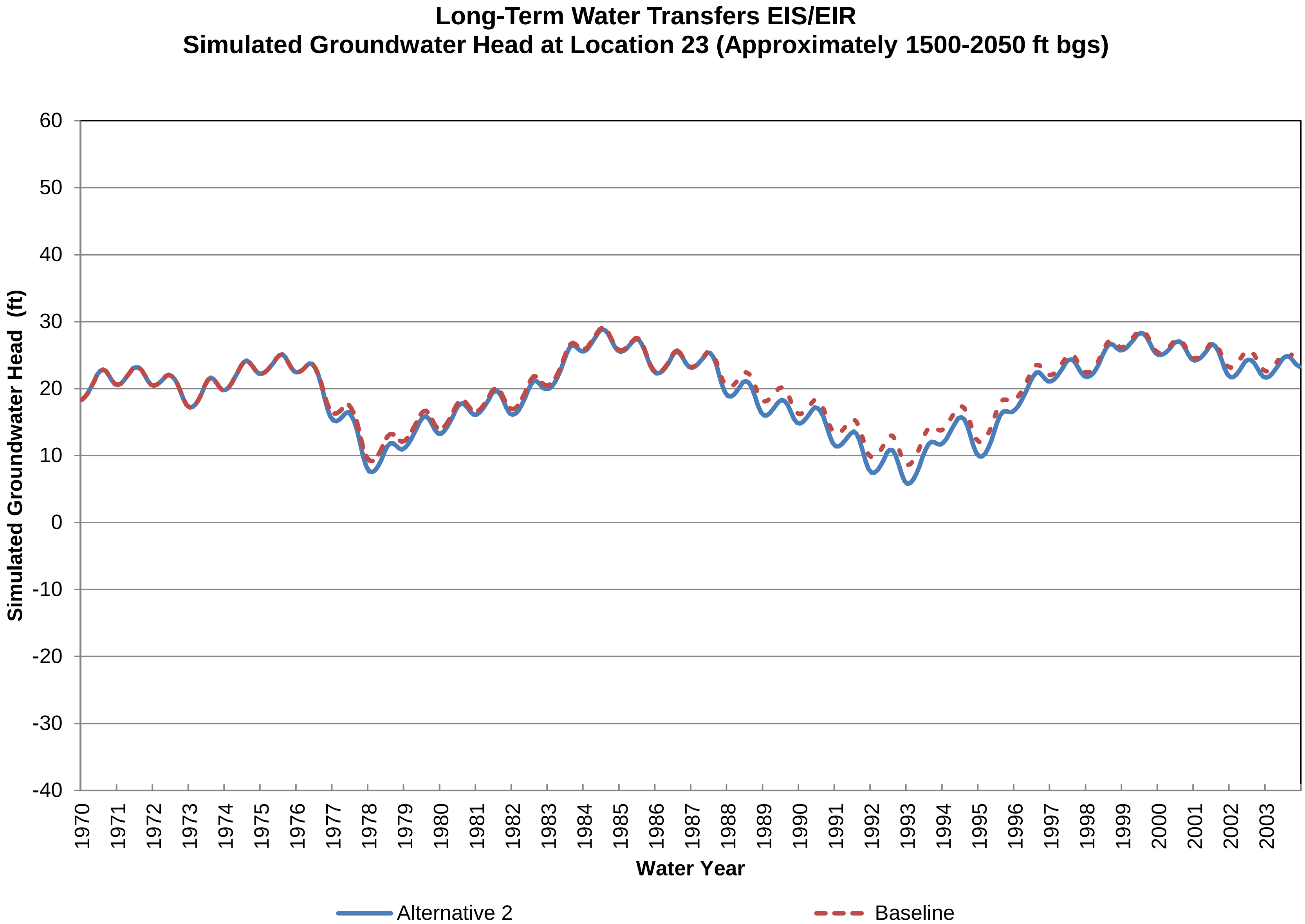
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 23 (Approximately 1500-2050 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1986
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1990
1991
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1994
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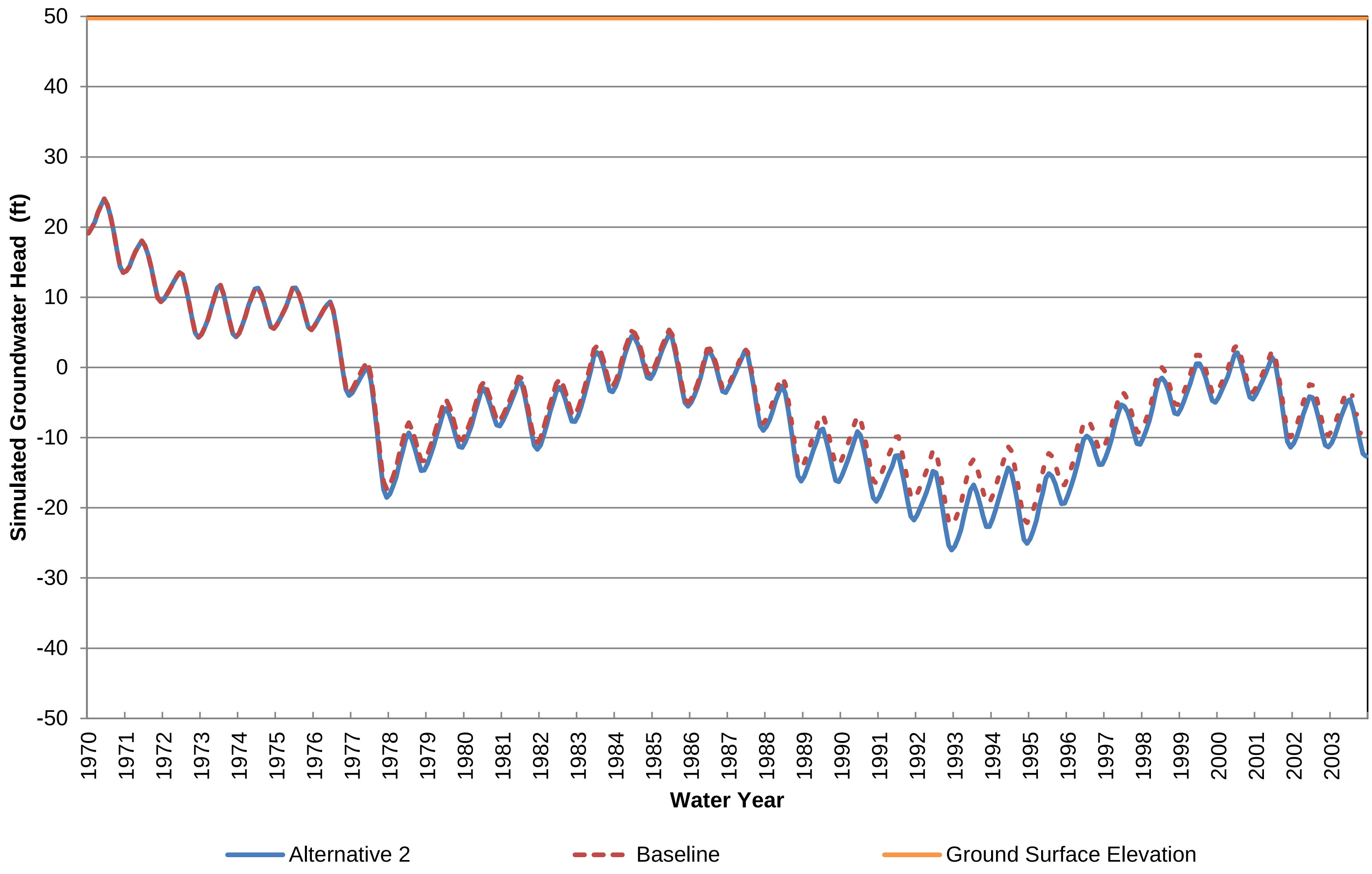
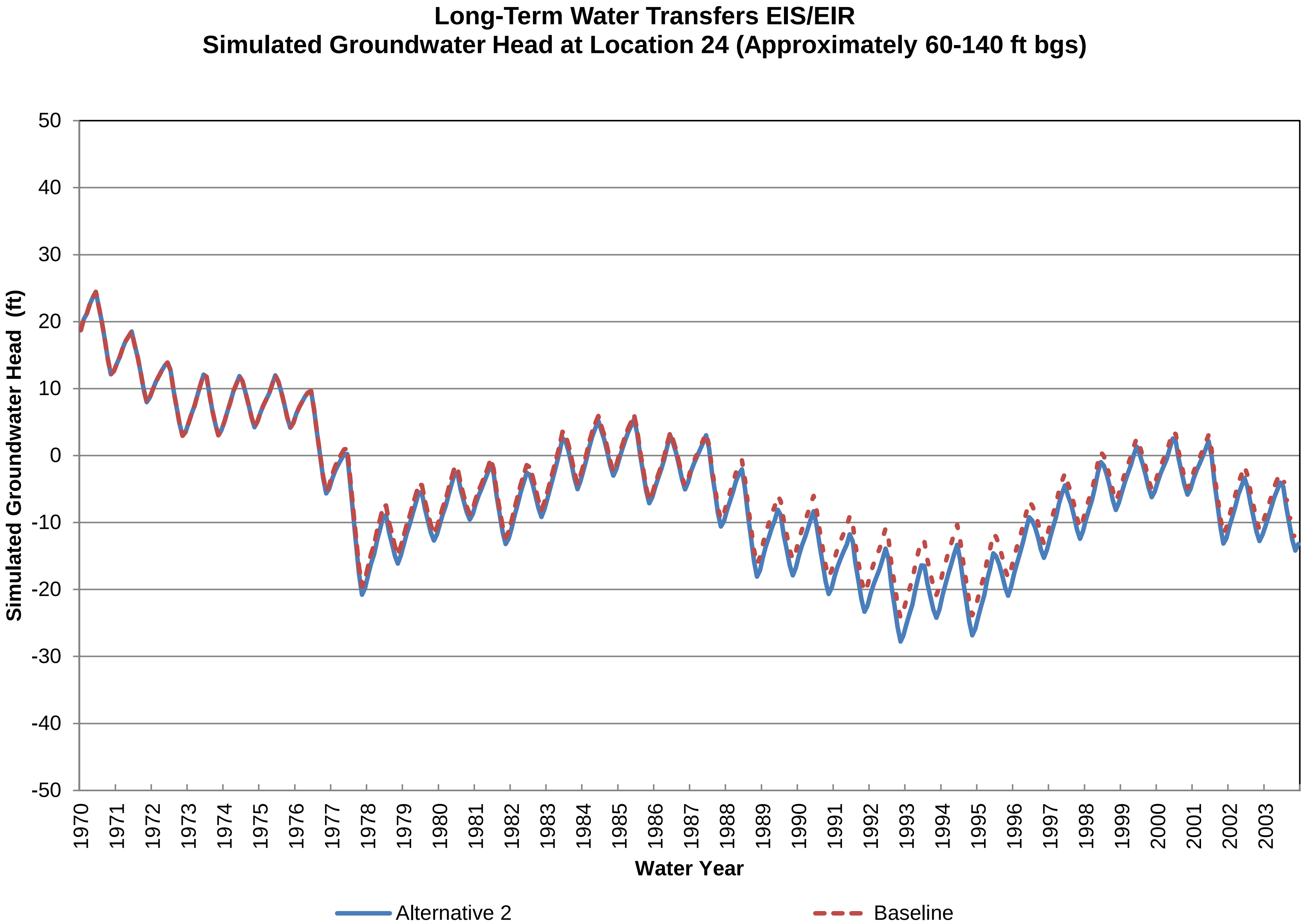
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 24 (Approximately 0-60 ft bgs)



266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 60-140 ft bgs)
50
40
30
20
10
0
-10
-20
-30
-40
-50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
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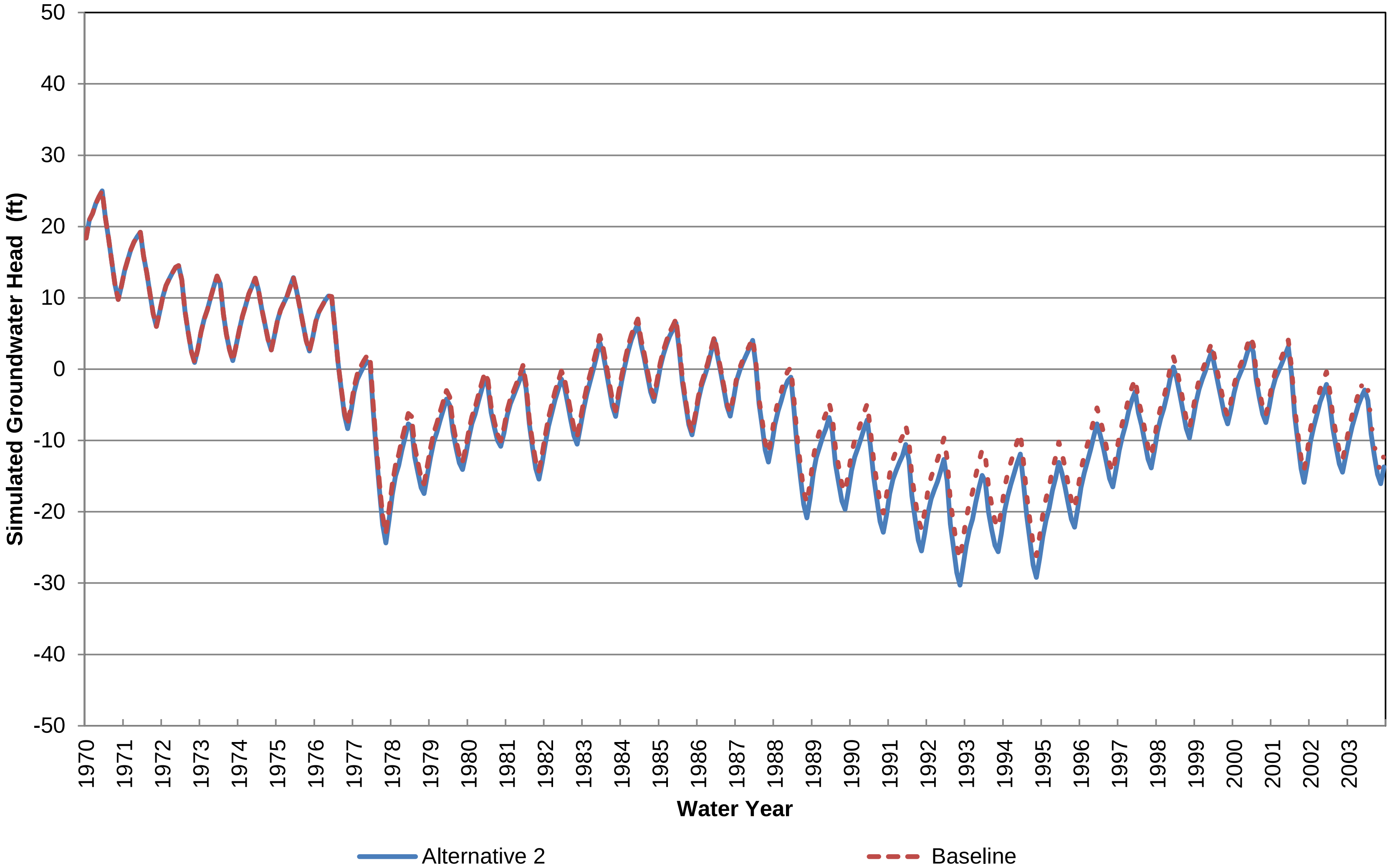
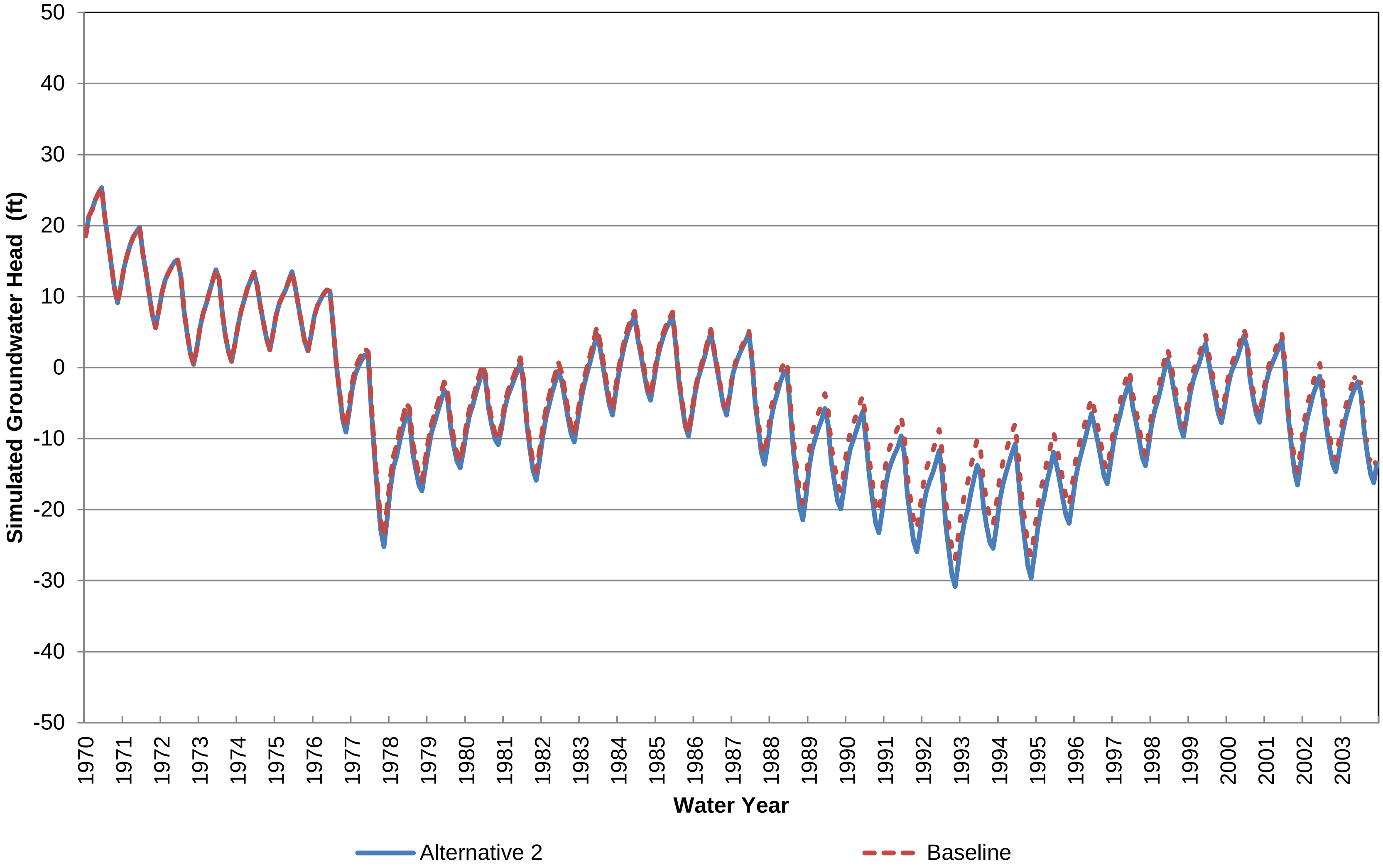
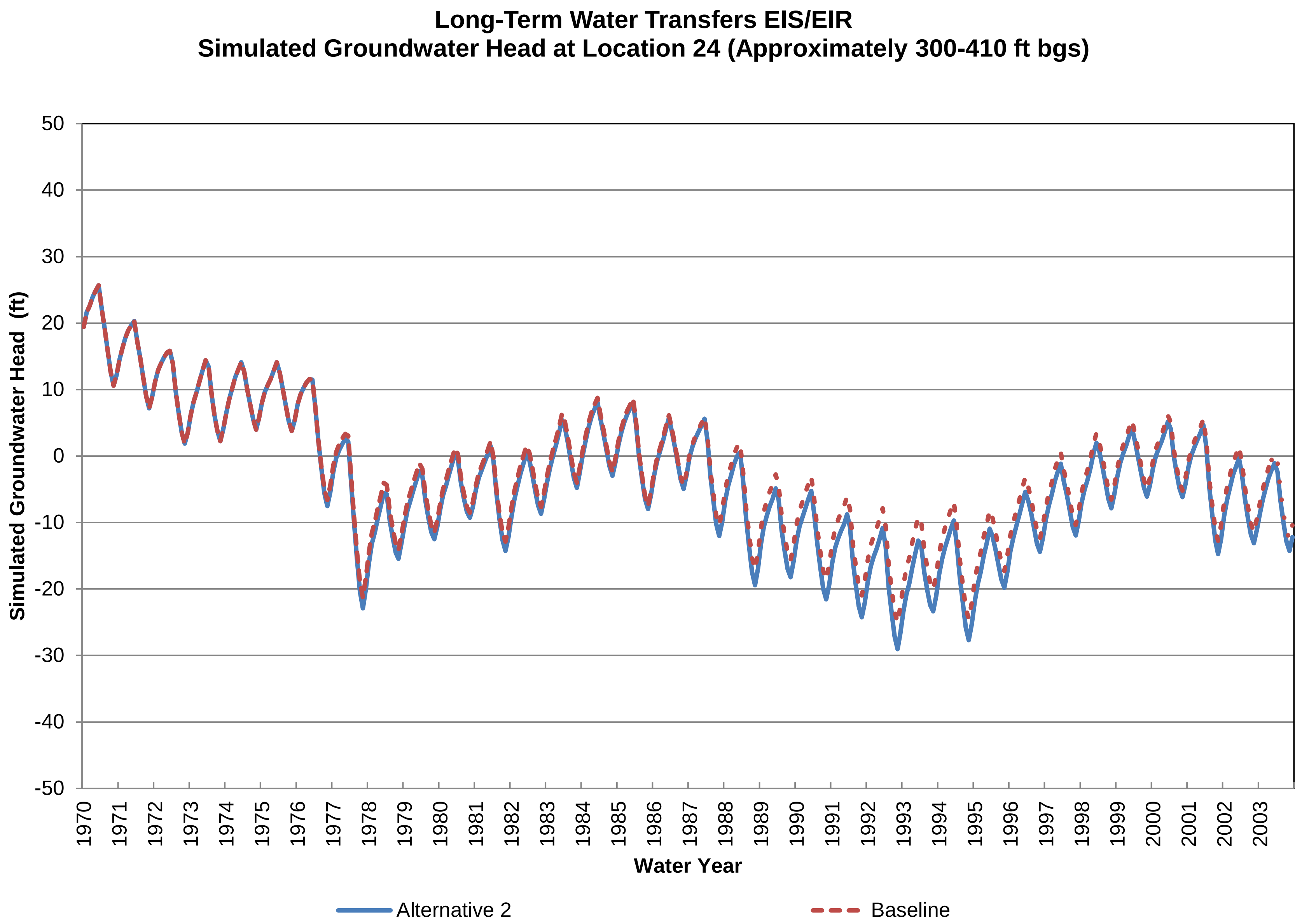
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 140-220 ft bgs)



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 220-300 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 300-410 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1994
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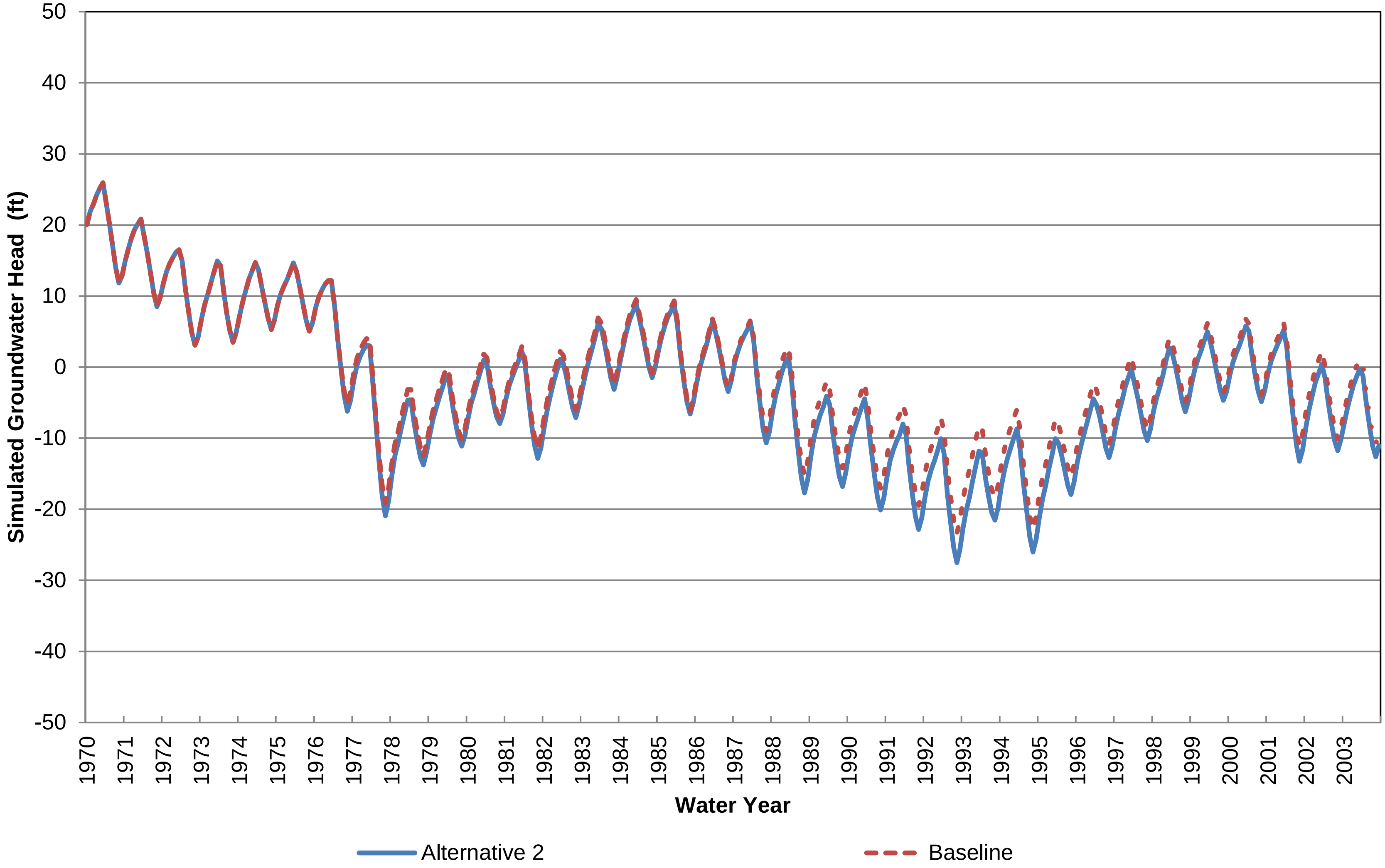
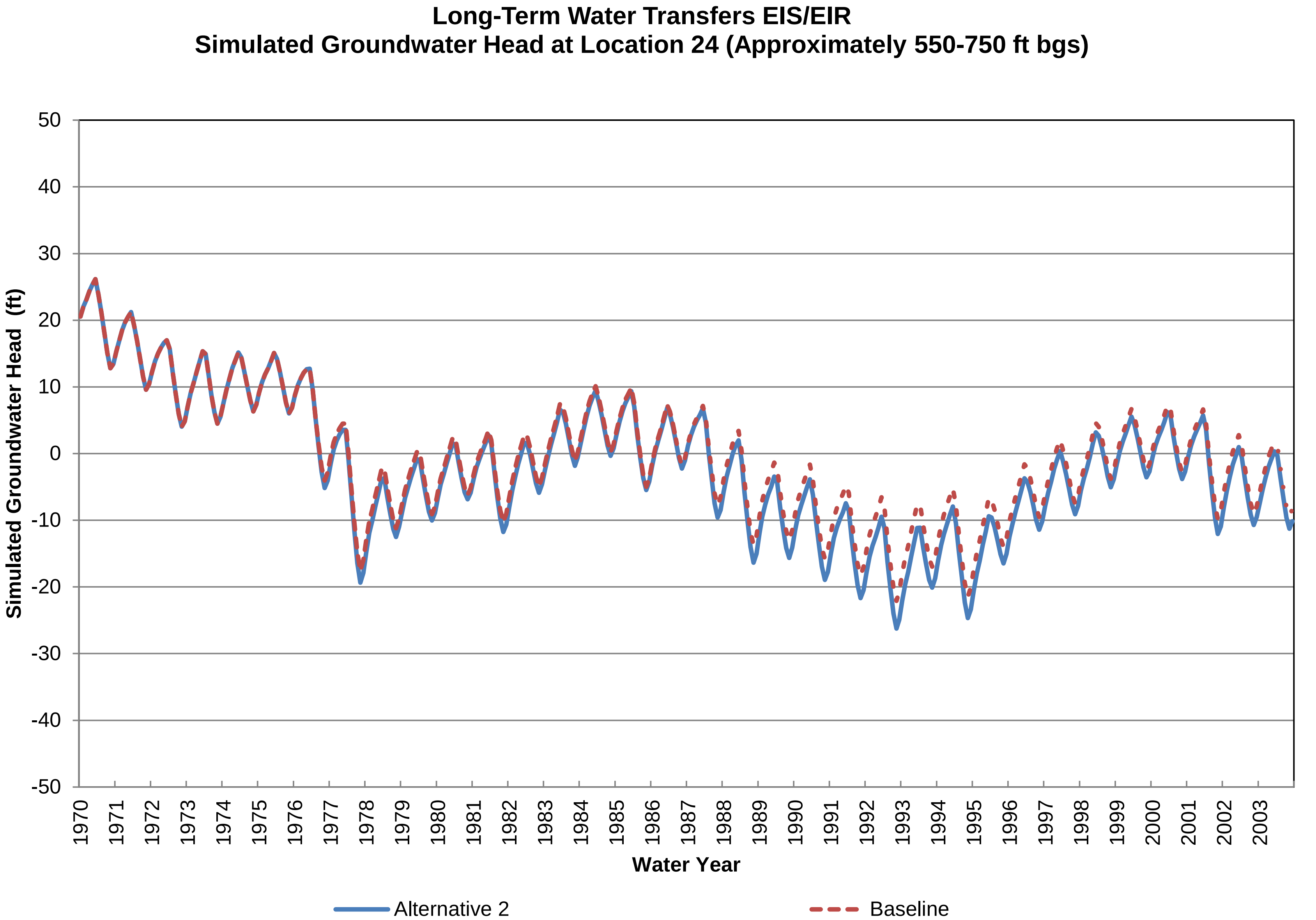
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 410-550 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 24 (Approximately 550-750 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1984
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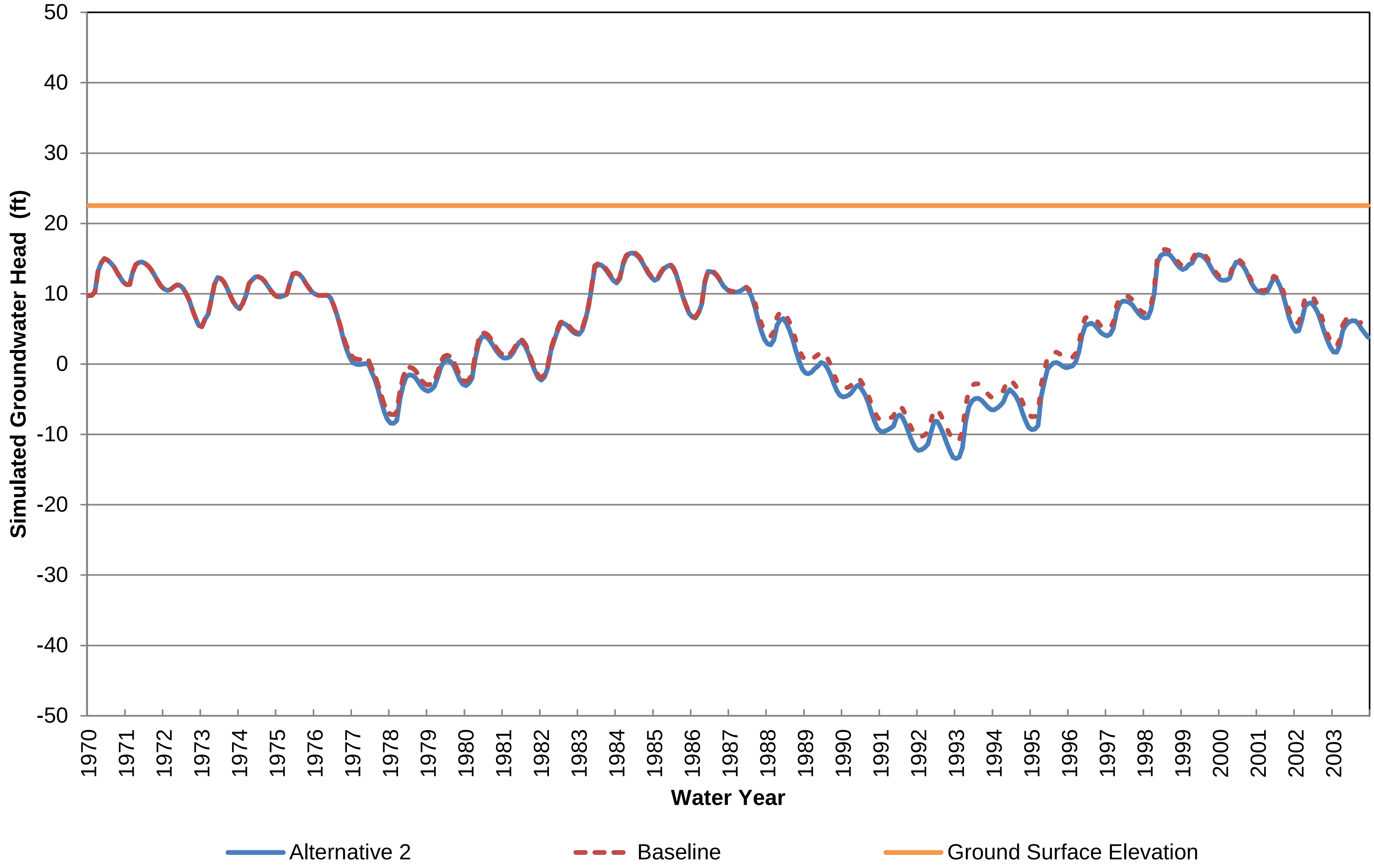
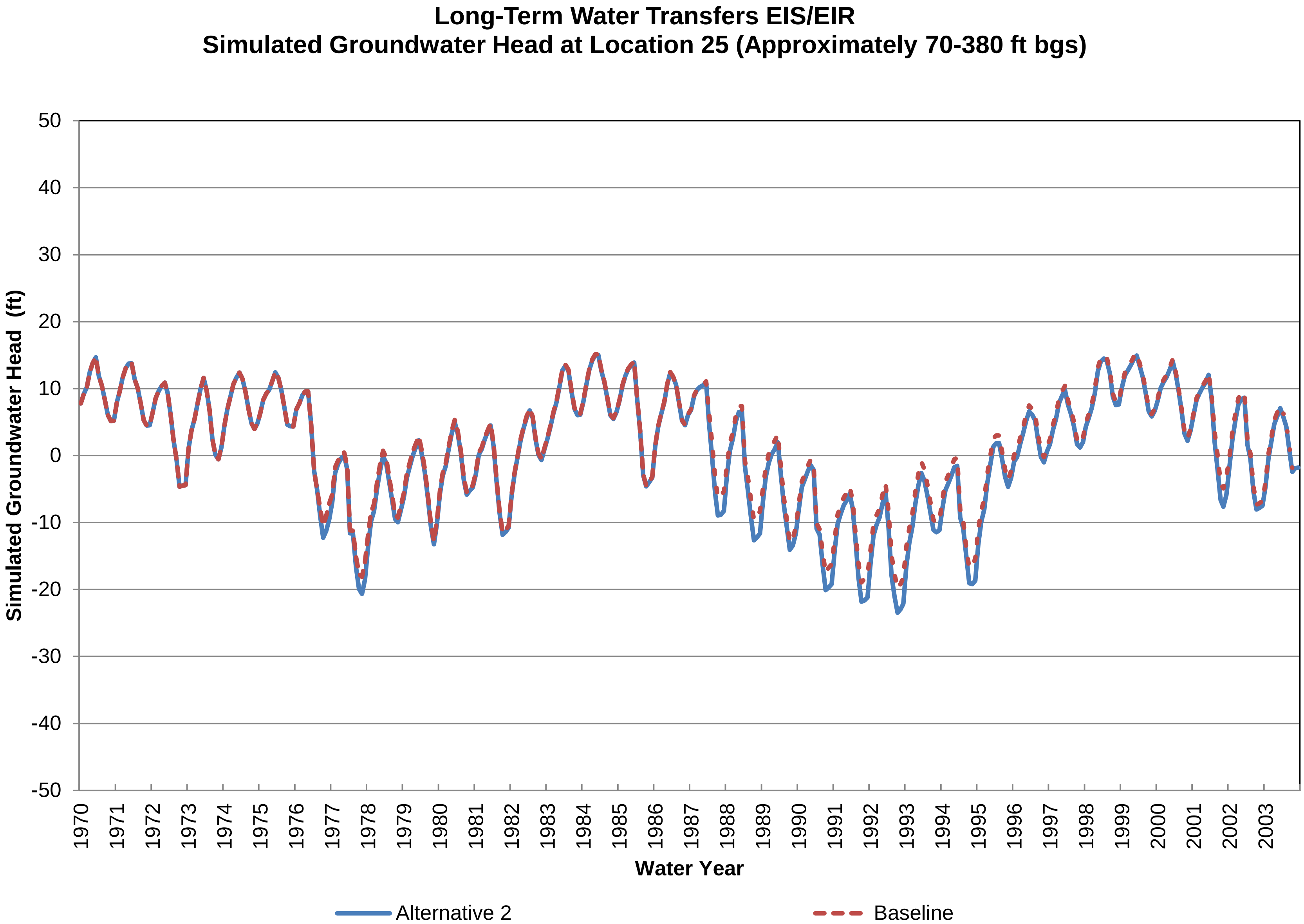
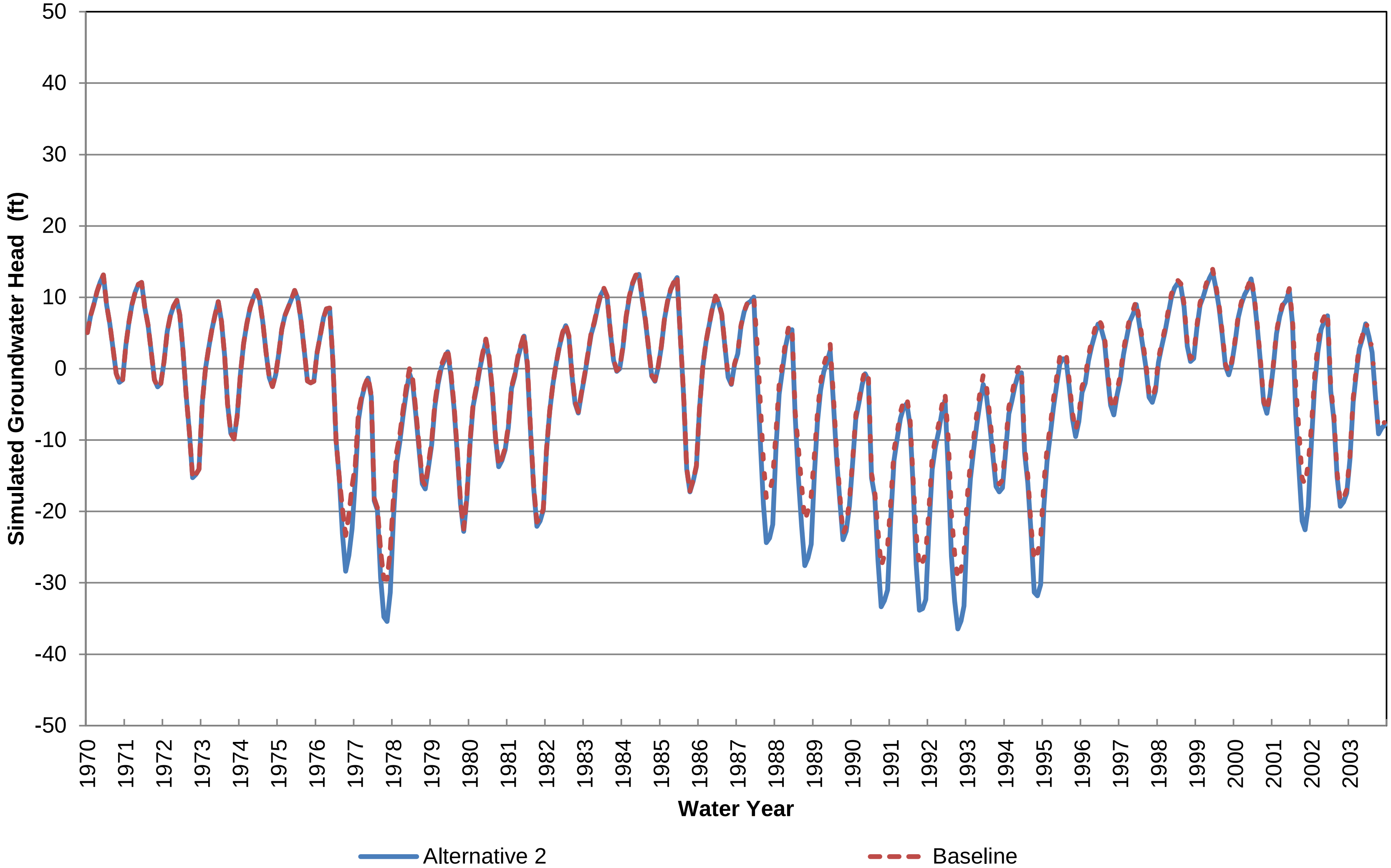
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 25 (Approximately 0-70 ft bgs)

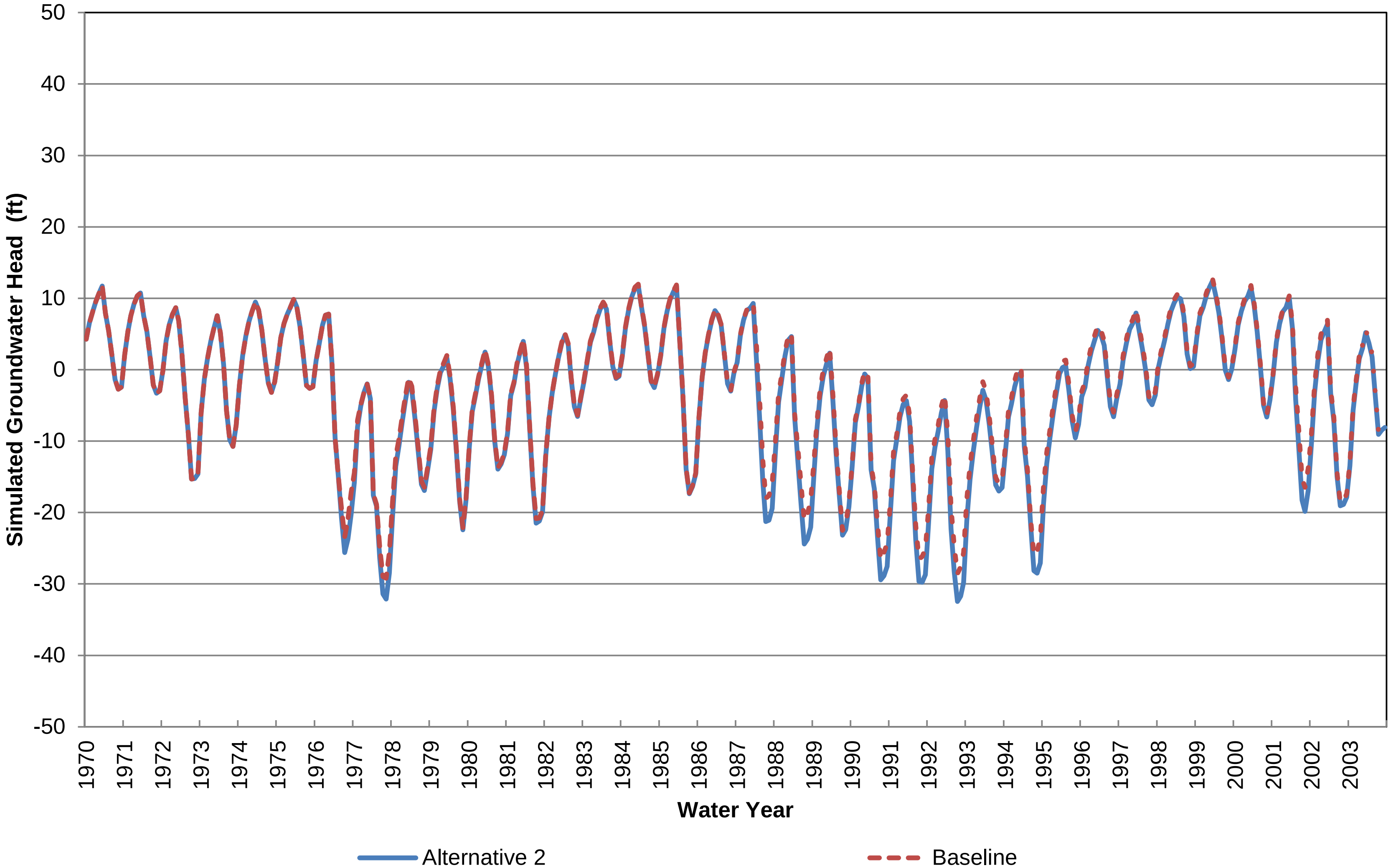



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 70-380 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

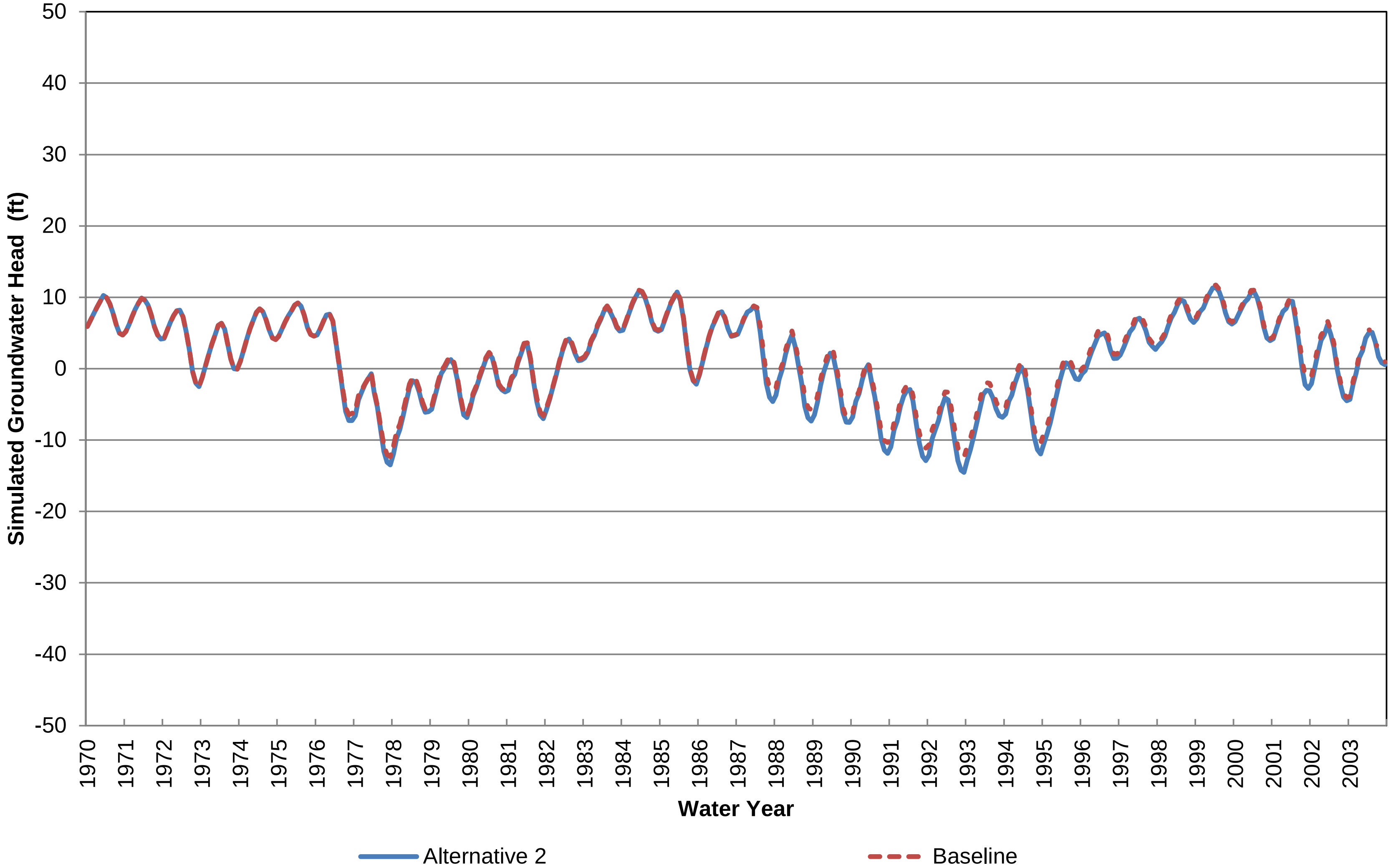
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 380-680 ft bgs)



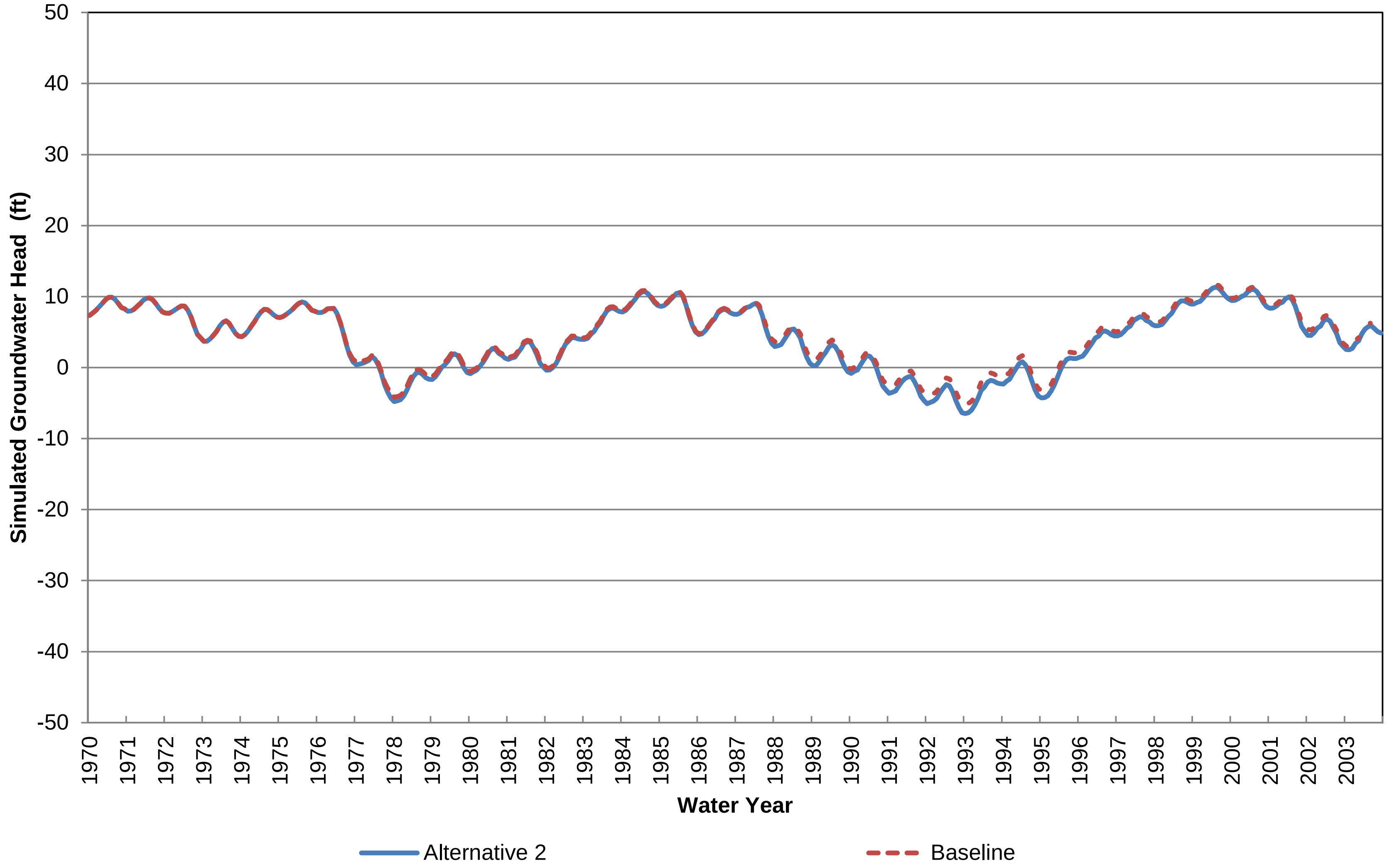
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 680-990 ft bgs)



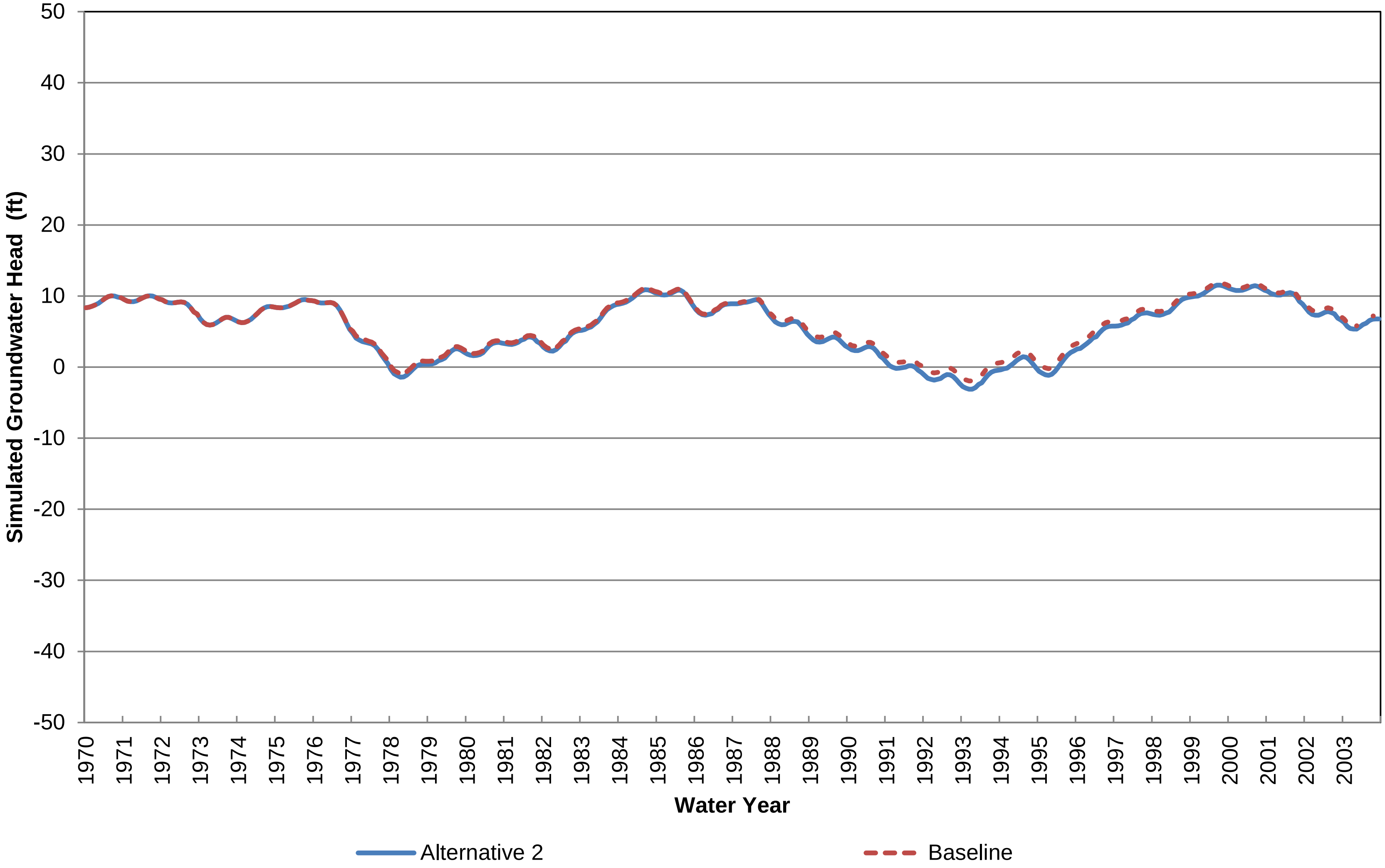
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 990-1530 ft bgs)

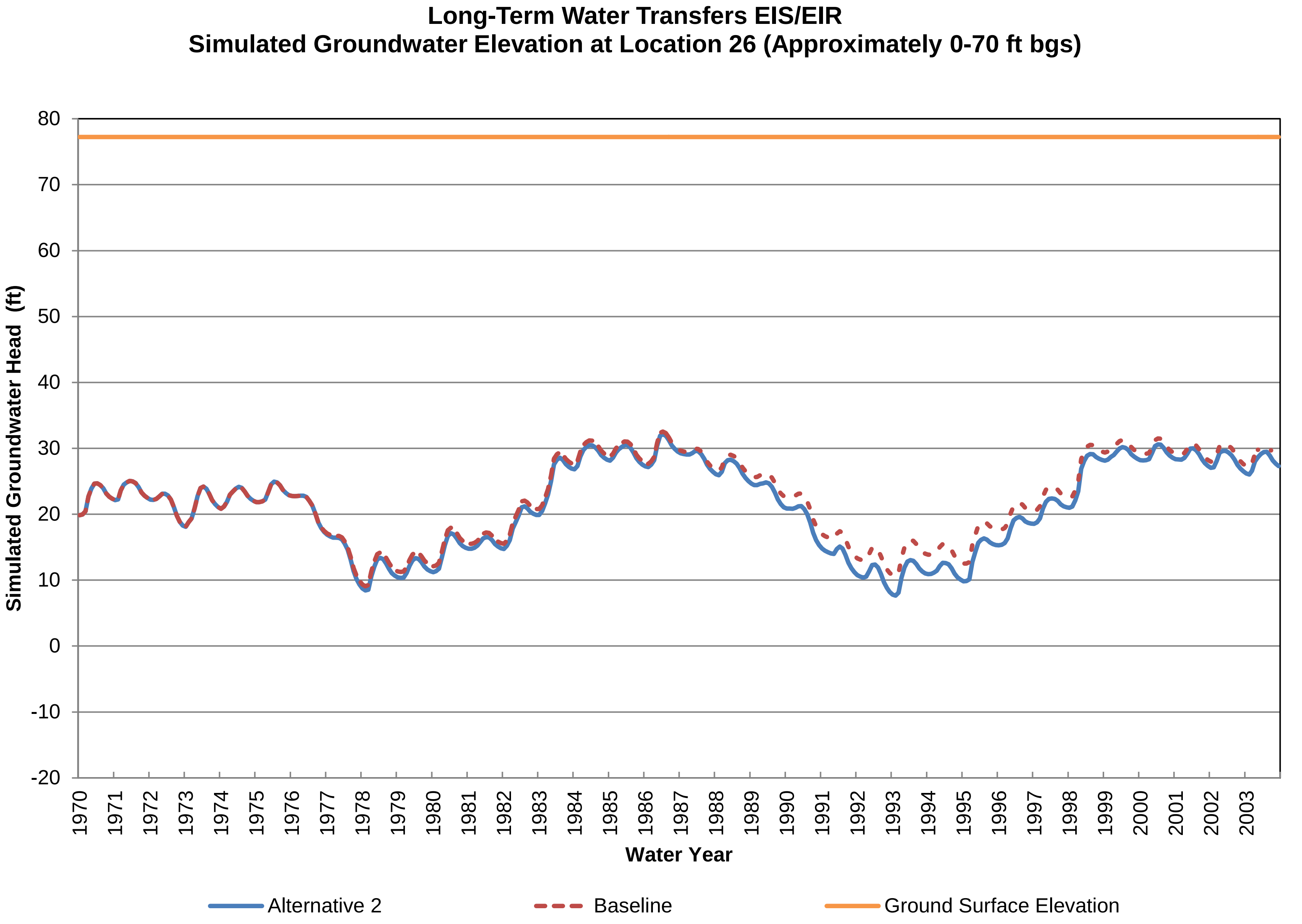


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 1530-2040 ft bgs)



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 25 (Approximately 2040-2800 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 26 (Approximately 0-70 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
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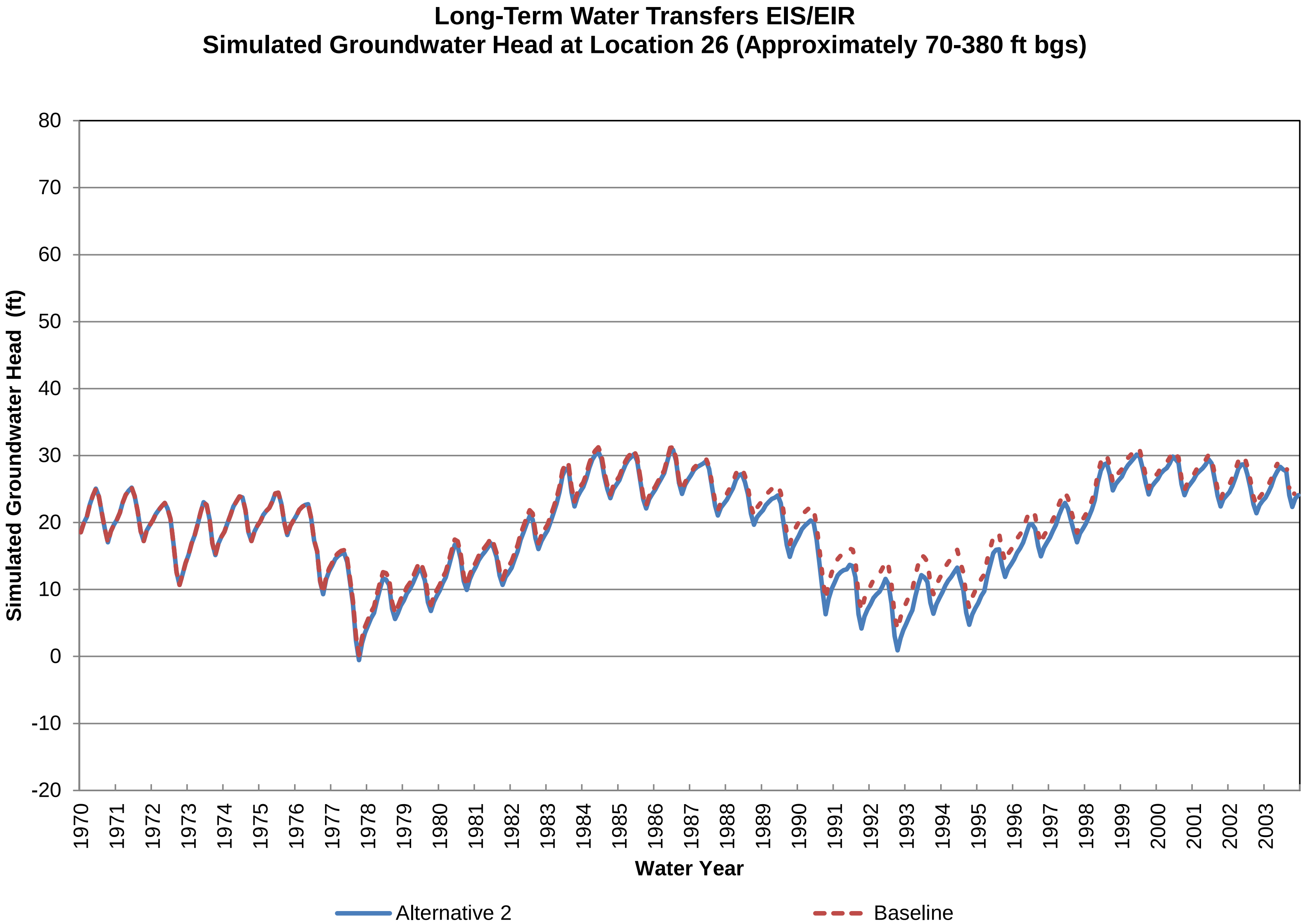
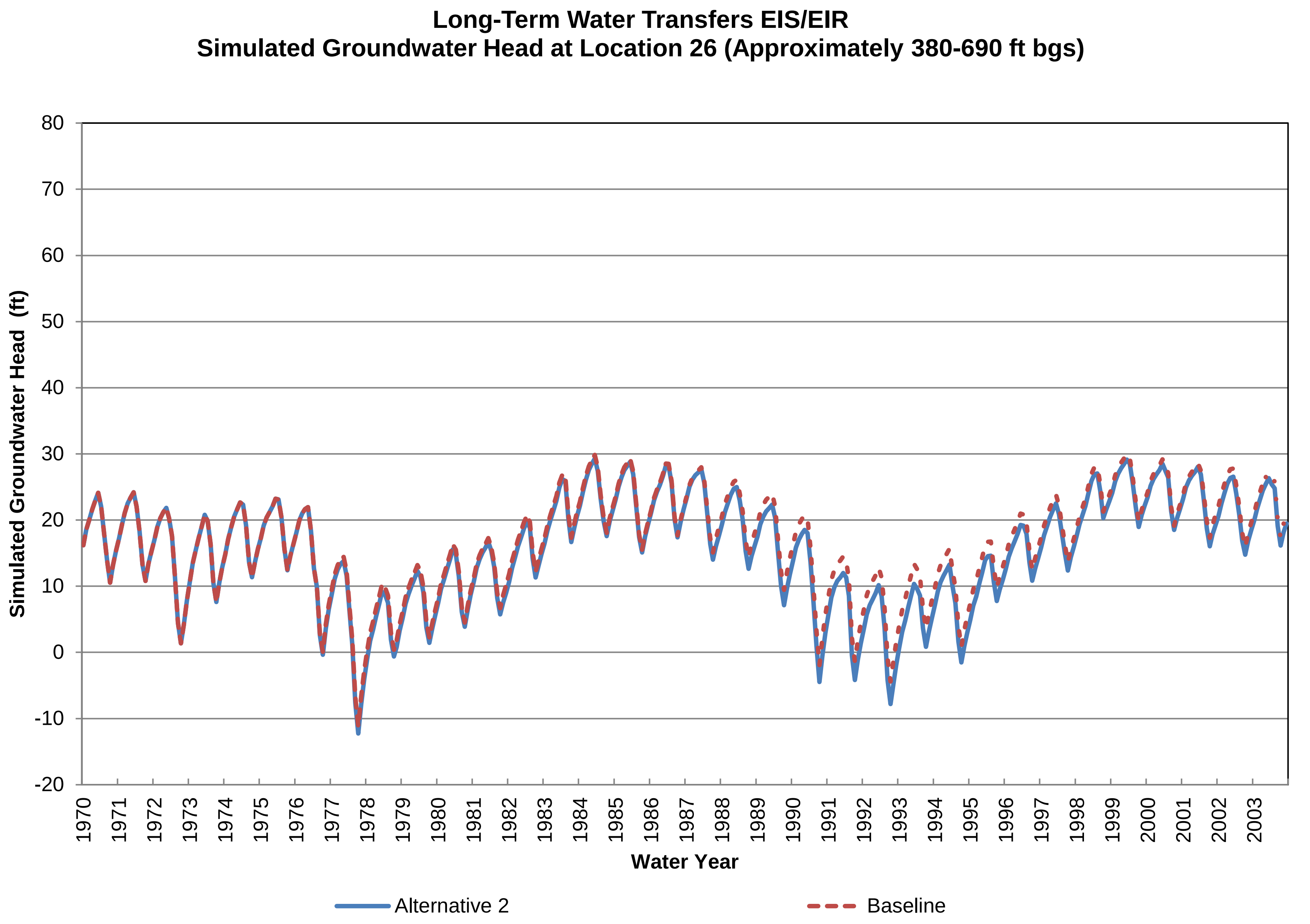
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 70-380 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 380-690 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
1987
1988
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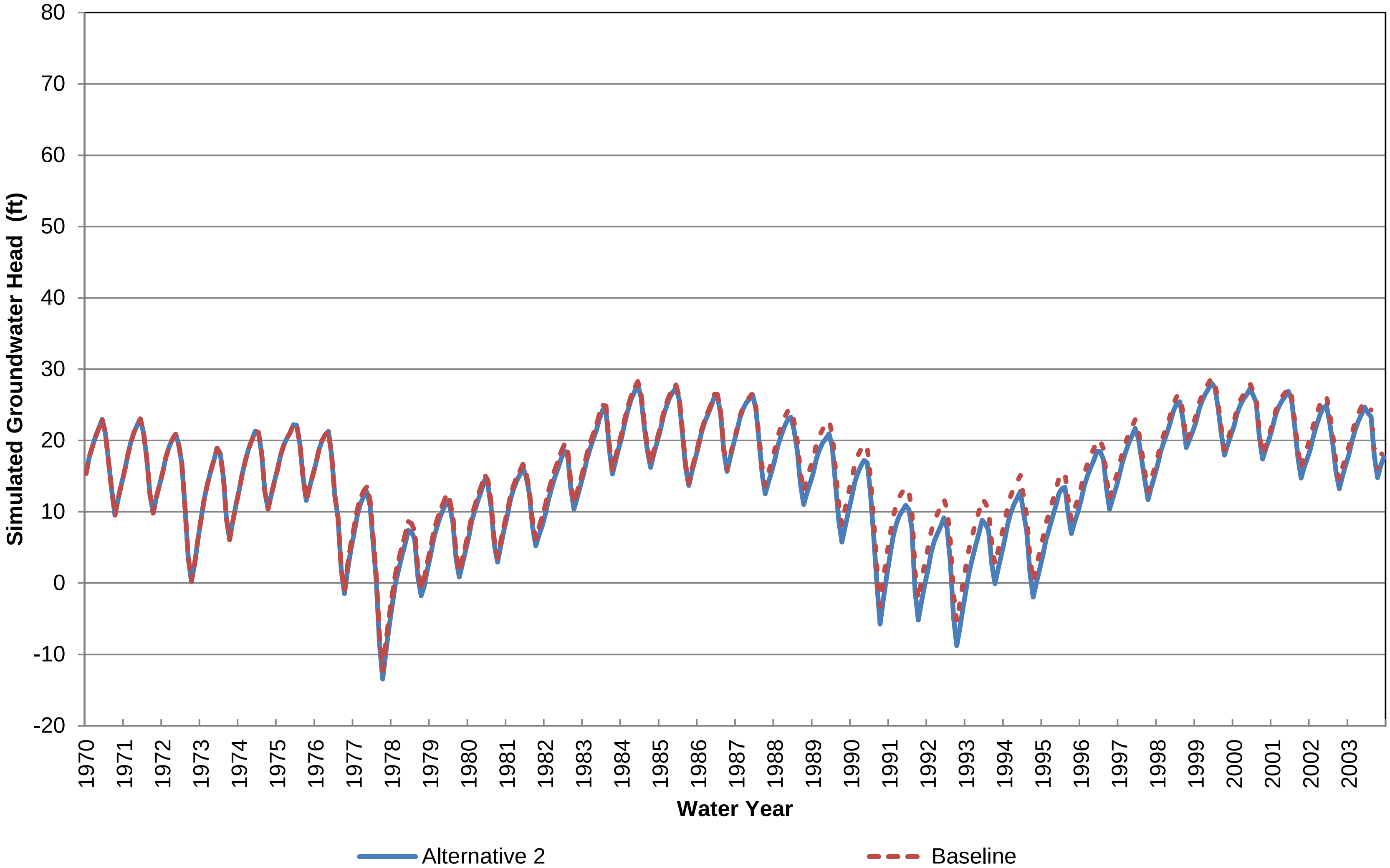
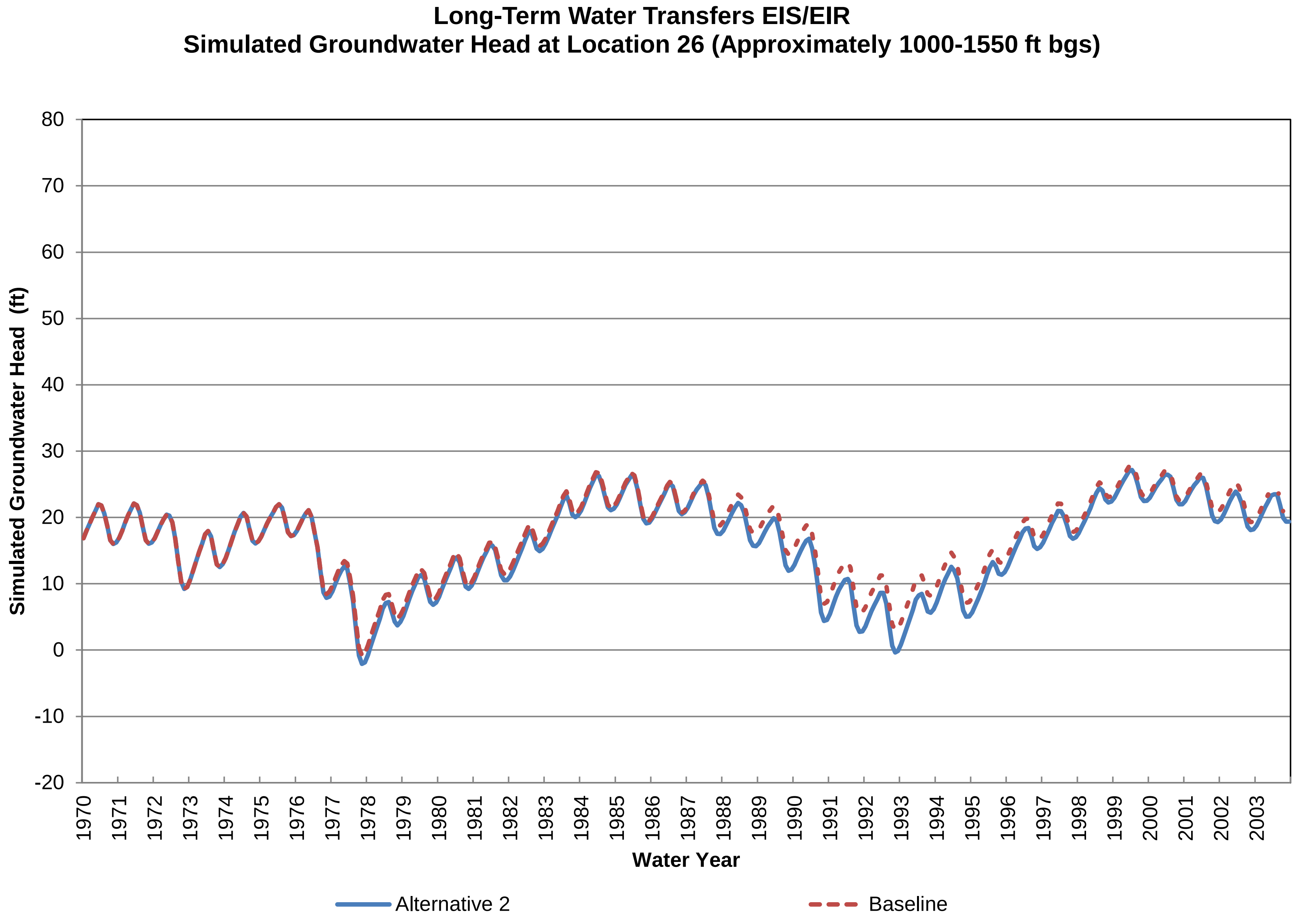
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 690-1000 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 1000-1550 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
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1988
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1993
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1995
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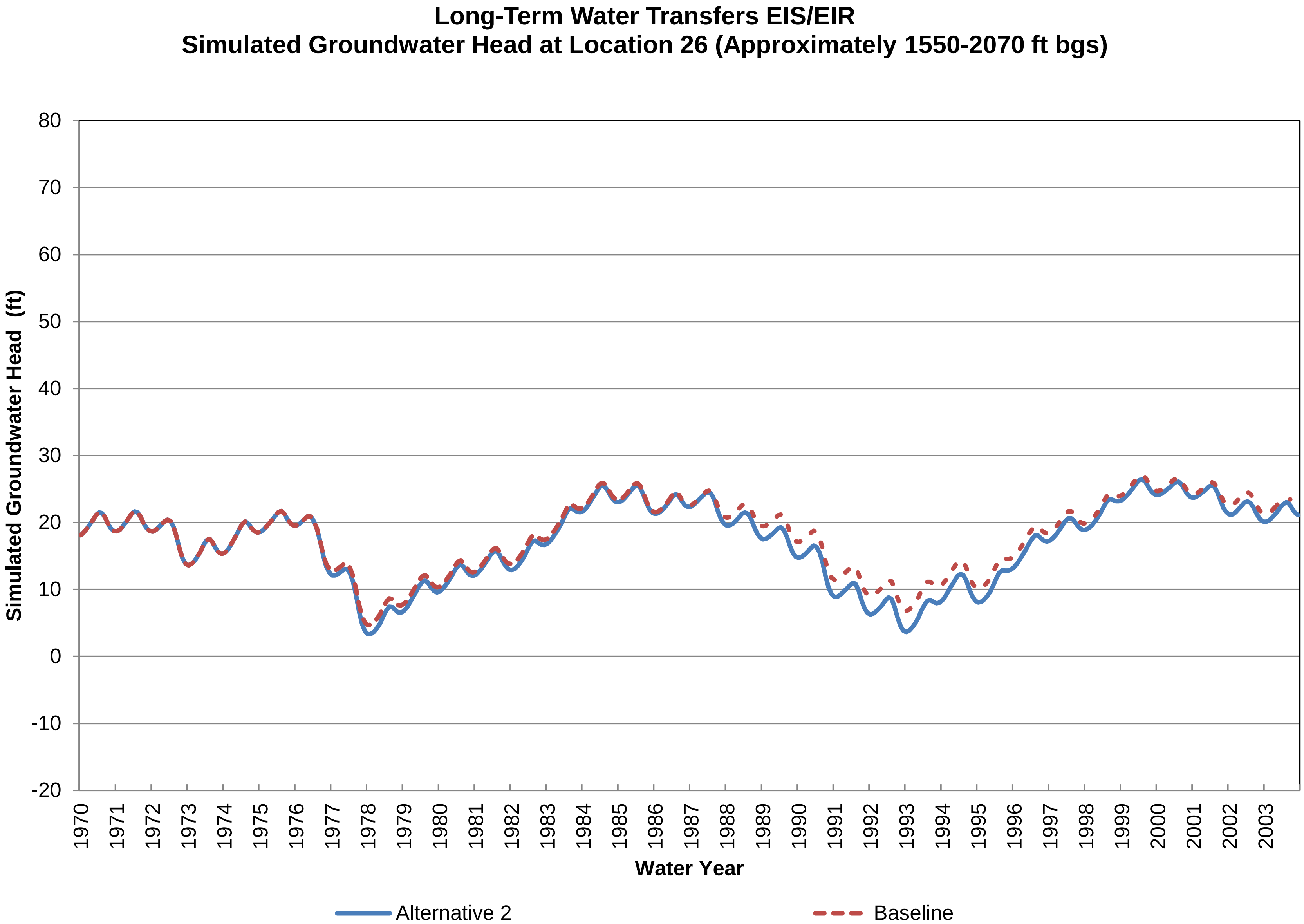
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 1550-2070 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
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1987
1988
1989
1990
1991
1992
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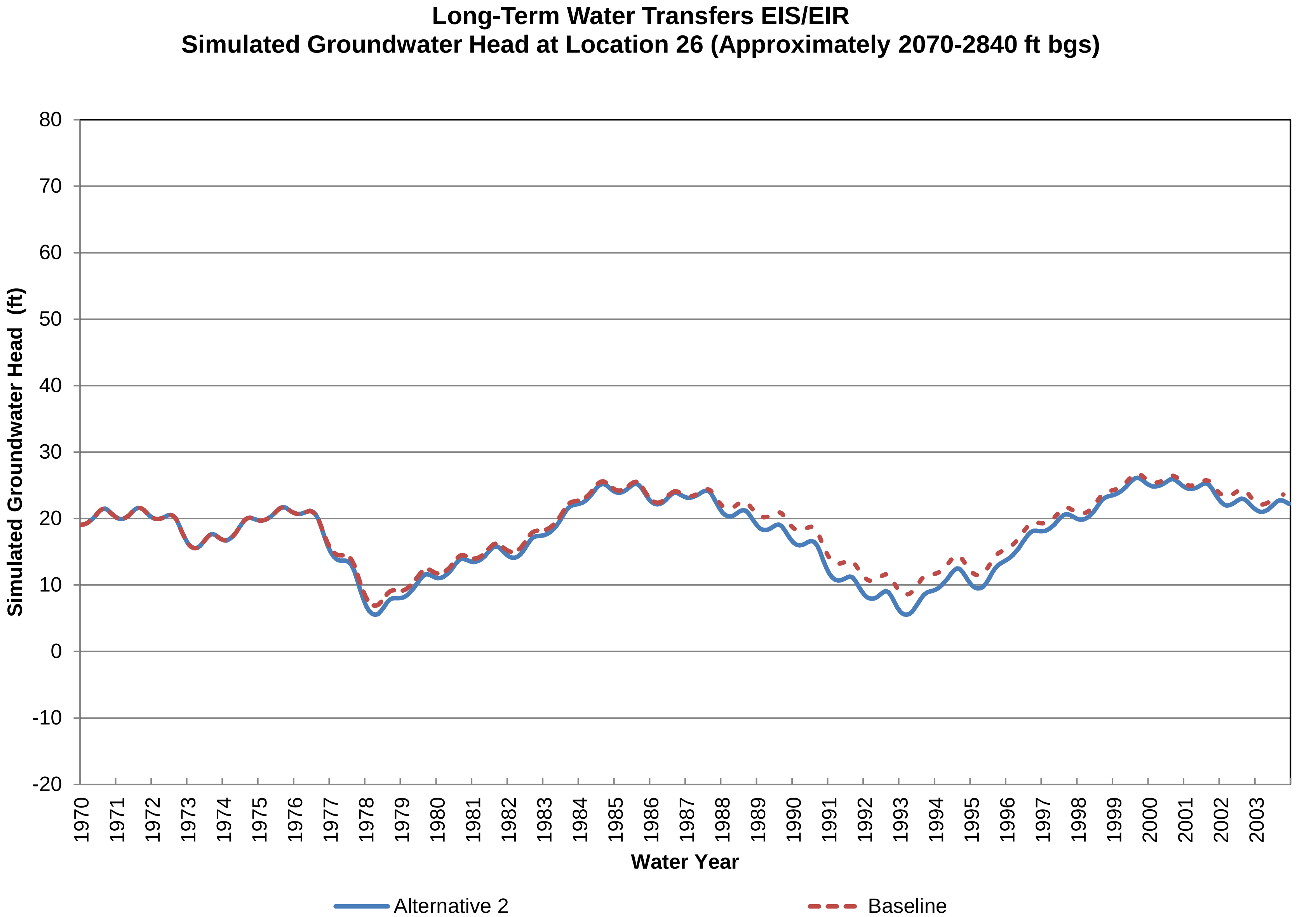
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 26 (Approximately 2070-2840 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1994
1995
1996
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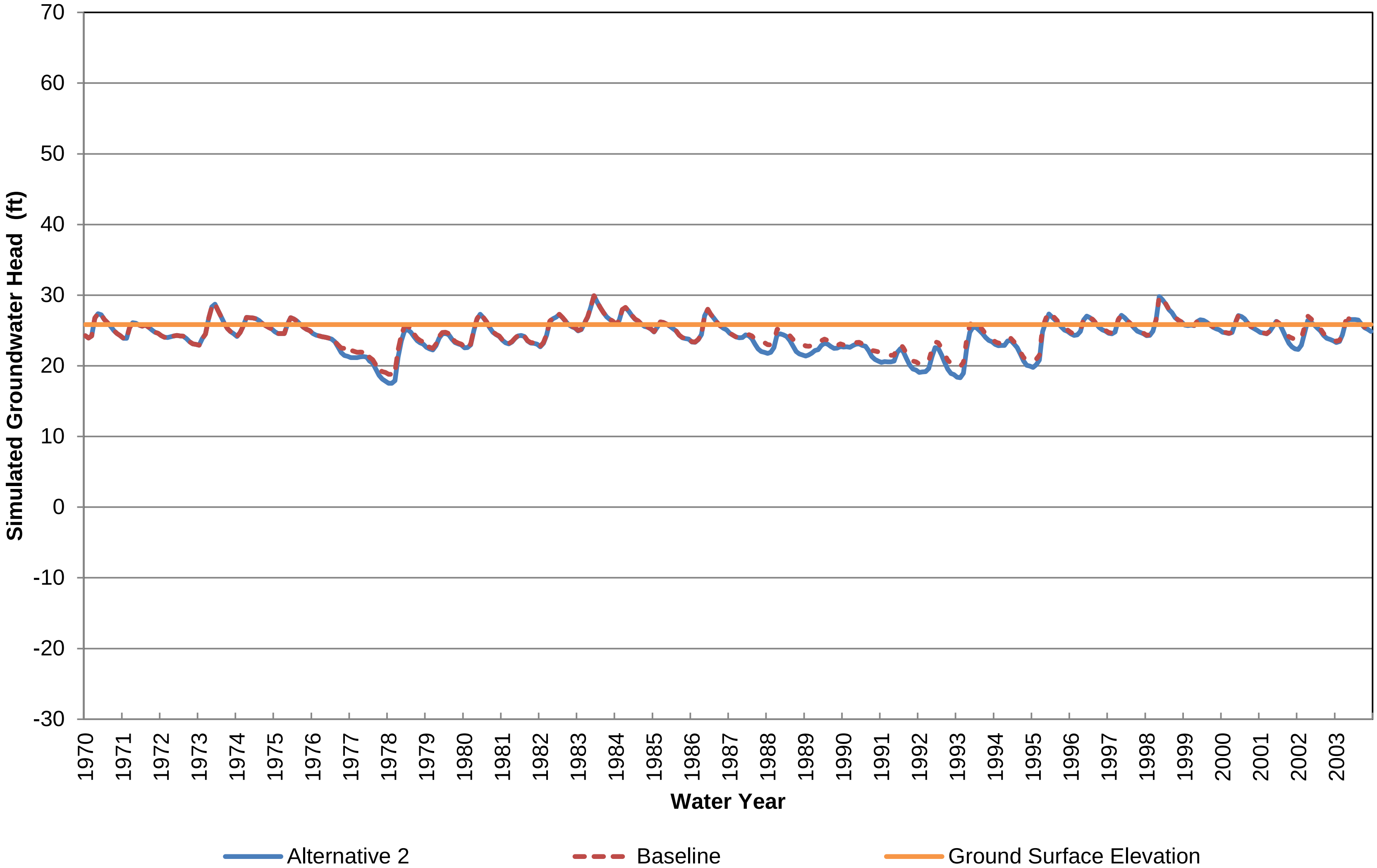
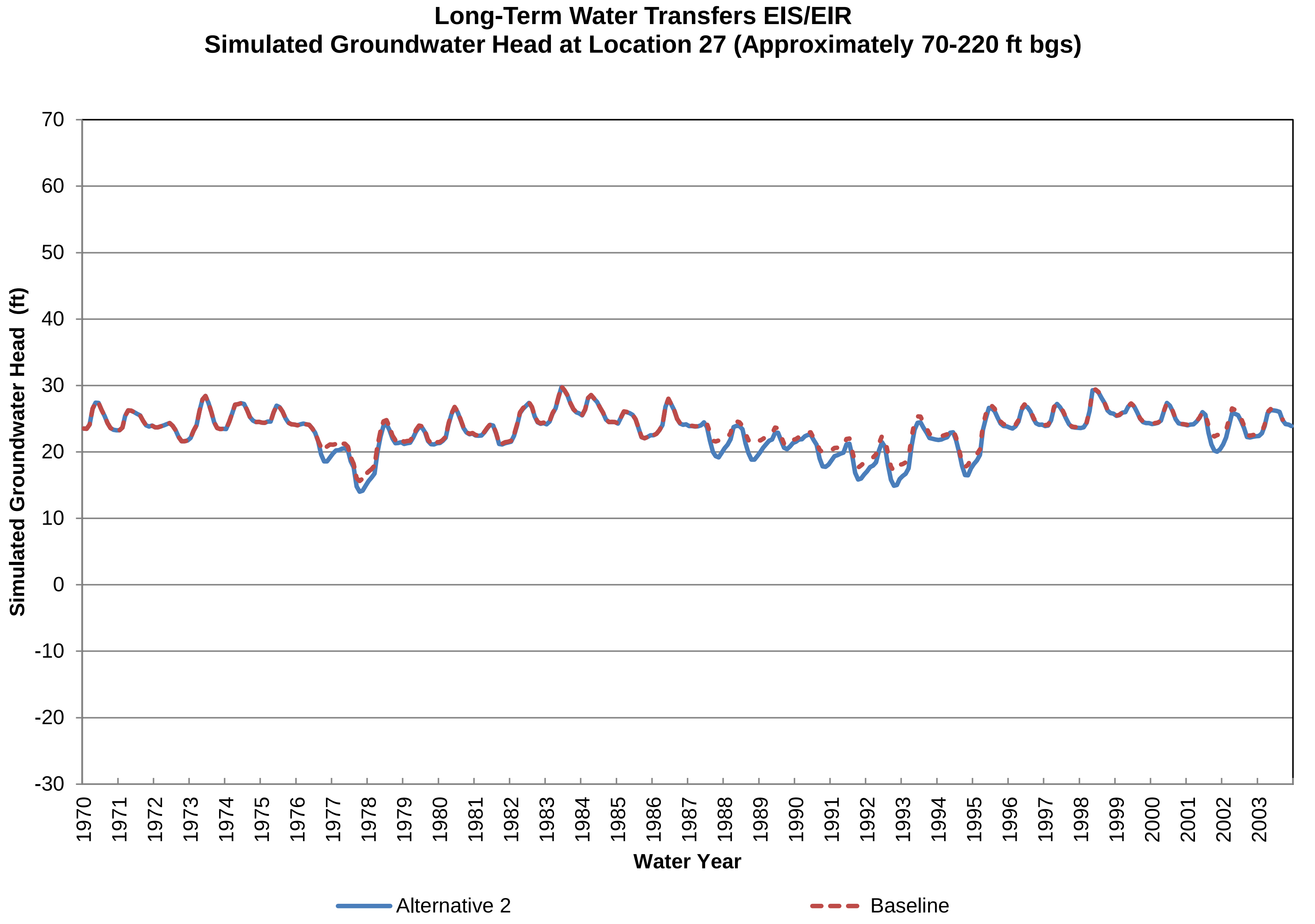
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 27 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 70-220 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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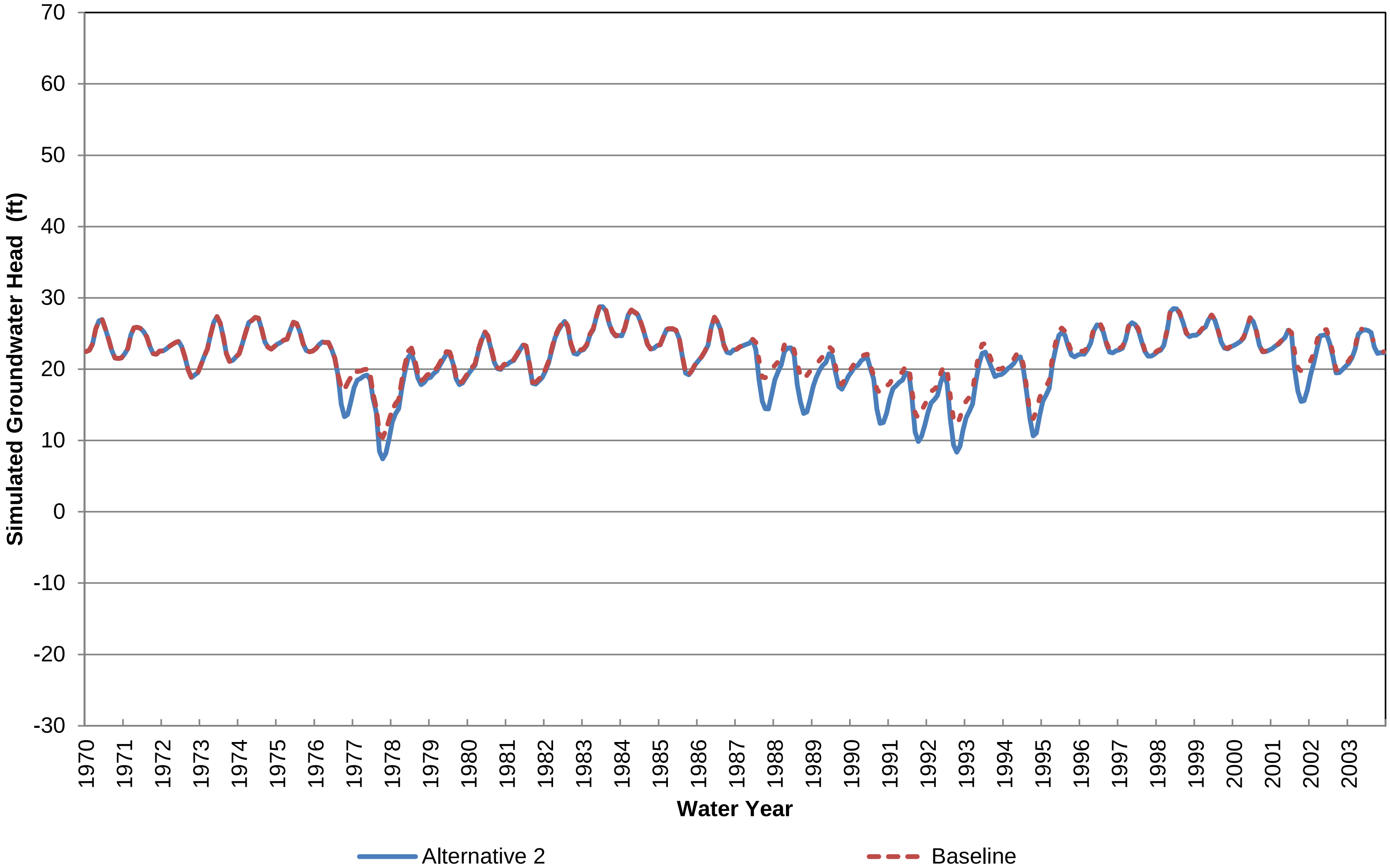
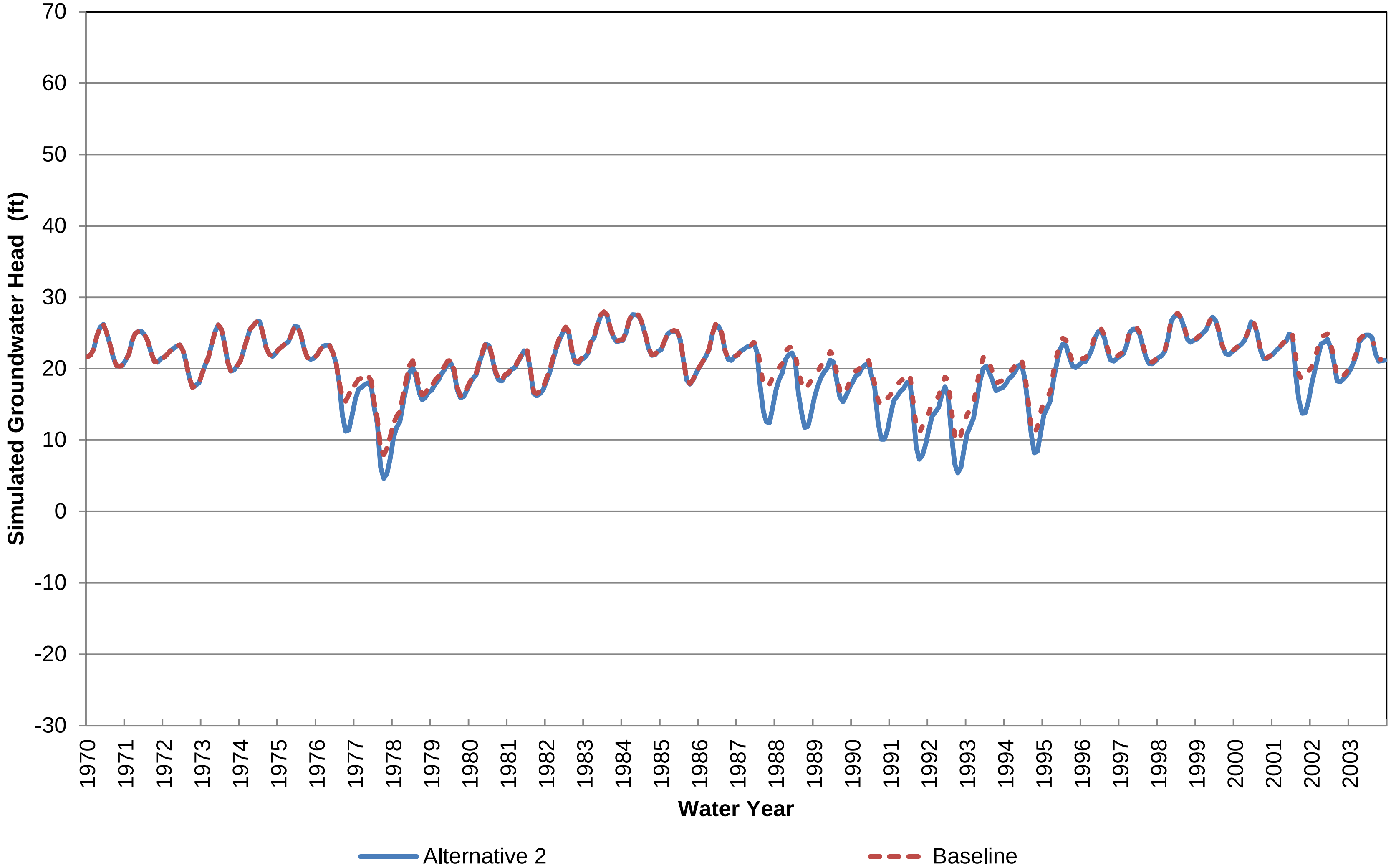
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

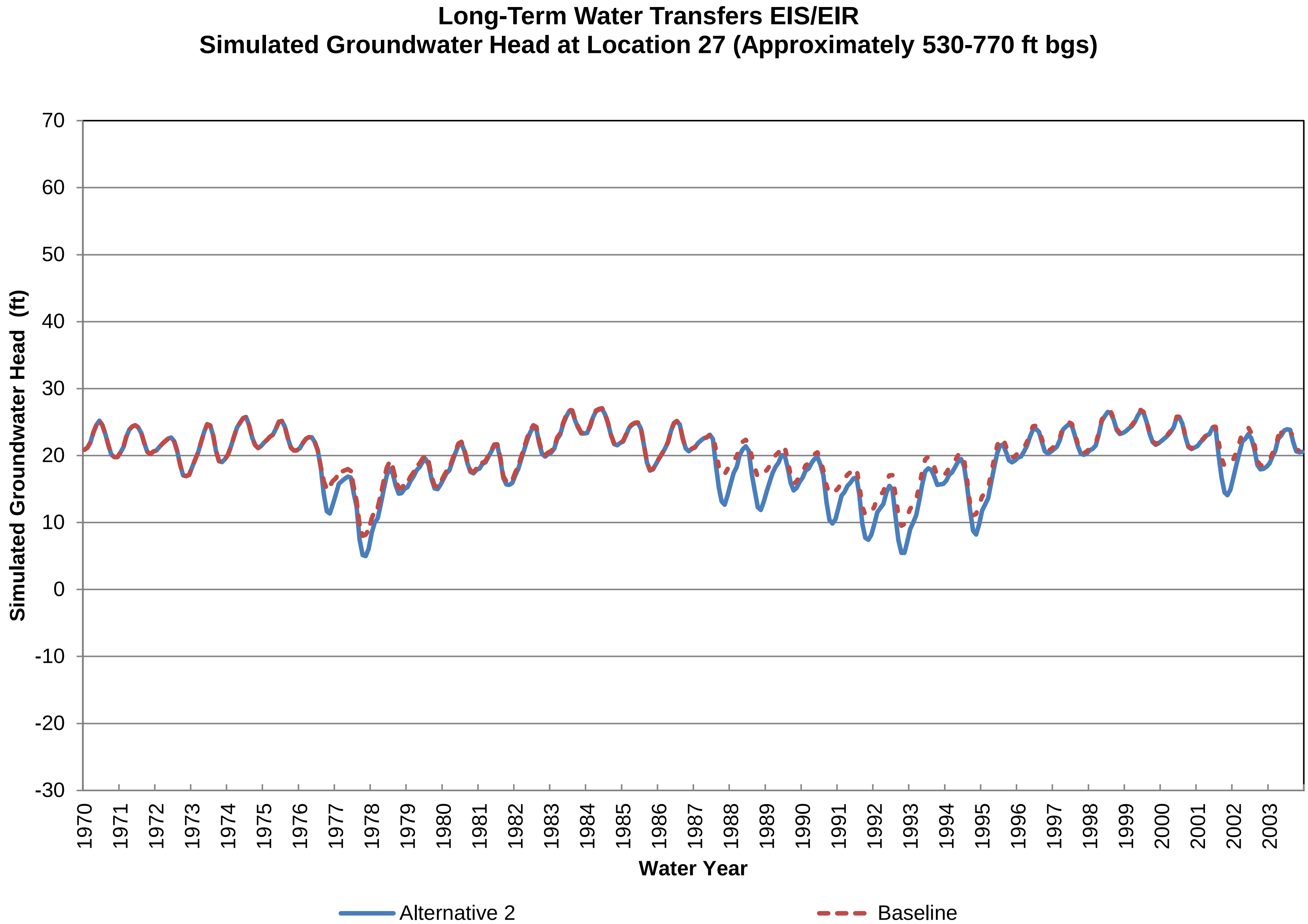
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 220-380 ft bgs)



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 380-530 ft bgs)



266B


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 530-770 ft bgs)
70
60
50
40
30
20
10
0
-10
-20
-30
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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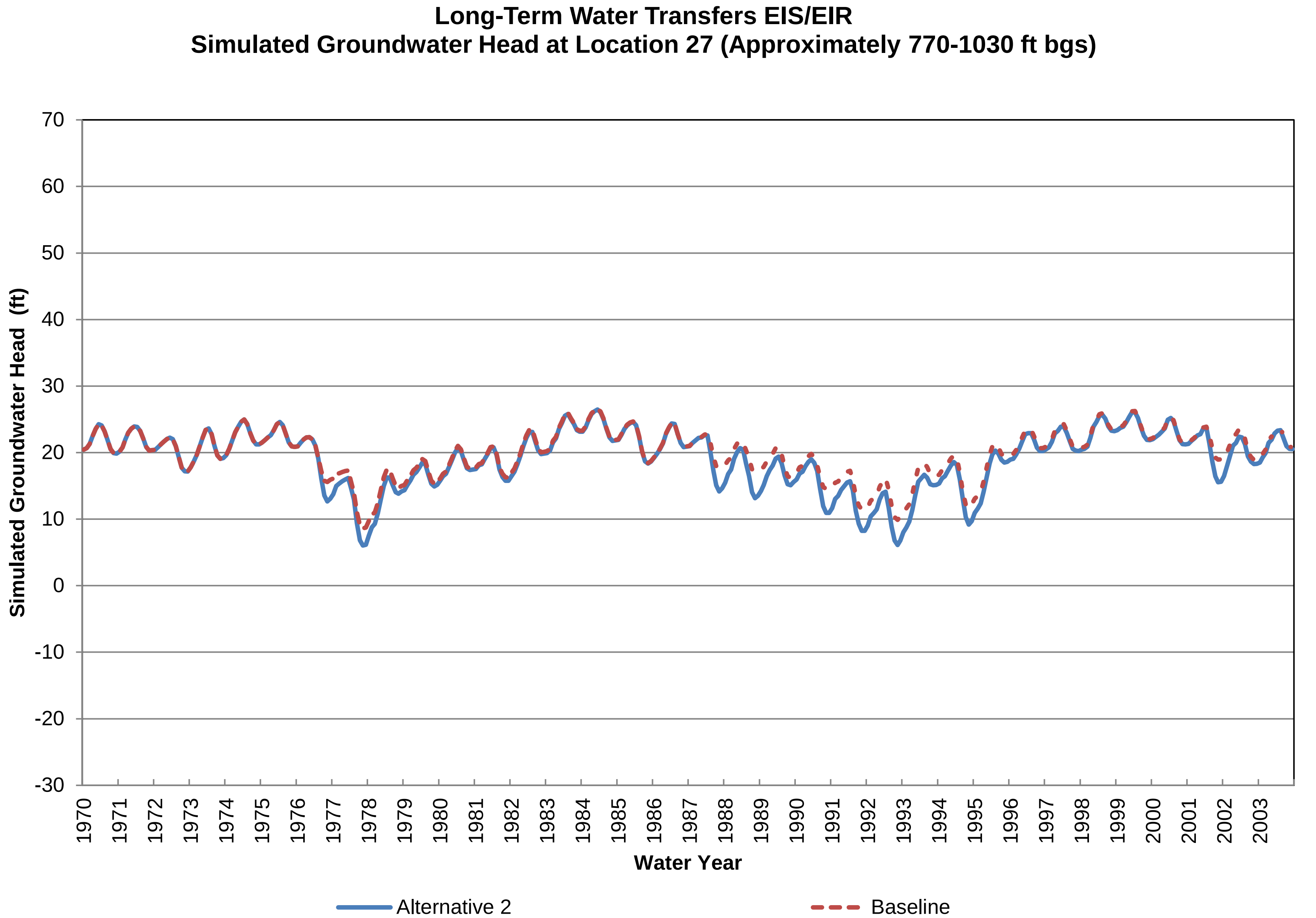
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 770-1030 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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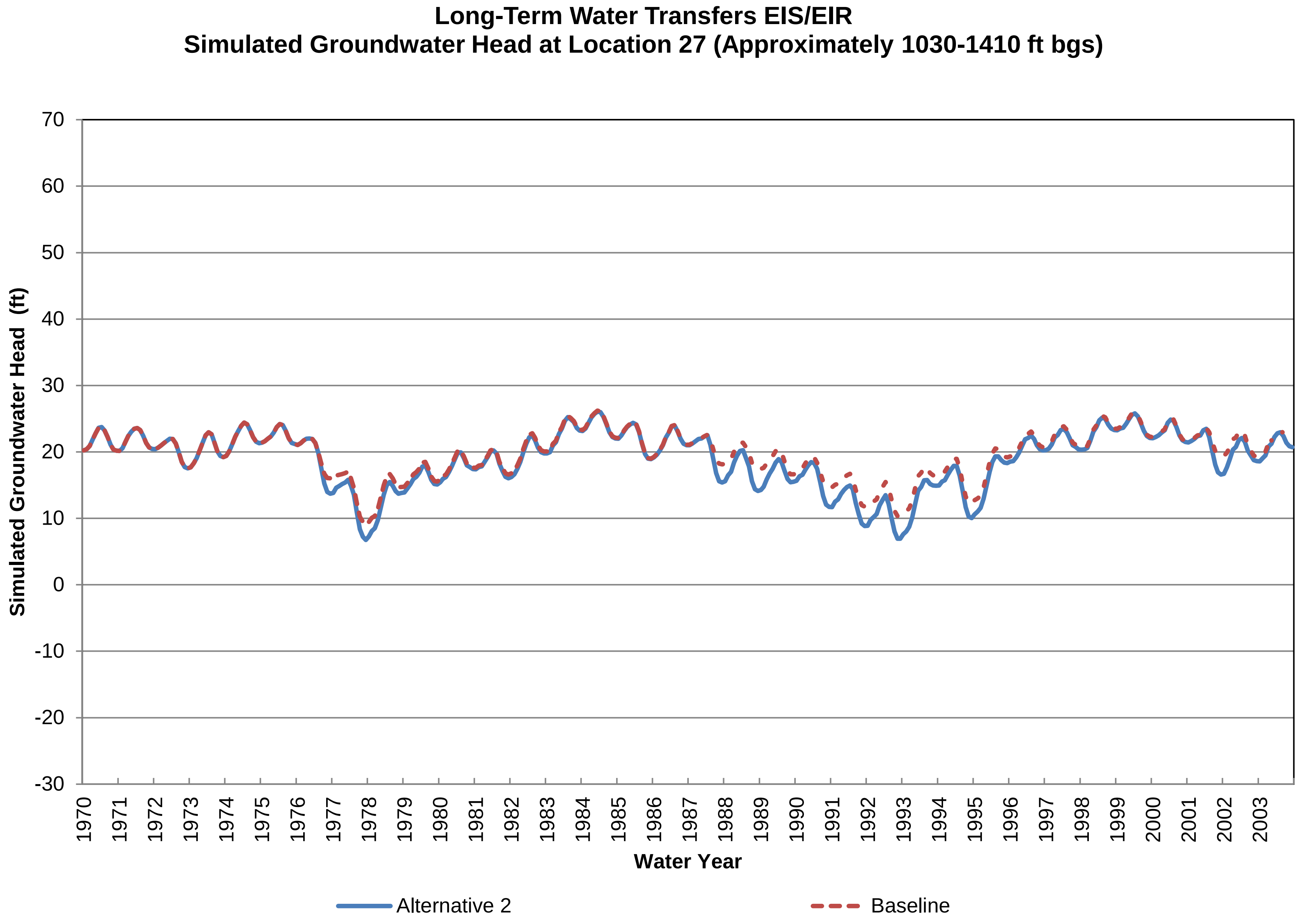
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 27 (Approximately 1030-1410 ft bgs)
Simulated Groundwater Head (ft)
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1986
1987
1988
1989
1990
1991
1992
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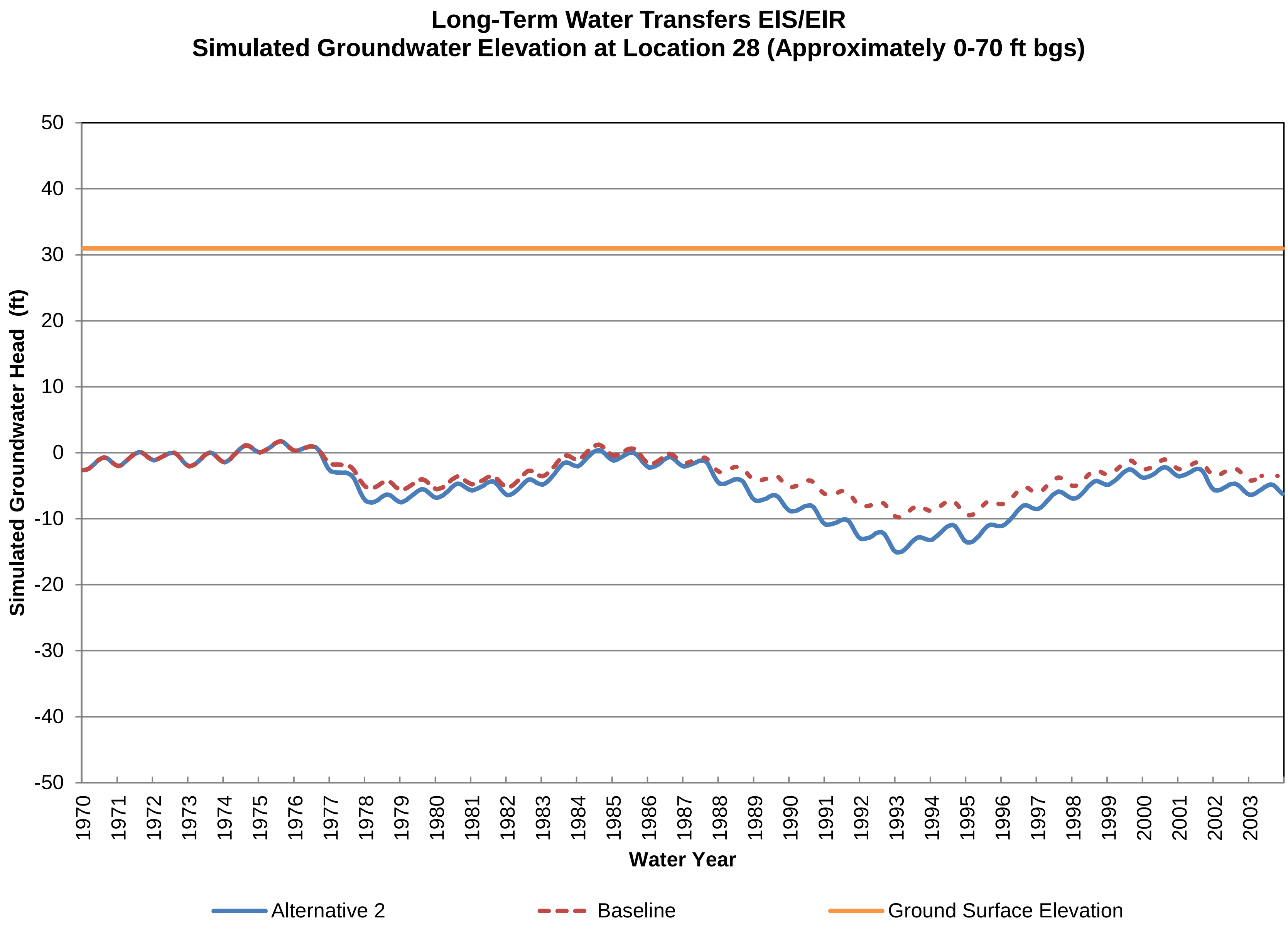
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 28 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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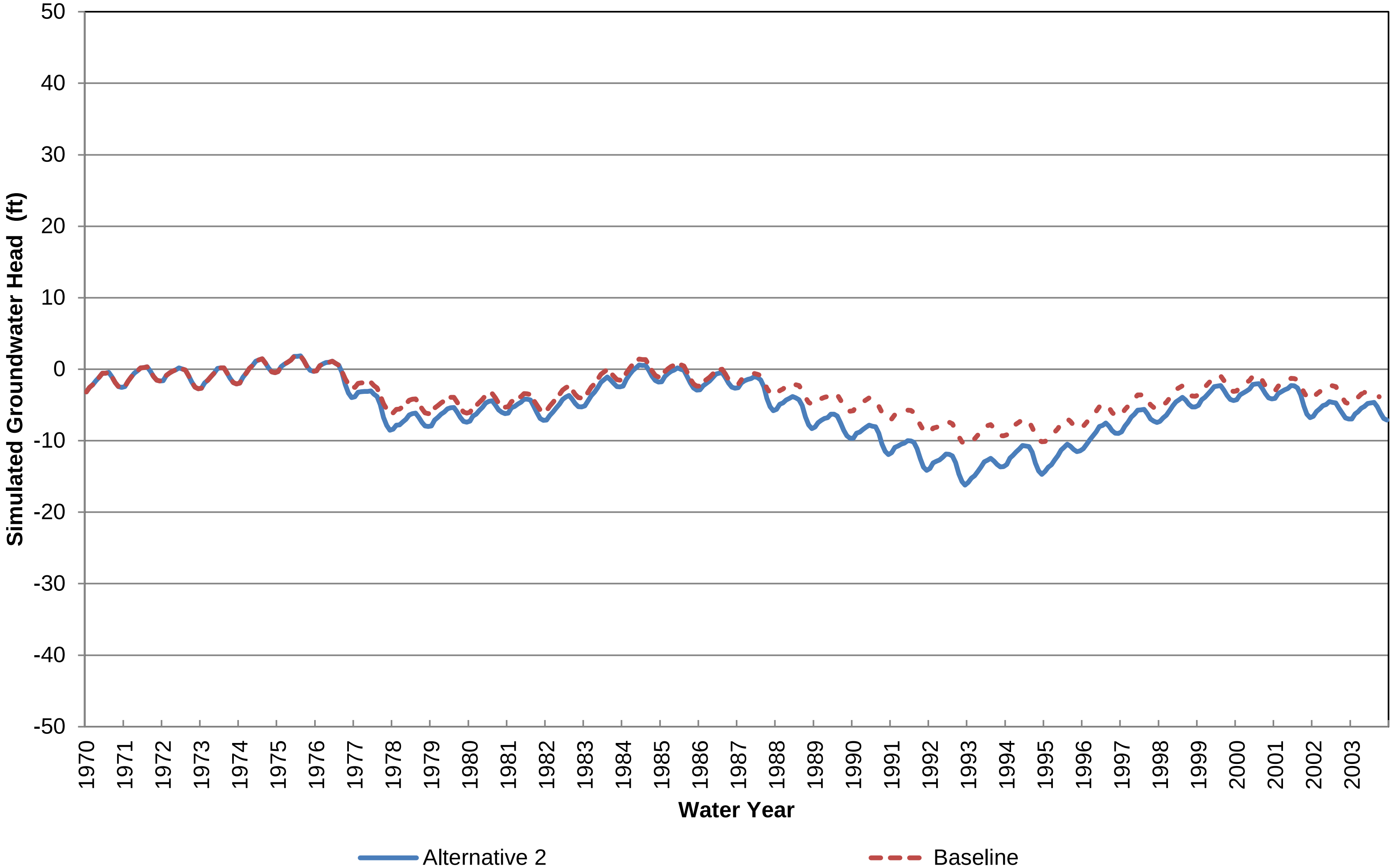
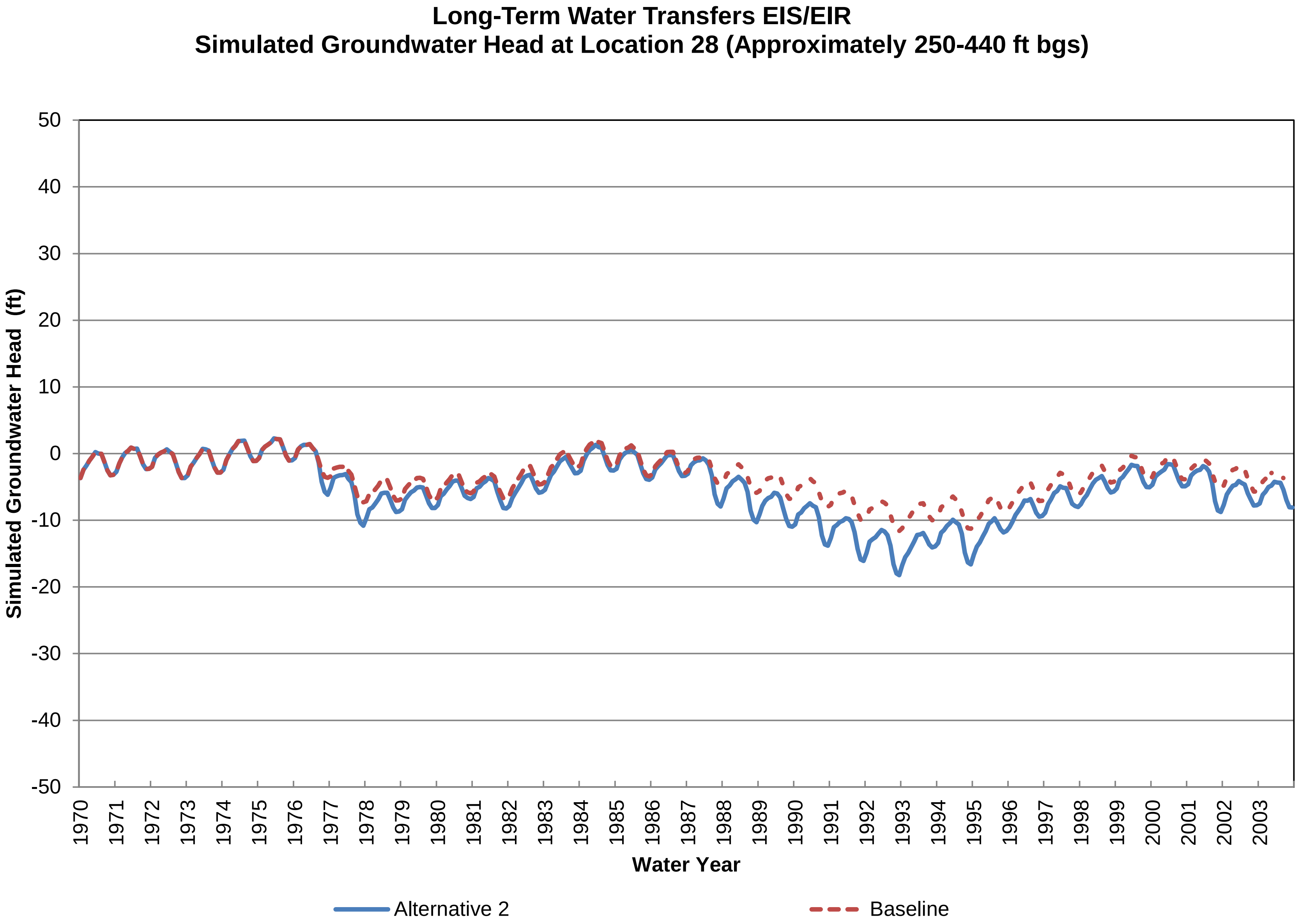
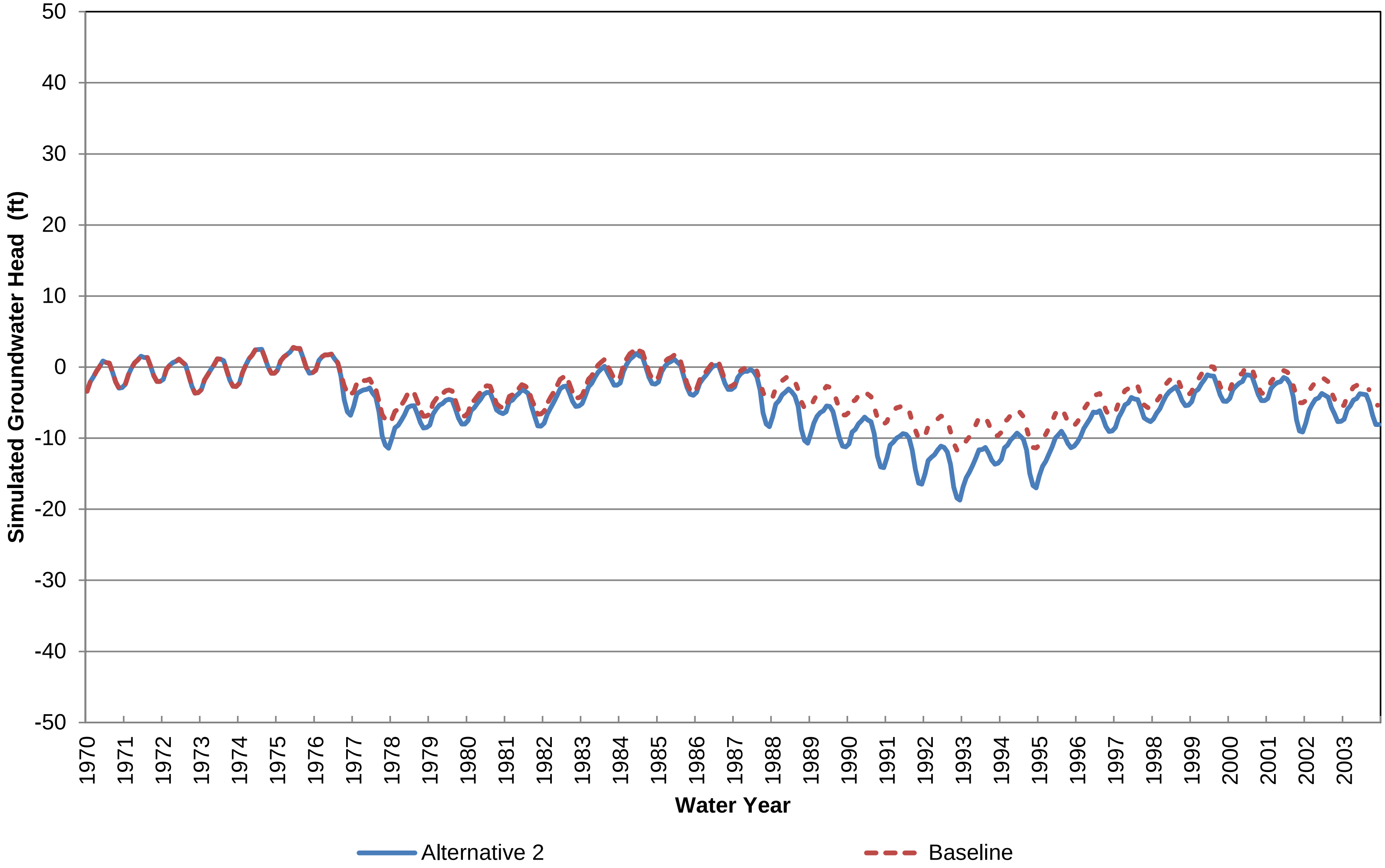
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

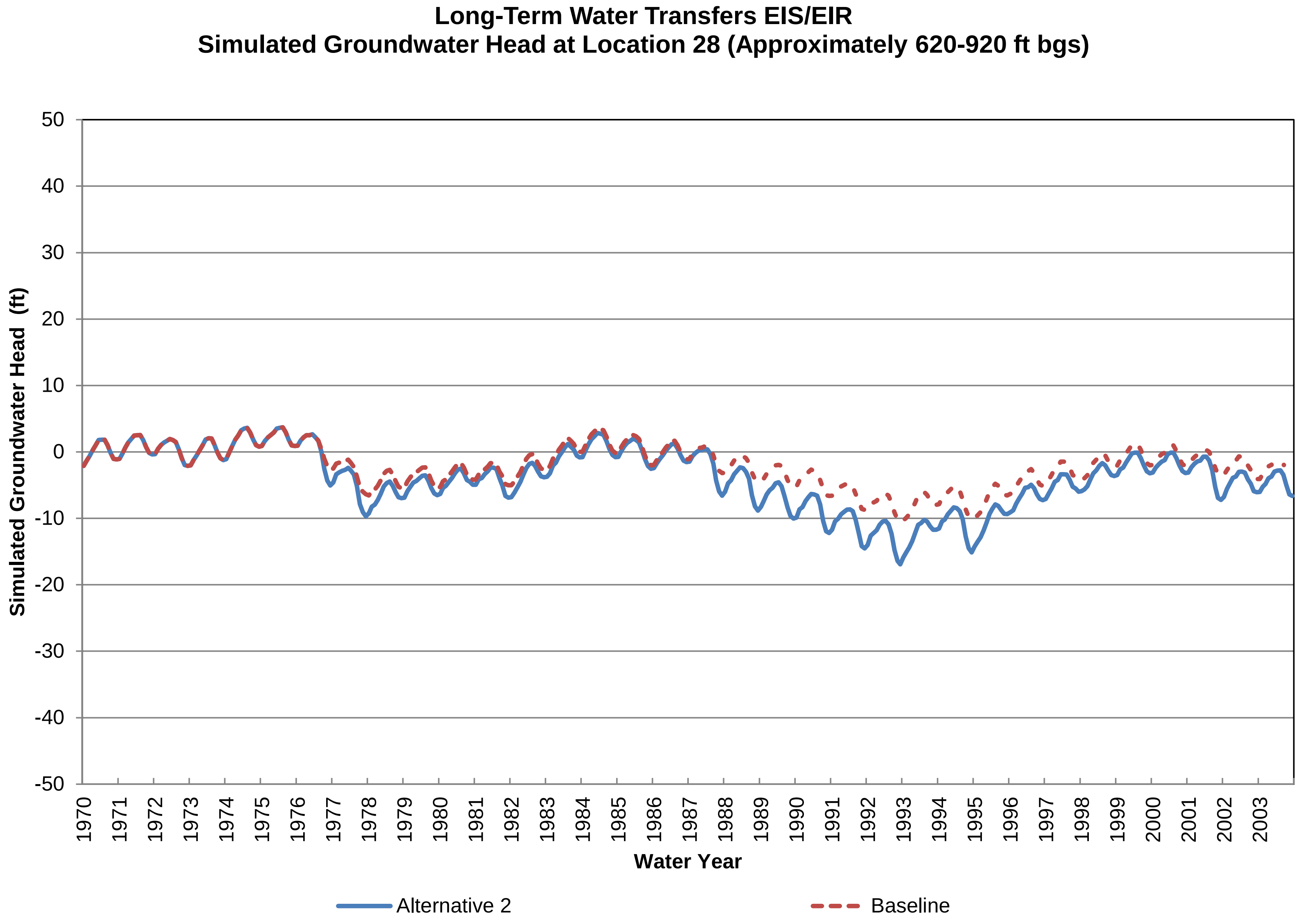
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 70-250 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 250-440 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 440-620 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 620-920 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
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1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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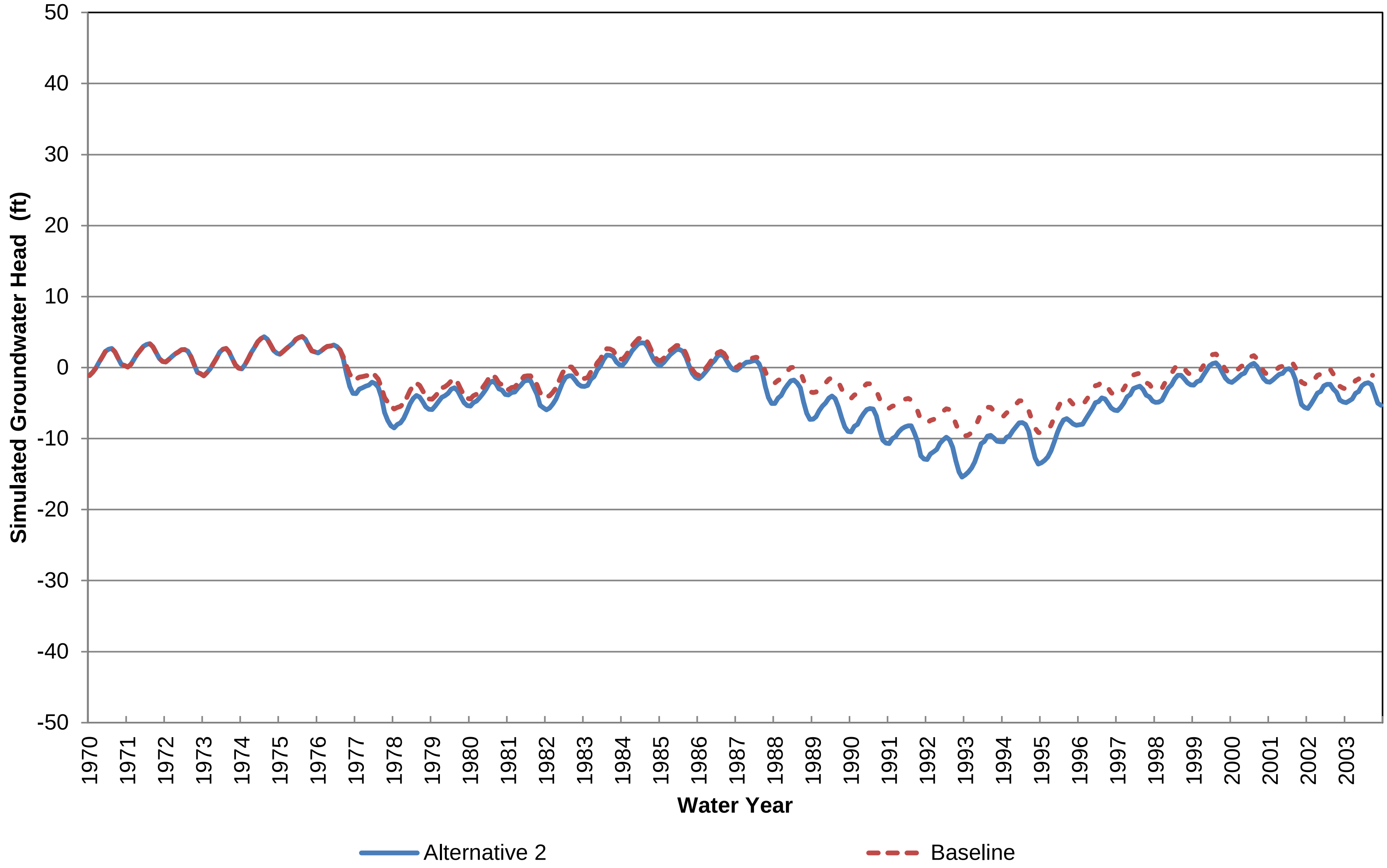
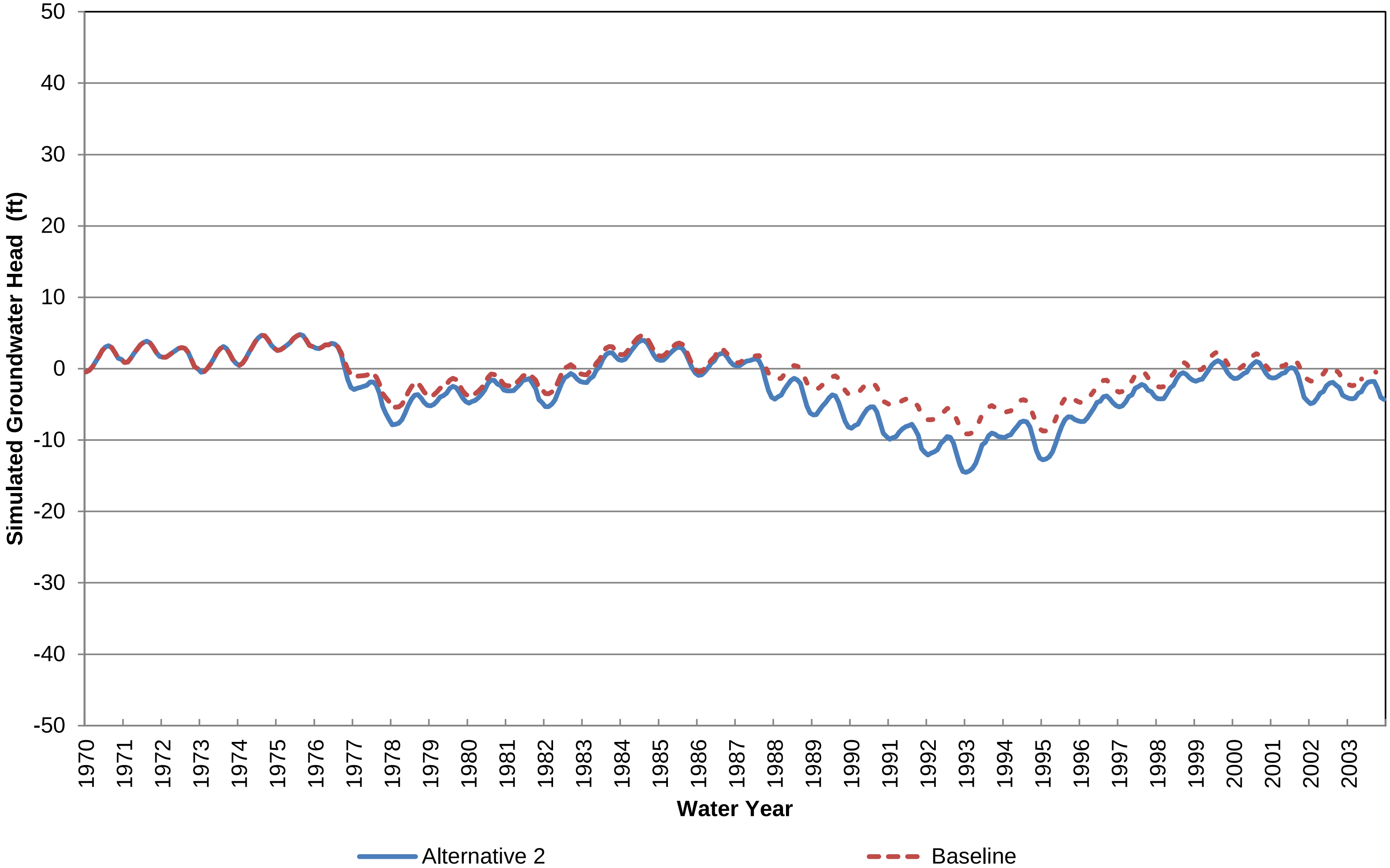
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

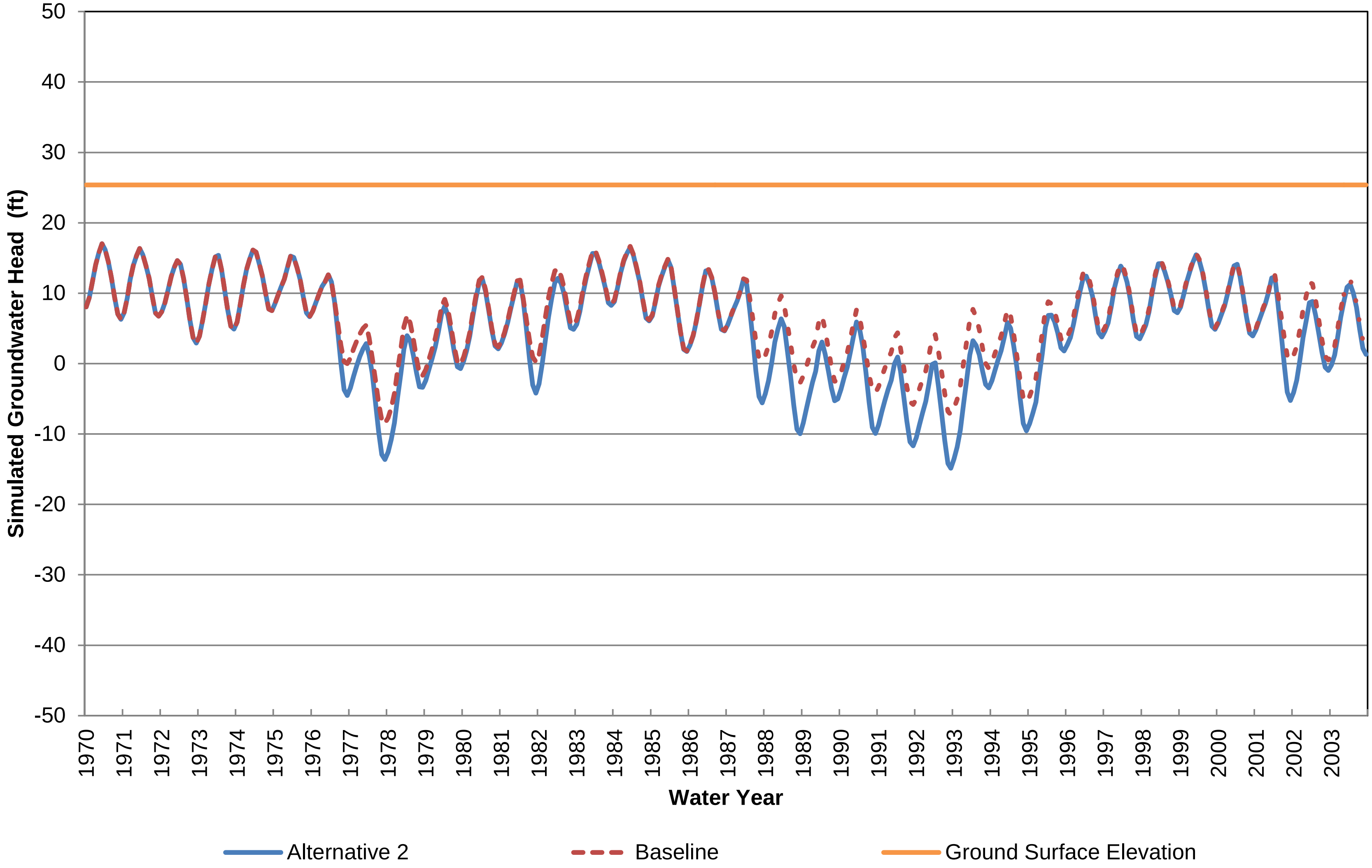
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 920-1220 ft bgs)



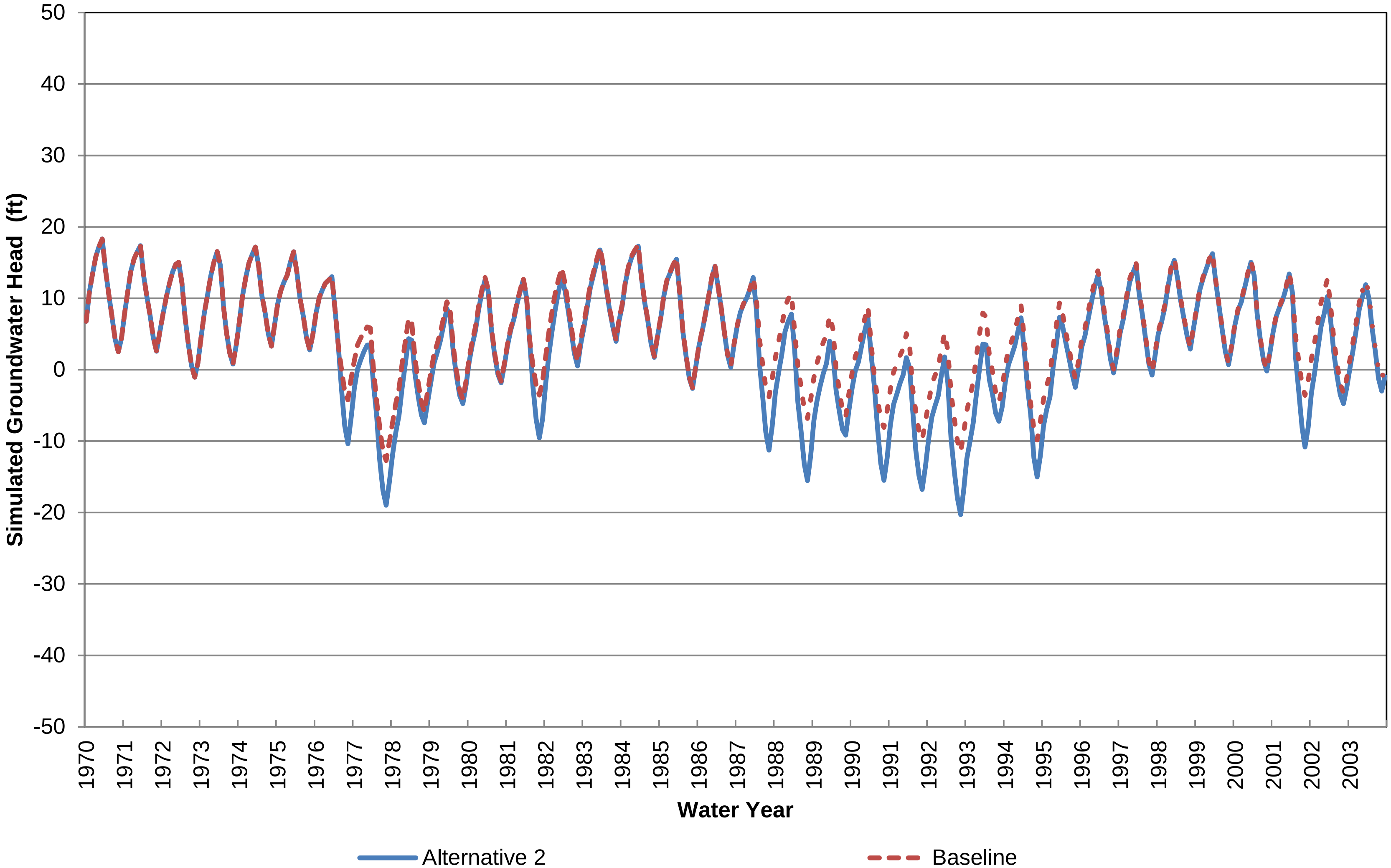
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 28 (Approximately 1220-1680 ft bgs)



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 29 (Approximately 0-70 ft bgs)

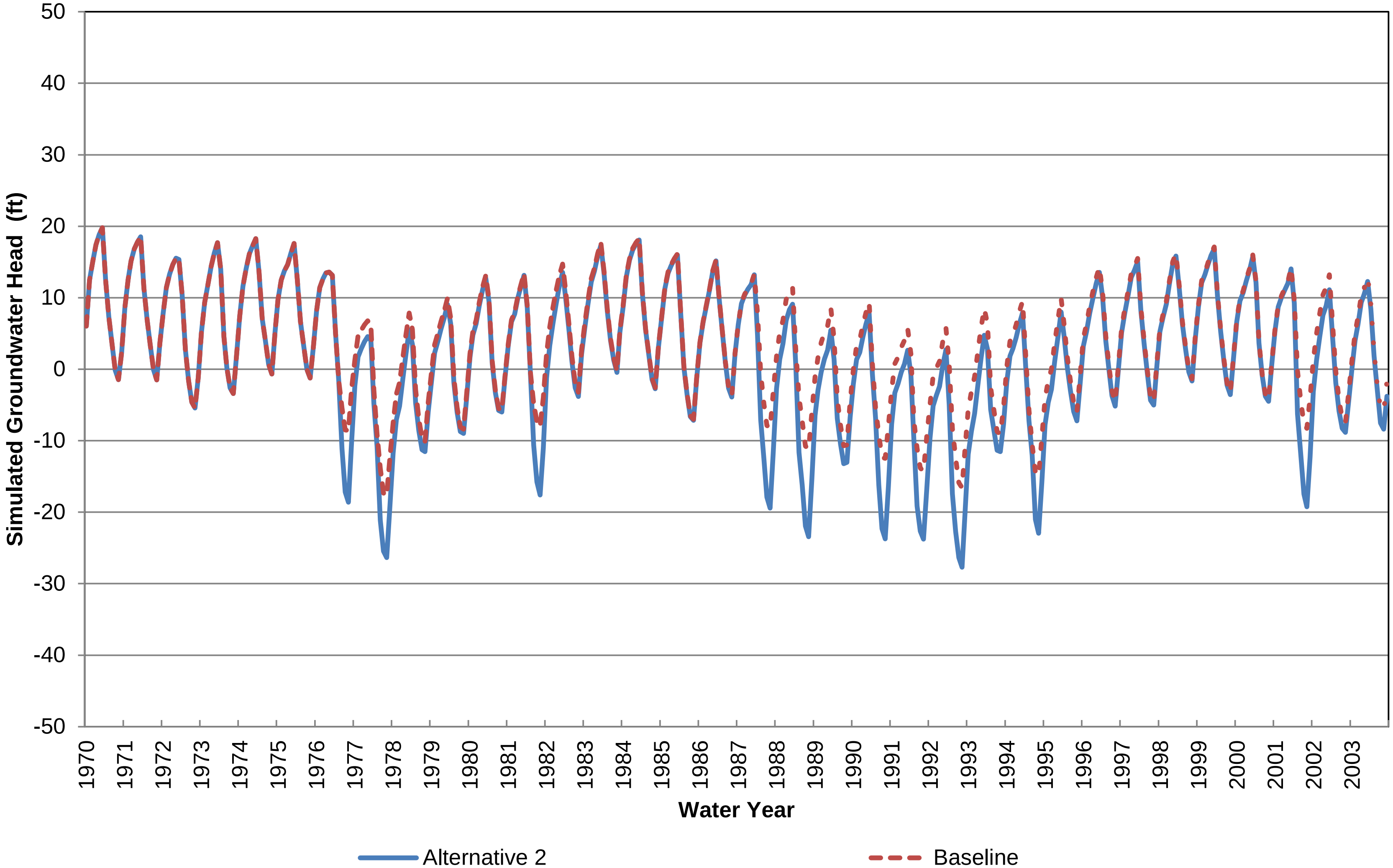


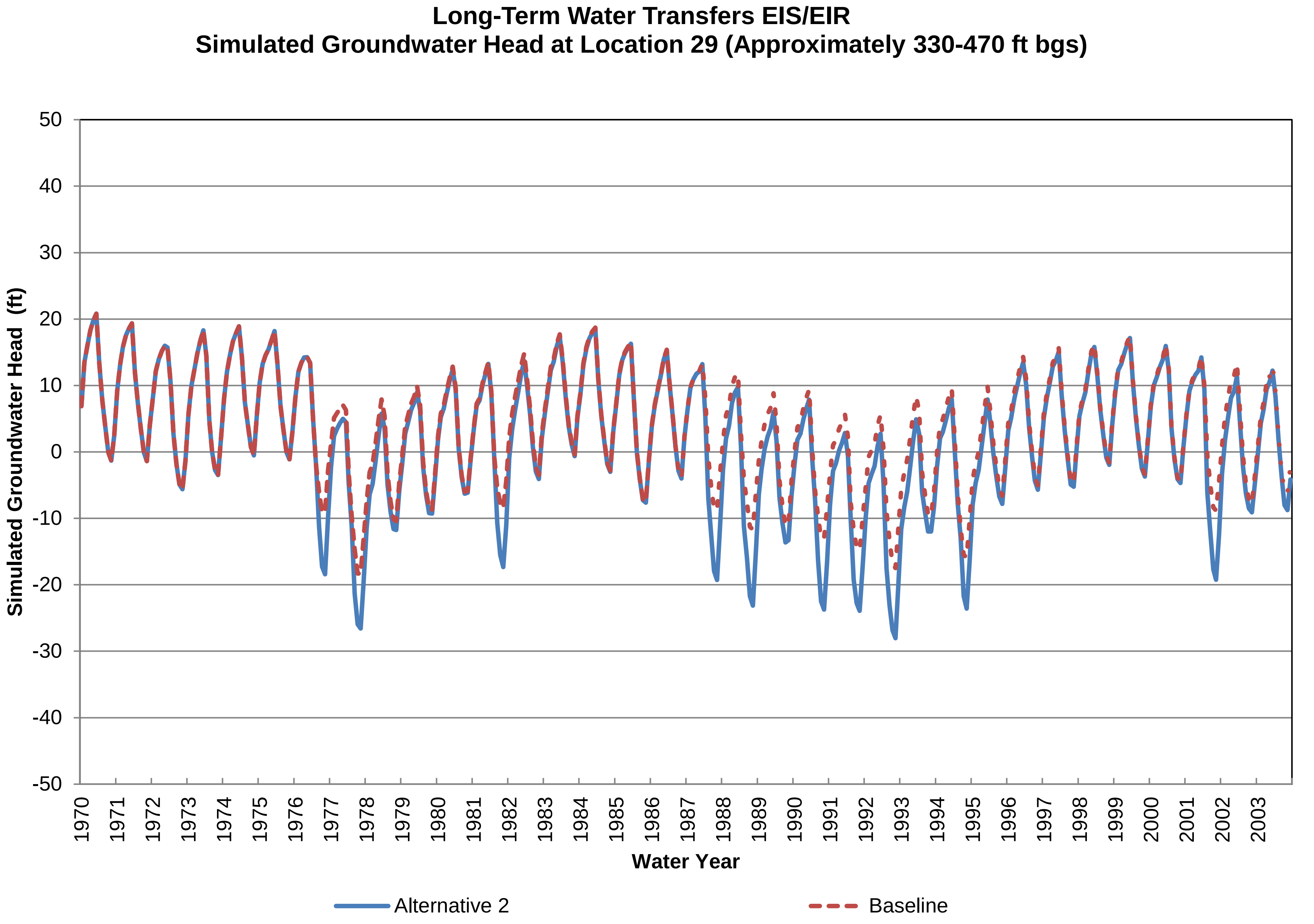
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 70-200 ft bgs)



266B

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 200-330 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 330-470 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
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1988
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1990
1991
1992
1993
1994
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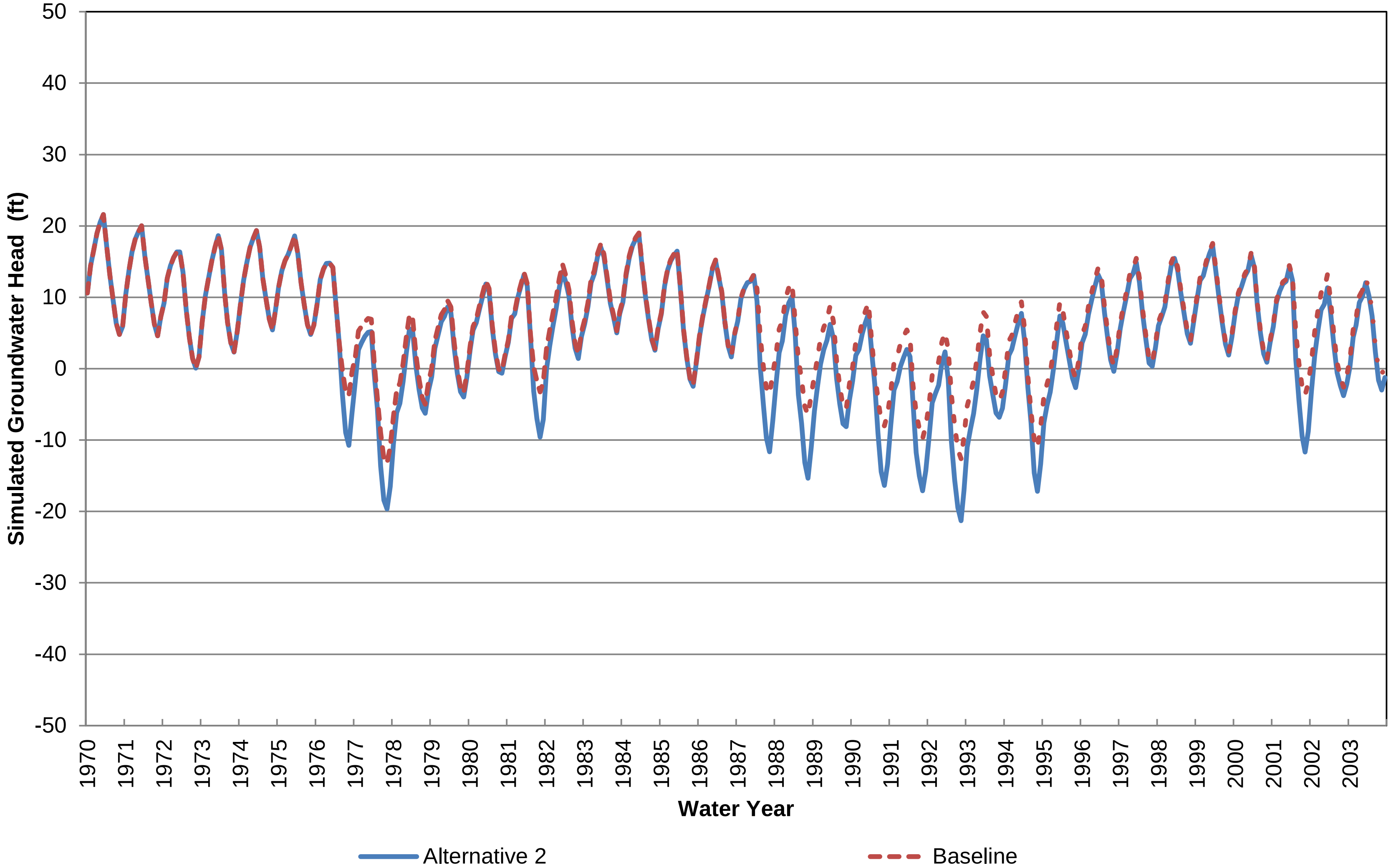
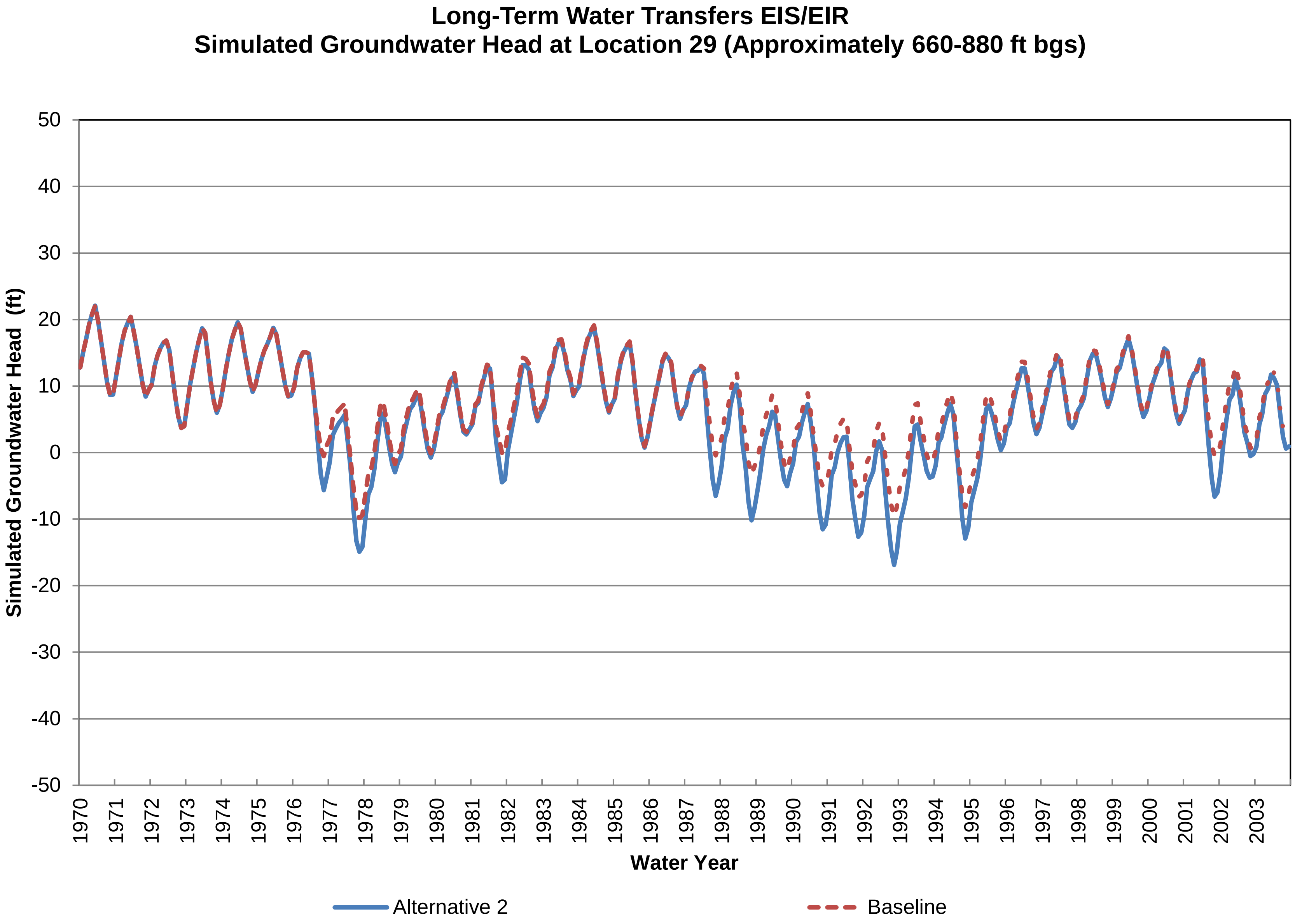
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 470-660 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 660-880 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
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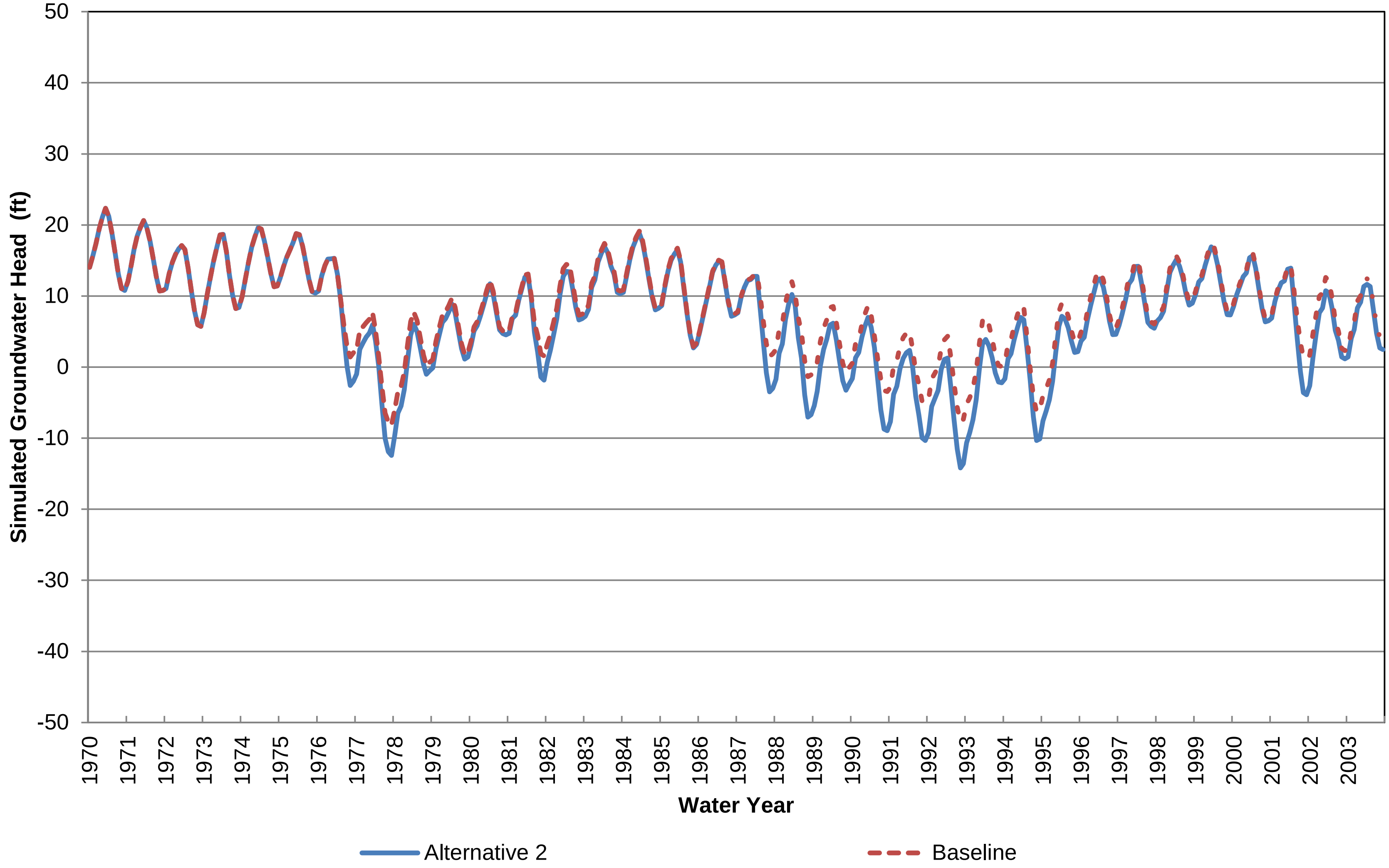
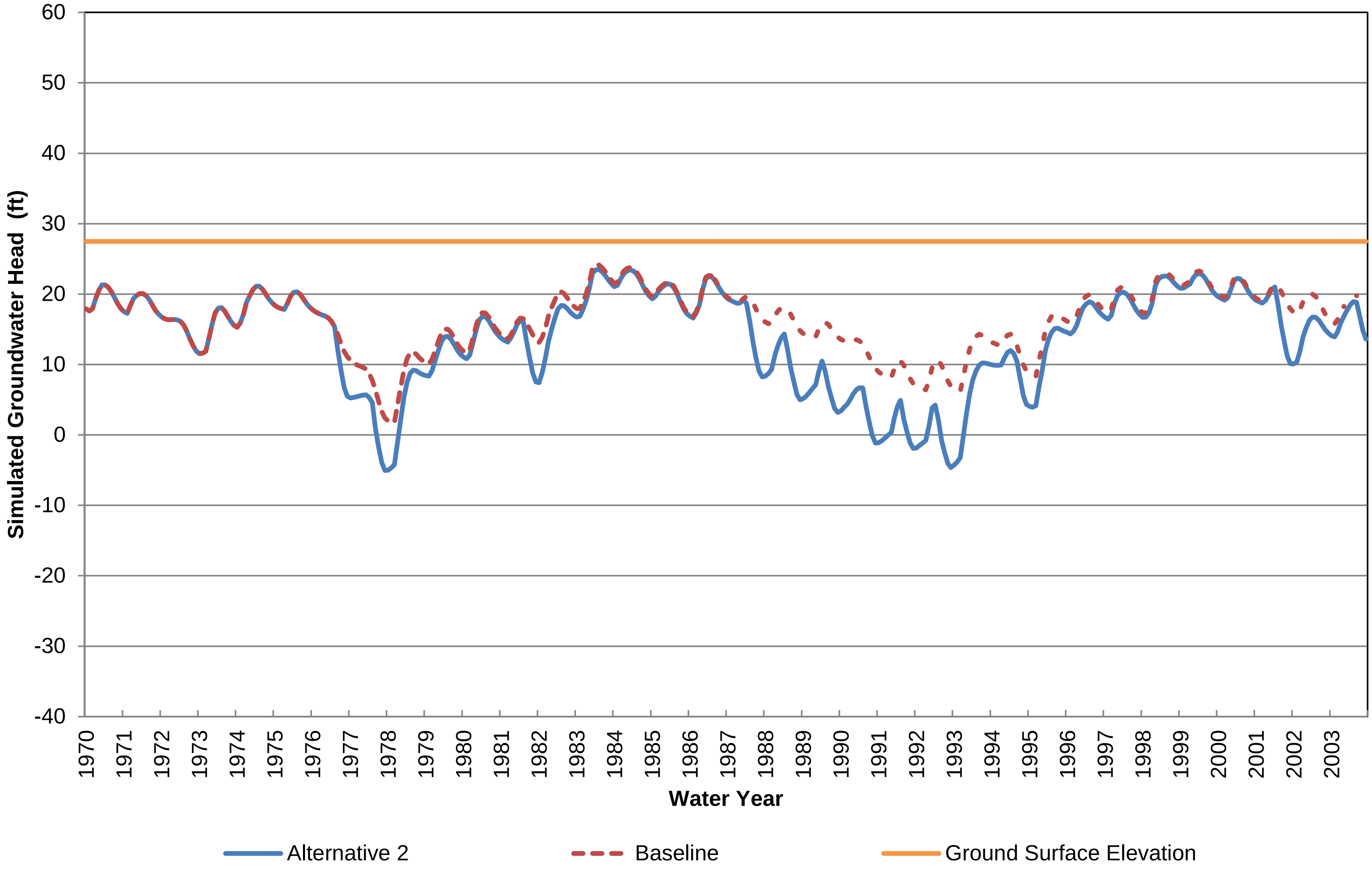
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B

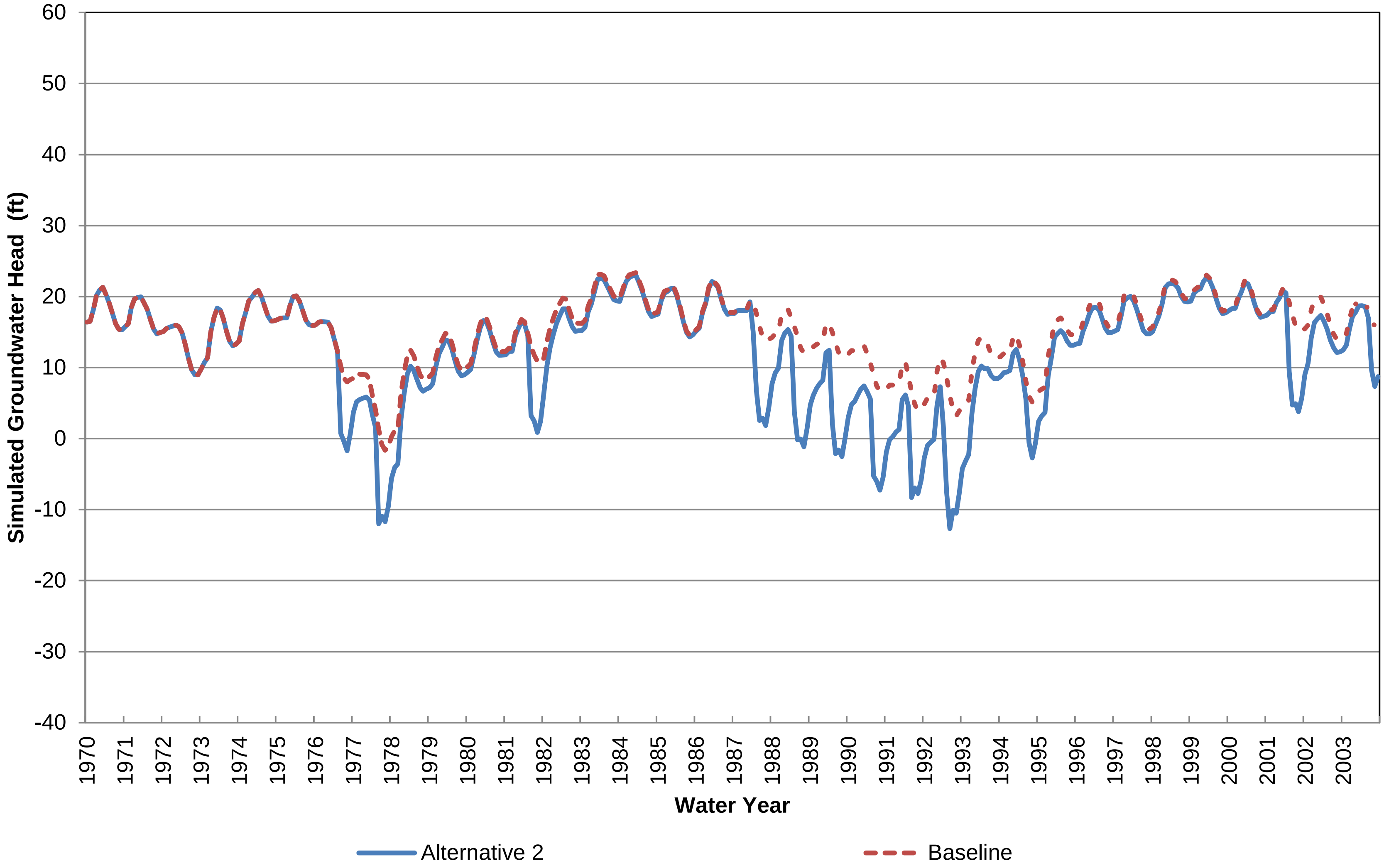
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 29 (Approximately 880-1210 ft bgs)

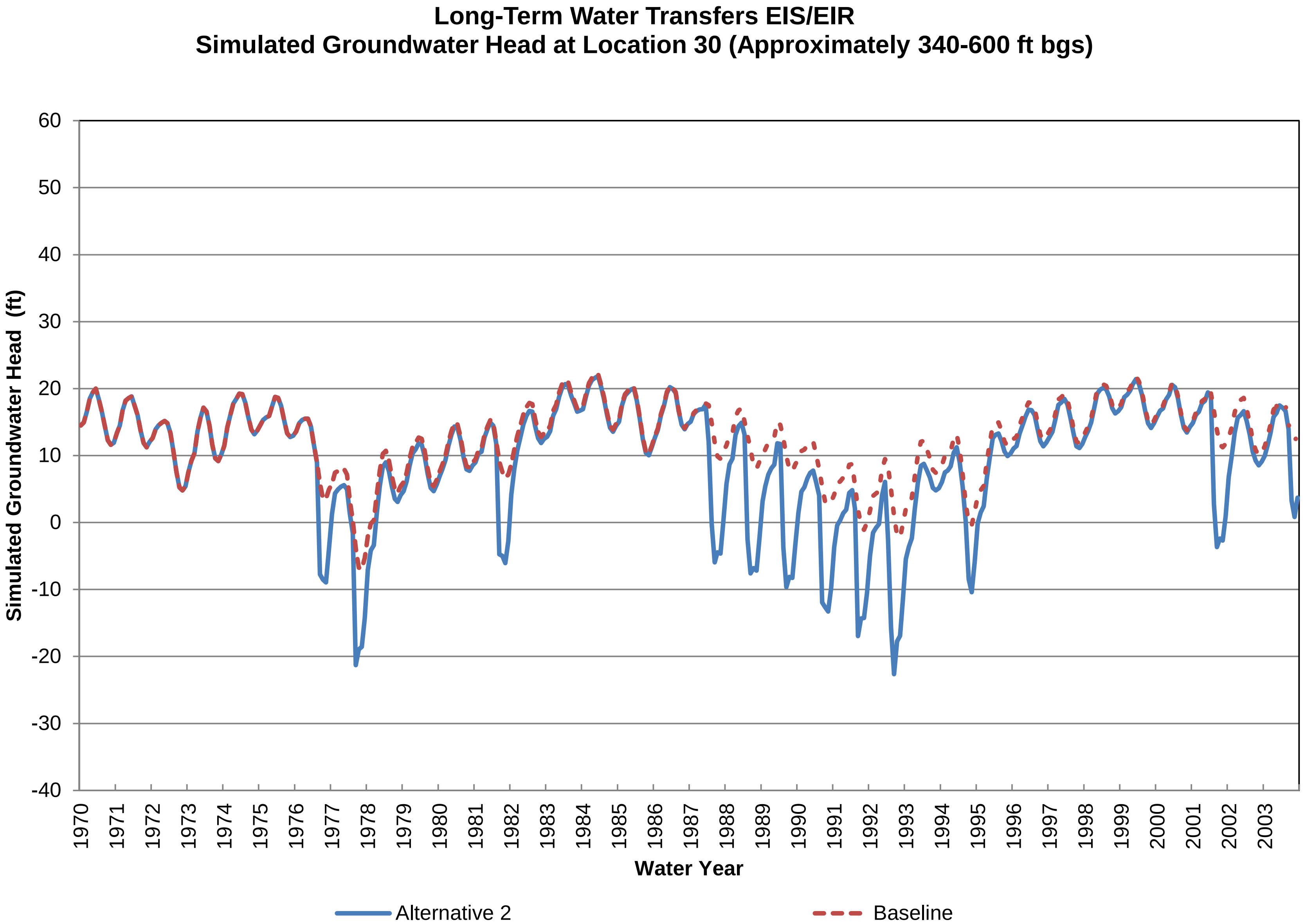


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 30 (Approximately 0-70 ft bgs)



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 70-340 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 340-600 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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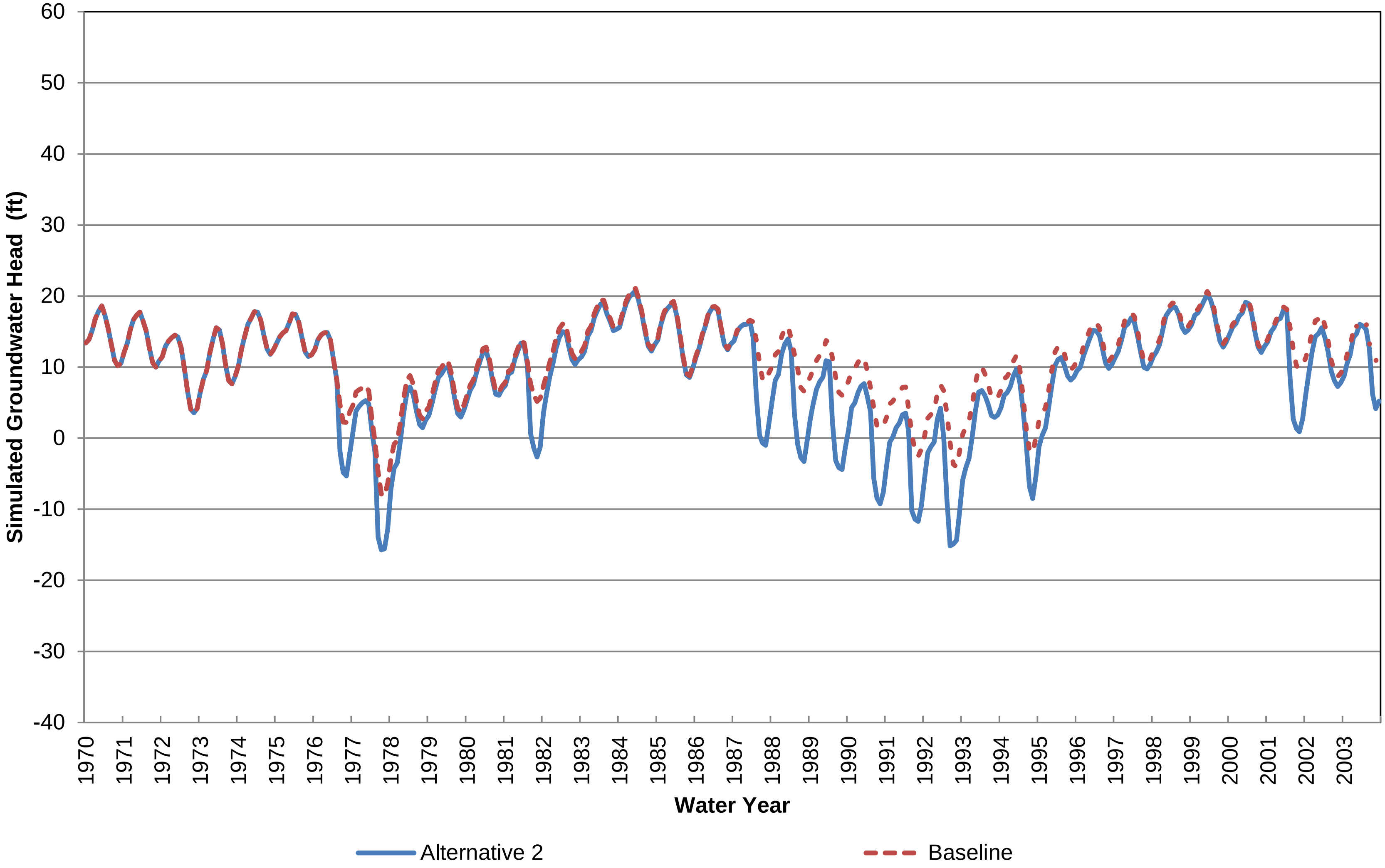
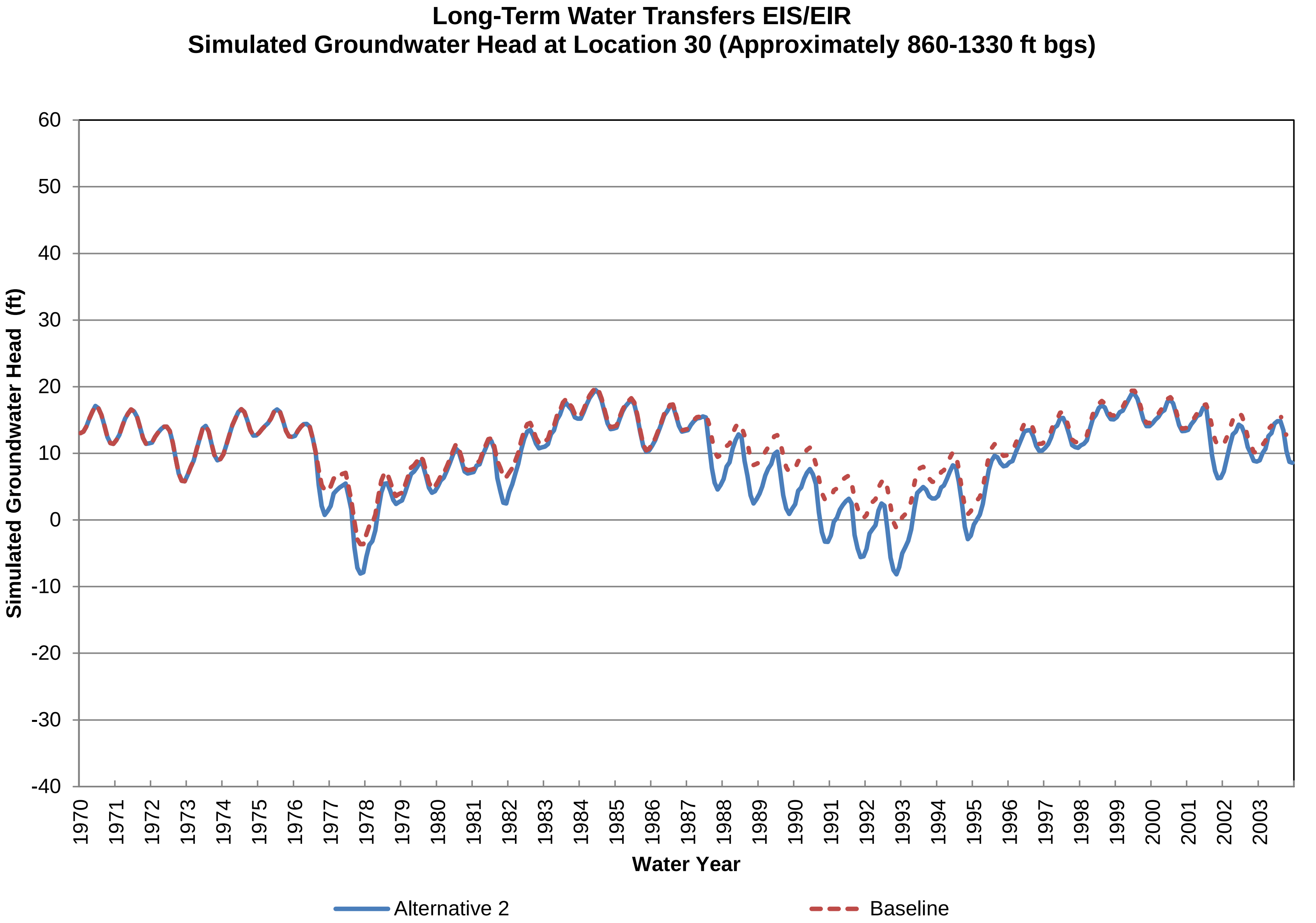
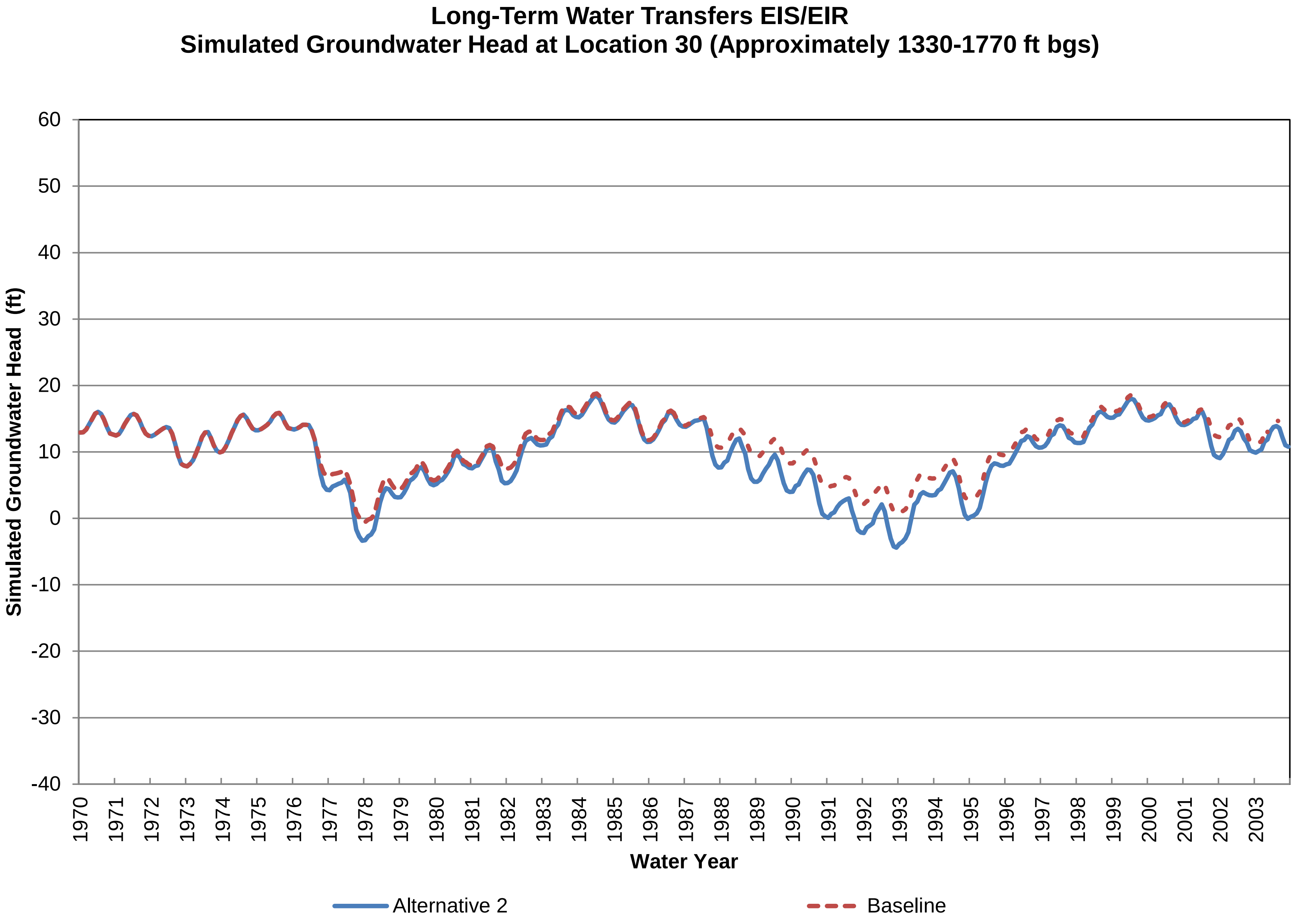
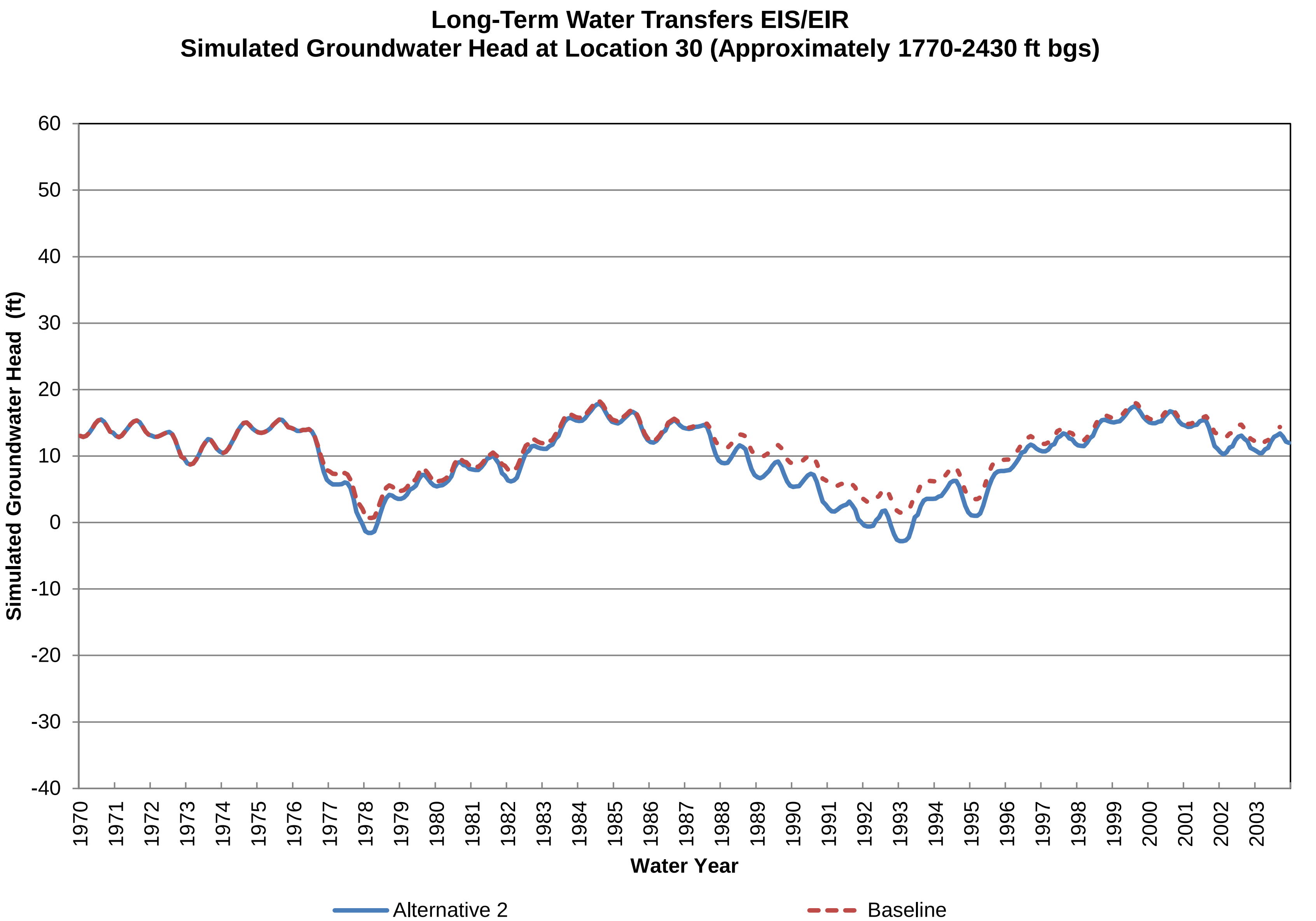
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 600-860 ft bgs)

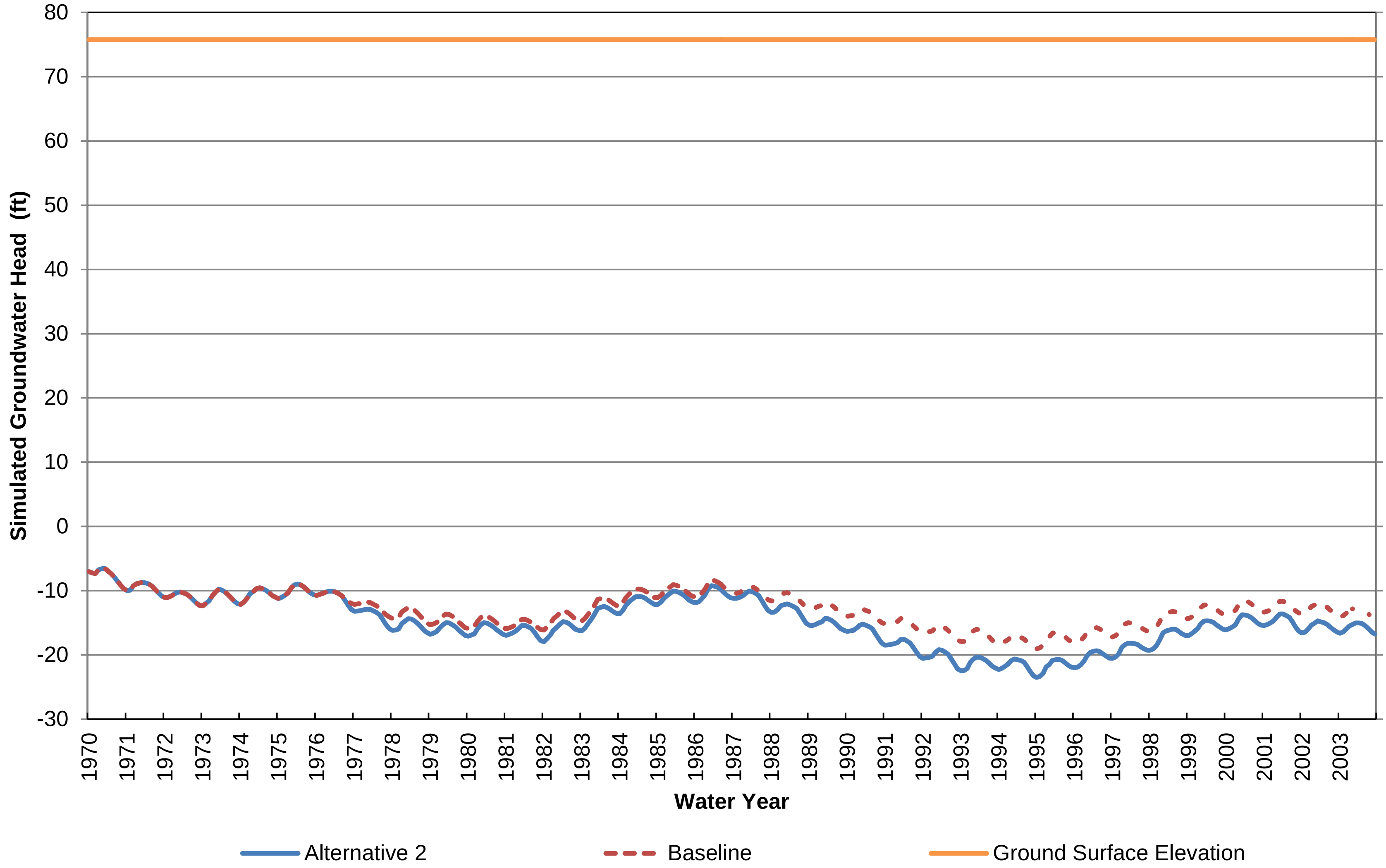


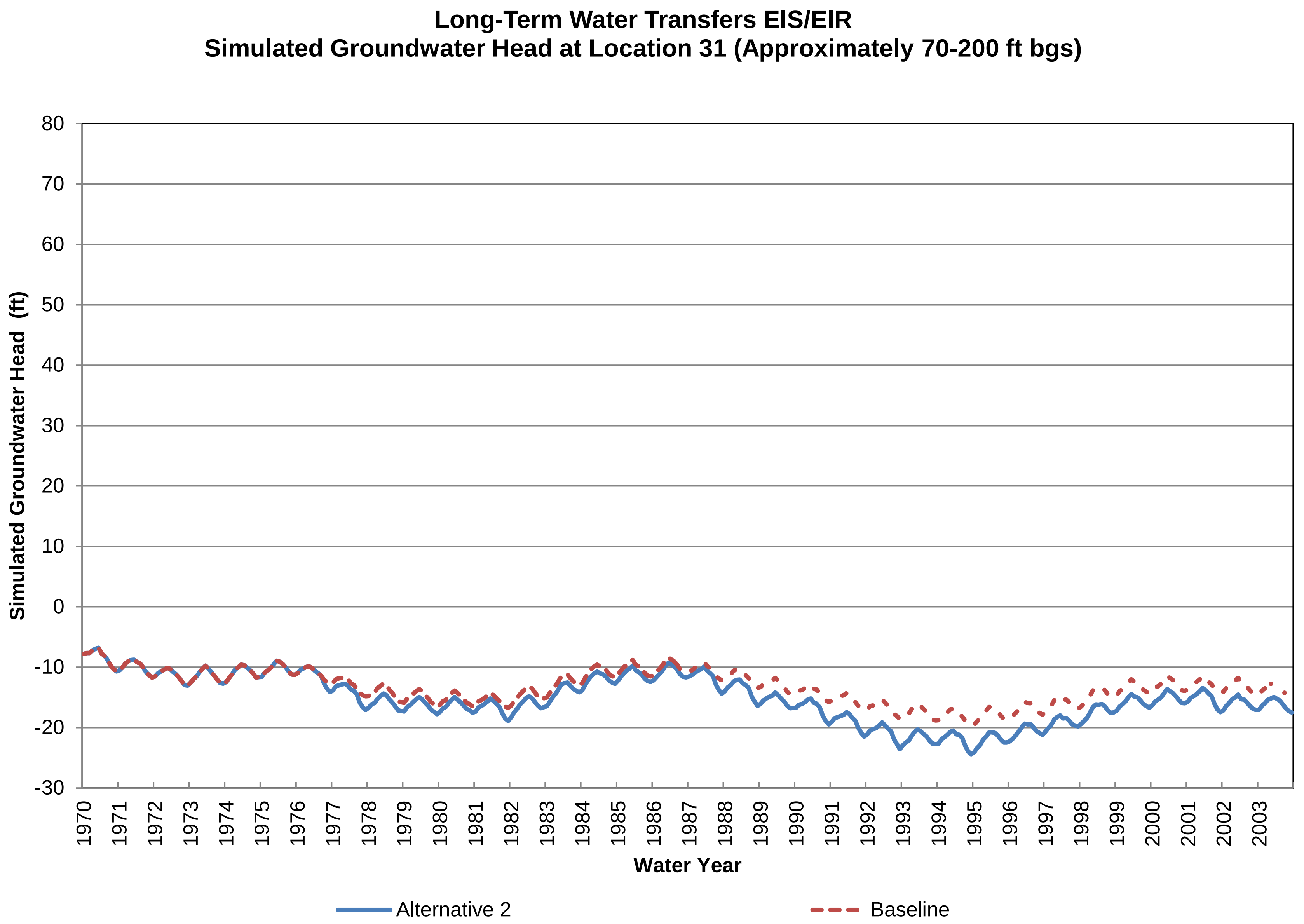

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 860-1330 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

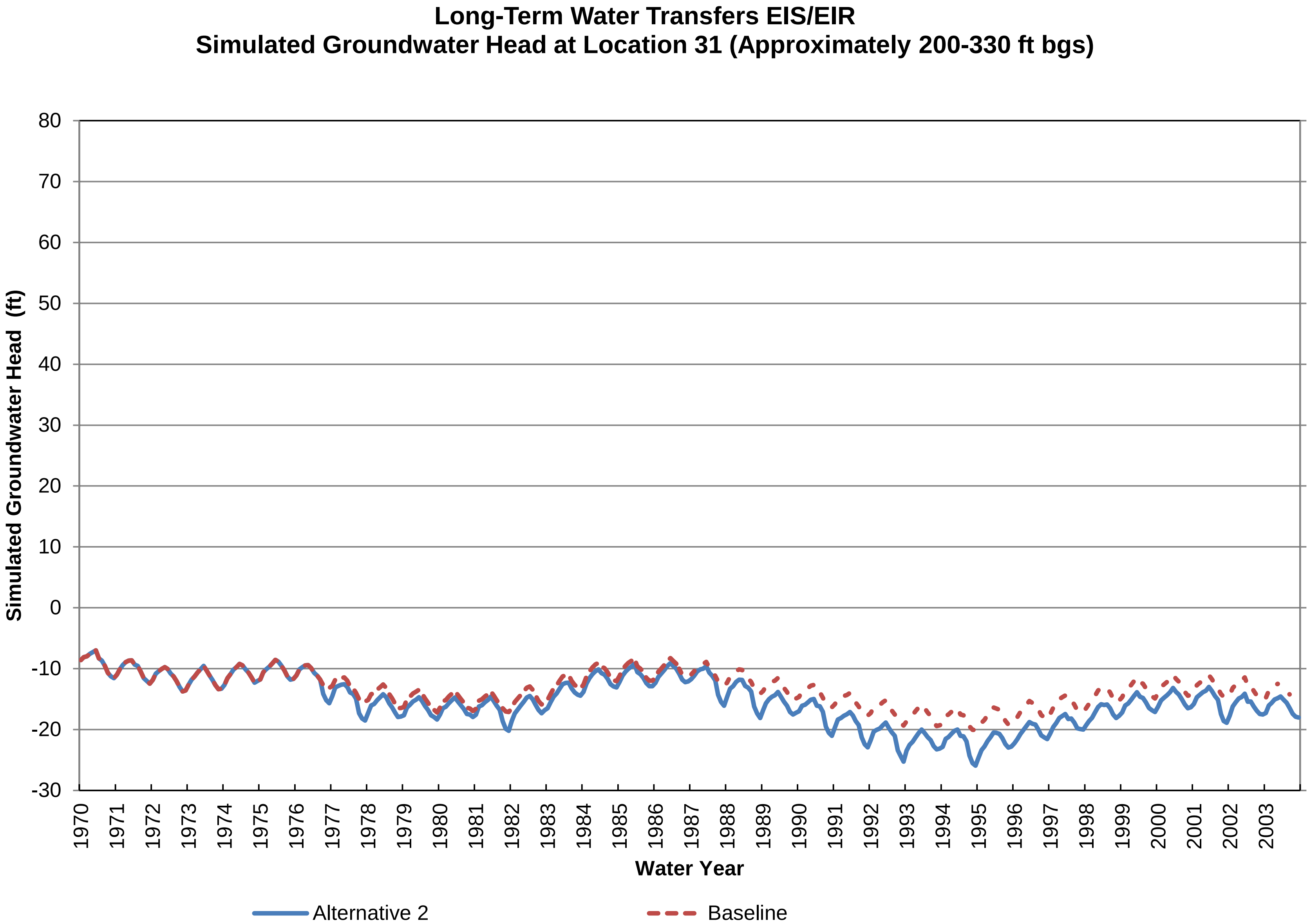

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 1330-1770 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

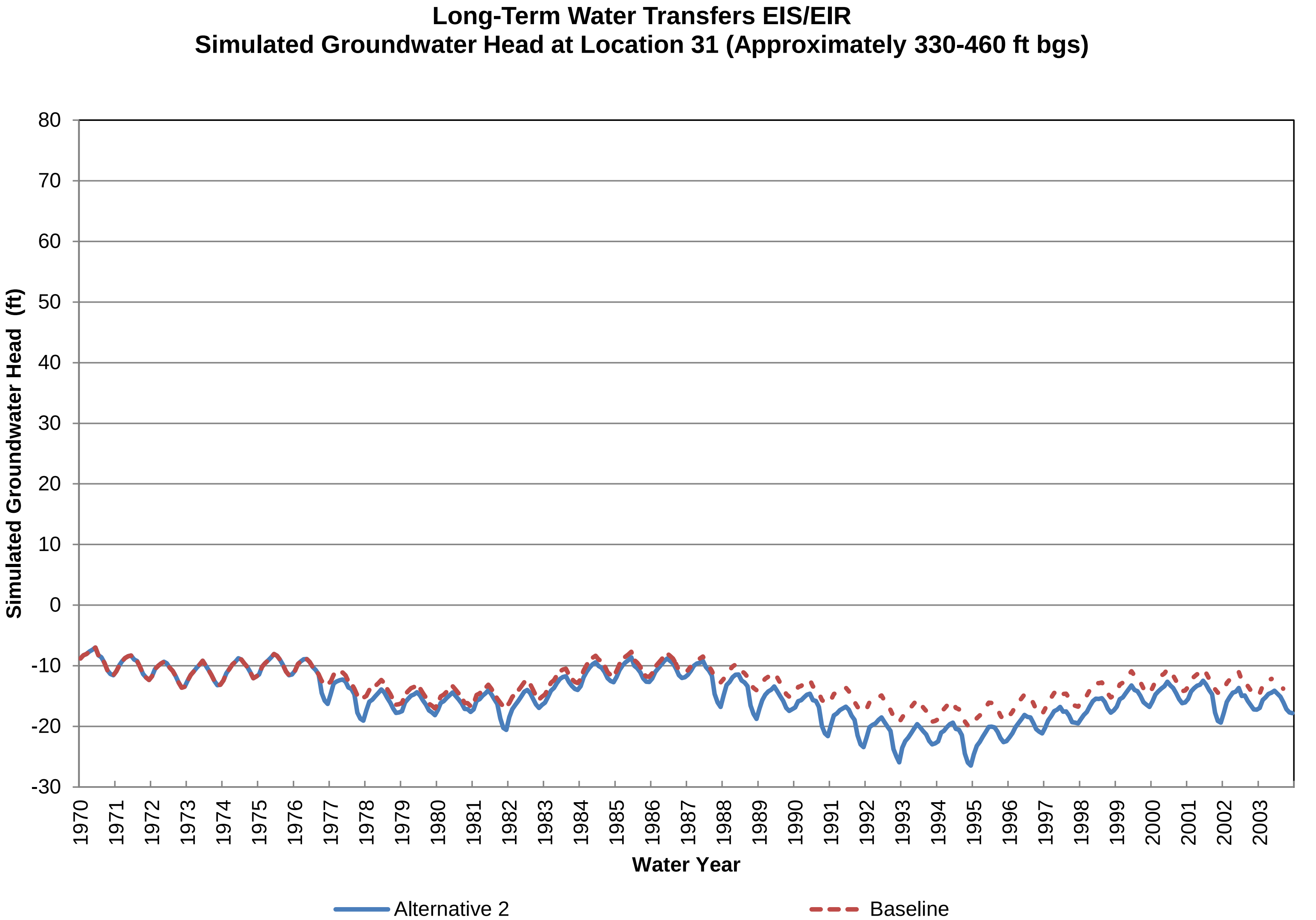

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 30 (Approximately 1770-2430 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 31 (Approximately 0-70 ft bgs)

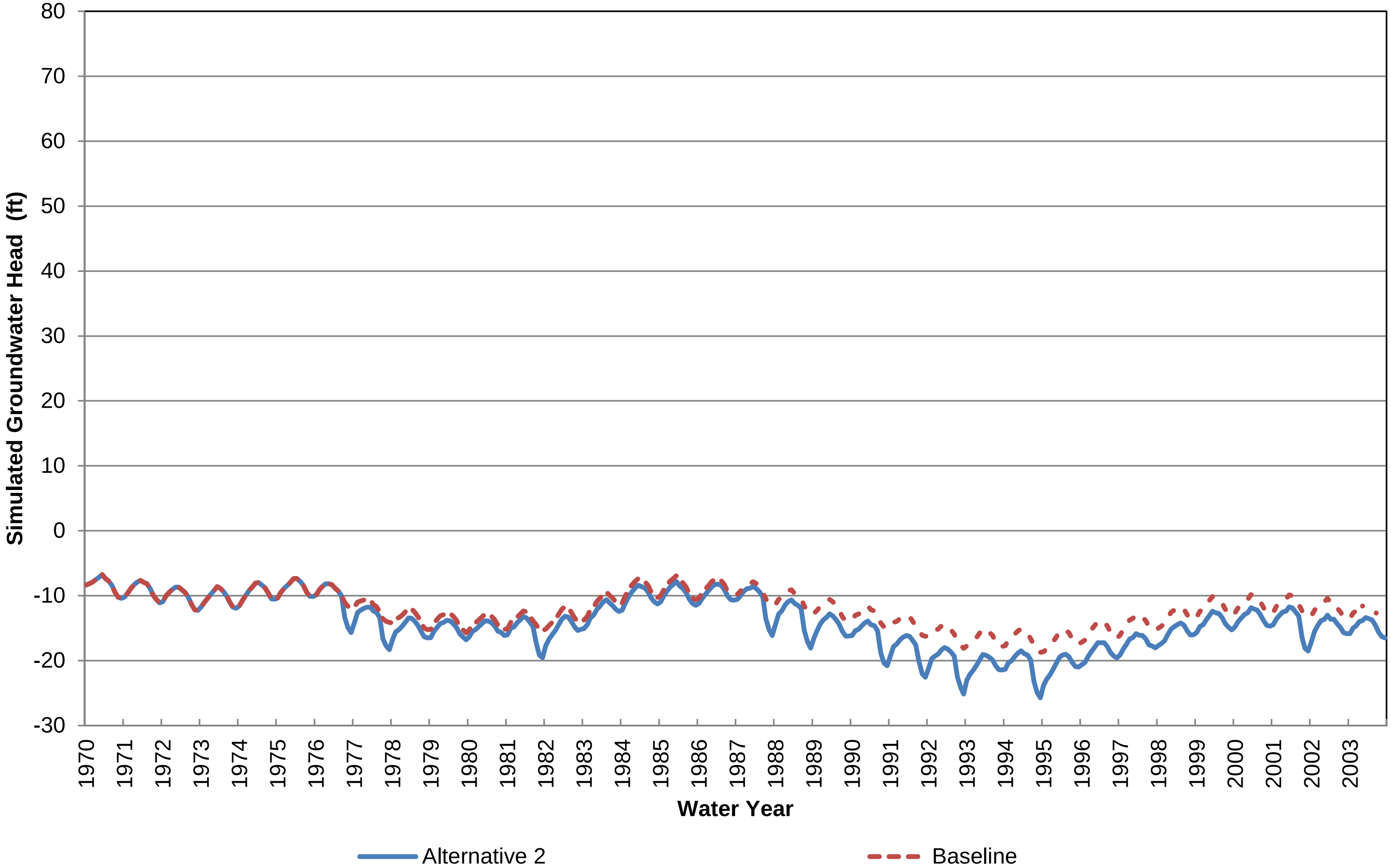


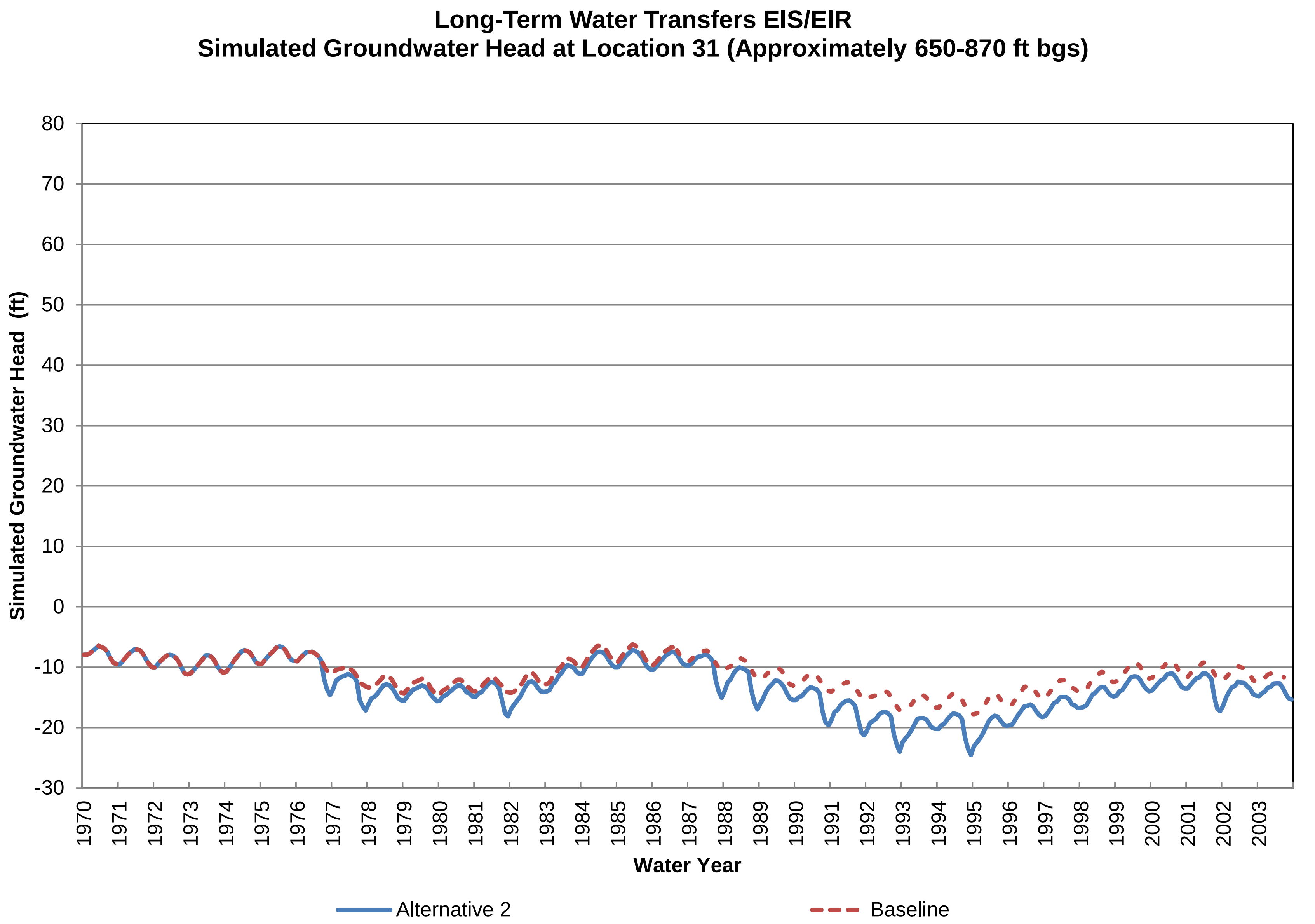

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 70-200 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 200-330 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

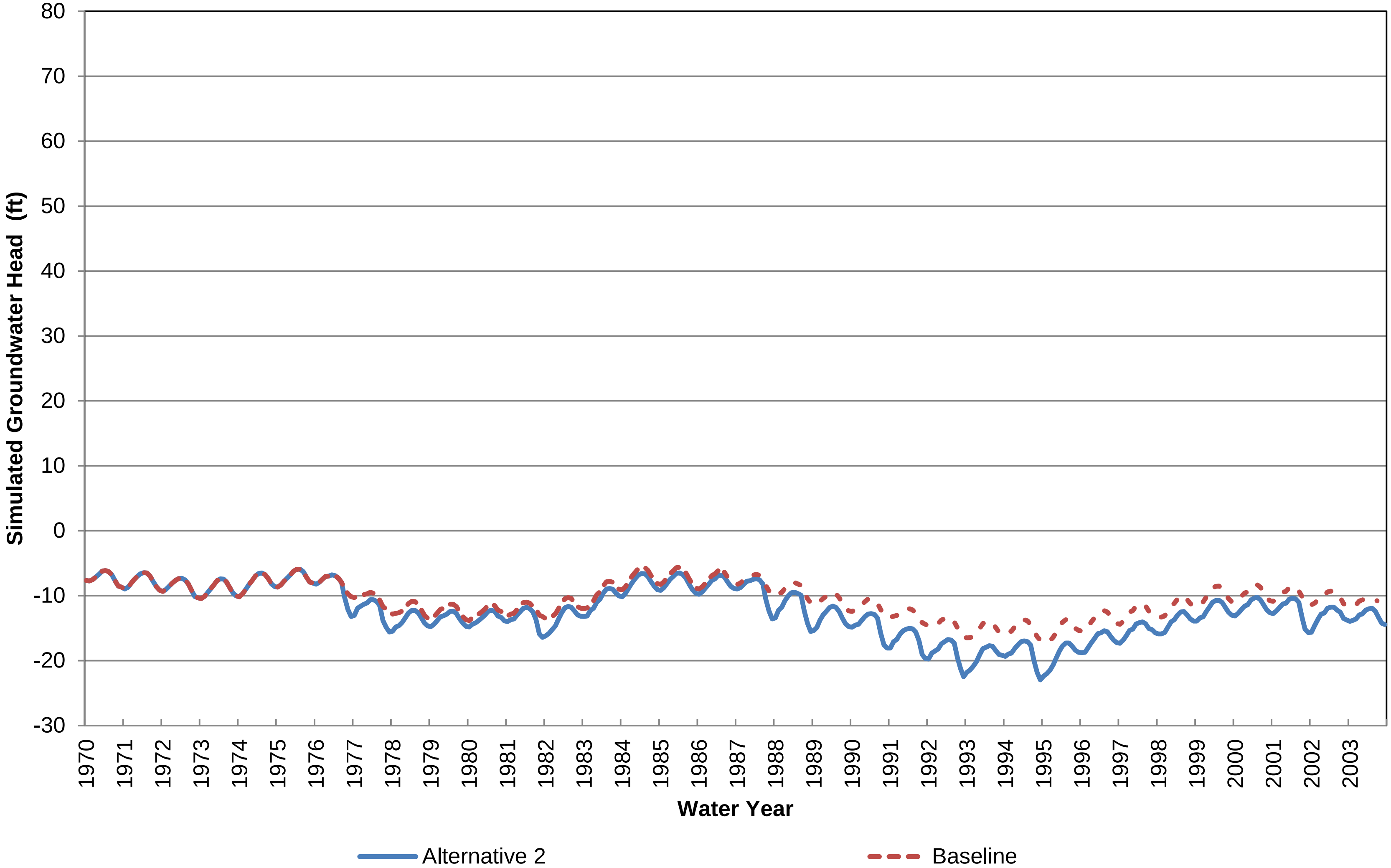

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 330-460 ft bgs)
Simulated Groundwater Head (ft)
80
70
60
50
40
30
20
10
0
-10
-20
-30
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

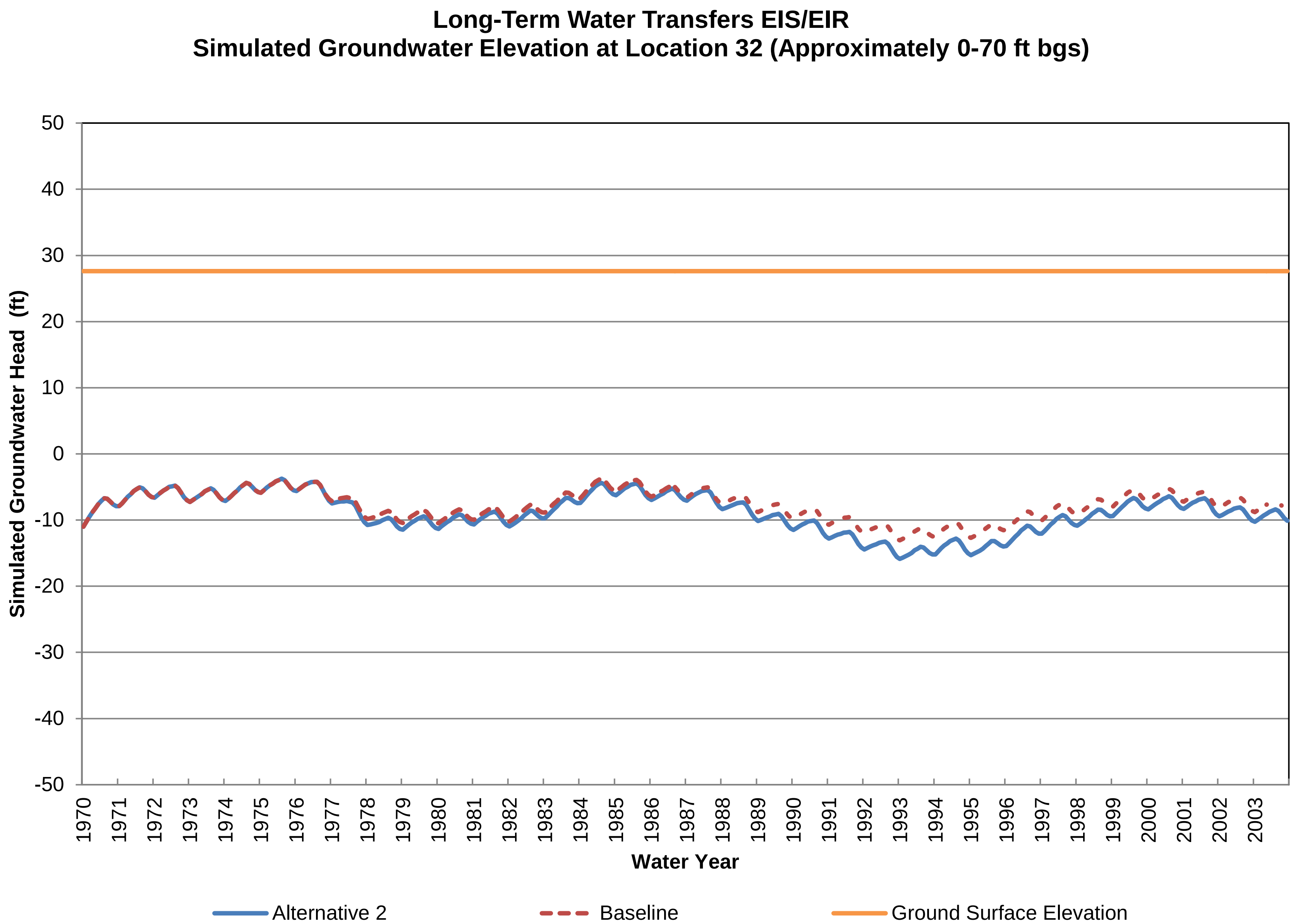
Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 460-650 ft bgs)

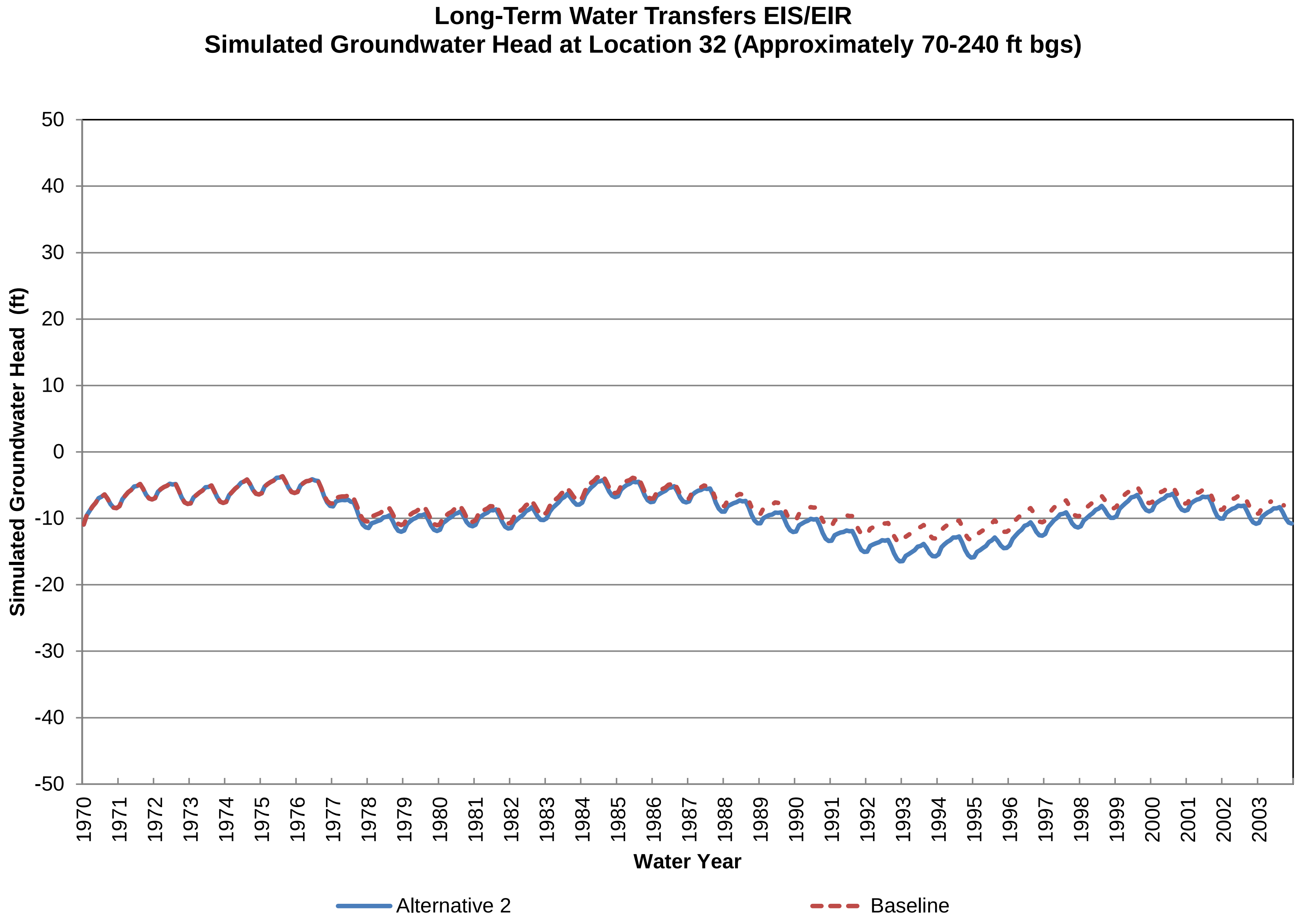



Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 650-870 ft bgs)
80
70
60
50
40
30
20
10
0
-10
-20
-30
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 31 (Approximately 870-1190 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 32 (Approximately 0-70 ft bgs)
50
40
30
20
10
0
-10
-20
-30
-40
-50
Simulated Groundwater Head (ft)
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 70-240 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
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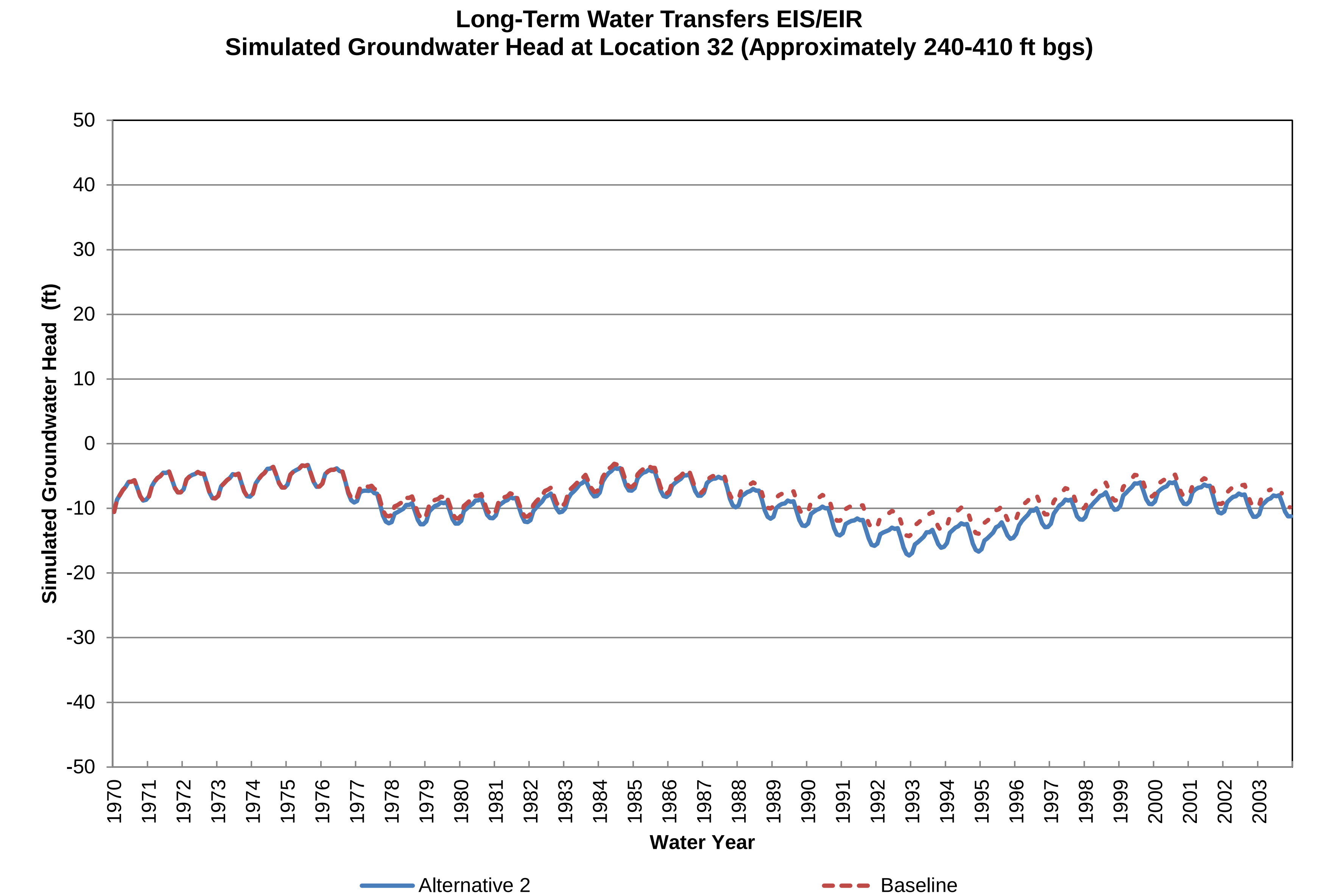
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 240-410 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
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1989
1990
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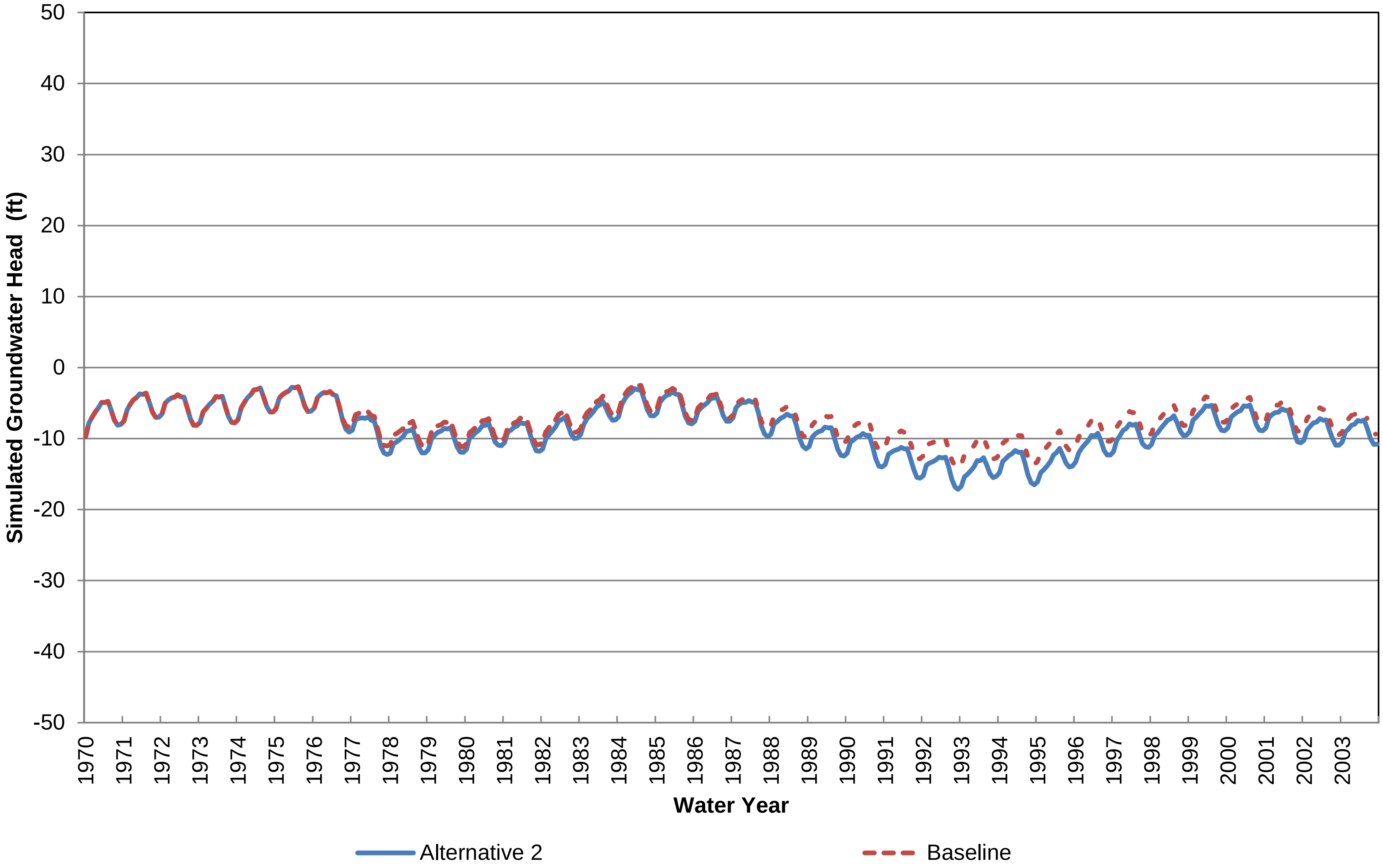
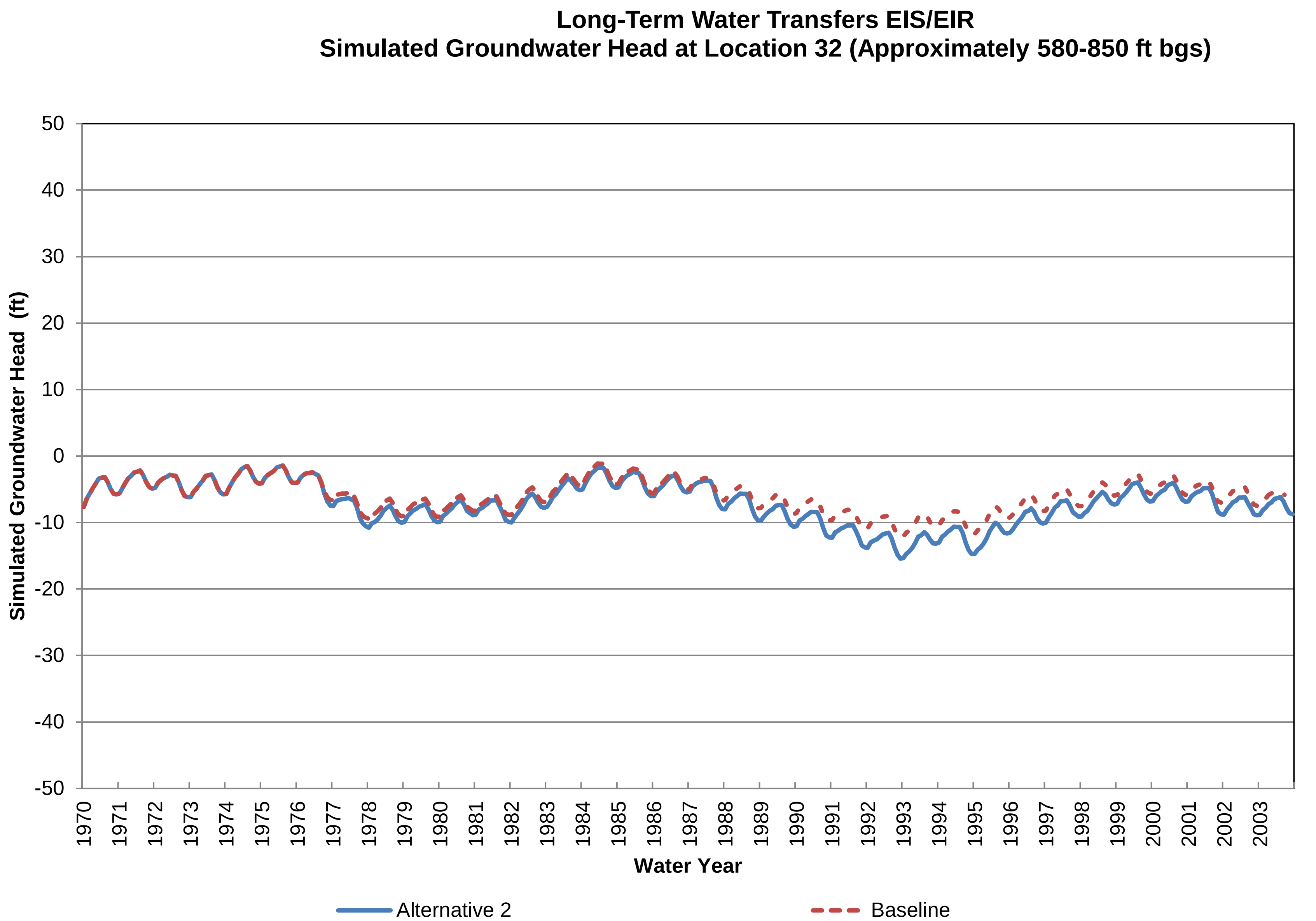
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 410-580 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 580-850 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
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1986
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1989
1990
1991
1992
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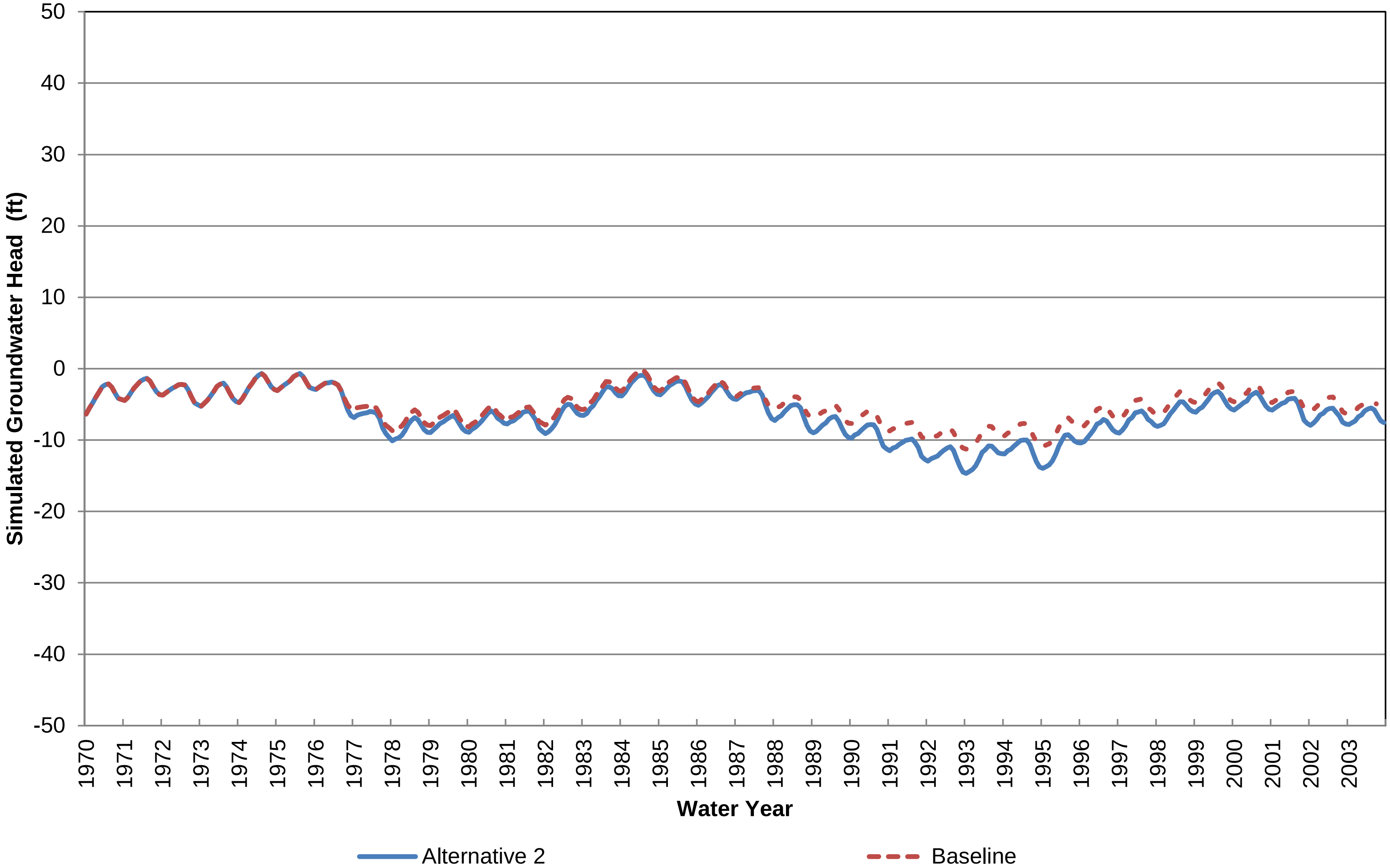
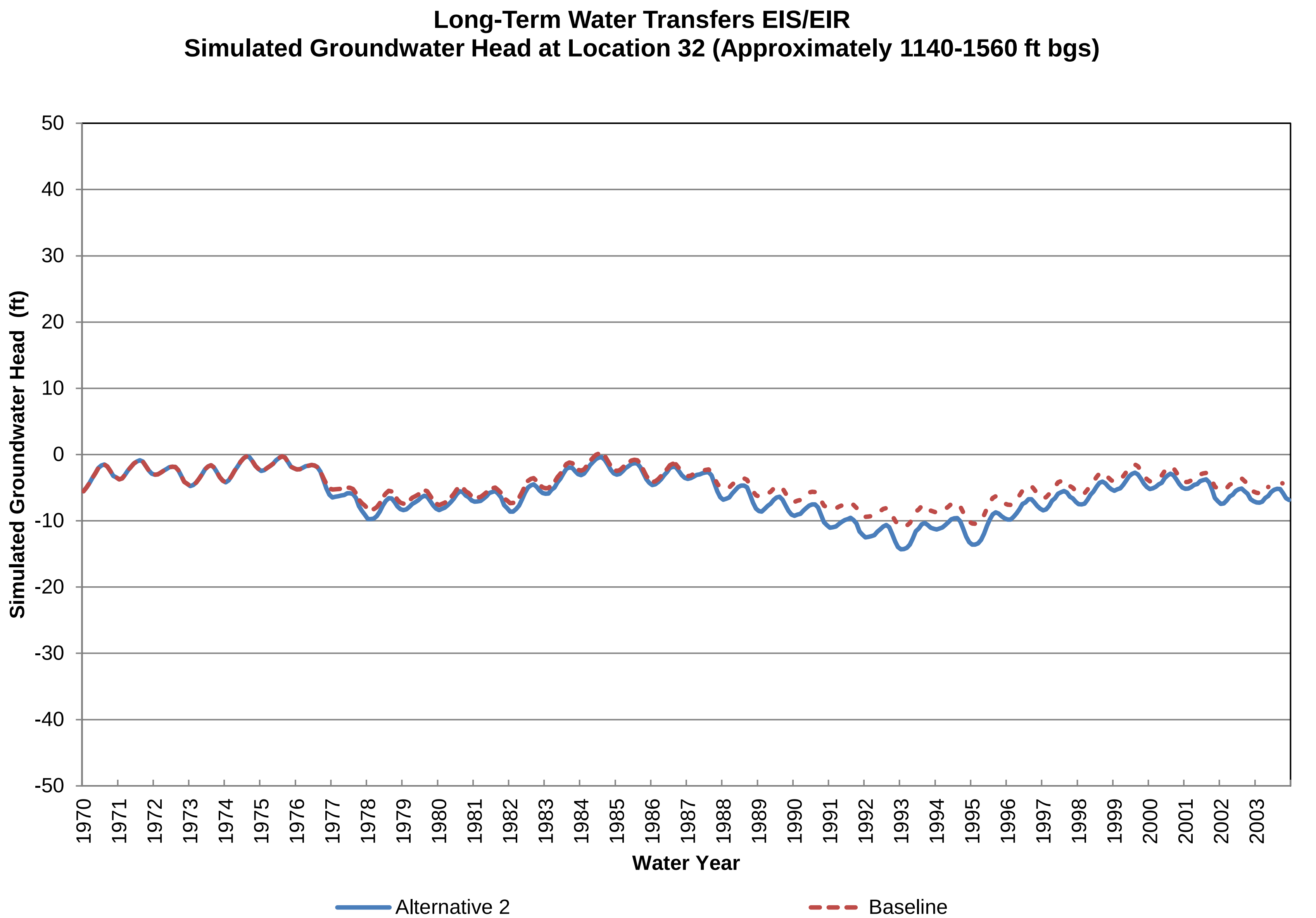
1996
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 850-1140 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 32 (Approximately 1140-1560 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
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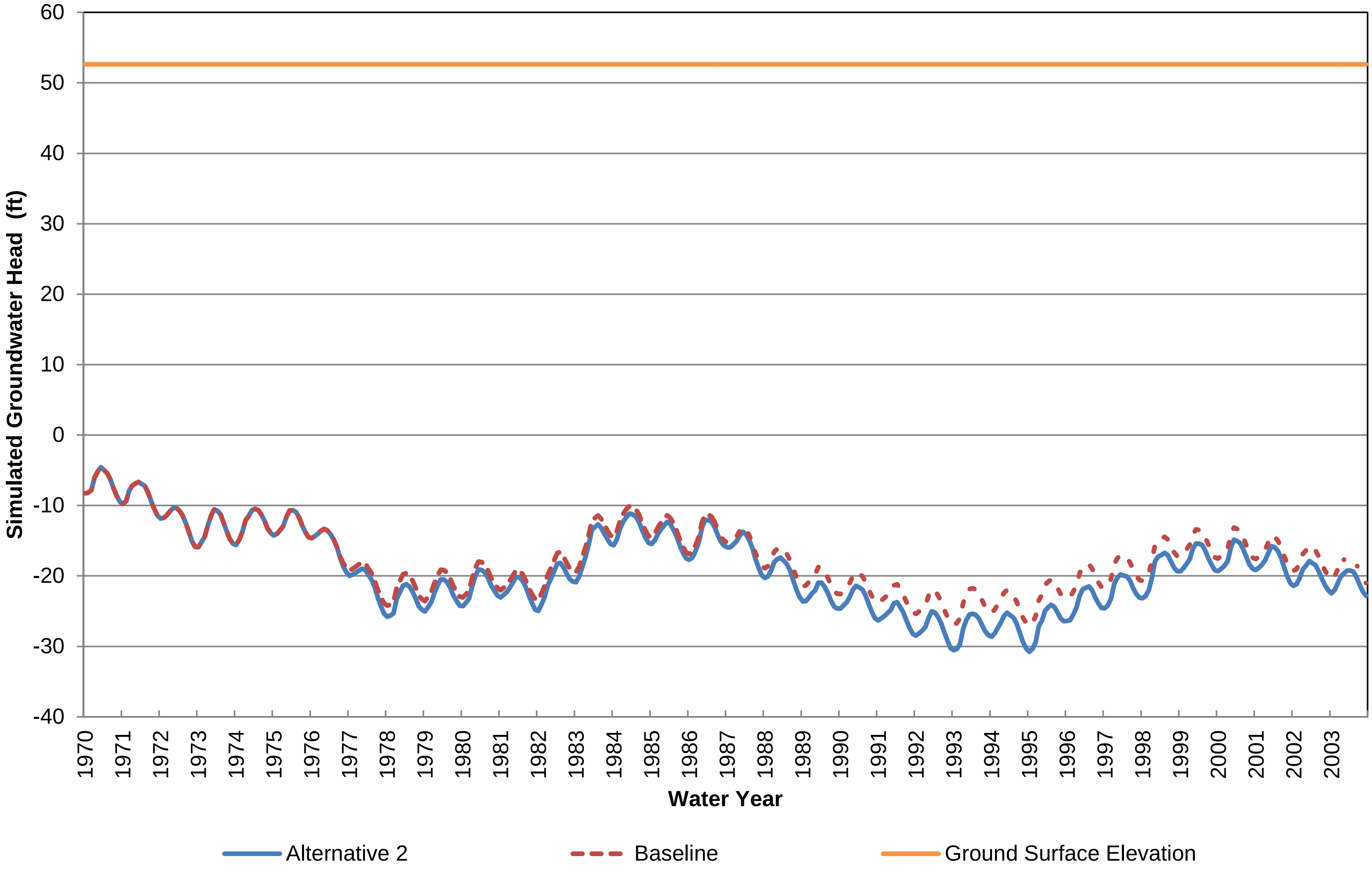
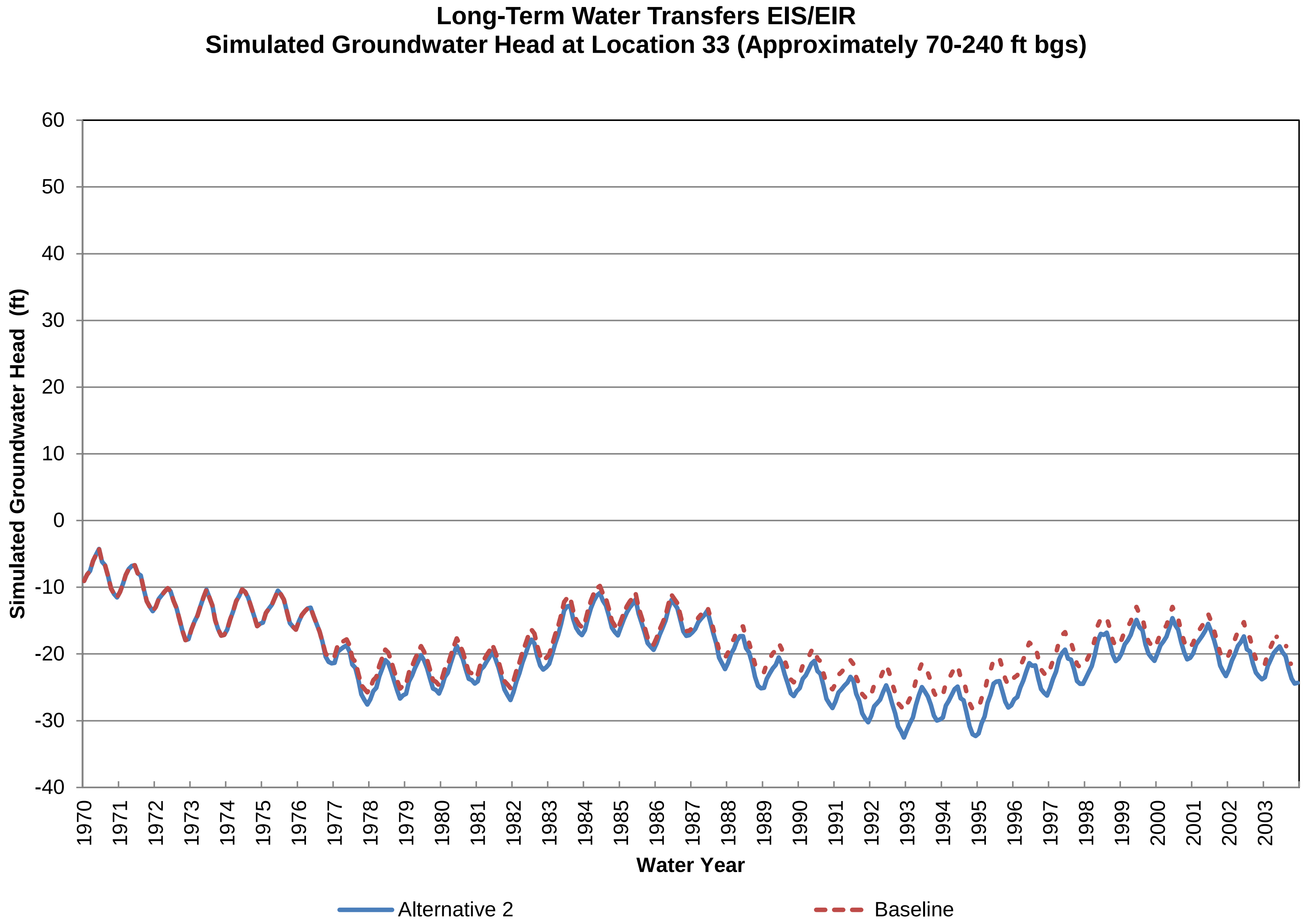
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 33 (Approximately 0-70 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 70-240 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
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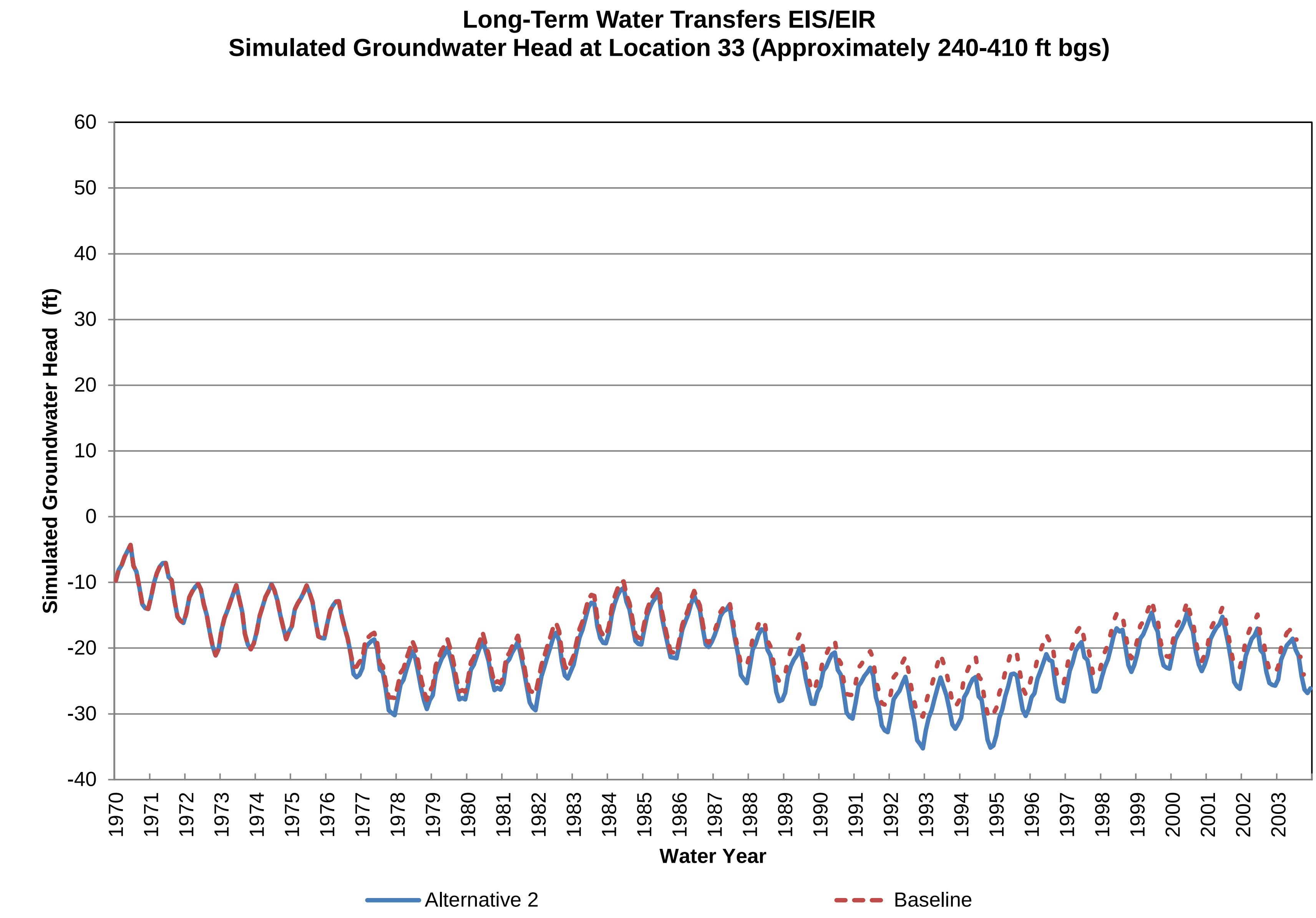
2000
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 240-410 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
1973
1974
1975
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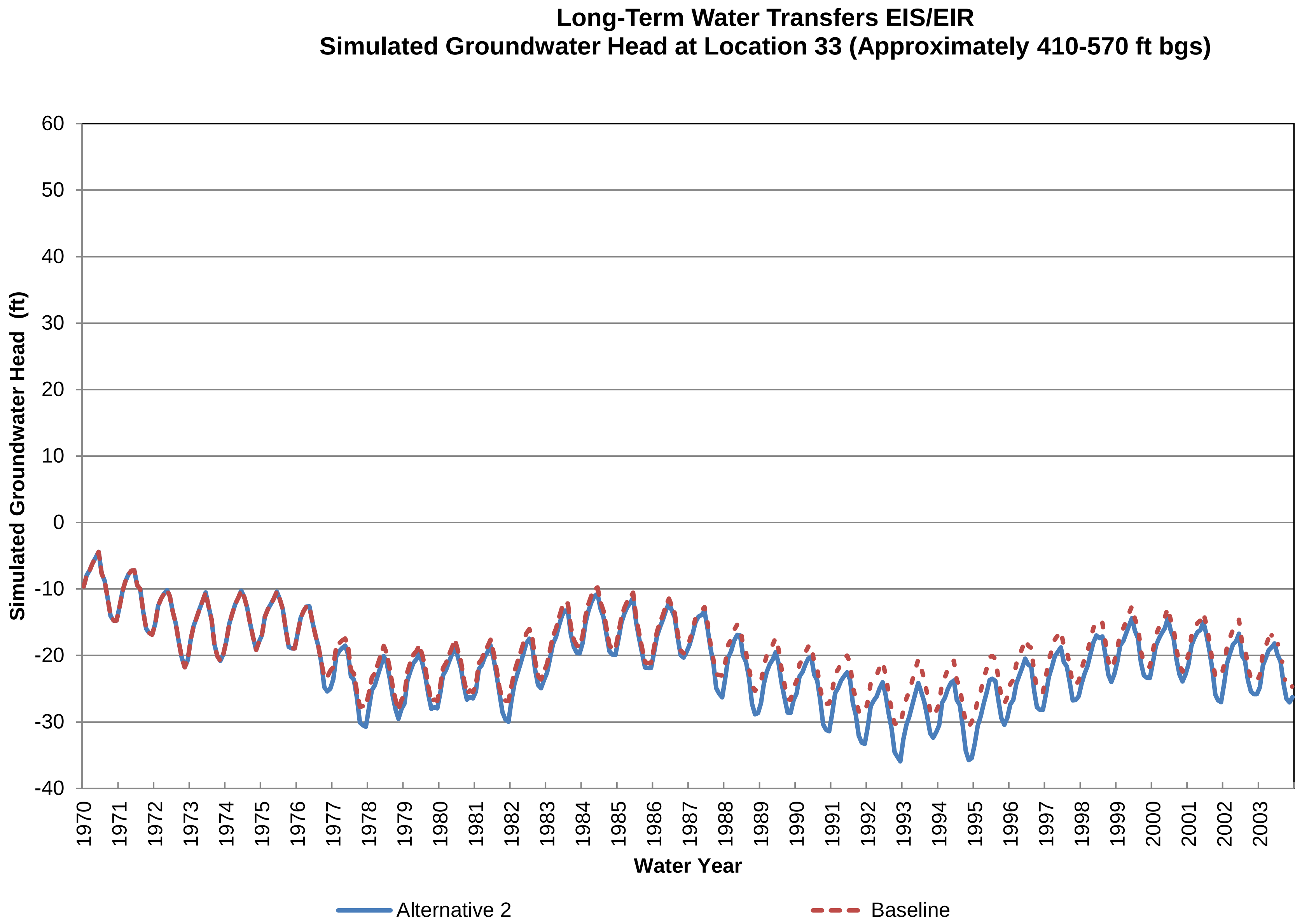
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 410-570 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
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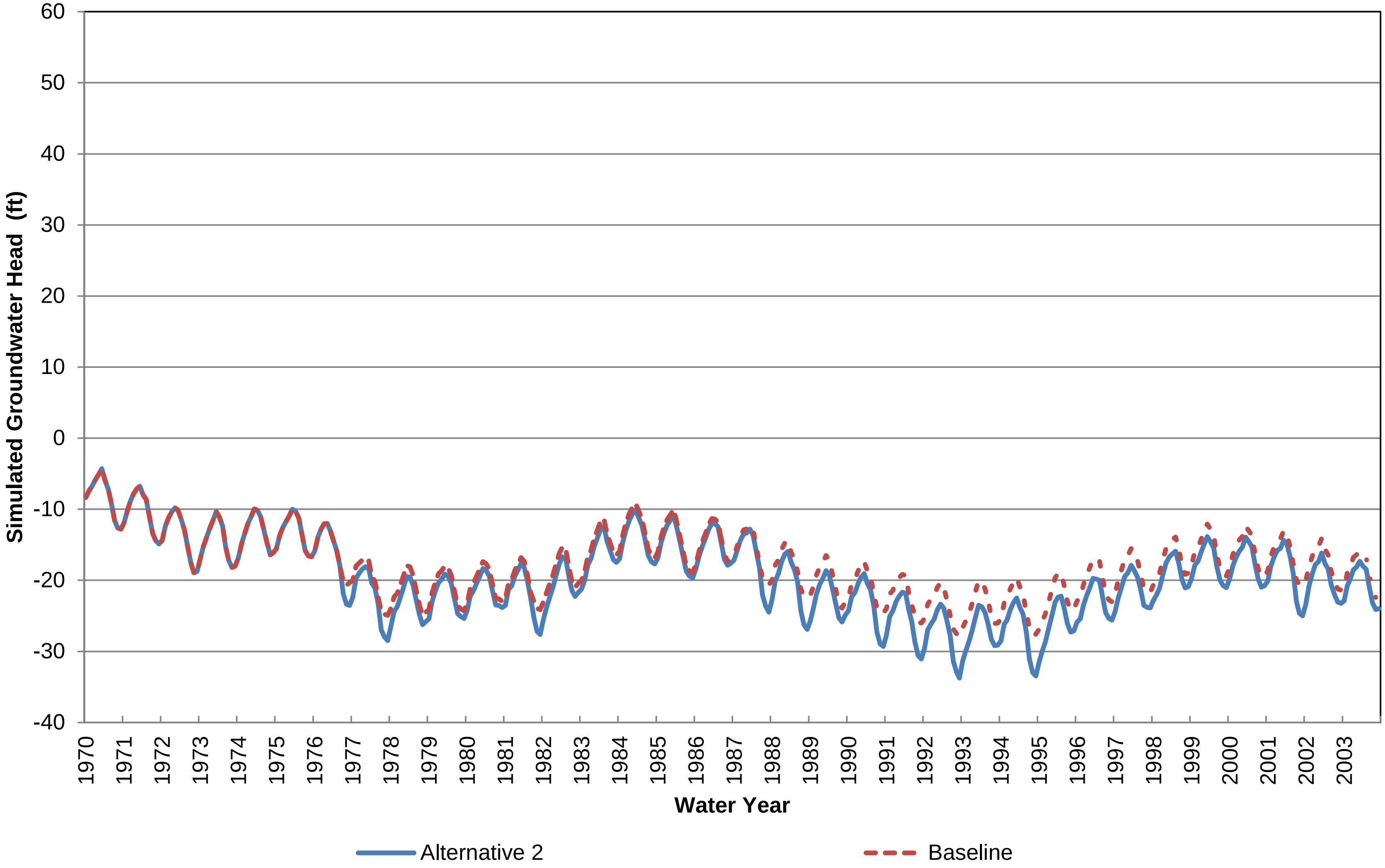
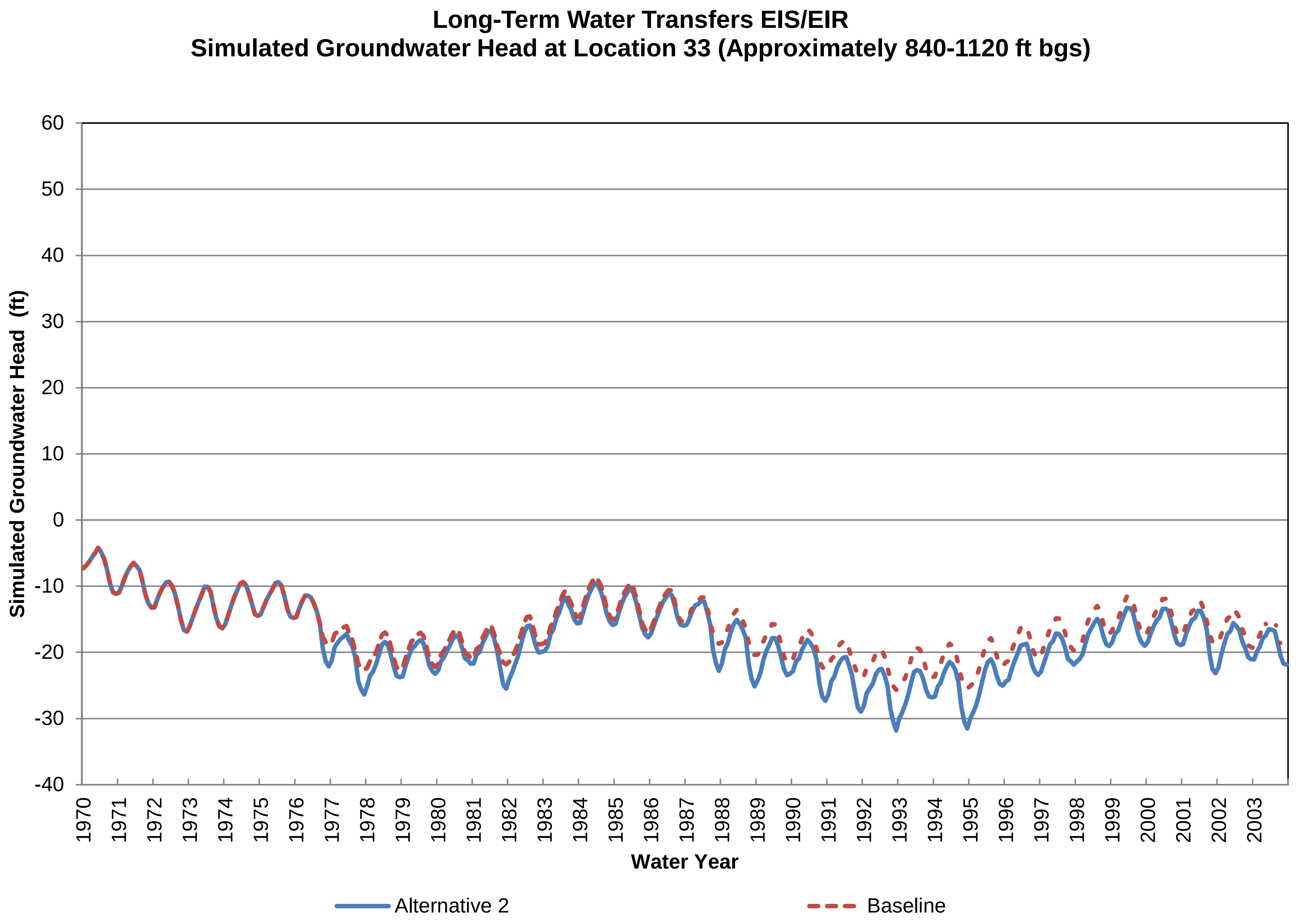
2001
2002
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 570-840 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 840-1120 ft bgs)
Simulated Groundwater Head (ft)
60
50
40
30
20
10
0
-10
-20
-30
-40
1970
1971
1972
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1974
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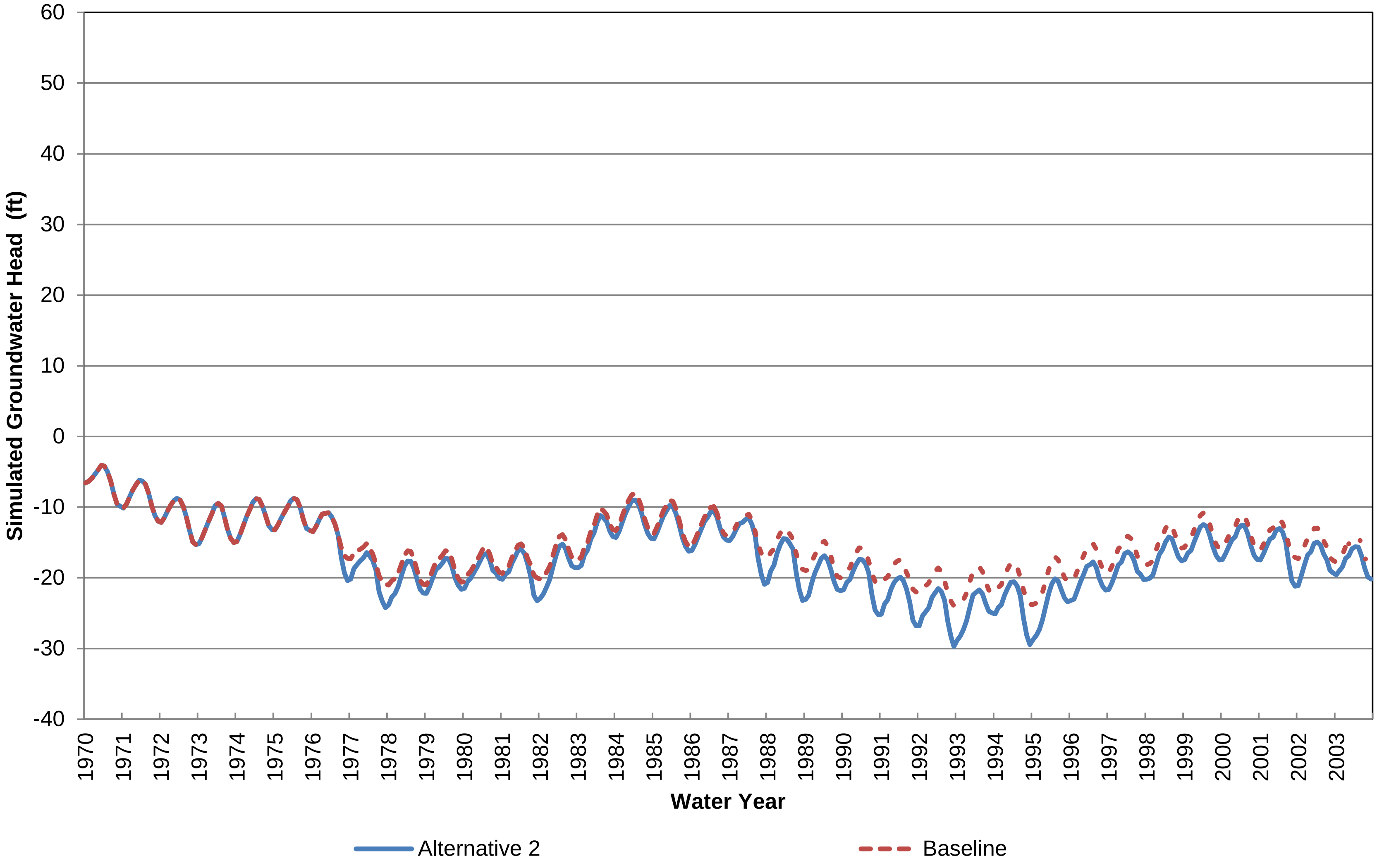
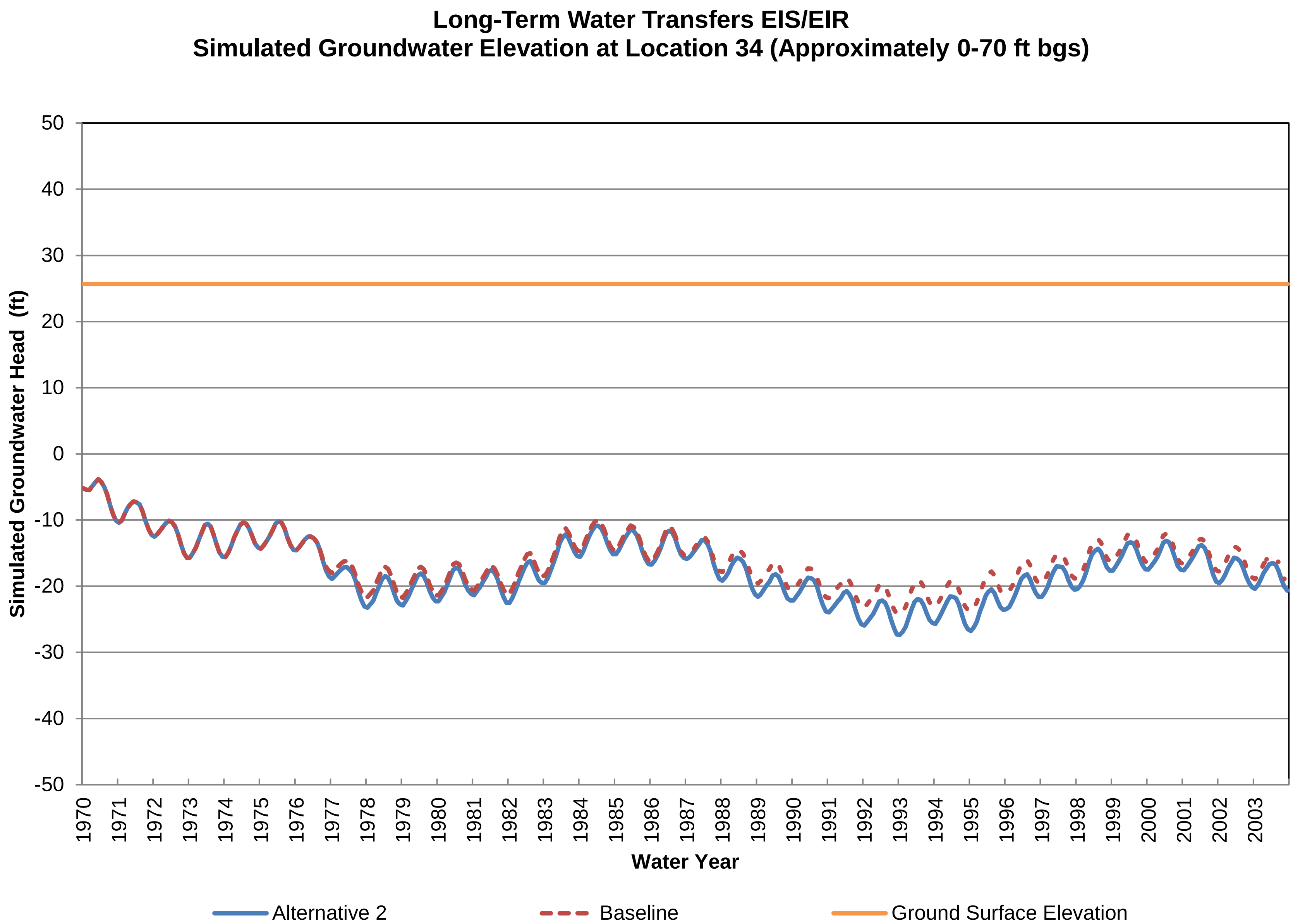
1997
1998
1999
2000
2001
2002
2003
Water Year
Alternative 2
Baseline

266B

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 33 (Approximately 1120-1540 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Elevation at Location 34 (Approximately 0-70 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
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1973
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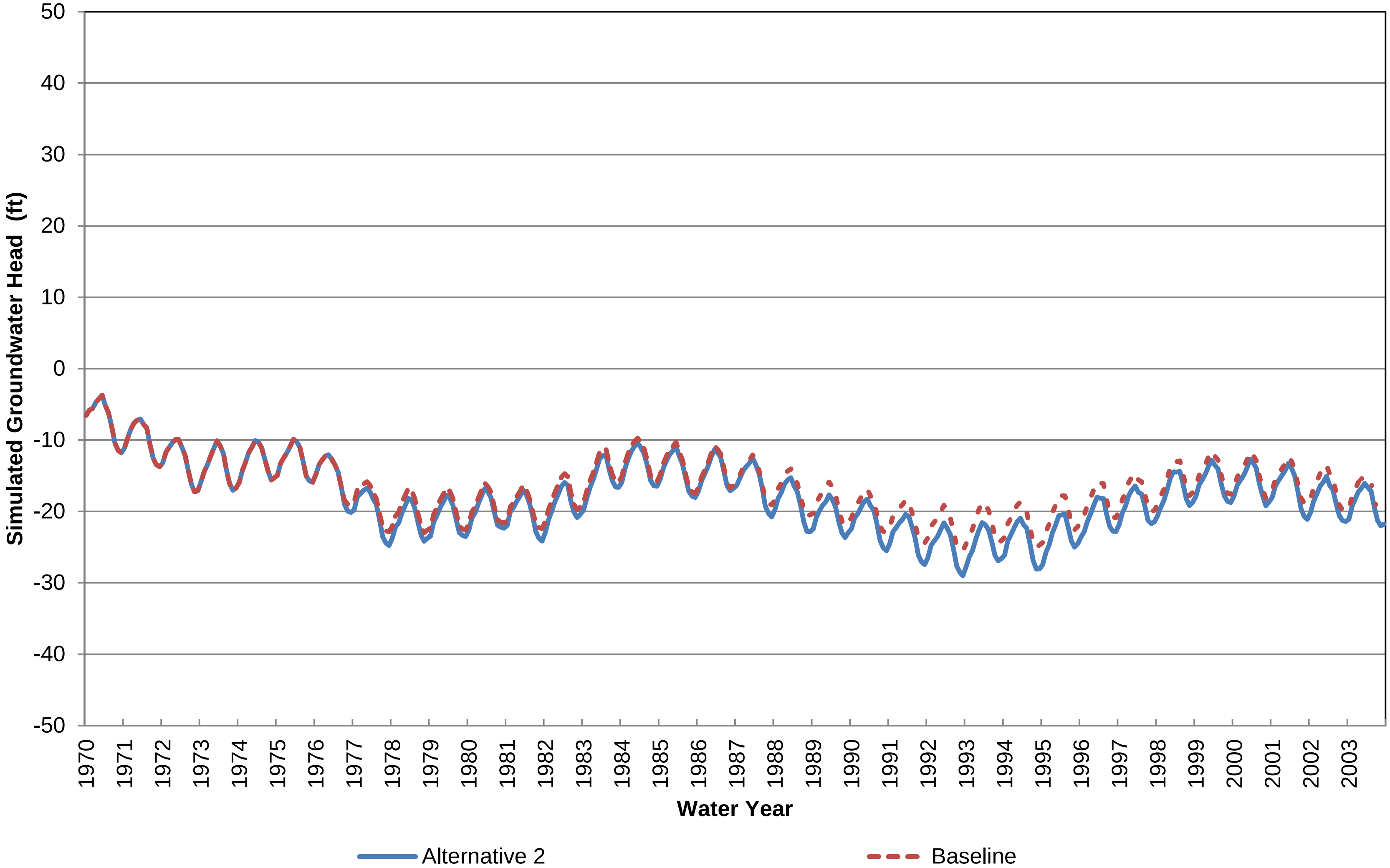
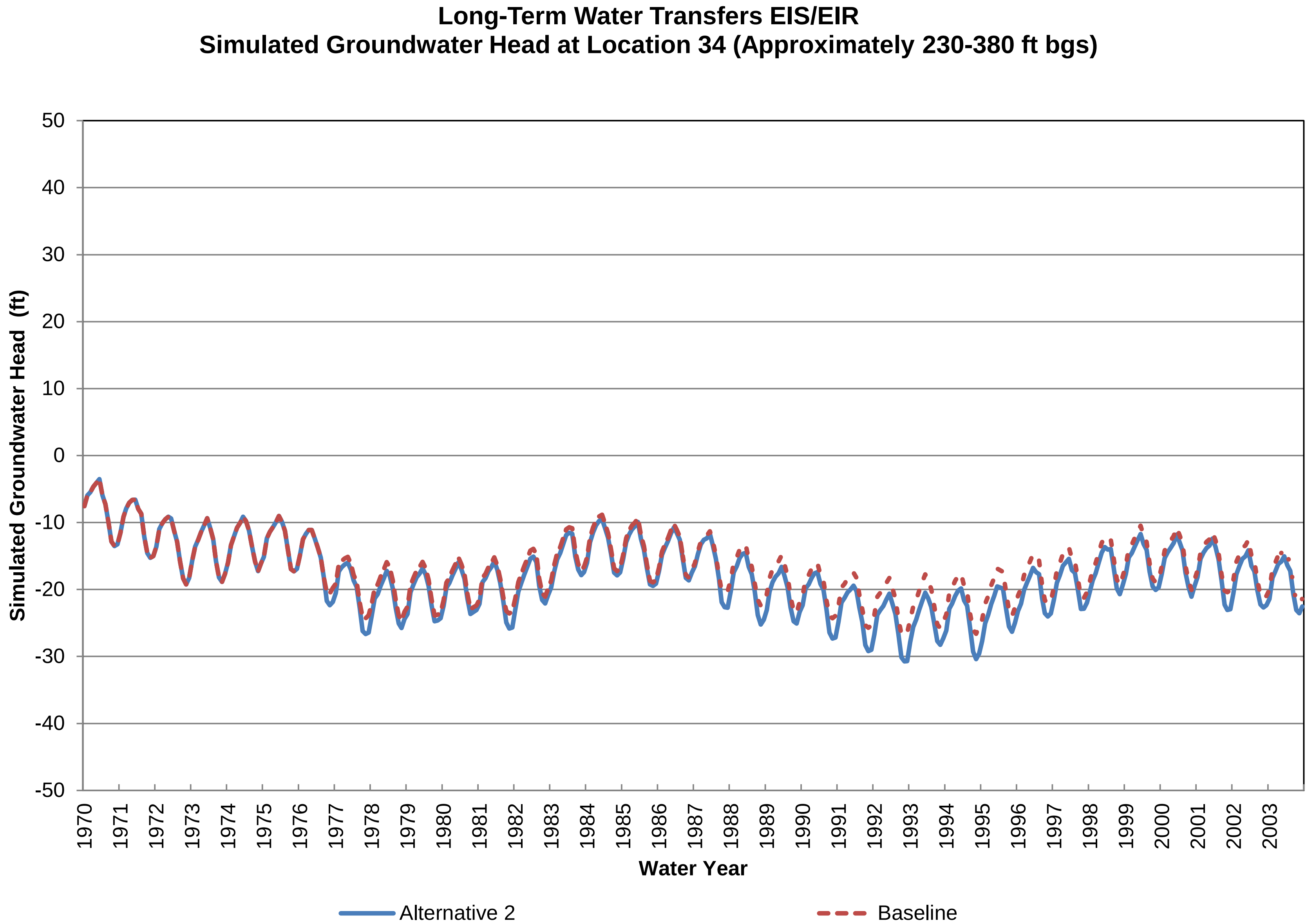
2002
2003
Water Year
Alternative 2
Baseline
Ground Surface Elevation

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 70-230 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 230-380 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
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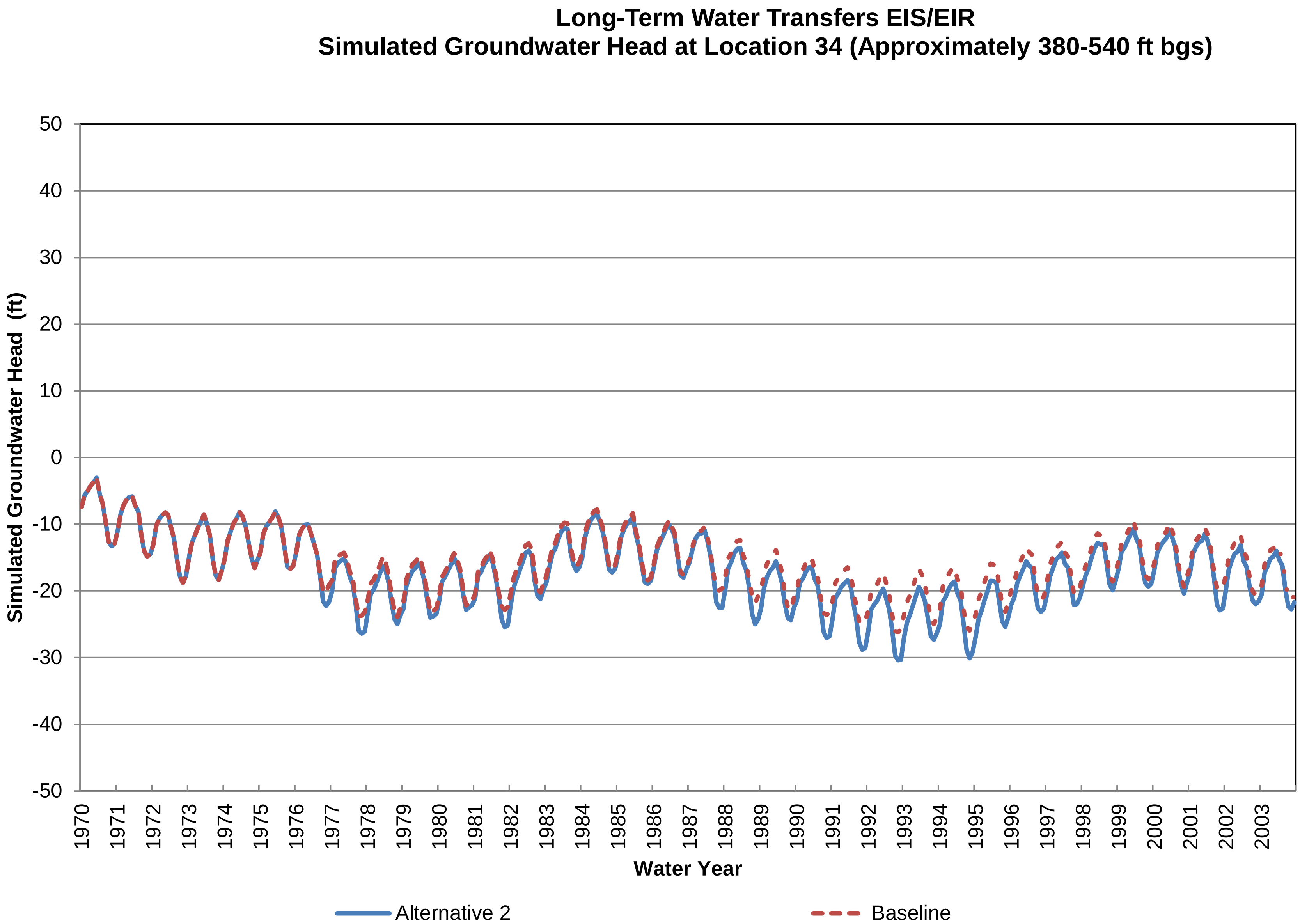
2001
2002
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 380-540 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
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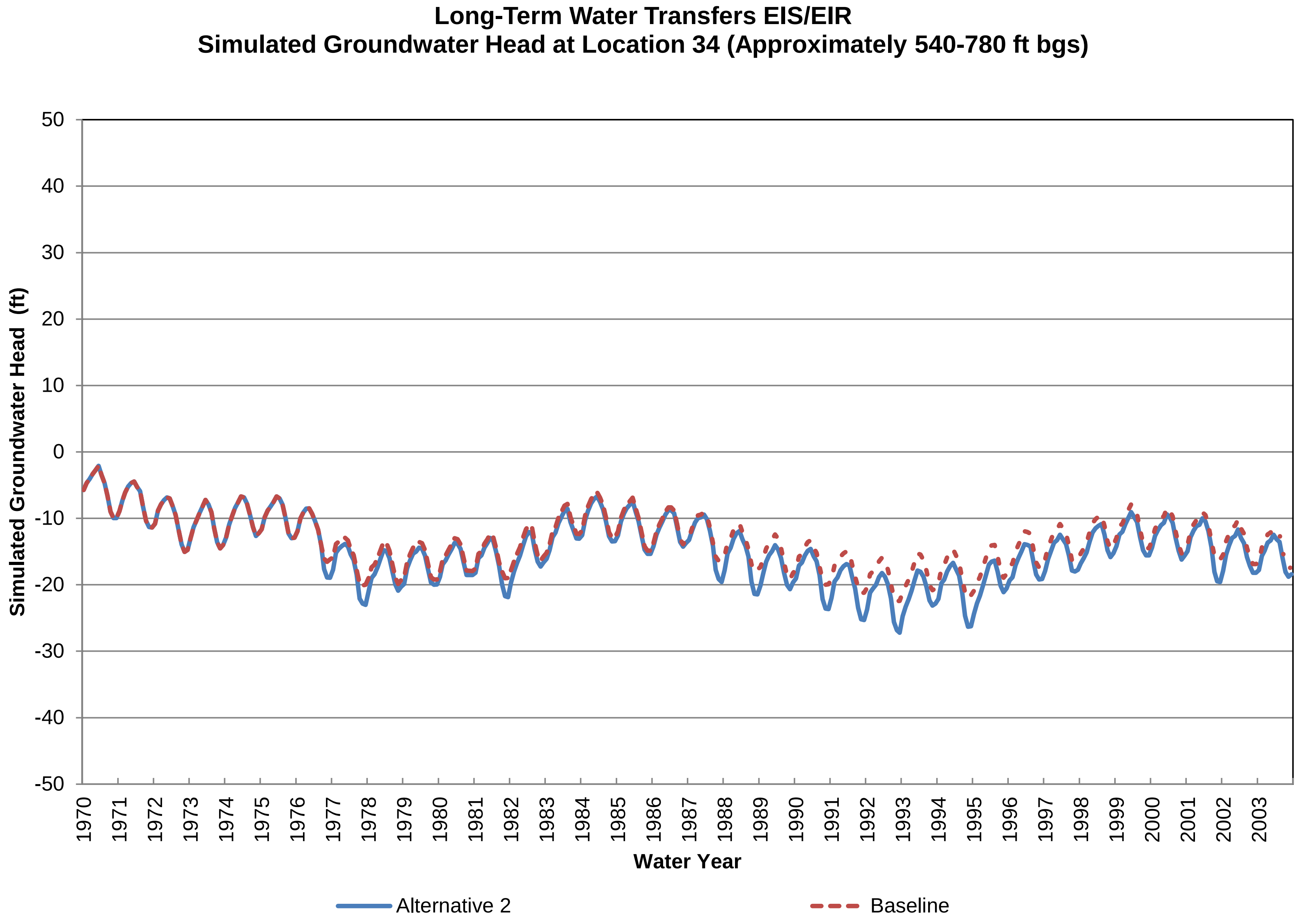
2003
Water Year
Alternative 2
Baseline


Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 540-780 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
1970
1971
1972
1973
1974
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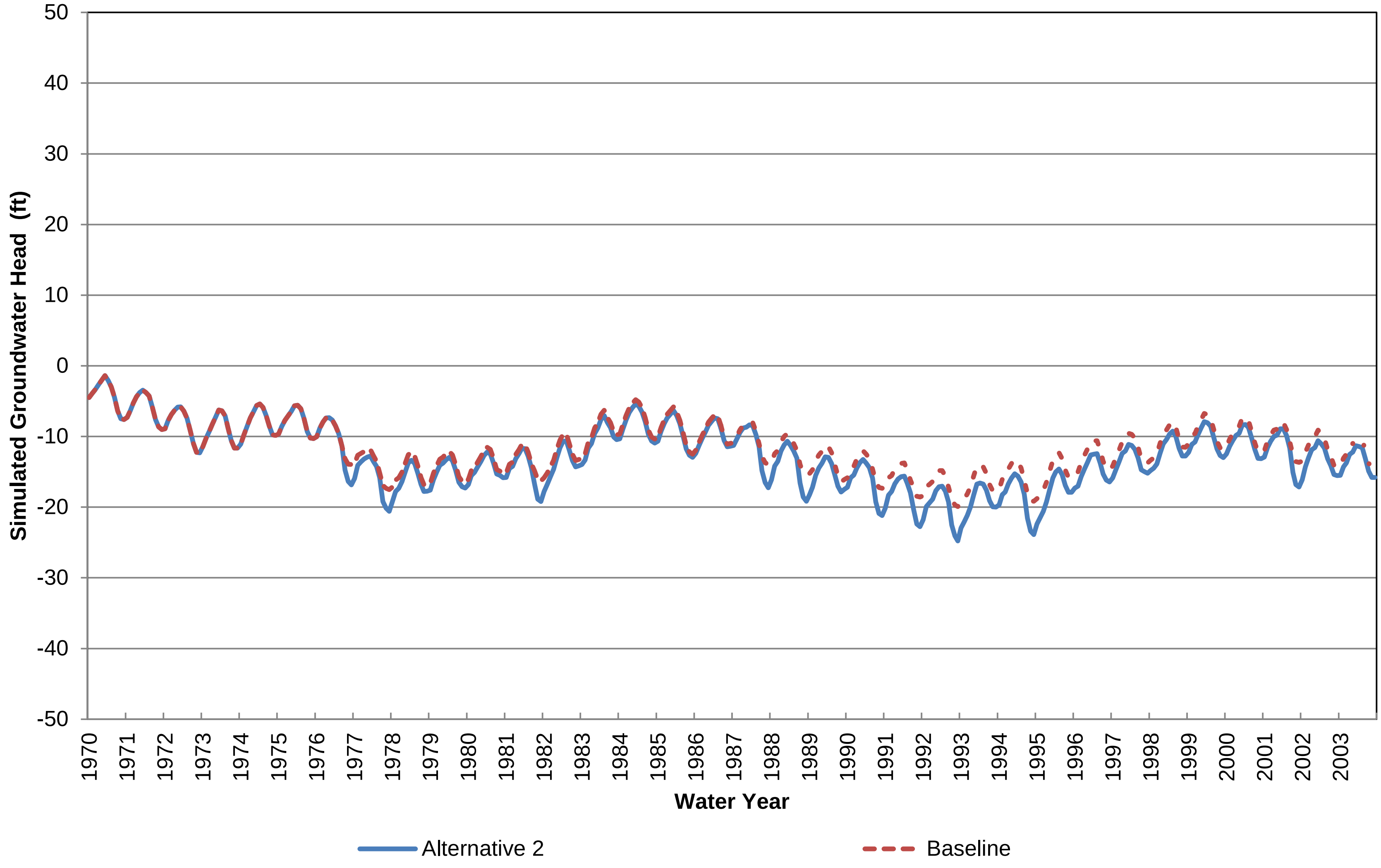
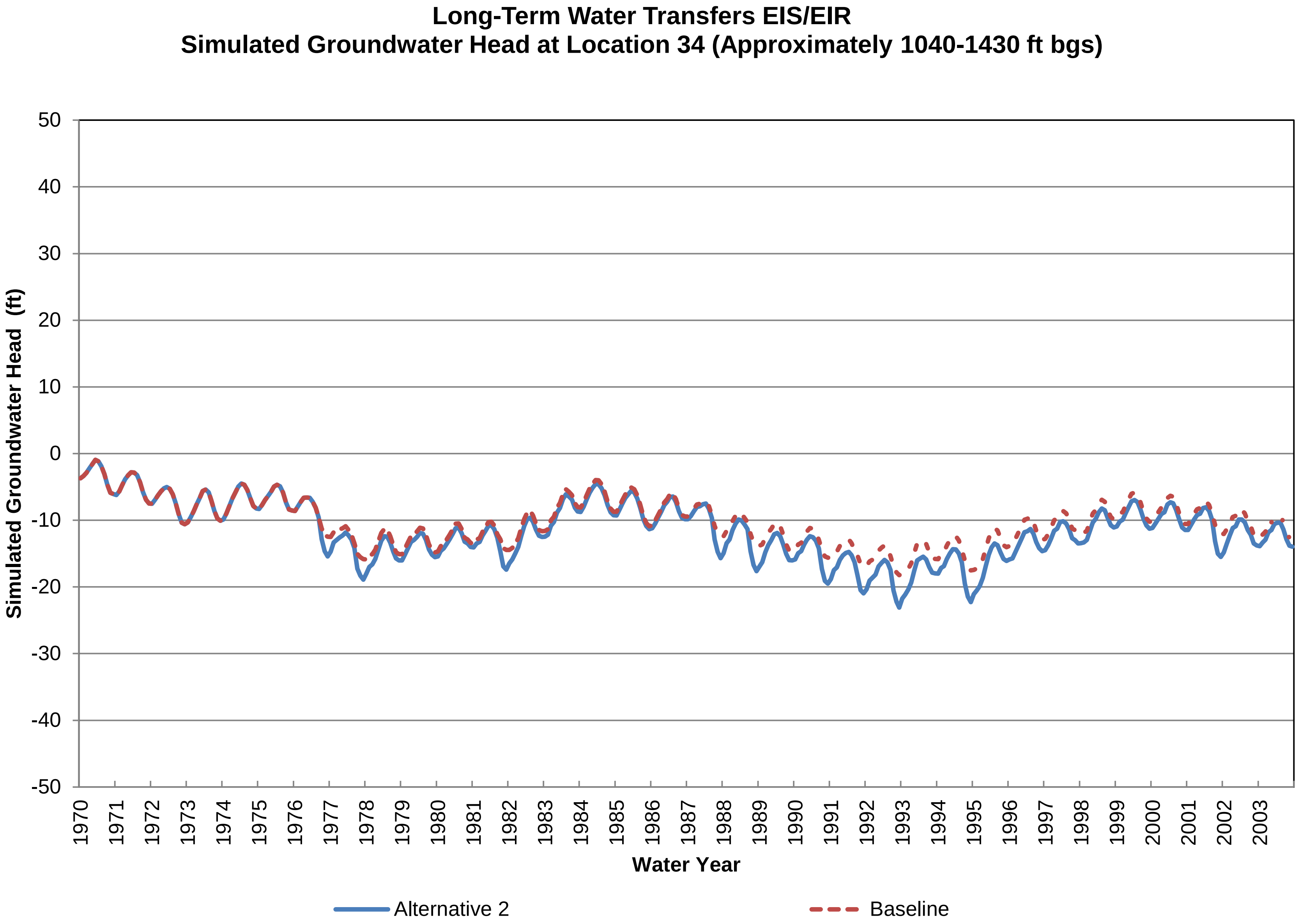
2003
Water Year
Alternative 2
Baseline

Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 780-1040 ft bgs)




Long-Term Water Transfers EIS/EIR
Simulated Groundwater Head at Location 34 (Approximately 1040-1430 ft bgs)
Simulated Groundwater Head (ft)
50
40
30
20
10
0
-10
-20
-30
-40
-50
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2003
Water Year
Alternative 2
Baseline

Appendix F

Air Quality Emission Calculations

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Table F-1. General Conformity Applicability Evaluation (Unmitigated Emissions)

County/ Nonattainment Area	Emissions (tons per year)							
	VOC	NOx	CO	SOx		PM10	PM2.5	
	Sacramento Metro[1,5]	Sacramento Metro[1,5]	Sacramento Area[2]	Sacramento[3,4]	Yuba City-Marysville[6]	Sacramento Co.	Sacramento[4]	Yuba City-Marysville[6]
Colusa	--	--	--	--	--	--	--	--
Glenn	--	--	--	--	--	--	--	--
Sacramento	2.1	71.9	5.6	0.010	--	0.2	0.2	--
Shasta	--	--	--	--	--	--	--	--
Solano	0.0	0.0	--	--	--	--	--	--
Sutter	2.3	19.5	--	--	3.1	--	--	0.8
Tehama	--	--	--	--	--	--	--	--
Yolo	0.7	7.9	--	--	--	--	--	--
Yuba	--	--	--	--	0.0	--	--	0.0
Total	5.1	99.3	5.6	0.010	3.1	0.2	0.2	0.8
Classification	Severe	Severe	Maintenance	PM2.5 Precursor	PM2.5 Precursor	Maintenance	Nonattainment	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100	100	100
Exceed?	No	Yes	No	No	No	No	No	No

Note:

[1]The Sacramento Metro 8-hour O3 nonattainment area consists of Sacramento and Yolo Counties and parts of El Dorado, Placer, Solano, and Sutter Counties. Emissions occurring within the attainment area of these counties are excluded from the total emissions.

[2]The Sacramento Area CO maintenance area is based on the Census Bureau Urbanized Area and consists of parts of Placer, Sacramento, and Yolo Counties. The general conformity applicability evaluation is based on emissions that would occur within the entire county to be conservative.

[3]All counties are designated as attainment areas for SO2; however, since SO2 is a precursor to PM2.5, its emissions must be evaluated under general conformity.

[4]The 24-hour PM2.5 nonattainment area for Sacramento includes Sacramento County and parts of El Dorado, Placer, Solano, and Yolo Counties. The general conformity applicability analysis assumes that all emissions that could occur within each county would occur within the Sacramento nonattainment area to be conservative.

[5]VOC and NOx emissions are excluded from Sutter County for Cranmore Farms, Garden Highway Mutual Water Company, Gilsizer Slough Ranch, Pelger Mutual Water Company, Reclamation District 1004, and Tule Basin Farms because they are located in areas designated as attainment for the federal 8-hour O3 NAAQS.

[6]The Yuba City-Marysville PM2.5 nonattainment area contains all of Sutter County and a part of Yuba County.

Table F-2. Emissions Outside of 8-Hour Ozone Nonattainment Area (tons per year)

Water Agency	County	VOC	NOx
Cranmore Farms	Sutter	Electric	Electric
Garden Highway Mutual Water Company	Sutter	Electric	Electric
Gilsizer Slough Ranch	Sutter	0.7	8.8
Pelger Mutual Water Company	Sutter	0.1	1.2
Reclamation District 1004	Sutter	n/a	n/a
Tule Basin Farms	Sutter	0.3	9.4
Total		1.0	19.3

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-3. Daily VOC Emissions

Water Agency	Daily VOC Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									13.32		13.32
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.92				0.92
Pleasant Grove-Verona Mutual Water Company							33.08		Electric		33.08
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		27.07	3.98				n/a				31.05
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				22.78							22.78
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							9.62				9.62
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							3.70				3.70
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**28.61**	**3.98**	**22.78**	**0.00**	**0.00**	**47.32**	**0.00**	**13.32**	**0.00**	**116.02**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-4. Daily NOx Emissions

Water Agency	Daily NOx Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									147.70		147.70
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		29.38									29.38
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							17.49				17.49
Pleasant Grove-Verona Mutual Water Company							285.31		Electric		285.31
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		354.91	49.10				n/a				404.01
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				787.78							787.78
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							118.61				118.61
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							128.06				128.06
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**384.29**	**49.10**	**787.78**	**0.00**	**0.00**	**549.47**	**0.00**	**147.70**	**0.00**	**1,918.33**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-5. Daily CO Emissions

Water Agency	Daily CO Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									125.01		125.01
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		27.06									27.06
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							23.01				23.01
Pleasant Grove-Verona Mutual Water Company							125.64		Electric		125.64
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		118.57	10.58				n/a				129.15
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				61.21							61.21
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							25.56				25.56
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							9.95				9.95
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**145.63**	**10.58**	**61.21**	**0.00**	**0.00**	**184.16**	**0.00**	**125.01**	**0.00**	**526.59**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-6. Daily SOx Emissions

Water Agency	Daily SOx Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									25.40		25.40
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		9.63									9.63
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							5.73				5.73
Pleasant Grove-Verona Mutual Water Company							31.29		Electric		31.29
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		36.05	3.25				n/a				39.29
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.11							0.11
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							7.84				7.84
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**45.68**	**3.25**	**0.11**	**0.00**	**0.00**	**44.89**	**0.00**	**25.40**	**0.00**	**119.32**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-7. Daily PM10 Emissions

Water Agency	Daily PM10 Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							8.13		Electric		8.13
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.37	0.52				n/a				6.90
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				1.93							1.93
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.86				1.86
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.92**	**0.52**	**1.93**	**0.00**	**0.00**	**11.68**	**0.00**	**6.39**	**0.00**	**28.43**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Unmitigated)

Table F-8. Daily PM2.5 Emissions

Water Agency	Daily PM2.5 Emissions (lbs/day)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							8.00		Electric		8.00
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.30	0.51				n/a				6.81
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				1.93							1.93
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.81				1.81
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.84**	**0.51**	**1.93**	**0.00**	**0.00**	**11.50**	**0.00**	**6.39**	**0.00**	**28.17**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-9. Annual VOC Emissions

Water Agency	Annual VOC Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.71		0.71
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.06				0.06
Pleasant Grove-Verona Mutual Water Company							2.26		Electric		2.26
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.03	0.15				n/a				1.18
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				2.08							2.08
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.71				0.71
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.27				0.27
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**1.14**	**0.15**	**2.08**	**0.00**	**0.00**	**3.31**	**0.00**	**0.71**	**0.00**	**7.39**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-10. Annual NOx Emissions

Water Agency	Annual NOx Emissions (tons per year)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									7.89		7.89
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		2.14									2.14
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.16				1.16
Pleasant Grove-Verona Mutual Water Company							19.53		Electric		19.53
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		13.49	1.87				n/a				15.36
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				71.89							71.89
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							8.79				8.79
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							9.38				9.38
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**15.64**	**1.87**	**71.89**	**0.00**	**0.00**	**38.86**	**0.00**	**7.89**	**0.00**	**136.14**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-11. Annual CO Emissions

Water Agency	Annual CO Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.68		6.68
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.97									1.97
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.53				1.53
Pleasant Grove-Verona Mutual Water Company							8.60		Electric		8.60
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		4.51	0.40				n/a				4.91
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				5.59							5.59
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.89				1.89
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.73				0.73
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**6.48**	**0.40**	**5.59**	**0.00**	**0.00**	**12.75**	**0.00**	**6.68**	**0.00**	**31.89**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-12. Annual SOx Emissions

Water Agency	Annual SOx Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									1.36		1.36
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.70									0.70
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.38				0.38
Pleasant Grove-Verona Mutual Water Company							2.14		Electric		2.14
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.37	0.12				n/a				1.49
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.58				0.58
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.00				0.00
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**2.07**	**0.12**	**0.01**	**0.00**	**0.00**	**3.10**	**0.00**	**1.36**	**0.00**	**6.67**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-13. Annual PM10 Emissions

Water Agency	Annual PM10 Emissions (tons per year)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.56		Electric		0.56
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.18							0.18
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.14				0.14
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.36**	**0.02**	**0.18**	**0.00**	**0.00**	**0.81**	**0.00**	**0.34**	**0.00**	**1.70**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Unmitigated)

Table F-14. Annual PM2.5 Emissions

Water Agency	Annual PM2.5 Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.55		Electric		0.55
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.18							0.18
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.13				0.13
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.35**	**0.02**	**0.18**	**0.00**	**0.00**	**0.80**	**0.00**	**0.34**	**0.00**	**1.68**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Anderson-Cottonwood Irrigation District	
Transfer Volume	5,226	acre feet/year
Location	Shasta	County
	Tehama	County

Federal Attainment Status

	Shasta	*Tehama*
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Table F-15. Anderson-Cottonwood Irrigation District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Barney Street	Barney Street	Shasta	Electric	2012	200	n/a	5,500	85%	737	4,422	24	4,366
Crowley Gulch	Crowley Gulch	Shasta	Electric	2012	50	n/a	1,000	15%	134	804	24	4,366
						Total	**6,500**	**100%**	**871**	**5,226**	**48**	**8,733**
						Total (Shasta County)	**6,500**	**100%**	**871**	**5,226**	**48**	**8,733**
						Total (Tehama County)	**0**	**0**	**0**	**0**	**0**	**0**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Conaway Preservation Group	Federal Attainment Status			Peak Month		
Transfer Volume	35,000 acre feet/year	PM10	A	*Engines subject to ATCM.*	9,964	AF/month	
Location	Yolo County	PM2.5	N		72,735	gallons/minute	
		O3	N		74%	peak pump rate	

Table F-16. Conaway Preservation Group Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
ConawayPG12W-1	12W-1	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG12W-2	12W-2	Yolo	Electric	TBD	250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG12W-5	12W-5	Yolo	Electric	TBD	250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG13W-3	13W-3	Yolo	Electric		200	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG16W-2	16W-2	Yolo	Diesel	2005	227	T2	1,600	2%	163	573	18	1,944	24,751	0.2	4.7	2.6	0.93	0.15	0.15	2.24	42.60	23.78	8.47	1.36	1.36	0.12	2.28	1.27	0.45	0.07	0.07
ConawayPG17W-3	17W-3	Yolo	Diesel	2005	227	T2	1,700	2%	173	608	18	1,944	24,751	0.2	4.7	2.6	0.93	0.15	0.15	2.24	42.60	23.78	8.47	1.36	1.36	0.12	2.28	1.27	0.45	0.07	0.07
ConawayPG1W-3	1W-3	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG20W-1	20W-1	Yolo	Electric		100	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG21W-1	21W-1	Yolo	Electric	TBD	250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG21W-3	21W-3	Yolo	Electric		100	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG24W-1	24W-1	Yolo	Electric	TBD	250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG31W-1	31W-1	Yolo	Electric		100	n/a	2,300	2%	234	823	18	1,944	n/a																		
ConawayPG32NW-1	32NW-1	Yolo	Electric		100	n/a	3,300	3%	336	1,181	18	1,944	n/a																		
ConawayPG32NW-2	32NW-2	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG32W-3	32W-3	Yolo	Electric		250	n/a	2,500	3%	255	895	18	1,944	n/a																		
ConawayPG33NW-1	33NW-1	Yolo	Electric		100	n/a	2,300	2%	234	823	18	1,944	n/a																		
ConawayPG33NW-2	33NW-2	Yolo	Electric		100	n/a	2,200	2%	224	787	18	1,944	n/a																		
ConawayPG33NW-3	33NW-3	Yolo	Electric		100	n/a	2,100	2%	214	752	18	1,944	n/a																		
ConawayPG33NW-4	33NW-4	Yolo	Electric		100	n/a	3,400	3%	346	1,217	18	1,944	n/a																		
ConawayPG33NW-5	33NW-5	Yolo	Electric		100	n/a	1,800	2%	183	644	18	1,944	n/a																		
ConawayPG33NW-6	33NW-6	Yolo	Electric		100	n/a	2,100	2%	214	752	18	1,944	n/a																		
ConawayPG33NW-7	33NW-7	Yolo	Electric		100	n/a	1,400	1%	143	501	18	1,944	n/a																		
ConawayPG33NW-8	33NW-8	Yolo	Electric		100	n/a	2,200	2%	224	787	18	1,944	n/a																		
ConawayPG5W-2	5W-2	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG5W-3	5W-3	Yolo	Electric		250	n/a	2,700	3%	275	966	18	1,944	n/a																		
ConawayPG6W-2	6W-2	Yolo	Electric		100	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG7W-1	7W-1	Yolo	Electric		75	n/a	1,800	2%	183	644	18	1,944	n/a																		
ConawayPG7W-2	7W-2	Yolo	Electric		250	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG7W-4	7W-4	Yolo	Electric		200	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG7W-4S	7W-4S	Yolo	Electric		200	n/a	3,500	4%	357	1,253	18	1,944	n/a																		
ConawayPG8W-2	8W-2	Yolo	Diesel	2002	227	T1	2,300	2%	234	823	18	1,944	24,751	1.0	6.9	8.5	0.93	0.40	0.40	8.83	62.50	77.45	8.47	3.67	3.67	0.47	3.34	4.14	0.45	0.20	0.20
ConawayPG8W-2N	8W-2N	Yolo	Electric		200	n/a	1,500	2%	153	537	18	1,944	n/a																		
ConawayPGOW-1	OW-1	Yolo	Electric		100	n/a	2,600	3%	265	930	18	1,944	n/a																		
ConawayPGOW-2	OW-2	Yolo	Electric		100	n/a	3,400	3%	346	1,217	18	1,944	n/a																		
ConawayPGOW-3	OW-3	Yolo	Electric		125	n/a	3,400	3%	346	1,217	18	1,944	n/a																		
ConawayPGOW-4	OW-4	Yolo	Electric		100	n/a	1,700	2%	173	608	18	1,944	n/a																		
ConawayPGOW-5	OW-5	Yolo	Electric		125	n/a	2,000	2%	204	716	18	1,944	n/a																		
						Total	**97,800**	**100%**	**9,964**	**35,000**	**673**	**71,912**	**74,253**							**13.32**	**147.70**	**125.01**	**25.40**	**6.39**	**6.39**	**0.71**	**7.89**	**6.68**	**1.36**	**0.34**	**0.34**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
- (purple) Assumed to be electric (similar to 32W-2)
- (green) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
- (blue) Emission factor based on NMHC+NOx emission standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Cordua Irrigation District
Transfer Volume	12,000 acre feet/year
Location	Yuba County

Federal Attainment Status

PM10	A	*Engines subject to ATCM.*
PM2.5	N	
O3	A	

Table F-17. Cordua Irrigation District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
COR1	COR1	Yuba	Electric		60	n/a	1,000	3%	129	323	23	1,757
COR2	COR2	Yuba	Electric		50	n/a	900	2%	116	291	23	1,757
COR3	COR3	Yuba	Electric		60	n/a	1,000	3%	129	323	23	1,757
COR4	COR4	Yuba	Electric		75	n/a	1,400	4%	181	453	23	1,757
COR5	COR5	Yuba	Electric		75	n/a	1,300	4%	168	420	23	1,757
COR8	COR8	Yuba	Electric		75	n/a	2,000	5%	259	647	23	1,757
COR9	COR9	Yuba	Electric		60	n/a	1,000	3%	129	323	23	1,757
COR10	COR10	Yuba	Electric		75	n/a	1,300	4%	168	420	23	1,757
COR11	COR11	Yuba	Electric		60	n/a	1,800	5%	233	582	23	1,757
COR12	COR12	Yuba	Electric		100	n/a	1,400	4%	181	453	23	1,757
COR13	COR13	Yuba	Electric		100	n/a	2,100	6%	272	679	23	1,757
COR14	COR14	Yuba	Electric		75	n/a	1,800	5%	233	582	23	1,757
COR18	COR18	Yuba	Electric	2013	100	n/a	2,000	5%	259	647	23	1,757
COR20	COR20	Yuba	Electric	2013	125	n/a	2,150	6%	278	695	23	1,757
COR21	COR21	Yuba	Electric		75	n/a	1,250	3%	162	404	23	1,757
COR22	COR22	Yuba	Electric		60	n/a	1,750	5%	226	566	23	1,757
COR23	COR23	Yuba	Electric		75	n/a	1,150	3%	149	372	23	1,757
COR25	COR25	Yuba	Electric	2013	75	n/a	1,600	4%	207	518	23	1,757
COR26	COR26	Yuba	Electric	2013	100	n/a	1,800	5%	233	582	23	1,757
COR27	COR27	Yuba	Electric		100	n/a	1,700	5%	220	550	23	1,757
COR16	COR16	Yuba	Electric		100	n/a	2,300	6%	298	744	23	1,757
COR17	COR17	Yuba	Electric		100	n/a	2,400	6%	311	776	23	1,757
COR24	COR24	Yuba	Electric		100	n/a	2,000	5%	259	647	23	1,757
						Total	**37,100**	**100%**	**4,800**	**12,000**	**531**	**40,402**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Cranmore Farms		Federal Attainment Status		
Transfer Volume	8,000 acre feet/year		PM10	A	*Engines subject to ATCM.*
Location	Sutter County		PM2.5	N	
			O3	N	

Table F-18. Cranmore Farms Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate		Transfer Volume		Operation	
							(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)
Cranmore Farms1	1	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms2	2	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms3	3	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms4	4	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms5	5	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
Cranmore Farms6	6	Sutter	Electric	TBD	125	n/a	3,000	17%	343	1,333	20	2,414
						Total	**18,000**	**100%**	**2,056**	**8,000**	**122**	**14,482**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Eastside Mutual Water Company	Federal Attainment Status			Peak Month	
Transfer Volume	2,230 acre feet/year	PM10	A	*Engines not subject to ATCM if remotely-located.*	465	AF/month
Location	Colusa County	PM2.5	A		3,396	gallons/minute
		O3	A		89%	peak pump rate

Table F-19. Eastside Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
7631T	7631T	Colusa	Diesel	2006	215	T3	3,800	100%	465	2,230	22	3,187	38,441	0.1	2.8	2.6	0.93	0.15	0.15	1.55	29.38	27.06	9.63	1.55	1.55	0.11	2.14	1.97	0.70	0.11	0.11
						n/a	**3,800**	**100%**	**465**	**2,230**	**22**	**3,187**	**38,441**							**1.55**	**29.38**	**27.06**	**9.63**	**1.55**	**1.55**	**0.11**	**2.14**	**1.97**	**0.70**	**0.11**	**0.11**

Notes:

If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).

AP-42 emission factors used for SOx in all cases.

If an emission standard is not available for a given pollutant, then AP-42 emission factors used.

PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend

[shaded] Emission factor based on NMHC+NOx emission standard

Conversion Factors

1 lb =	453.6 g
1 ton =	2,000 lbs
1 month =	30.4 days
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4 lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal	

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Glenn-Colusa Irrigation District	
Transfer Volume	25,000	acre feet/year
Location	Glenn	County
	Colusa	County

Federal Attainment Status

	Glenn	*Colusa*
PM10	A	A
PM2.5	A	A
O3	A	A

Engines not subject to ATCM if remotely-located.

Table F-20. Glenn-Colusa Irrigation District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
GCID 1	GCID 1	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 2	GCID 2	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 3	GCID 3	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 4	GCID 4	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID 5	GCID 5	Glenn	Electric		110	n/a	2,605	8%	345	2,067	24	4,309
GCID X1	GCID X1	Glenn	Electric		110	n/a	2,389	8%	316	1,896	24	4,309
GCID X2	GCID X2	Glenn	Electric		110	n/a	3,305	10%	437	2,622	24	4,309
GCID X3	GCID X3	Glenn	Electric		110	n/a	2,605	8%	345	2,067	24	4,309
GCID X4	GCID X4	Glenn	Electric		110	n/a	2,389	8%	316	1,896	24	4,309
GCID X5	GCID X5	Glenn	Electric		110	n/a	2,605	8%	345	2,067	24	4,309
Test Hole 7	Test Hole 7	Glenn	Electric		110	n/a	2,389	8%	316	1,896	24	4,309
						Total	**31,507**	**100%**	**4,167**	**25,000**	**260**	**47,402**
						Total (Glenn County)	**31,507**	**100%**	**4,167**	**25,000**	**260**	**47,402**
						Total (Colusa County)	**0**	**0%**	**0**	**0**	**0**	**0**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(purple)	Assumed to be electric (similar to other wells operated by water agency)
(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Natomas Central Mutual Water Company				
Transfer Volume	30,000 acre feet/year				
Location	Sacramento County				
	Sutter County				

Federal Attainment Status

	Sacramento	*Sutter*	
PM10	M	A	*Engines subject to ATCM.*
PM2.5	N	N	
O3	N	N	

Table F-21. Natomas Central Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate		Transfer Volume		Operation	
							(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)
Natomas Central MWCWilley, Ed	Willey, Ed	Sacramento	Electric		250	n/a	5,500	2%	128	638	4	630
Natomas Central MWCOse, Mary-site 8, well 1	Ose, Mary-site 8, well 1	Sacramento	Electric		200	n/a	5,500	2%	128	638	4	630
Natomas Central MWCOse, Mary-site 9, well 2	Ose, Mary-site 9, well 2	Sacramento	Electric		150	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert-site 1 well 2	Leal, Robert-site 1 well 2	Sutter	Electric		100	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-1	DeWitt, Jack-1	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-2	DeWitt, Jack-2	Sacramento	Electric		80	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-3	DeWitt, Jack-3	Sacramento	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-4	DeWitt, Jack-4	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-5	DeWitt, Jack-5	Sacramento	Electric		20	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-6	DeWitt, Jack-6	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Sutter	Electric		25	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Sutter	Electric		25	n/a	5,500	2%	128	638	4	630
Natomas Central MWCDeWitt, Jack--8	DeWitt, Jack--8	Sacramento	Electric		250	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phil #2-site 5 well 14	Morrison, Phil #2-site 5 well 14	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCBianchi, John- site 2, well 10	Bianchi, John- site 2, well 10	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCBianchi, John-site 2 well 11	Bianchi, John-site 2 well 11	Sutter	Electric		80	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLauppe and Sons	Lauppe and Sons	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCWiley, Wane-site 7 , well 18	Wiley, Wane-site 7 , well 18	Sacramento	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-1 (rice box)	Leal, Robert L-1 (rice box)	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-3	Leal, Robert L-3	Sutter	Electric		50	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-4	Leal, Robert L-4	Sutter	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-5	Leal, Robert L-5	Sutter	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-6	Leal, Robert L-6	Sutter	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-7	Leal, Robert L-7	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-8	Leal, Robert L-8	Sutter	Electric		200	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-9	Leal, Robert L-9	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert L-2	Leal, Robert L-2	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert #1	Leal, Robert #1	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCLeal, Robert #2	Leal, Robert #2	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCSpangler, Dan-site 4 well 13	Spangler, Dan-site 4 well 13	Sutter	Electric		80	n/a	5,500	2%	128	638	4	630
Natomas Central MWCVestal, Sid	Vestal, Sid	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCVestal, Sid-1	Vestal, Sid-1	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Dewitt, Jack-9 Housley N	Dewitt, Jack-9 Housley N	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Dewitt, Jack-10 Housley	Dewitt, Jack-10 Housley	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Dewitt, Jack-11 Housley	Dewitt, Jack-11 Housley	Sutter	Electric		20	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phil-#3 site 5 well 15	Morrison, Phil-#3 site 5 well 15	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phil-#4 site 5 well 16	Morrison, Phil-#4 site 5 well 16	Sutter	Electric		40	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Frazer	NBC-Frazer	Sutter	Electric		50	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Lucich North	NBC-Lucich North	Sutter	Electric		75	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC- Natomas Farm#1	NBC- Natomas Farm#1	Sacramento	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Cummings	NBC-Cummings	Sacramento	Electric		20	n/a	5,500	2%	128	638	4	630
Natomas Central MWCMorrison, Phillip-#5	Morrison, Phillip-#5	Sutter	Electric		60	n/a	5,500	2%	128	638	4	630
Natomas Central MWCPerry, Joe	Perry, Joe	Sacramento	Electric		125	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Kismat-2	NBC-Kismat-2	Sacramento	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Kismat-3	NBC-Kismat-3	Sutter	Electric		30	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Kismat-4	NBC-Kismat-4	Sacramento	Electric		110	n/a	5,500	2%	128	638	4	630
Natomas Central MWCNBC-Sliva	NBC-Sliva	Sacramento	Electric		50	n/a	5,500	2%	128	638	4	630
						Total	**258,500**	100%	**6,000**	**30,000**	**195**	**29,623**
						Total (Sacramento County)	**93,500**	**36%**	**2,170**	**10,851**	**70**	**10,715**
						Total (Sutter County)	**165,000**	**64%**	**3,830**	**19,149**	**124**	**18,908**

Legend

(purple)	Assumed to be electric
(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pelger Mutual Water Company		
Transfer Volume	3,750	acre feet/year	
Location	Sutter	County	

Federal Attainment Status

PM10	A	*Engines subject to ATCM.*
PM2.5	N	
O3	N	

Peak Month

860	AF/month
6,281	gallons/minute
66%	peak pump rate

Table F-22. Pelger Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Pelger MWCWell 1 Tucker	Well 1 Tucker	Sutter	Electric	0	110	n/a	3,100	33%	281	1,224	16	2,144	n/a																		
Pelger MWCWell 2 Flopet	Well 2 Flopet	Sutter	Diesel	2008	173	T3	2,100	22%	190	829	16	2,144	20,806	0.1	2.8	3.7	0.93	0.22	0.22	0.92	17.49	23.01	5.73	1.38	1.38	0.06	1.16	1.53	0.38	0.09	0.09
Pelger MWCWell 3 Klein	Well 3 Klein	Sutter	Electric	0	110	n/a	4,300	45%	389	1,697	16	2,144	n/a																		
						Total	**9,500**	**100%**	**860**	**3,750**	**49**	**6,431**	**20,806**							**0.92**	**17.49**	**23.01**	**5.73**	**1.38**	**1.38**	**0.06**	**1.16**	**1.53**	**0.38**	**0.09**	**0.09**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
- (green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
- (blue) Emission factor based on NMHC+NOx emission standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pleasant Grove-Verona Mutual Water Company		Federal Attainment Status				Peak Month	
Transfer Volume	18,000 acre feet/year			*Sutter*	*Yolo*		4,000	AF/month
Location	Sutter County		PM10	A	A	*Engines subject to ATCM.*	29,198	gallons/minute
	Yolo County		PM2.5	N	N		37%	peak pump rate
			O3	N	N			

Table F-23. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
PGVMWCWill-Lee 4A	Will-Lee 4A	Sutter	Diesel	2000	160	T1	1,500	2%	77	345	9	1,248	11,206	1.1	6.9	3.0	0.93	0.22	0.21	3.67	22.09	9.75	2.99	0.71	0.69	0.25	1.51	0.67	0.20	0.05	0.05
PGVMWCRiver Ranch #19	River Ranch #19	Sutter	Diesel	1995	200	T0	2,500	3%	128	575	9	1,248	14,008	1.1	14.1	3.0	0.93	0.15	0.15	4.59	56.55	12.19	3.74	0.60	0.59	0.31	3.87	0.83	0.26	0.04	0.04
PGVMWCMLF #1	MLF #1	Sutter	Electric		30	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCMLF #2	MLF #2	Sutter	Electric		250	n/a	5,000	6%	255	1,149	9	1,248	n/a																		
PGVMWCMLF Monster Well	MLF Monster Well	Sutter	Electric		60	n/a	3,100	4%	158	713	9	1,248	n/a																		
PGVMWCMLF #17/12	MLF #17/12	Sutter	Electric		50	n/a	1,500	2%	77	345	9	1,248	n/a																		
PGVMWCMLF #11	MLF #11	Sutter	Diesel	2004	250	T2	4,200	5%	215	966	9	1,248	17,510	0.2	4.7	2.6	0.93	0.15	0.15	1.24	23.52	13.13	4.67	0.75	0.75	0.08	1.61	0.90	0.32	0.05	0.05
PGVMWCMLF #13/15	MLF #13/15	Sutter	Electric		240	n/a	4,800	6%	245	1,103	9	1,248	n/a																		
PGVMWCMLF #16	MLF #16	Sutter	Electric		240	n/a	1,700	2%	87	391	9	1,248	n/a																		
PGVMWCWilley #1	Willey #1	Sutter	Diesel	2000	168	T1	3,000	4%	153	690	9	1,248	11,767	1.1	6.9	3.0	0.93	0.22	0.21	3.85	23.19	10.24	3.14	0.74	0.73	0.26	1.59	0.70	0.21	0.05	0.05
PGVMWCWilley #2	Willey #2	Sutter	Electric		250	n/a	3,000	4%	153	690	9	1,248	n/a																		
PGVMWCWilley #3	Willey #3	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCWilley #4	Willey #4	Sutter	Diesel	1974	150	T0	3,000	4%	153	690	9	1,248	10,506	1.1	14.1	3.0	0.93	0.22	0.21	3.44	42.41	9.14	2.80	0.66	0.65	0.24	2.90	0.63	0.19	0.05	0.04
PGVMWCScheidel&Osterli #18A	Scheidel&Osterli #18A	Sutter	Electric	TBD	250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCWill-Lee 30	Will-Lee 30	Sutter	Diesel	2000	100	T1	1,500	2%	77	345	9	1,248	7,004	1.1	6.9	3.0	0.93	0.22	0.21	2.29	13.81	6.09	1.87	0.44	0.43	0.16	0.94	0.42	0.13	0.03	0.03
PGVMWCWill-Lee 31	Will-Lee 31	Sutter	Electric		250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCWill-Lee 32	Will-Lee 32	Sutter	Electric		250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCWill-Lee 33	Will-Lee 33	Sutter	Electric		250	n/a	2,500	3%	128	575	9	1,248	n/a																		
PGVMWCNicholas Sand Field Well	Nicholas Sand Field Well	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCNicholas Filipino Camp #2	Nicholas Filipino Camp #2	Sutter	Electric		40	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas Filipino Camp South	Nicholas Filipino Camp South	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCNicholas Johnston Field Well #2	Nicholas Johnston Field Well #2	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas Johnston Well	Nicholas Johnston Well	Yolo	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas 72-acre Field South	Nicholas 72-acre Field South	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCNicholas 72-Acre Field North	Nicholas 72-Acre Field North	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCNicholas BBC Well	Nicholas BBC Well	Sutter	Electric		250	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCKelly 190 Field Well #2	Kelly 190 Field Well #2	Sutter	Electric		30	n/a	2,000	3%	102	460	9	1,248	n/a																		
PGVMWCKelly Windmill Field Well #2	Kelly Windmill Field Well #2	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCKelly Windmill North Field Well	Kelly Windmill North Field Well	Sutter	Diesel	2002	62.1	T1	2,000	3%	102	460	9	1,248	4,350	1.1	6.9	3.0	0.93	0.30	0.29	1.42	8.57	3.78	1.16	0.37	0.37	0.10	0.59	0.26	0.08	0.03	0.03
PGVMWCKelly 306 Well	Kelly 306 Well	Sutter	Electric		250	n/a	2,600	3%	133	598	9	1,248	n/a																		
PGVMWCScheidel&Osterli #16	Scheidel&Osterli #16	Sutter	Diesel	1997	234	T1	3,400	4%	174	782	9	1,248	16,389	1.0	6.9	8.5	0.93	0.40	0.40	4.56	32.31	40.03	4.38	1.90	1.90	0.31	2.21	2.74	0.30	0.13	0.13
PGVMWCScheidel&Osterli #17	Scheidel&Osterli #17	Sutter	Diesel	1999	101	T0	1,500	2%	77	345	9	1,248	7,074	1.1	14.1	3.0	0.93	0.22	0.21	2.32	28.56	6.15	1.89	0.45	0.44	0.16	1.95	0.42	0.13	0.03	0.03
						Total	**78,300**	**100%**	**4,000**	**18,000**	**292**	**39,951**	**117,213**							**33.08**	**285.31**	**125.64**	**31.29**	**8.13**	**8.00**	**2.26**	**19.53**	**8.60**	**2.14**	**0.56**	**0.55**
						Total (Sutter County)	**76,300**	**97%**	**3,898**	**17,540**	**283**	**38,703**	**117,213**							**33.08**	**285.31**	**125.64**	**31.29**	**8.13**	**8.00**	**2.26**	**19.53**	**8.60**	**2.14**	**0.56**	**0.55**
						Total (Yolo County)	**2,000**	**3%**	**102**	**460**	**9**	**1,248**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Notes:

If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).

AP-42 emission factors used for SOx in all cases.

If an emission standard is not available for a given pollutant, then AP-42 emission factors used.

PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend

(green)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
(blue)	Emission factor based on NMHC+NOx emission standard
(pink)	Emission factor based on AP-42 (engine not subject to emission standard for pollutant in ATCM)

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 108		
Transfer Volume	15,000	acre feet/year	
Location	Colusa	County	
	Yolo	County	

Federal Attainment Status

	Colusa	*Yolo*	
PM10	A	A	*Engines subject to ATCM.*
PM2.5	A	N	
O3	A	N	

Table F-24. Reclamation District 108 Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
RD 108Well#1 Heidrick	Well#1 Heidrick	Colusa	Electric		100	n/a	3,500	18%	458	2,749	23	4,265
RD 108Well #5 RiggsRanch	Well #5 RiggsRanch	Colusa	Electric		150	n/a	1,700	9%	223	1,335	23	4,265
RD 108Well #6 CountyLine	Well #6 CountyLine	Colusa	Electric		250	n/a	5,900	31%	772	4,634	23	4,265
RD 108Well#7 Tract 6	Well#7 Tract 6	Yolo	Electric		250	n/a	4,000	21%	524	3,141	23	4,265
RD 108Well #4 Huff	Well #4 Huff	Colusa	Electric		250	n/a	4,000	21%	524	3,141	23	4,265
						Total	**19,100**	**100%**	**2,500**	**15,000**	**117**	**21,325**
						Total (Colusa County)	**15,100**	**79%**	**1,976**	**11,859**	**93**	**17,060**
						Total (Yolo County)	**4,000**	**21%**	**524**	**3,141**	**23**	**4,265**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 1004		Federal Attainment Status					Peak Month
Transfer Volume	7,175 acre feet/year			*Colusa*	*Glenn*	*Sutter*		2,870 AF/month
Location	Colusa County		PM10	A	A	A	*Engines subject to ATCM.*	20,950 gallons/minute
	Glenn County		PM2.5	A	A	N		29% peak pump rate
	Sutter County		O3	A	A	N		

Table F-25. Reclamation District 1004 Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Gardener No. 374672	Gardener No. 374672	Colusa	Diesel	2008	215	T3	3,500	5%	138	345	7	535	6,456	0.1	2.8	2.6	0.93	0.15	0.15	0.50	9.46	8.71	3.10	0.50	0.50	0.02	0.36	0.33	0.12	0.02	0.02
Gardener No. 498178	Gardener No. 498178	Colusa	Diesel	2009	215	T3	3,500	5%	138	345	7	535	6,456	0.1	2.8	2.6	0.93	0.15	0.15	0.50	9.46	8.71	3.10	0.50	0.50	0.02	0.36	0.33	0.12	0.02	0.02
Stonewell #6 No. 11334	Stone Well #6 No.11334	Colusa	Electric	2006	40	n/a	1,800	2%	71	177	7	535	n/a																		
Drumheller Well #7	Drumheller Well No.7	Colusa	Diesel	TBD	225	T0	4,000	5%	158	394	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Myers Well #1 No. 3457	Myers Well #1 No.3457	Colusa	Electric	2006	40	n/a	2,200	3%	87	217	7	535	n/a																		
Myers Well #2 No. 340884	Myers Well #2 No. 340884	Colusa	Electric	1982	100	n/a	4,100	6%	162	404	7	535	n/a																		
Sikes & Parachini #1 No. 93124	Sikes & Parachini Well #1 WS No.93124	Colusa	Diesel	2006	173	T2	4,000	5%	158	394	7	535	5,195	0.2	4.7	3.7	0.93	0.22	0.22	0.66	12.56	10.02	2.50	0.60	0.60	0.03	0.48	0.38	0.09	0.02	0.02
Sikes & Parachini #2 No. 374682	Sikes & Parachini Well #2 WS No. 374682	Colusa	Diesel	2008	150	T3	4,000	5%	158	394	7	535	4,504	0.1	2.8	3.7	0.93	0.22	0.22	0.35	6.60	8.69	2.16	0.52	0.52	0.01	0.25	0.33	0.08	0.02	0.02
Rancho Caleta No. 726883	Rancho Caleta No. 726883	Colusa	Diesel	2004	170	T2	4,500	6%	177	444	7	535	5,105	0.2	4.7	3.7	0.93	0.22	0.22	0.65	12.34	9.84	2.45	0.59	0.59	0.02	0.47	0.37	0.09	0.02	0.02
Behring Ranch Club House No. 496461	Behring Ranch Club House Well No.496461	Colusa	Electric		125	n/a	3,400	5%	134	335	7	535	n/a																		
Behring Ranch West Well No. 97863	Behring Ranch West Well No.97863	Colusa	Electric		125	n/a	2,300	3%	91	227	7	535	n/a																		
Behring Ranch 10 Field Well No. 496441	Behring Ranch 10 Field Well No. 496441	Colusa	Diesel	2008	225	T3	5,800	8%	229	572	7	535	6,756	0.1	2.8	2.6	0.93	0.15	0.15	0.52	9.90	9.12	3.25	0.52	0.52	0.02	0.38	0.35	0.12	0.02	0.02
Behring Ranch Pearl 20094	Behring Ranch Pearl Well No. 20094	Colusa	Diesel	TBD	225	T0	2,500	3%	99	246	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Behring Ranch Nursery Well No. 17N1W10H1	Behring Ranch Nursery Well No. 17N1W10H1	Colusa	Diesel	TBD	225	T0	1,000	1%	39	99	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Hall Well No. X	Hall Well No. X	Colusa	Electric	TBD	125	n/a	4,500	6%	177	444	7	535	n/a																		
Hall Well No. 369428	Hall Well No.369428	Colusa	Electric	2011	125	n/a	4,500	6%	177	444	7	535	n/a																		
East Morgan Well	East Morgan Well #1 No. 374667 17N01W14N001M	Colusa	Diesel	TBD	225	T0	2,600	4%	103	256	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
ast Morgan Well	East Morgan Well#2 No. 498195 17N01W15Q001M	Colusa	Diesel	TBD	225	T0	1,300	2%	51	128	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Mohammad No.	Mohammad No.e0084085 17N01W02D001M	Colusa	Electric	TBD	125	n/a	4,500	6%	177	444	7	535	n/a																		
Southam Sartain	Southam Sartain Well 18N01W26D001M	Glenn	Diesel	TBD	225	T0	4,800	7%	189	473	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Barale Well	Barale Well	Colusa	Diesel	TBD	225	T0	4,000	5%	158	394	7	535	6,756	1.1	14.1	3.0	0.93	0.15	0.15	3.98	49.10	10.58	3.25	0.52	0.51	0.15	1.87	0.40	0.12	0.02	0.02
Total							**72,800**	**100%**	**2,870**	**7,175**	**148**	**11,240**	**81,767**							**31.05**	**404.01**	**129.15**	**39.29**	**6.90**	**6.81**	**1.18**	**15.36**	**4.91**	**1.49**	**0.26**	**0.26**
Total (Colusa County)							**68,000**	**93%**	**2,681**	**6,702**	**141**	**10,705**	**75,010**							**27.07**	**354.91**	**118.57**	**36.05**	**6.37**	**6.30**	**1.03**	**13.49**	**4.51**	**1.37**	**0.24**	**0.24**
Total (Glenn County)							**4,800**	**7%**	**189**	**473**	**7**	**535**	**6,756**							**3.98**	**49.10**	**10.58**	**3.25**	**0.52**	**0.51**	**0.15**	**1.87**	**0.40**	**0.12**	**0.02**	**0.02**
Total (Sutter County)							**0**	**0%**	**0**	**0**	**0**	**0**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
(green)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
(blue)	Emission factor based on NMHC+NOx emission standard

Conversion Factors
1 lb =	453.6 g
1 ton =	2,000 lbs
1 month =	30.4 days
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal	

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	River Garden Farms		Federal Attainment Status		
Transfer Volume	9,000 acre feet/year		PM10	A	*Engines subject to ATCM.*
Location	Yolo County		PM2.5	N	
			O3	N	

Table F-26. River Garden Farms Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
River Garden FarmsField 65 PW	Field 65 PW	Yolo	Electric	2008	110	n/a	2,500	14%	287	1,293	21	2,810
River Garden FarmsField 71 PW	Field 71 PW	Yolo	Electric	2001	110	n/a	1,700	10%	195	880	21	2,810
River Garden FarmsField 98 PW	Field 98 PW	Yolo	Electric	1963	110	n/a	2,900	17%	333	1,500	21	2,810
River Garden FarmsField 104 PW	Field 104 PW	Yolo	Electric	2008	110	n/a	2,500	14%	287	1,293	21	2,810
River Garden FarmsField 104-09 PW	Field 104-09 PW	Yolo	Electric	2009	110	n/a	2,990	17%	344	1,547	21	2,810
River Garden FarmsField 91-09 PW	Field 91-09 PW	Yolo	Electric	2009	110	n/a	2,840	16%	327	1,469	21	2,810
River Garden FarmsField 117 PW	Field 117 PW	Yolo	Electric	2009	110	n/a	1,965	11%	226	1,017	21	2,810
						Total	**17,395**	**100%**	**2,000**	**9,000**	**144**	**19,669**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sycamore Mutual Water Company	
Transfer Volume	15,000	acre feet/year
Location	Colusa	County

Federal Attainment Status

PM10	A	*Engines not subject to ATCM if remotely-located.*
PM2.5	A	
O3	A	

Table F-27. Sycamore Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Sycamore Family Trust1	1	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust2	2	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust3	3	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust4	4	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust5	5	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust6	6	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust7	7	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust8	8	Colusa	Electric	TBD	125	n/a	3,000	9%	257	1,286	15	2,328
Sycamore Family Trust11	11	Colusa	Electric		100	n/a	2,500	7%	214	1,071	15	2,328
Sycamore Family Trust14	14	Colusa	Electric		100	n/a	2,500	7%	214	1,071	15	2,328
Sycamore Family Trust15	15	Colusa	Electric		75	n/a	2,500	7%	214	1,071	15	2,328
Sycamore Family Trust17	17	Colusa	Electric		125	n/a	3,500	10%	300	1,500	15	2,328
						Total	**35,000**	**100%**	**3,000**	**15,000**	**184**	**27,930**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Te Velde Revocable Family Trust		Federal Attainment Status		
Transfer Volume	7,094 acre feet/year		PM10	A	*Engines subject to ATCM.*
Location	Yolo County		PM2.5	N	
			O3	N	

Table F-28. Te Velde Revocable Family Trust Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Te VeldeGW1	GW1	Yolo	Electric	N/A	127	n/a	4,656	29%	518	2,090	20	2,438
Te VeldeGW10	GW10	Yolo	Electric	N/A	143	n/a	2,833	18%	315	1,272	20	2,438
Te VeldeGW9	GW9	Yolo	Electric	N/A	104	n/a	2,200	14%	245	988	20	2,438
Te VeldeGW4	GW4	Yolo	Electric	N/A	125	n/a	3,715	24%	413	1,668	20	2,438
Te VeldeGW3	GW3	Yolo	Electric	N/A	52	n/a	2,400	15%	267	1,077	20	2,438
						Total	**15,804**	**100%**	**1,758**	**7,094**	**99**	**12,189**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	City of Sacramento		Federal Attainment Status		
Transfer Volume	5,000 acre feet/year		PM10	M	*Engines subject to ATCM.*
Location	Sacramento County		PM2.5	N	
			O3	N	

Table F-29. City of Sacramento Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
City of Sacramento WSA83	WELL83	Sacramento	electric		30	n/a	373	2%	29	88	14	1,278
City of Sacramento WSA92	WELL92	Sacramento	electric		50	n/a	785	4%	62	185	14	1,278
City of Sacramento WSA93	WELL93	Sacramento	electric		50	n/a	411	2%	32	97	14	1,278
City of Sacramento WSA94	WELL94	Sacramento	electric		50	n/a	879	4%	69	207	14	1,278
City of Sacramento WSA107	WELL107	Sacramento	electric		50	n/a	727	3%	57	171	14	1,278
City of Sacramento WSA116	WELL116	Sacramento	electric		75	n/a	673	3%	53	158	14	1,278
City of Sacramento WSA120	WELL120	Sacramento	electric		50	n/a	572	3%	45	135	14	1,278
City of Sacramento WSA122	WELL122	Sacramento	electric		50	n/a	470	2%	37	111	14	1,278
City of Sacramento WSA124	WELL124	Sacramento	electric		50	n/a	541	3%	42	127	14	1,278
City of Sacramento WSA126	WELL126	Sacramento	electric		50	n/a	433	2%	34	102	14	1,278
City of Sacramento WSA127	WELL127	Sacramento	electric		50	n/a	592	3%	46	139	14	1,278
City of Sacramento WSA129	WELL129	Sacramento	electric		50	n/a	466	2%	37	110	14	1,278
City of Sacramento WSA131	WELL131	Sacramento	electric		50	n/a	431	2%	34	101	14	1,278
City of Sacramento WSA133	WELL133	Sacramento	electric		150	n/a	757	4%	59	178	14	1,278
City of Sacramento WSA134	WELL134	Sacramento	electric		60	n/a	676	3%	53	159	14	1,278
City of Sacramento WSA137	WELL137	Sacramento	electric		75	n/a	541	3%	42	127	14	1,278
City of Sacramento WSA138	WELL138	Sacramento	electric		75	n/a	505	2%	40	119	14	1,278
City of Sacramento WSA139	WELL139	Sacramento	electric		50	n/a	818	4%	64	193	14	1,278
City of Sacramento WSA142	WELL142	Sacramento	electric		75	n/a	940	4%	74	221	14	1,278
City of Sacramento WSA143	WELL143	Sacramento	electric		50	n/a	379	2%	30	89	14	1,278
City of Sacramento WSA144	WELL144	Sacramento	electric		50	n/a	549	3%	43	129	14	1,278
City of Sacramento WSA153	WELL153	Sacramento	electric		100	n/a	1027	5%	81	242	14	1,278
City of Sacramento WSA154	WELL154	Sacramento	electric		50	n/a	502	2%	39	118	14	1,278
City of Sacramento WSA155	WELL155	Sacramento	electric		50	n/a	675	3%	53	159	14	1,278
City of Sacramento WSA156	WELL156	Sacramento	electric		75	n/a	525	2%	41	124	14	1,278
City of Sacramento WSA157	WELL157	Sacramento	electric		50	n/a	781	4%	61	184	14	1,278
City of Sacramento WSA158	WELL158	Sacramento	electric		50	n/a	781	4%	61	184	14	1,278
City of Sacramento WSA159	WELL159	Sacramento	electric		75	n/a	535	3%	42	126	14	1,278
City of Sacramento WSA164	WELL164	Sacramento	electric		150	n/a	1101	5%	86	259	14	1,278
City of Sacramento WSAX1	WELLX1	Sacramento	electric		150	n/a	1400	7%	110	329	14	1,278
City of Sacramento WSAX2	WELLX2	Sacramento	electric		150	n/a	1400	7%	110	329	14	1,278
						Total	**21,245**	**100%**	**1,667**	**5,000**	**434**	**39,623**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(purple)	Assumed to be electric (similar to other wells operated by water agency)
(green)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sacramento County Water Agency	Federal Attainment Status			
Transfer Volume	15,000 acre feet/year	PM10	M	*Engines subject to ATCM.*	
Location	Sacramento County	PM2.5	N		
		O3	N		

Table F-30. Sacramento County Water Agency Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Sacramento County WAW 040	W 040	Sacramento	Electric		115	n/a	1,160	2%	104	312	16	1,463
Sacramento County WAW 041	W 041	Sacramento	Electric		65	n/a	676	1%	61	182	16	1,463
Sacramento County WAW 042	W 042	Sacramento	Electric		77	n/a	727	1%	65	196	16	1,463
Sacramento County WAW 043	W 043	Sacramento	Electric		94	n/a	918	2%	82	247	16	1,463
Sacramento County WAW 044	W 044	Sacramento	Electric		73	n/a	515	1%	46	139	16	1,463
Sacramento County WAW 047	W 047	Sacramento	Electric		88	n/a	1,030	2%	92	277	16	1,463
Sacramento County WAW 049	W 049	Sacramento	Electric		92	n/a	853	2%	77	230	16	1,463
Sacramento County WAW 052	W 052	Sacramento	Electric		120	n/a	1,192	2%	107	321	16	1,463
Sacramento County WAW 056	W 056	Sacramento	Electric		200	n/a	3,000	5%	269	808	16	1,463
Sacramento County WAW 061	W 061	Sacramento	Electric		145	n/a	1,570	3%	141	423	16	1,463
Sacramento County WAW 062	W 062	Sacramento	Electric		100	n/a	455	1%	41	123	16	1,463
Sacramento County WAW 063	W 063	Sacramento	Electric		100	n/a	1,119	2%	100	301	16	1,463
Sacramento County WAW 064	W 064	Sacramento	Electric		141	n/a	1,205	2%	108	325	16	1,463
Sacramento County WAW 065	W 065	Sacramento	Electric		57	n/a	589	1%	53	159	16	1,463
Sacramento County WAW 066	W 066	Sacramento	Electric		125	n/a	1,700	3%	153	458	16	1,463
Sacramento County WAW 067	W 067	Sacramento	Electric		135	n/a	1,425	3%	128	384	16	1,463
Sacramento County WAW 068	W 068	Sacramento	Electric		141	n/a	1,624	3%	146	437	16	1,463
Sacramento County WAW 069	W 069	Sacramento	Electric		154	n/a	1,663	3%	149	448	16	1,463
Sacramento County WAW 070	W 070	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 073	W 073	Sacramento	Electric		175	n/a	2,000	4%	180	539	16	1,463
Sacramento County WAW 074	W 074	Sacramento	Electric		50	n/a	500	1%	45	135	16	1,463
Sacramento County WAW 076	W 076	Sacramento	Electric		150	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 077	W 077	Sacramento	Electric		125	n/a	2,000	4%	180	539	16	1,463
Sacramento County WAW 078	W 078	Sacramento	Electric		125	n/a	2,400	4%	216	647	16	1,463
Sacramento County WAW 087	W 087	Sacramento	Electric		150	n/a	1,900	3%	171	512	16	1,463
Sacramento County WAW 092	W 092	Sacramento	Electric		75	n/a	1,160	2%	104	312	16	1,463
Sacramento County WAW 095	W 095	Sacramento	Electric		200	n/a	2,200	4%	198	593	16	1,463
Sacramento County WAW 096	W 096	Sacramento	Electric		150	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 105	W 105	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 106	W 106	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 109	W 109	Sacramento	Electric		200	n/a	2,600	5%	233	700	16	1,463
Sacramento County WAW 110	W 110	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 112	W 112	Sacramento	Electric		100	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 114	W 114	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 129	W 129	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 130	W 130	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 122	W 122	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 123	W 123	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
Sacramento County WAW 124	W 124	Sacramento	Electric		200	n/a	1,500	3%	135	404	16	1,463
						Total	**55,681**	**100%**	**5,000**	**15,000**	**625**	**57,058**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

(shaded cell)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Sacramento Suburban Water District	Federal Attainment Status			Peak Month		
Transfer Volume	30,000 acre feet/year	PM10	M	*Engines subject to ATCM.*	5,000	AF/month	
Location	Sacramento County	PM2.5	N		36,498	gallons/minute	
		O3	N		74%	peak pump rate	

Table F-31. Sacramento Suburban Water District Criteria Pollutant Emissions

		Well											Fuel	Emission Factors						Daily Emissions						Annual Emissions					
		Location			Power Rating	Emission	Pump Rate		Transfer Volume		Operation		Consumption	(lb/MMBtu)						(lbs/day)						(tons per year)					
Description	Well	(County)	Fuel Type	Model Year	(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(MMBtu/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Sacramento Suburban WD5	5	Sacramento	Electric		110	n/a	330	1%	34	201	18	3,312	n/a																		
Sacramento Suburban WD7	7	Sacramento	Electric		110	n/a	180	0%	18	110	18	3,312	n/a																		
Sacramento Suburban WD9	9	Sacramento	Electric		110	n/a	625	1%	64	381	18	3,312	n/a																		
Sacramento Suburban WD12	12	Sacramento	Electric		110	n/a	540	1%	55	329	18	3,312	n/a																		
Sacramento Suburban WD13	13	Sacramento	Electric		110	n/a	820	2%	83	500	18	3,312	n/a																		
Sacramento Suburban WD14	14	Sacramento	Electric		110	n/a	570	1%	58	348	18	3,312	n/a																		
Sacramento Suburban WD18	18	Sacramento	Electric		110	n/a	840	2%	85	512	18	3,312	n/a																		
Sacramento Suburban WD19	19	Sacramento	Electric		110	n/a	950	2%	97	579	18	3,312	n/a																		
Sacramento Suburban WD22	22	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD23	23	Sacramento	Electric		110	n/a	550	1%	56	335	18	3,312	n/a																		
Sacramento Suburban WD24	24	Sacramento	Electric		110	n/a	590	1%	60	360	18	3,312	n/a																		
Sacramento Suburban WD25	25	Sacramento	Electric		110	n/a	750	2%	76	457	18	3,312	n/a																		
Sacramento Suburban WD26	26	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD28	28	Sacramento	Electric		110	n/a	585	1%	59	357	18	3,312	n/a																		
Sacramento Suburban WD30	30	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD35	35	Sacramento	Electric		110	n/a	1000	2%	102	610	18	3,312	n/a																		
Sacramento Suburban WD37	37	Sacramento	Natural Gas		190	n/a	700	1%	71	427	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD38	38	Sacramento	Natural Gas		190	n/a	500	1%	51	305	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD40	40	Sacramento	Natural Gas		190	n/a	675	1%	69	412	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD41	41	Sacramento	Electric/Natural Gas		190	n/a	600	1%	61	366	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD43	43	Sacramento	Electric/Natural Gas		190	n/a	850	2%	86	518	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD45	45	Sacramento	Natural Gas		190	n/a	750	2%	76	457	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD47	47	Sacramento	Electric/Natural Gas		190	n/a	885	2%	90	540	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD50	50	Sacramento	Electric		110	n/a	500	1%	51	305	18	3,312	n/a																		
Sacramento Suburban WD51	51	Sacramento	Electric		110	n/a	285	1%	29	174	18	3,312	n/a																		
Sacramento Suburban WD60	60	Sacramento	Electric		110	n/a	600	1%	61	366	18	3,312	n/a																		
Sacramento Suburban WD65	65	Sacramento	Electric		110	n/a	1250	3%	127	762	18	3,312	n/a																		
Sacramento Suburban WD66	66	Sacramento	Electric		110	n/a	1350	3%	137	823	18	3,312	n/a																		
Sacramento Suburban WD69	69	Sacramento	Electric		110	n/a	450	1%	46	274	18	3,312	n/a																		
Sacramento Suburban WD70	70	Sacramento	Electric		110	n/a	350	1%	36	213	18	3,312	n/a																		
Sacramento Suburban WD71	71	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD72	72	Sacramento	Electric		110	n/a	1850	4%	188	1,128	18	3,312	n/a																		
Sacramento Suburban WD73	73	Sacramento	Electric		110	n/a	3500	7%	356	2,134	18	3,312	n/a																		
Sacramento Suburban WD74	74	Sacramento	Electric		110	n/a	2700	5%	274	1,647	18	3,312	n/a																		
Sacramento Suburban WD75	75	Sacramento	Electric		110	n/a	1150	2%	117	701	18	3,312	n/a																		
Sacramento Suburban WD76	76	Sacramento	Electric		110	n/a	250	1%	25	152	18	3,312	n/a																		
Sacramento Suburban WD77	77	Sacramento	Electric		110	n/a	400	1%	41	244	18	3,312	n/a																		
Sacramento Suburban WD20A	20A	Sacramento	Electric		110	n/a	1100	2%	112	671	18	3,312	n/a																		
Sacramento Suburban WD2A	2A	Sacramento	Electric		110	n/a	995	2%	101	607	18	3,312	n/a																		
Sacramento Suburban WD32A	32A	Sacramento	Electric		110	n/a	1905	4%	194	1,162	18	3,312	n/a																		
Sacramento Suburban WD33A	33A	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD3A	3A	Sacramento	Electric		110	n/a	370	1%	38	226	18	3,312	n/a																		
Sacramento Suburban WD40A	40A	Sacramento	Electric		110	n/a	2525	5%	257	1,540	18	3,312	n/a																		
Sacramento Suburban WD46R	46R	Sacramento	Electric/Natural Gas		190	n/a	800	2%	81	488	18	3,312	4,405	0.118	4.08	0.317	0.00059	0.00999	0.00999	2.85	98.47	7.65	0.01	0.24	0.24	0.26	8.99	0.70	0.00	0.02	0.02
Sacramento Suburban WD4B	4B	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD55A	55A	Sacramento	Electric		110	n/a	2000	4%	203	1,220	18	3,312	n/a																		
Sacramento Suburban WD68R	68R	Sacramento	Electric		110	n/a	1600	3%	163	976	18	3,312	n/a																		
						Total	**49,195**	**100%**	**5,000**	**30,000**	**853**	**155,656**	**35,238**							**22.78**	**787.78**	**61.21**	**0.11**	**1.93**	**1.93**	**2.08**	**71.89**	**5.59**	**0.01**	**0.18**	**0.18**

Legend

[shaded box] Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 MMBtu =	1,000,000	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr	(Estimated from Waukesha engine specifications)
Higher Heating Value	1,020	Btu/scf	(AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Butte Water District	
Transfer Volume	5,500	acre feet/year
Location	Butte	County
	Sutter	County

Federal Attainment Status

	Butte	Sutter	
PM10	A	A	*Engines subject to ATCM.*
PM2.5	N	N	
O3	N	N	

Table F-32. Butte Water District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Butte Water District#1	#1	Sutter	Electric	2008 Floway 16 MKM	300	n/a	4,000	49%	447	2,683	20	3,643
Butte Water District#2	#2	Sutter	Electric	2008 Floway 16 DKH	350	n/a	4,200	51%	470	2,817	20	3,643
						Total	**8,200**	**100%**	**917**	**5,500**	**40**	**7,285**
						Total (Butte County)	**0**	**0%**	**0**	**0**	**0**	**0**
						Total (Sutter County)	**8,200**	**100%**	**917**	**5,500**	**40**	**7,285**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Garden Highway Mutual Water Company		Federal Attainment Status		
Transfer Volume	14,000 acre feet/year		PM10	A	*Engines subject to ATCM.*
Location	Sutter County		PM2.5	N	
			O3	N	

Table F-33. Garden Highway Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Garden Highway MWC4	#4	Sutter	Electric		110	n/a	2,300	12%	295	1,651	23	3,899
Garden Highway MWC17	#17	Sutter	Electric		110	n/a	3,100	16%	397	2,226	23	3,899
Garden Highway MWC19	#19	Sutter	Electric		110	n/a	2,800	14%	359	2,010	23	3,899
Garden Highway MWC22	#22	Sutter	Electric		110	n/a	2,700	14%	346	1,938	23	3,899
Garden Highway MWC23	#23	Sutter	Electric		110	n/a	2,200	11%	282	1,579	23	3,899
Garden Highway MWC24	#24	Sutter	Electric	TBD	110	n/a	3,200	16%	410	2,297	23	3,899
Garden Highway MWC25	#25	Sutter	Electric	TBD	110	n/a	3,200	16%	410	2,297	23	3,899
						Total	**19,500**	**100%**	**2,500**	**14,000**	**160**	**27,294**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

[shaded cell] Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Gilsizer Slough Ranch	Federal Attainment Status			Peak Month	
Transfer Volume	3,900 acre feet/year	PM10	A	*Engines subject to ATCM.*	800	AF/month
Location	Sutter County	PM2.5	N		5,840	gallons/minute
		O3	N		97%	peak pump rate

Table F-34. Gilsizer Slough Ranch Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Gilsizer #1	Gilsizer #1	Sutter	Diesel		162	T0	2,016	33%	267	1,300	24	3,502	31,828	1.1	14.1	3.0	0.93	0.22	0.21	9.62	118.61	25.56	7.84	1.86	1.81	0.71	8.79	1.89	0.58	0.14	0.13
Gilsizer #2	Gilsizer #2	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
Gilsizer #3	Gilsizer #3	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
						Total	**6,048**	**100%**	**800**	**3,900**	**71**	**10,506**	**31,828**							**9.62**	**118.61**	**25.56**	**7.84**	**1.86**	**1.81**	**0.71**	**8.79**	**1.89**	**0.58**	**0.14**	**0.13**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
(shaded cell) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors
1 lb = 453.6 g
1 ton = 2,000 lbs
1 month = 30.4 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption
0.4 lb/hp-hr *(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL *(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Goose Club Farms and Teichert Aggregates
Transfer Volume	10,000 acre feet/year
Location	Sutter County

Federal Attainment Status

PM10	A	*Engines subject to ATCM.*
PM2.5	N	
O3	N	

Table F-35. Goose Club Farms and Teichert Aggregates Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Goose Club1	1	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club2	2	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club3	3	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club4	4	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club5	5	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club6	6	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club7	7	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club8	8	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club9	9	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club10	10	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club11	11	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club12	12	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
Goose Club13	13	Sutter	Electric	TBD	125	n/a	3,000	8%	185	769	11	1,393
						Total	**39,000**	**100%**	**2,400**	**10,000**	**143**	**18,103**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Tule Basin Farms	Federal Attainment Status			Peak Month	
Transfer Volume	7,320 acre feet/year	PM10	A	*Engines subject to ATCM.*	1,520	AF/month
Location	Sutter County	PM2.5	N		11,095	gallons/minute
		O3	N		96%	peak pump rate

Table F-36. Tule Basin Farms Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (MMBtu/yr)
Tule Basin1	1	Sutter	Electric		125	n/a	3,050	27%	403	1,941	24	3,457	n/a
Tule Basin2	2	Sutter	Natural Gas	1985	190	n/a	3,600	31%	476	2,291	24	3,457	4,598
Tule Basin3	3	Sutter	Electric		125	n/a	4,850	42%	641	3,087	24	3,457	n/a
						Total	**11,500**	**100%**	**1,520**	**7,320**	**71**	**10,371**	**4,598**

Description	Emission Factors (lb/MMBtu) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Tule Basin1																		
Tule Basin2	0.118	4.08	0.317	0.00059	0.00999	0.00999	3.70	128.06	9.95	0.02	0.31	0.31	0.27	9.38	0.73	0.00	0.02	0.02
Tule Basin3																		
							3.70	**128.06**	**9.95**	**0.02**	**0.31**	**0.31**	**0.27**	**9.38**	**0.73**	**0.00**	**0.02**	**0.02**

Conversion Factors

1 MMBtu = 1,000,000 Btu
1 ton = 2,000 lbs
1 month = 30.4 days
1 hour = 60 minutes
1 acre-foot = 325,851 gallons
http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC = 7,000 Btu/bhp-hr (Estimated from Waukesha engine specifications)
Higher Heating Value 1,020 Btu/scf (AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

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Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Reclamation District 2068	
Transfer Volume	4,500	acre feet/year
Location	Solano	County
	Yolo	County

Federal Attainment Status

	Solano	Yolo	
PM10	A	A	*Engines subject to ATCM.*
PM2.5	N	N	
O3	N	N	

Table F-37. Reclamation District 2068 Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
RD-2068TP-1	TP-1	Solano	Electric		75	n/a	1,500	25%	188	1,125	22	4,073
RD-2068GW-2	GW-2	Solano	Electric	TBD	75	n/a	1,500	25%	188	1,125	22	4,073
RD-2068GW-3	GW-3	Solano	Electric	TBD	75	n/a	1,500	25%	188	1,125	22	4,073
RD-2068GW-4	GW-4	Solano	Electric	TBD	75	n/a	1,500	25%	188	1,125	22	4,073
						Total	**6,000**	**100%**	**750**	**4,500**	**89**	**16,293**
						Total (Solano County)	**6,000**	**100%**	**750**	**4,500**	**89**	**16,293**
						Total (Yolo County)	**0**	**0%**	**0**	**0**	**0**	**0**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

[shaded cell] Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Groundwater Substitution Air Quality Emissions (Unmitigated)

Agency	Pope Ranch	
Transfer Volume	2,800	acre feet/year
Location	Yolo	County

Federal Attainment Status

PM10	A	*Engines subject to ATCM.*
PM2.5	N	
O3	N	

Table F-38. Pope Ranch Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)
Pope RanchX1	X1	Yolo	Electric	TBD	110	n/a	2,117	50%	280	1,400	24	3,591
Pope RanchX2	X2	Yolo	Electric	TBD	110	n/a	2,117	50%	280	1,400	24	3,591
						Total	**4,234**	**100%**	**560**	**2,800**	**47**	**7,183**

Note: Local criteria pollutant emissions not estimated because all engines are electric.

Legend

[shaded cell] Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

CARB Airborne Toxic Control Measure (ATCM) for Stationary Compression Ignition Engines

Table F-39. Summary of the Emission Standards for New Stationary Diesel-Fueled CI Engines > 50 BHP used in Agricultural Operations

Horsepower Range	Diesel PM [1] (g/bhp-hr)	HC (g/bhp-hr)	NOx (g/bhp-hr)	NMHC+NOx (g/bhp-hr)	CO (g/bhp-hr)
50<HP<100	0.3				
100<=HP<175	0.22				
175<=HP	0.15				

Source: See Section 93115.8(a)

Notes:

[1] Less than or equal to the emission standard OR Off-Road CI Engine Certification Standard for an off-road engine of the maximum rated power, whichever is more stringent.

[2] Off-Road CI Engine Certification Standard for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard, or Tier 1 standards.

[3] Prior to January 1, 2008, these limits shall not apply to engines sold from one agricultural operation to another and funded under State or federal incentive.

Table F-40. Emission Standards for Noncertified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower (HP) Range	Compliance Date [1]	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2011	0.3				
75<=HP<100	2011	0.3				
100<=HP<175	2010	0.22				
175<=HP<=750	2010	0.15				
750<HP	2014	0.075				

Source: See Sections 93115.8(b) (2) and (4)

Note:

[1] Compliance date on or after December 31

[2] Engine Certification Standards for off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.

[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in an agricultural operation shall not exceed Tier 1 standards in Title 13.

Table F-41. Emission Standards Tier 1- and Tier 2-Certified Greater than 50 BHP In-Use Stationary Diesel-Fueled Engines Used in Agricultural Operations

Horsepower Range (hp)	Compliance Date	PM (g/bhp-hr)	HC [2,3] (g/bhp-hr)	NOx [2,3] (g/bhp-hr)	NMHC+NOx [2,3] (g/bhp-hr)	CO [2,3] (g/bhp-hr)
50<HP<75	2015	0.02				
75<=HP<175	2015	0.01				
175<=hp<=750	2014	0.01				
750<HP	2014	0.075				

Source: See Sections 93115.8(b)(3) and (4)

Notes:

[1] Compliance date on or after December 31 or 12 years after the date of initial installation, whichever is later.

[2] Off-Road CI Engine Certification Standards for an off-road engine of the model year and maximum rated power of the engine installed to meet the applicable PM standard.

[3] If no limits have been established for an off-road engine of the same model year and maximum rated power, then the in-use stationary diesel-fueled engine used in agricultural operation shall not exceed Tier 1 standards in Tier 13, CCR, section 2423 for an off-road engine of the same maximum rated power irrespective of model year.

Table F-42. Tier 1, Tier 2, and Tier 3 Exhaust Emission Standards

Maximum Rated Power	Tier	Model Year	(g/kW-hr)					(g/hp-hr)				
			NOx	HC	NMHC+NOx	CO	PM	NOx	HC	NMHC+NOx	CO	PM
kW<8 *hp <11*	T1	2000-2004	-	-	10.5	8.0	1	-	-	7.8	6.0	0.75
	T2	2005 -2007	-	-	7.5	8.0	0.8	-	-	5.6	6.0	0.60
8≤kW<19 *11<=hp<25*	T1	2000-2004	-	-	9.5	6.6	0.8	-	-	7.1	4.9	0.60
	T2	2005 -2007	-	-	7.5	6.6	0.8	-	-	5.6	4.9	0.60
19≤kW<37 *25<=hp<50*	T1	2000-2003	-	-	9.5	5.5	0.8	-	-	7.1	4.1	0.60
	T2	2004 -2007	-	-	7.5	5.5	0.6	-	-	5.6	4.1	0.45
37≤kW<56 *50<=hp<75*	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.30
	T3	2008 -2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.30
56≤kW<75 *75<=hp<100*	T1	2000-2003	9.2	-	-	-	-	6.9	-	-	-	-
	T2	2004-2007	-	-	7.5	5.0	0.4	-	-	5.6	3.7	0.30
	T3	2008-2011	-	-	4.7	5.0	0.4	-	-	3.5	3.7	0.30
75≤kW<130 *100<=hp<175*	T1	2000-2002	9.2	-	-	-	-	6.9	-	-	-	-
	T2	2003-2006	-	-	6.6	5.0	0.3	-	-	4.9	3.7	0.22
	T3	2007 -2011	-	-	4.0	5.0	0.3	-	-	3.0	3.7	0.22
130≤kW<225 *175<=hp<300*	T1	1996-2002	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2003-2005	-	-	6.6	3.5	0.2	-	-	4.9	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
225≤kW<450 *300<=hp<600*	T1	1996-2000	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2001-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
450≤kW≤560 *600<=hp<750*	T1	1996-2001	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2002-2005	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15
	T3	2006 -2010	-	-	4.0	3.5	0.2	-	-	3.0	2.6	0.15
kW>560 *hp>750*	T1	2000-2005	9.2	1.3	-	11.4	0.54	6.9	1.0	-	8.5	0.40
	T2	2006 -2010	-	-	6.4	3.5	0.2	-	-	4.8	2.6	0.15

Source: Title 13, California Code of Regulations, Division 3, Chapter 9, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

NOx and NMHC fraction - Table B-26

NOx	95%
NMHC	5%

http://www.arb.ca.gov/msprog/moyer/guidelines/cmp_guidelines_part4.pdf

PM Size Fractions

PM10	0.96
PM2.5	0.937
Ratio	0.98

CARB PMSIZE Profile No. 116 (STAT. I.C. ENGINE-DIESEL)

Table F-43. Tier 4 Exhaust Emission Standards

MAXIMUM ENGINE POWER	MODEL YEAR	TYPE	PM	NMHC+	NMHC	NOx	CO
			grams per horsepower-hour				
hp<11	2008 and later	FINAL	0.30	5.6	-	-	6.0
11<=hp<25							4.9
25<=hp<50	2008-2012	INTERIM	0.22	5.6	-	-	4.1
	2013 and later	FINAL	0.02	3.5			
50<=hp<75	2008-2012	INTERIM	0.22	3.5	-	-	3.7
	2013 and later	FINAL	0.02				
75<=hp<100	2012-2014	PHASE-IN	0.01	-	0.14	0.3	3.7
		PHASE-OUT		3.5	-	-	
		or/ ALT NOx			0.14	2.5	
	2015 and later	FINAL		-		0.3	
100<=hp<175	2012-2014	PHASE-IN	0.01	-	0.14	0.3	3.7
		PHASE-OUT		3.0	-	-	
		or/ ALT NOx		-	0.14	2.5	
	2015 and later	FINAL			0.14	0.3	
175<=hp<=750	2011-2013	PHASE-IN	0.01	-	0.14	0.3	2.6
	2014 and later	PHASE-OUT		3.0	-	-	
		or/ ALT NOx		-	0.14	1.5	
		FINAL				0.3	
750 hp<GEN<=1205 hp	2011-2014	INTERIM	0.07	-	0.30	2.6	2.6
	2015 and later	FINAL	0.02		0.14	0.5	
GEN>1205 hp	2011-2014	INTERIM	0.07	-	0.30		2.6
	2015 and later	FINAL	0.02		0.14	0.5	
ELSE>750 hp	2011-2014	INTERIM	0.07	-	0.30	2.6	2.6
	2015 and later	FINAL	0.03	-	0.14		

Source: Title 13, California Code of Regulations, Article 4, Section 2423, "Off-Road Compression-Ignition Engines and Equipment."

Table F-44. Engine Tier Matrix

	Year																			
HP Range	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
hp <11	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
11<=hp<25	T0	T0	T0	T0	T1	T1	T1	T1	T1	T2	T2	T2	T4	T4	T4	T4	T4	T4	T4	T4
25<=hp<50	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
50<=hp<75	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4I	T4	T4	T4
75<=hp<100	T0	T0	T0	T0	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T4I	T4I	T4I	T4
100<=hp<175	T0	T0	T0	T0	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4
175<=hp<300	T1	T1	T1	T1	T1	T1	T1	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
300<=hp<600	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
600<=hp<750	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T3	T3	T3	T3	T3	T4I	T4I	T4I	T4	T4
hp>750	T0	T0	T0	T0	T1	T1	T1	T1	T1	T1	T2	T2	T2	T2	T2	T4I	T4I	T4I	T4I	T4

Key:

T0 = Tier 0 (Noncertified)
T1 = Tier 1
T2 = Tier 2
T3 = Tier 3
T4 = Tier 4
T4I = Tier 4 Interim

AP-42 Emission Factors

Table F-45. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines [a]

Pollutant	Gasoline Fuel Emission Factor (lb/hp-hr) (power output)	Gasoline Fuel Emission Factor (lb/MMBtu) (fuel input)	Diesel Fuel Emission Factor (lb/hp-hr) (power output)	Diesel Fuel Emission Factor (lb/MMBtu) (fuel input)	Emission Factor Rating	Note
NOx	0.011	1.63	0.031	4.41	D	
CO	6.96E-03 [d]	0.99 [d]	6.68E-03	0.95	D	
SOx	5.91E-04	0.084	2.05E-03	0.29	D	
PM10	7.21E-04	0.1	2.20E-03	0.31	D	[b]
CO2	1.08	154	1.15	164	B	[c]
Aldehydes	4.85E-04	0.07	4.63E-04	0.07	D	
TOC						
Exhaust	0.015	2.1	2.47E-03	0.35	D	
Evaporative	6.61E-04	0.09	0.00	0.00	E	
Crankcase	4.85E-03	0.69	4.41E-05	0.01	E	
Refueling	1.08E-03	0.15	0.00	0.00	E	

Source: U.S. Environmental Protection Agency. 1996. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.3: Gasoline and Diesel Industrial Engines.

Notes:

[a] References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kwhr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.

[b] PM-10 = particulate matter less than or equal to 10 :m aerodynamic diameter. All particulate is assumed to be 10 µm in size.

[c] Assumes 99% conversion of carbon in fuel to CO2 with 87 weight % carbon in diesel, 86 weight % carbon in gasoline, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and gasoline heating value of 20,300 Btu/lb.

[d] Instead of 0.439 lb/hp-hr (power output) and 62.7 lb/mmBtu (fuel input), the correct emissions factors values are 6.96 E-03 lb/hp-hr (power output) and 0.99 lb/mmBtu (fuel input), respectively. This is an editorial correction. March 24, 2009

For large stationary diesel engines (greater than 600 horsepower [hp]) see Chapter 3.4: Large Stationary Diesel and All Stationary Dual-Fuel Engines.

Table F-46. Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines [a]

Pollutant	Emission Factor (lb/MMBtu) [b] (fuel input)	Emission Factor Rating
NOx [c] 90 - 105% Load	4.08E+00	B
NOx [c] <90% Load	8.47E-01	B
CO [c] 90 - 105% Load	3.17E-01	C
CO [c] <90% Load	5.57E-01	B
CO2 [d]	1.10E+02	A
SO2 [e]	5.88E-04	A
TOC [f]	1.47E+00	A
Methane[g]	1.25E+00	C
VOC [h]	1.18E-01	C
PM10 (filterable) [i]	7.71E-05	D
PM2.5 (filterable) [i]	7.71E-05	D
PM Condensable [j]	9.91E-03	D

Source: U.S. Environmental Protection Agency. 2000. Compilation of Air Pollutant Emission Factors (AP-42). Chapter 3.2: Natural Gas-Fired Reciprocating Engines. July.

Notes:

[a] Reference 7. Factors represent uncontrolled levels. For NOx, CO, and PM10, “uncontrolled” means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, the data set may include units with control techniques used for NOx control, such as PCC“uncontrolled” means no oxidation control; and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μ) aerodynamic diameter. A “<“ sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

lb/hp-hr = (lb/MMBtu) (heat input, MMBtu/hr) (1/operating HP, 1/hp)

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO2. CO2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60EF).

[e] Based on 100% conversion of fuel sulfur to SO2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered ≤ 1 μ in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

Engine Size Summary

Table F-47. Summary of Average Engine Horsepower by Fuel Type

Average of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		125		125
Butte Water District		325		325
City of Sacramento		60		60
Conaway Preservation Group	227	138		147
Cordua Irrigation District		82		82
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	129	118		124
Reclamation District 1004	191	76		145
Reclamation District 108		200		200
Reclamation District 2068		75		75
Sacramento County Water Agency		116		116
Sycamore Mutual Water Company		117		117
Te Velde Revocable Family Trust		110		110
Tule Basin Farms		125	190	147
Grand Total	**162**	**110**	**190**	**117**

Table F-48. Summary of Maximum Engine Horsepower by Fuel Type

Max of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		200		200
Butte Water District		350		350
City of Sacramento		150		150
Conaway Preservation Group	227	250		250
Cordua Irrigation District		125		125
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	250	250		250
Reclamation District 1004	225	125		225
Reclamation District 108		250		250
Reclamation District 2068		75		75
Sacramento County Water Agency		200		200
Sycamore Mutual Water Company		125		125
Te Velde Revocable Family Trust		143		143
Tule Basin Farms		125	190	190
Grand Total	**250**	**350**	**190**	**350**

Table F-49. Summary of Minimum Engine Horsepower by Fuel Type

Min of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		50		50
Butte Water District		300		300
City of Sacramento		30		30
Conaway Preservation Group	227	75		75
Cordua Irrigation District		50		50
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	62	30		30
Reclamation District 1004	150	40		40
Reclamation District 108		100		100
Reclamation District 2068		75		75
Sacramento County Water Agency		50		50
Sycamore Mutual Water Company		75		75
Te Velde Revocable Family Trust		52		52
Tule Basin Farms		125	190	125
Grand Total	**62**	**30**	**190**	**30**

Table F-50. General Conformity Applicability Evaluation (Mitigated Emissions)

County/ Nonattainment Area	Emissions (tons per year)							
	VOC	NOx	CO	SOx		PM10	PM2.5	
	Sacramento Metro[1,5]	Sacramento Metro[1,5]	Sacramento Area[2]	Sacramento[3,4]	Yuba City-Marysville[6]	Sacramento Co.	Sacramento[4]	Yuba City-Marysville[6]
Colusa	--	--	--	--	--	--	--	--
Glenn	--	--	--	--	--	--	--	--
Sacramento	0.1	4.9	0.4	0.001	--	0.01	0.01	--
Shasta	--	--	--	--	--	--	--	--
Solano	0.0	0.0	--	--	--	--	--	--
Sutter	0.3	3.6	--	--	3.1	--	--	0.5
Tehama	--	--	--	--	--	--	--	--
Yolo	0.7	7.9	--	--	--	--	--	--
Yuba	--	--	--	--	0.0	--	--	0.0
Total	1.2	16.3	0.4	0.001	3.1	0.01	0.01	0.5
Classification	Severe	Severe	Maintenance	PM2.5 Precursor	PM2.5 Precursor	Maintenance	Nonattainment	Nonattainment
De Minimis Threshold (tpy)	25	25	100	100	100	100	100	100
Exceed?	No	No	No	No	No	No	No	No

Note:

[1]The Sacramento Metro 8-hour O3 nonattainment area consists of Sacramento and Yolo Counties and parts of El Dorado, Placer, Solano, and Sutter Counties. Emissions occurring within the attainment area of these counties are excluded from the total emissions.

[2]The Sacramento Area CO maintenance area is based on the Census Bureau Urbanized Area and consists of parts of Placer, Sacramento, and Yolo Counties. The general conformity applicability evaluation is based on emissions that would occur within the entire county to be conservative.

[3]All counties are designated as attainment areas for SO2; however, since SO2 is a precursor to PM2.5, its emissions must be evaluated under general conformity.

[4]The 24-hour PM2.5 nonattainment area for Sacramento includes Sacramento County and parts of El Dorado, Placer, Solano, and Yolo Counties. The general conformity applicability analysis assumes that all emissions that could occur within each county would occur within the Sacramento nonattainment area to be conservative.

[5]VOC and NOx emissions are excluded from Sutter County for Cranmore Farms, Garden Highway Mutual Water Company, Gilsizer Slough Ranch, Pelger Mutual Water Company, Reclamation District 1004, and Tule Basin Farms because they are located in areas designated as attainment for the federal 8-hour O3 NAAQS.

[6]The Yuba City-Marysville PM2.5 nonattainment area contains all of Sutter County and a part of Yuba County.

Table F-51. Emissions Outside of 8-Hour Ozone Nonattainment Area (tons per year)

Water Agency	County	VOC	NOx
Cranmore Farms	Sutter	Electric	Electric
Garden Highway Mutual Water Company	Sutter	Electric	Electric
Gilsizer Slough Ranch	Sutter	0.1	1.8
Pelger Mutual Water Company	Sutter	0.1	1.2
Reclamation District 1004	Sutter	n/a	n/a
Tule Basin Farms	Sutter	0.3	1.4
Total		0.4	4.3

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-52. Daily VOC Emissions

Water Agency	Daily VOC Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									13.32		13.32
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.92				0.92
Pleasant Grove-Verona Mutual Water Company							2.21		Electric		2.21
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		27.07	3.98				n/a				31.05
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				1.57							1.57
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.26				1.26
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							3.70				3.70
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**28.61**	**3.98**	**1.57**	**0.00**	**0.00**	**8.10**	**0.00**	**13.32**	**0.00**	**55.58**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-53. Daily NOx Emissions

Water Agency	Daily NOx Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									147.70		147.70
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		29.38									29.38
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							17.49				17.49
Pleasant Grove-Verona Mutual Water Company							22.80		Electric		22.80
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		354.91	49.10				n/a				404.01
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				54.26							54.26
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							23.92				23.92
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							19.21				19.21
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**384.29**	**49.10**	**54.26**	**0.00**	**0.00**	**83.42**	**0.00**	**147.70**	**0.00**	**718.77**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-54. Daily CO Emissions

Water Agency	Daily CO Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									125.01		125.01
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		27.06									27.06
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							23.01				23.01
Pleasant Grove-Verona Mutual Water Company							48.31		Electric		48.31
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		118.57	10.58				n/a				129.15
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				4.22							4.22
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							31.47				31.47
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							9.95				9.95
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**145.63**	**10.58**	**4.22**	**0.00**	**0.00**	**112.75**	**0.00**	**125.01**	**0.00**	**398.18**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-55. Daily SOx Emissions

Water Agency	Daily SOx Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									25.40		25.40
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		9.63									9.63
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							5.73				5.73
Pleasant Grove-Verona Mutual Water Company							13.72		Electric		13.72
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		36.05	3.25				n/a				39.29
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							7.84				7.84
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**45.68**	**3.25**	**0.01**	**0.00**	**0.00**	**27.32**	**0.00**	**25.40**	**0.00**	**101.65**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-56. Daily PM10 Emissions

Water Agency	Daily PM10 Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							1.49		Electric		1.49
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.37	0.52				n/a				6.90
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.13							0.13
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.89				1.89
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.92**	**0.52**	**0.13**	**0.00**	**0.00**	**5.07**	**0.00**	**6.39**	**0.00**	**20.04**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Daily Groundwater Substitution Emissions by County (Mitigated)

Table F-57. Daily PM2.5 Emissions

Water Agency	Daily PM2.5 Emissions (lbs/day)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.39		6.39
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.55									1.55
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.38				1.38
Pleasant Grove-Verona Mutual Water Company							1.47		Electric		1.47
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		6.30	0.51				n/a				6.81
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.13							0.13
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.89				1.89
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.31				0.31
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**7.84**	**0.51**	**0.13**	**0.00**	**0.00**	**5.06**	**0.00**	**6.39**	**0.00**	**19.93**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-58. Annual VOC Emissions

Water Agency	Annual VOC Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.71		0.71
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.06				0.06
Pleasant Grove-Verona Mutual Water Company							0.35		Electric		0.35
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.03	0.15				n/a				1.18
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.14							0.14
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.09				0.09
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.27				0.27
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**1.14**	**0.15**	**0.14**	**0.00**	**0.00**	**0.77**	**0.00**	**0.71**	**0.00**	**2.92**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-59. Annual NOx Emissions

Water Agency	Annual NOx Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									7.89		7.89
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		2.14									2.14
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.16				1.16
Pleasant Grove-Verona Mutual Water Company							3.56		Electric		3.56
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		13.49	1.87				n/a				15.36
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				4.88							4.88
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							1.77				1.77
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							1.41				1.41
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**15.64**	**1.87**	**4.88**	**0.00**	**0.00**	**7.90**	**0.00**	**7.89**	**0.00**	**38.17**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-60. Annual CO Emissions

Water Agency	Annual CO Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									6.68		6.68
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		1.97									1.97
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							1.53				1.53
Pleasant Grove-Verona Mutual Water Company							7.54		Electric		7.54
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		4.51	0.40				n/a				4.91
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.38							0.38
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							2.33				2.33
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.73				0.73
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**6.48**	**0.40**	**0.38**	**0.00**	**0.00**	**12.13**	**0.00**	**6.68**	**0.00**	**26.07**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-61. Annual SOx Emissions

Water Agency	Annual SOx Emissions (tons per year)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									1.36		1.36
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.70									0.70
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.38				0.38
Pleasant Grove-Verona Mutual Water Company							2.14		Electric		2.14
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		1.37	0.12				n/a				1.49
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.00							0.00
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.58				0.58
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.00				0.00
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**2.07**	**0.12**	**0.00**	**0.00**	**0.00**	**3.10**	**0.00**	**1.36**	**0.00**	**6.66**

Note:

Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-62. Annual PM10 Emissions

Water Agency	Annual PM10 Emissions (tons per year)										
	Butte	**Colusa**	**Glenn**	**Sacramento**	**Shasta**	**Solano**	**Sutter**	**Tehama**	**Yolo**	**Yuba**	**Total**
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.23		Electric		0.23
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.14				0.14
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.36**	**0.02**	**0.01**	**0.00**	**0.00**	**0.49**	**0.00**	**0.34**	**0.00**	**1.22**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

Summary of Annual Groundwater Substitution Emissions by County (Mitigated)

Table F-63. Annual PM2.5 Emissions

Water Agency	Annual PM2.5 Emissions (tons per year)										
	Butte	Colusa	Glenn	Sacramento	Shasta	Solano	Sutter	Tehama	Yolo	Yuba	Total
Sacramento River of Analysis											
Anderson-Cottonwood Irrigation District					Electric			n/a			0.00
Conaway Preservation Group									0.34		0.34
Cordua Irrigation District										Electric	0.00
Cranmore Farms							Electric				0.00
Eastside Mutual Water Company		0.11									0.11
Glenn-Colusa Irrigation District		n/a	Electric								0.00
Natomas Central Mutual Water Company				Electric			Electric				0.00
Pelger Mutual Water Company							0.09				0.09
Pleasant Grove-Verona Mutual Water Company							0.23		Electric		0.23
Reclamation District 108		Electric							Electric		0.00
Reclamation District 1004		0.24	0.02				n/a				0.26
River Garden Farms									Electric		0.00
Sycamore Mutual Water Company		Electric									0.00
Te Velde Revocable Family Trust									Electric		0.00
American River Area of Analysis											
City of Sacramento				Electric							0.00
Sacramento County Water Agency				Electric							0.00
Sacramento Suburban Water District				0.01							0.01
Feather River Area of Analysis											
Butte Water District	n/a						Electric				0.00
Garden Highway Mutual Water Company							Electric				0.00
Gilsizer Slough Ranch							0.14				0.14
Goose Club Farms and Teichert Aggregates							Electric				0.00
Tule Basin Farms							0.02				0.02
Delta Region Area of Analysis											
Reclamation District 2068						Electric			n/a		0.00
Pope Ranch									Electric		0.00
Total	**0.00**	**0.35**	**0.02**	**0.01**	**0.00**	**0.00**	**0.48**	**0.00**	**0.34**	**0.00**	**1.21**

Note:
Counties designated as "n/a" (not applicable) if water agency is located in the county, but no engines would operate in the county.

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Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Pleasant Grove-Verona Mutual Water Company	Federal Attainment Status				Peak Month	
Transfer Volume	18,000 acre feet/year		*Sutter*	*Yolo*		4,000	AF/month
Location	Sutter County	PM10	A	A	*Engines subject to ATCM.*	29,198	gallons/minute
	Yolo County	PM2.5	N	N		37%	peak pump rate
		O3	N	N			

Table F-64. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (gal/yr)	Emission Factors (g/bhp-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
PGVMWCWill-Lee 4A	Will-Lee 4A	Sutter	Diesel	2012	160	T4I	1,500	2%	77	345	4	1,248	11,206	0.14	0.3	3.7	0.93	0.01	0.01	0.20	0.42	5.26	1.31	0.02	0.02	0.03	0.07	0.82	0.20	0.00	0.00
PGVMWCRiver Ranch #19	River Ranch #19	Sutter	Diesel	2010	200	T3	2,500	3%	128	575	4	1,248	14,008	0.1	2.8	2.6	0.93	0.15	0.15	0.26	5.00	4.61	1.64	0.26	0.26	0.04	0.78	0.72	0.26	0.04	0.04
PGVMWCMLF #1	MLF #1	Sutter	Electric		30	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCMLF #2	MLF #2	Sutter	Electric		250	n/a	5,000	6%	255	1,149	4	1,248	n/a																		
PGVMWCMLF Monster Well	MLF Monster Well	Sutter	Electric		60	n/a	3,100	4%	158	713	4	1,248	n/a																		
PGVMWCMLF #17/12	MLF #17/12	Sutter	Electric		50	n/a	1,500	2%	77	345	4	1,248	n/a																		
PGVMWCMLF #11	MLF #11	Sutter	Diesel	2011	250	T4I	4,200	5%	215	966	4	1,248	17,510	0.14	0.3	2.6	0.93	0.01	0.01	0.31	0.66	5.76	2.05	0.03	0.03	0.05	0.10	0.90	0.32	0.01	0.01
PGVMWCMLF #13/15	MLF #13/15	Sutter	Electric		240	n/a	4,800	6%	245	1,103	4	1,248	n/a																		
PGVMWCMLF #16	MLF #16	Sutter	Electric		240	n/a	1,700	2%	87	391	4	1,248	n/a																		
PGVMWCWilley #1	Willey #1	Sutter	Diesel	2012	168	T4I	3,000	4%	153	690	4	1,248	11,767	0.14	0.3	3.7	0.93	0.01	0.01	0.21	0.44	5.53	1.38	0.02	0.02	0.03	0.07	0.86	0.21	0.00	0.00
PGVMWCWilley #2	Willey #2	Sutter	Electric		250	n/a	3,000	4%	153	690	4	1,248	n/a																		
PGVMWCWilley #3	Willey #3	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCWilley #4	Willey #4	Sutter	Diesel	2010	150	T3	3,000	4%	153	690	4	1,248	10,506	0.1	2.8	3.7	0.93	0.22	0.22	0.20	3.75	4.94	1.23	0.30	0.30	0.03	0.59	0.77	0.19	0.05	0.05
PGVMWCScheidel&Osterli #18A	Scheidel&Osterli #18A	Sutter	Electric	TBD	250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCWill-Lee 30	Will-Lee 30	Sutter	Diesel	2012	100	T4I	1,500	2%	77	345	4	1,248	7,004	0.14	0.3	3.7	0.93	0.01	0.01	0.13	0.26	3.29	0.82	0.01	0.01	0.02	0.04	0.51	0.13	0.00	0.00
PGVMWCWill-Lee 31	Will-Lee 31	Sutter	Electric		250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCWill-Lee 32	Will-Lee 32	Sutter	Electric		250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCWill-Lee 33	Will-Lee 33	Sutter	Electric		250	n/a	2,500	3%	128	575	4	1,248	n/a																		
PGVMWCNicholas Sand Field Well	Nicholas Sand Field Well	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCNicholas Filipino Camp #2	Nicholas Filipino Camp #2	Sutter	Electric		40	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas Filipino Camp South	Nicholas Filipino Camp South	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCNicholas Johnston Field Well #2	Nicholas Johnston Field Well #2	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas Johnston Well	Nicholas Johnston Well	Yolo	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas 72-acre Field South	Nicholas 72-acre Field South	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCNicholas 72-Acre Field North	Nicholas 72-Acre Field North	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCNicholas BBC Well	Nicholas BBC Well	Sutter	Electric		250	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCKelly 190 Field Well #2	Kelly 190 Field Well #2	Sutter	Electric		30	n/a	2,000	3%	102	460	4	1,248	n/a																		
PGVMWCKelly Windmill Field Well #2	Kelly Windmill Field Well #2	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCKelly Windmill North Field Well	Kelly Windmill North Field Well	Sutter	Diesel	2008	62.1	T4I	2,000	3%	102	460	4	1,248	4,350	0.2	3.3	3.7	0.93	0.22	0.22	0.10	1.82	2.04	0.51	0.12	0.12	0.01	0.28	0.32	0.08	0.02	0.02
PGVMWCKelly 306 Well	Kelly 306 Well	Sutter	Electric		250	n/a	2,600	3%	133	598	4	1,248	n/a																		
PGVMWCScheidel&Osterli #16	Scheidel&Osterli #16	Sutter	Diesel	2011	234	T4I	3,400	4%	174	782	4	1,248	16,389	0.14	0.3	2.6	0.93	0.01	0.01	0.29	0.62	5.39	1.92	0.03	0.03	0.05	0.10	0.84	0.30	0.00	0.00
PGVMWCScheidel&Osterli #17	Scheidel&Osterli #17	Sutter	Diesel	2010	101	T3	1,500	2%	77	345	4	1,248	7,074	0.1	2.8	3.7	0.93	0.22	0.22	0.13	2.53	3.32	0.83	0.20	0.20	0.02	0.39	0.52	0.13	0.03	0.03
						Total	**78,300**	**100%**	**4,000**	**18,000**	**128**	**39,951**	**117,213**							**2.21**	**22.80**	**48.31**	**13.72**	**1.49**	**1.47**	**0.35**	**3.56**	**7.54**	**2.14**	**0.23**	**0.23**
						Total (Sutter County)	**76,300**	**97%**	**3,898**	**17,540**	**124**	**38,703**	**117,213**							**2.21**	**22.80**	**48.31**	**13.72**	**1.49**	**1.47**	**0.35**	**3.56**	**7.54**	**2.14**	**0.23**	**0.23**
						Total (Yolo County)	**2,000**	**3%**	**102**	**460**	**4**	**1,248**	**0**							**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Notes:
If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).
AP-42 emission factors used for SOx in all cases.
If an emission standard is not available for a given pollutant, then AP-42 emission factors used.
PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend
- (green) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type
- (blue) Emission factor based on NMHC+NOx emission standard
- (purple) Emissions of all pollutants consistent with the applicable tier necessary to control PM emissions under the ATCM for mitigation

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4 lb/hp-hr		*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855 g/mL		*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13 lb/gal		

Daily Hours of Operation	4

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Sacramento Suburban Water District	Federal Attainment Status			Peak Month	
Transfer Volume	30,000 acre feet/year	PM10	M	*Engines subject to ATCM.*	5,000	AF/month
Location	Sacramento County	PM2.5	N		36,498	gallons/minute
		O3	N		74%	peak pump rate

Table F-65. Sacramento Suburban Water District Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (MMBtu/yr)	Emission Factors (lb/MMBtu) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Sacramento Suburban WD5	5	Sacramento	Electric		110	n/a	330	1%	34	201	18	3,312	n/a																		
Sacramento Suburban WD7	7	Sacramento	Electric		110	n/a	180	0%	18	110	18	3,312	n/a																		
Sacramento Suburban WD9	9	Sacramento	Electric		110	n/a	625	1%	64	381	18	3,312	n/a																		
Sacramento Suburban WD12	12	Sacramento	Electric		110	n/a	540	1%	55	329	18	3,312	n/a																		
Sacramento Suburban WD13	13	Sacramento	Electric		110	n/a	820	2%	83	500	18	3,312	n/a																		
Sacramento Suburban WD14	14	Sacramento	Electric		110	n/a	570	1%	58	348	18	3,312	n/a																		
Sacramento Suburban WD18	18	Sacramento	Electric		110	n/a	840	2%	85	512	18	3,312	n/a																		
Sacramento Suburban WD19	19	Sacramento	Electric		110	n/a	950	2%	97	579	18	3,312	n/a																		
Sacramento Suburban WD22	22	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD23	23	Sacramento	Electric		110	n/a	550	1%	56	335	18	3,312	n/a																		
Sacramento Suburban WD24	24	Sacramento	Electric		110	n/a	590	1%	60	360	18	3,312	n/a																		
Sacramento Suburban WD25	25	Sacramento	Electric		110	n/a	750	2%	76	457	18	3,312	n/a																		
Sacramento Suburban WD26	26	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD28	28	Sacramento	Electric		110	n/a	585	1%	59	357	18	3,312	n/a																		
Sacramento Suburban WD30	30	Sacramento	Electric		110	n/a	650	1%	66	396	18	3,312	n/a																		
Sacramento Suburban WD35	35	Sacramento	Electric		110	n/a	1000	2%	102	610	18	3,312	n/a																		
Sacramento Suburban WD37	37	Sacramento	Natural Gas		190	n/a	700	1%	71	427	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD38	38	Sacramento	Natural Gas		190	n/a	500	1%	51	305	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD40	40	Sacramento	Natural Gas		190	n/a	675	1%	69	412	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD41	41	Sacramento	Electric		110	n/a	600	1%	61	366	18	3,312	n/a																		
Sacramento Suburban WD43	43	Sacramento	Electric		110	n/a	850	2%	86	518	18	3,312	n/a																		
Sacramento Suburban WD45	45	Sacramento	Natural Gas		190	n/a	750	2%	76	457	2.5	450	599	0.118	4.08	0.317	0.000588	0.009987	0.009987	0.39	13.57	1.05	0.00	0.03	0.03	0.04	1.22	0.09	0.00	0.00	0.00
Sacramento Suburban WD47	47	Sacramento	Electric		110	n/a	885	2%	90	540	18	3,312	n/a																		
Sacramento Suburban WD50	50	Sacramento	Electric		110	n/a	500	1%	51	305	18	3,312	n/a																		
Sacramento Suburban WD51	51	Sacramento	Electric		110	n/a	285	1%	29	174	18	3,312	n/a																		
Sacramento Suburban WD60	60	Sacramento	Electric		110	n/a	600	1%	61	366	18	3,312	n/a																		
Sacramento Suburban WD65	65	Sacramento	Electric		110	n/a	1250	3%	127	762	18	3,312	n/a																		
Sacramento Suburban WD66	66	Sacramento	Electric		110	n/a	1350	3%	137	823	18	3,312	n/a																		
Sacramento Suburban WD69	69	Sacramento	Electric		110	n/a	450	1%	46	274	18	3,312	n/a																		
Sacramento Suburban WD70	70	Sacramento	Electric		110	n/a	350	1%	36	213	18	3,312	n/a																		
Sacramento Suburban WD71	71	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD72	72	Sacramento	Electric		110	n/a	1850	4%	188	1,128	18	3,312	n/a																		
Sacramento Suburban WD73	73	Sacramento	Electric		110	n/a	3500	7%	356	2,134	18	3,312	n/a																		
Sacramento Suburban WD74	74	Sacramento	Electric		110	n/a	2700	5%	274	1,647	18	3,312	n/a																		
Sacramento Suburban WD75	75	Sacramento	Electric		110	n/a	1150	2%	117	701	18	3,312	n/a																		
Sacramento Suburban WD76	76	Sacramento	Electric		110	n/a	250	1%	25	152	18	3,312	n/a																		
Sacramento Suburban WD77	77	Sacramento	Electric		110	n/a	400	1%	41	244	18	3,312	n/a																		
Sacramento Suburban WD20A	20A	Sacramento	Electric		110	n/a	1100	2%	112	671	18	3,312	n/a																		
Sacramento Suburban WD2A	2A	Sacramento	Electric		110	n/a	995	2%	101	607	18	3,312	n/a																		
Sacramento Suburban WD32A	32A	Sacramento	Electric		110	n/a	1905	4%	194	1,162	18	3,312	n/a																		
Sacramento Suburban WD33A	33A	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD3A	3A	Sacramento	Electric		110	n/a	370	1%	38	226	18	3,312	n/a																		
Sacramento Suburban WD40A	40A	Sacramento	Electric		110	n/a	2525	5%	257	1,540	18	3,312	n/a																		
Sacramento Suburban WD46R	46R	Sacramento	Electric		110	n/a	800	2%	81	488	18	3,312	n/a																		
Sacramento Suburban WD4B	4B	Sacramento	Electric		110	n/a	2675	5%	272	1,631	18	3,312	n/a																		
Sacramento Suburban WD55A	55A	Sacramento	Electric		110	n/a	2000	4%	203	1,220	18	3,312	n/a																		
Sacramento Suburban WD68R	68R	Sacramento	Electric		110	n/a	1600	3%	163	976	18	3,312	n/a																		
						Total	**49,195**	**100%**	**5,000**	**30,000**	**790**	**144,209**	**2,394**							**1.57**	**54.26**	**4.22**	**0.01**	**0.13**	**0.13**	**0.14**	**4.88**	**0.38**	**0.00**	**0.01**	**0.01**

Legend

(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
(lavender)	Dual-fuel engine (electric and natural gas) required to operate in electric mode to mitigate emissions
(orange)	Operation of natural gas fired engines will be controlled to reduce emissions less than significance thresholds as mitigation

Conversion Factors

1 MMBtu =	1,000,000	Btu
1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr	(Estimated from Waukesha engine specifications)
Higher Heating Value	1,020	Btu/scf	(AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Gilsizer Slough Ranch		Federal Attainment Status			Peak Month		
Transfer Volume	3,900	acre feet/year	PM10	A	*Engines subject to ATCM.*	800	AF/month	
Location	Sutter	County	PM2.5	N		5,840	gallons/minute	
			O3	N		97%	peak pump rate	

Table F-66. Gilsizer Slough Ranch Criteria Pollutant Emissions

Description	Well	Well Location	Fuel Type	Model Year	Power Rating	Emission	Pump Rate		Transfer Volume		Operation		Fuel Consumption	Emission Factors (g/bhp-hr)						Daily Emissions (lbs/day)						Annual Emissions (tons per year)					
		(County)			(hp)	Tier	(gpm)	(% of Total)	(AF/month)	(AF/year)	(hours/day)	(hours/year)	(gal/yr)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Gilsizer #1	Gilsizer #1	Sutter	Diesel	2011	162	T3	2,016	33%	267	1,300	24	3,502	31,828	0.1	2.8	3.7	0.93	0.22	0.22	1.26	23.92	31.47	7.84	1.89	1.89	0.09	1.77	2.33	0.58	0.14	0.14
Gilsizer #2	Gilsizer #2	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
Gilsizer #3	Gilsizer #3	Sutter	Electric	TBD	110	n/a	2,016	33%	267	1,300	24	3,502	n/a																		
						Total	**6,048**	**100%**	**800**	**3,900**	**71**	**10,506**	**31,828**							**1.26**	**23.92**	**31.47**	**7.84**	**1.89**	**1.89**	**0.09**	**1.77**	**2.33**	**0.58**	**0.14**	**0.14**

Notes:

If a specific HP and emission tier combination has an emission standard of NMHC+NOx, then 95% of emissions assumed to be NOx and 5% of emissions assumed to be VOC (see CARB Carl Moyer Program Guidelines).

AP-42 emission factors used for SOx in all cases.

If an emission standard is not available for a given pollutant, then AP-42 emission factors used.

PM2.5 assumed to be 98% of PM10 emissions based on size fractions for stationary internal combustion diesel engines.

Legend

(green shading)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type
(blue shading)	Based on NMHC+NOx standard

Conversion Factors

1 lb =	453.6	g
1 ton =	2,000	lbs
1 month =	30.4	days
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Diesel Engine Fuel Consumption

0.4	lb/hp-hr	*(Based on spec sheet for John Deere 6068H, 6.8L Engine, 173 HP)*
0.855	g/mL	*(Based on MSDS for Hess Diesel Fuel All Types)*
7.13	lb/gal	

Groundwater Substitution Air Quality Emissions (Mitigated)

Agency	Tule Basin Farms	Federal Attainment Status			Peak Month
Transfer Volume	7,320 acre feet/year	PM10	A	*Engines subject to ATCM.*	1,520 AF/month
Location	Sutter County	PM2.5	N		11,095 gallons/minute
		O3	N		96% peak pump rate

Table F-67. Tule Basin Farms Criteria Pollutant Emissions

Description	Well	Well Location (County)	Fuel Type	Model Year	Power Rating (hp)	Emission Tier	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/month)	Transfer Volume (AF/year)	Operation (hours/day)	Operation (hours/year)	Fuel Consumption (MMBtu/yr)	Emission Factors (lb/MMBtu) VOC	NOx	CO	SOx	PM10	PM2.5	Daily Emissions (lbs/day) VOC	NOx	CO	SOx	PM10	PM2.5	Annual Emissions (tons per year) VOC	NOx	CO	SOx	PM10	PM2.5
Tule Basin1	1	Sutter	Electric		125	n/a	3,050	27%	403	1,941	24	3,457	n/a																		
Tule Basin2	2	Sutter	Natural Gas	1985	190	n/a	3,600	31%	476	2,291	24	3,457	4,598	0.118	0.61	0.317	0.000588	0.009987	0.009987	3.70	19.21	9.95	0.02	0.31	0.31	0.27	1.41	0.73	0.00	0.02	0.02
Tule Basin3	3	Sutter	Electric		125	n/a	4,850	42%	641	3,087	24	3,457	n/a																		
						Total	**11,500**	**100%**	**1,520**	**7,320**	**71**	**10,371**	**4,598**							**3.70**	**19.21**	**9.95**	**0.02**	**0.31**	**0.31**	**0.27**	**1.41**	**0.73**	**0.00**	**0.02**	**0.02**

Conversion Factors

1 MMBtu =	1,000,000 Btu
1 ton =	2,000 lbs
1 month =	30.4 days
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000 Btu/bhp-hr	(Estimated from Waukesha engine specifications)
Higher Heating Value	1,020 Btu/scf	(AP-42, Chapter 3.2: Natural Gas-fired Reciprocating Engines)

SCR control efficiency	85%

Table F-68. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Butte Water District												
Exhaust Emissions	(1)	(13)	(17)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(142)	(21)	--	--	--	--	(13)	(2)
Harvesting	--	--	--	--	(17)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	6	1	--	--	--	--	1	0
Butte Water District Subtotal	(1)	(13)	(17)	(4)	(153)	(23)	(0)	(1)	(1)	(0)	(14)	(2)
Conaway Preservation Group												
Exhaust Emissions	(1)	(23)	(31)	(8)	(2)	(2)	(0)	(2)	(2)	(1)	(0)	(0)
Land Preparation	--	--	--	--	(205)	(31)	--	--	--	--	(18)	(3)
Harvesting	--	--	--	--	(40)	(6)	--	--	--	--	(4)	(1)
Wind Erosion	--	--	--	--	18	4	--	--	--	--	2	0
Conaway Preservation Group Subtotal	(1)	(23)	(31)	(8)	(228)	(35)	(0)	(2)	(2)	(1)	(21)	(3)
Cranmore Farms												
Exhaust Emissions	(0)	(3)	(4)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(61)	(9)	--	--	--	--	(6)	(1)
Harvesting	--	--	--	--	(4)	(1)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	1	0	--	--	--	--	0	0
Cranmore Farms Subtotal	(0)	(3)	(4)	(1)	(64)	(10)	(0)	(0)	(0)	(0)	(6)	(1)
Glenn-Colusa Irrigation District												
Exhaust Emissions	(4)	(72)	(95)	(24)	(6)	(6)	(0)	(5)	(6)	(2)	(0)	(0)
Land Preparation	--	--	--	--	(1,550)	(232)	--	--	--	--	(140)	(21)
Harvesting	--	--	--	--	(96)	(14)	--	--	--	--	(9)	(1)
Wind Erosion	--	--	--	--	416	83	--	--	--	--	37	7
Glenn-Colusa Irrigation District Subtotal	(4)	(72)	(95)	(24)	(1,236)	(169)	(0)	(5)	(6)	(2)	(111)	(15)
Goose Club Farms and Teichert Aggregates												
Exhaust Emissions	(1)	(11)	(14)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(245)	(37)	--	--	--	--	(22)	(3)
Harvesting	--	--	--	--	(15)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	6	1	--	--	--	--	1	0
Goose Club Farms and Teichert Aggregates Subtotal	(1)	(11)	(14)	(4)	(255)	(39)	(0)	(1)	(1)	(0)	(23)	(3)
Pelger Mutual Water Company												
Exhaust Emissions	(0)	(3)	(4)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(62)	(9)	--	--	--	--	(6)	(1)
Harvesting	--	--	--	--	(4)	(1)	--	--	--	--	(0)	(0)
Wind Erosion	--	--	--	--	1	0	--	--	--	--	0	0
Pelger Mutual Water Company Subtotal	(0)	(3)	(4)	(1)	(65)	(10)	(0)	(0)	(0)	(0)	(6)	(1)

Table F-68. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Pleasant Grove-Verona Mutual Water Company												
Exhaust Emissions	(1)	(10)	(13)	(3)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(221)	(33)	--	--	--	--	(20)	(3)
Harvesting	--	--	--	--	(13)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	5	1	--	--	--	--	0	0
Pleasant Grove-Verona Mutual Water Company Subtotal	(1)	(10)	(13)	(3)	(230)	(35)	(0)	(1)	(1)	(0)	(21)	(3)
Reclamation District 108												
Exhaust Emissions	(1)	(22)	(29)	(7)	(2)	(2)	(0)	(1)	(2)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(338)	(51)	--	--	--	--	(30)	(5)
Harvesting	--	--	--	--	(33)	(5)	--	--	--	--	(3)	(0)
Wind Erosion	--	--	--	--	75	15	--	--	--	--	7	1
Reclamation District 108 Subtotal	(1)	(22)	(29)	(7)	(298)	(42)	(0)	(1)	(2)	(0)	(27)	(4)
Reclamation District 1004												
Exhaust Emissions	(1)	(11)	(14)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(238)	(36)	--	--	--	--	(21)	(3)
Harvesting	--	--	--	--	(15)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	44	9	--	--	--	--	4	1
Reclamation District 1004 Subtotal	(1)	(11)	(14)	(4)	(210)	(30)	(0)	(1)	(1)	(0)	(19)	(3)
Reclamation District 2068												
Exhaust Emissions	(0)	(8)	(11)	(3)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(39)	(6)	--	--	--	--	(4)	(1)
Harvesting	--	--	--	--	(7)	(1)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	5	1	--	--	--	--	0	0
Reclamation District 2068 Subtotal	(0)	(8)	(11)	(3)	(41)	(6)	(0)	(1)	(1)	(0)	(4)	(1)
Sycamore Mutual Water Company												
Exhaust Emissions	(1)	(11)	(14)	(4)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(242)	(36)	--	--	--	--	(22)	(3)
Harvesting	--	--	--	--	(15)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	66	13	--	--	--	--	6	1
Sycamore Mutual Water Company Subtotal	(1)	(11)	(14)	(4)	(191)	(26)	(0)	(1)	(1)	(0)	(17)	(2)

Table F-68. Summary of Cropland Idling Emissions by Water Agency

	Daily Emissions (lbs per day)						Annual Emissions (tons per year)					
Water Agency	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Te Velde Revocable Family Trust												
Exhaust Emissions	(0)	(8)	(10)	(3)	(1)	(1)	(0)	(1)	(1)	(0)	(0)	(0)
Land Preparation	--	--	--	--	(67)	(10)	--	--	--	--	(6)	(1)
Harvesting	--	--	--	--	(13)	(2)	--	--	--	--	(1)	(0)
Wind Erosion	--	--	--	--	6	1	--	--	--	--	1	0
Te Velde Revocable Family Trust Subtotal	(0)	(8)	(10)	(3)	(75)	(11)	(0)	(1)	(1)	(0)	(7)	(1)
Exhaust Emissions Total	(10)	(195)	(256)	(64)	(15)	(15)	(1)	(13)	(17)	(4)	(1)	(1)
Land Preparation Total	0	0	0	0	(3,409)	(511)	0	0	0	0	(307)	(46)
Harvesting Total	0	0	0	0	(271)	(41)	0	0	0	0	(24)	(4)
Wind Erosion Total	0	0	0	0	651	130	0	0	0	0	59	12
GRAND TOTAL	**(10)**	**(195)**	**(256)**	**(64)**	**(3,045)**	**(437)**	**(1)**	**(13)**	**(17)**	**(4)**	**(274)**	**(39)**

Size Fractions

Description	PM10	PM2.5	Ratio
PM Profile ID No. 411, Windblown Dust - Agricultural	0.5	0.1	0.2
PM Profile ID No. 417, Agricultural Tilling Dust	0.4543	0.0681	0.1499

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Table F-69. Reduced Exhaust Emissions from Cropland Idling

Water Agency	Groundwater Substitution	Cropland Idling/ Crop Shifting	GW Pumping Equivalent	Reduced Daily Emissions (lbs/day)						Reduced Annual Emissions (tons/year)					
	(acre-feet/year)	(acre-feet/year)	(acre-feet/year)	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5
Butte Water District	5,500	11,500	2,706	1	13	17	4	1	1	0.0	0.8	1.1	0.3	0.1	0.1
Conaway Preservation Group	35,000	21,349	5,023	1	23	31	8	2	2	0.1	1.6	2.0	0.5	0.1	0.1
Cranmore Farms	8,000	2,500	588	0	3	4	1	0	0	0.0	0.2	0.2	0.1	0.0	0.0
Glenn-Colusa Irrigation District	25,000	66,000	15,529	4	72	95	24	6	6	0.3	4.8	6.3	1.6	0.4	0.4
Goose Club Farms and Teichert Aggregates	10,000	10,000	2,353	1	11	14	4	1	1	0.0	0.7	1.0	0.2	0.1	0.1
Pelger Mutual Water Company	3,750	2,538	597	0	3	4	1	0	0	0.0	0.2	0.2	0.1	0.0	0.0
Pleasant Grove-Verona Mutual Water Company	18,000	9,000	2,118	1	10	13	3	1	1	0.0	0.7	0.9	0.2	0.1	0.1
Reclamation District 108	15,000	20,000	4,706	1	22	29	7	2	2	0.1	1.5	1.9	0.5	0.1	0.1
Reclamation District 1004	7,175	10,000	2,353	1	11	14	4	1	1	0.0	0.7	1.0	0.2	0.1	0.1
Reclamation District 2068	4,500	7,500	1,765	0	8	11	3	1	1	0.0	0.5	0.7	0.2	0.0	0.0
Sycamore Mutual Water Company	15,000	10,000	2,353	1	11	14	4	1	1	0.0	0.7	1.0	0.2	0.1	0.1
Te Velde Revocable Family Trust	7,094	6,975	1,641	0	8	10	3	1	1	0.0	0.5	0.7	0.2	0.0	0.0
Total	**154,019**	**177,362**	**41,732**	**10**	**195**	**256**	**64**	**15**	**15**	**0.7**	**12.9**	**17.0**	**4.2**	**1.0**	**1.0**

Notes:
Pelger Mutual Water Company used to estimate emissions for other water agencies.
Engine power rating equal to 250 hp for Pelger Mutual Water Company engines.
The Byron Buck memo is based on diesel-fueled engines with sizes ranging from 121 to 225 hp; all engines are noncertified (Tier 0).
Pelger Mutual Water Company engines are therefore determined to be a sufficient proxy to estimate the difference in emissions between groundwater substitution and cropland idling.

1 acre-foot of groundwater pumped = 4.25 acre-feet produced by fallowing
Source: Byron Buck & Associates. 2009. "Comparison of Summertime Emission Credits from Land Fallowing Versus Groundwater Pumping."

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Fugitive Dust Emissions from Cropland Idling

Table F-70. Land Preparation (Reduced Emissions)

District	County	Acres	Daily PM10 Emissions (lbs/day)	Annual PM10 Emissions (tons per year)
		Rice	Rice	Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	0	0
Conaway Preservation Group	Yolo	6,469	205	18
Cordua Irrigation District	Yuba	0	0	0
Cranmore Farms	Sutter	758	61	6
Eastside Mutual Water Company	Colusa	0	0	0
Glenn-Colusa Irrigation District	Glenn/Colusa	20,000	1,550	140
Natomas Central Mutual Water Company	Sacramento/Sutter	0	0	0
Pelger Mutual Water Company	Sutter	769	62	6
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	221	20
Reclamation District 108	Colusa/Yolo	6,061	338	30
Reclamation District 1004	Colusa/Glenn/Sutter	3,030	238	21
River Garden Farms	Yolo	0	0	0
Sycamore Mutual Water Company	Colusa	3,030	242	22
Te Velde Revocable Family Trust	Yolo	2,114	67	6
American River Area of Analysis				
City of Sacramento	Sacramento	0	0	0
Placer County Water Agency	Placer	0	0	0
Sacramento County Water Agency	Sacramento	0	0	0
Sacramento Suburban Water District	Sacramento	0	0	0
Yuba River Area of Analysis				
Browns Valley Irrigation District	Yuba	0	0	0
Feather River Area of Analysis				
Butte Water District	Butte/Sutter	3,485	142	13
Garden Highway Mutual Water Company	Sutter	0	0	0
Gilsizer Slough Ranch	Sutter	0	0	0
Goose Club Farms and Teichert Aggregates	Sutter	3,030	245	22
South Sutter Water District	Sutter/Placer	0	0	0
Tule Basin Farms	Sutter	0	0	0
Merced River Area of Analysis				
Merced Irrigation District	Merced	0	0	0
Delta Region Area of Analysis				
Reclamation District 2068	Solano/Yolo	2,273	39	4
Pope Ranch	Yolo	0	0	0
Total		**53,746**	**3,409**	**307**

Table F-71. Harvesting (Reduced Emissions)

District	County	Acres Rice	Daily PM10 Emissions (lbs/day) Rice	Annual PM10 Emissions (tons per year) Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	0	0
Conaway Preservation Group	Yolo	6,469	40	4
Cordua Irrigation District	Yuba	0	0	0
Cranmore Farms	Sutter	758	4	0
Eastside Mutual Water Company	Colusa	0	0	0
Glenn-Colusa Irrigation District	Glenn/Colusa	20,000	96	9
Natomas Central Mutual Water Company	Sacramento/Sutter	0	0	0
Pelger Mutual Water Company	Sutter	769	4	0
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	13	1
Reclamation District 108	Colusa/Yolo	6,061	33	3
Reclamation District 1004	Colusa/Glenn/Sutter	3,030	15	1
River Garden Farms	Yolo	0	0	0
Sycamore Mutual Water Company	Colusa	3,030	15	1
Te Velde Revocable Family Trust	Yolo	2,114	13	1
American River Area of Analysis				
City of Sacramento	Sacramento	0	0	0
Placer County Water Agency	Placer	0	0	0
Sacramento County Water Agency	Sacramento	0	0	0
Sacramento Suburban Water District	Sacramento	0	0	0
Yuba River Area of Analysis				
Browns Valley Irrigation District	Yuba	0	0	0
Feather River Area of Analysis				
Butte Water District	Butte/Sutter	3,485	17	1
Garden Highway Mutual Water Company	Sutter	0	0	0
Gilsizer Slough Ranch	Sutter	0	0	0
Goose Club Farms and Teichert Aggregates	Sutter	3,030	15	1
South Sutter Water District	Sutter/Placer	0	0	0
Tule Basin Farms	Sutter	0	0	0
Merced River Area of Analysis				
Merced Irrigation District	Merced	0	0	0
Delta Region Area of Analysis				
Reclamation District 2068	Solano/Yolo	2,273	7	1
Pope Ranch	Yolo	0	0	0
Total		**53,746**	**271**	**24**

Table F-72. Windblown Dust (Increased Emissions)

District	County	Acres	Daily PM10 Emissions (lbs/day)	Annual PM10 Emissions (tons per year)
		Rice	Rice	Rice
Sacramento River Area of Analysis				
Anderson-Cottonwood Irrigation District	Shasta/Tehama	0	--	--
Conaway Preservation Group	Yolo	6,469	18	2
Cordua Irrigation District	Yuba	0	--	--
Cranmore Farms	Sutter	758	1	0
Eastside Mutual Water Company	Colusa	0	--	--
Glenn-Colusa Irrigation District	Glenn/Colusa	20,000	416	37
Natomas Central Mutual Water Company	Sacramento/Sutter	0	--	--
Pelger Mutual Water Company	Sutter	769	1	0
Pleasant Grove-Verona Mutual Water Company	Sutter	2,727	5	0
Reclamation District 108	Colusa/Yolo	6,061	75	7
Reclamation District 1004	Colusa/Glenn/Sutter	3,030	44	4
River Garden Farms	Yolo	0	--	--
Sycamore Mutual Water Company	Colusa	3,030	66	6
Te Velde Revocable Family Trust	Yolo	2,114	6	1
American River Area of Analysis				
City of Sacramento	Sacramento	0	--	--
Placer County Water Agency	Placer	0	--	--
Sacramento County Water Agency	Sacramento	0	--	--
Sacramento Suburban Water District	Sacramento	0	--	--
Yuba River Area of Analysis				
Browns Valley Irrigation District	Yuba	0	--	--
Feather River Area of Analysis				
Butte Water District	Butte/Sutter	3,485	6	1
Garden Highway Mutual Water Company	Sutter	0	--	--
Gilsizer Slough Ranch	Sutter	0	--	--
Goose Club Farms and Teichert Aggregates	Sutter	3,030	6	1
South Sutter Water District	Sutter/Placer	0	--	--
Tule Basin Farms	Sutter	0	--	--
Merced River Area of Analysis				
Merced Irrigation District	Merced	0	--	--
Delta Region Area of Analysis				
Reclamation District 2068	Solano/Yolo	2,273	5	0
Pope Ranch	Yolo	0	--	--
Total		**53,746**	**651**	**59**

Note:
Fraction of PM10 (FRPM10) from wind erosion: 0.50
(PM10 Emissions = PM x FRPM10)

Conversions

1 ton =	2,000	pounds	
Project duration =	180	days	(assumes 6-month crop idling season)

Legend

(green)	Windblown dust emission factor for pasture land used because emission factor for agricultural lands not available.
(blue)	Windblown dust emission factor for pasture land used because emission factor for agricultural lands not available (for Yolo County only).
(orange)	Windblown dust emission factor for pasture land used because emission factor for agricultural lands not available (for Sutter County only).

Agricultural Land Preparation

Table F-73. Summary of Crop Profile, Acre-Pass, and Emission Factor

Crop profile	Land Preparation Operations	Category	Acre-Pass	Emission Factor	
				Operation (lbs PM10/Acre-pass)	Crop (lbs PM10/Acre/year)
Alfalfa	Unspecified	Discing	1.25	1.2	4
	Land Maintenance	Land Planing	0.2	12.5	
Almonds	Float	Land Planing	0.25	12.5	3.13
Citrus	Unspecified	Discing	0.06	1.2	0.07
Corn	List & Fertilize	Weeding	1	0.8	6.9
	Mulch Beds	Discing	1	1.2	
	Finish Disc	Discing	1	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
	Stubble Disc	Discing	1	1.2	
Cotton	Land Preparation	Discing	4	1.2	8.9
	Land Maintenance	Land Planing	0.2	12.5	
	Seed Bed Preparation	Weeding	2	0.8	
DryBeans	Land Maintenance	Land Planing	0.2	12.5	7.7
	Chisel	Discing	1	1.2	
	Shaping	Weeding	1	0.8	
	Disc	Discing	2	1.2	
	Listing	Weeding	1	0.8	
Garbanzo	Chisel	Discing	1	1.2	7.7
	Listing	Weeding	1	0.8	
	Shaping	Weeding	1	0.8	
	Disc	Discing	2	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
Garlic	Land Maintenance	Land Planing	0.2	12.5	6.5
	Disc & Roll	Discing	1	1.2	
	Chisel	Discing	1	1.2	
	List	Weeding	1	0.8	
	Shape Beds	Weeding	1	0.8	
Grapes-Raisin	Terrace	Weeding	1	0.8	2.6
	Spring Tooth	Weeding	0.2	0.8	
	Subsoil	Ripping	0.05	4.6	
	Disc & Furrow-out	Discing	1	1.2	
	Level (new vineyard)	Land Planing	0.02	12.5	
Grapes-Table	Subsoil	Ripping	0.05	4.6	0.83
	Disc & Furrow-out	Discing	0.5	1.2	
Grapes-Wine	Level (new vineyard)	Land Planing	0.02	12.5	1.5
	Spring Tooth	Weeding	0.2	0.8	
	Subsoil	Ripping	0.05	4.6	
	Disc & Furrow-out	Discing	0.75	1.2	
Lettuce*	Land Maintenance	Land Planing	0.2	12.5	12.75
	Disc & Roll	Discing	2/2	1.2	
	Chisel	Discing	2/2	1.2	
	List	Weeding	2/2	0.8	
	Plane	Land Planing	½	12.5	
	Shape Beds & Roll	Weeding	2/2	0.8	
Melon	Plow	Discing	1	1.2	5.7
	Shape Beds	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
	Disc	Discing	1	1.2	
No Land Prep.	Unspecified	Discing	0	1.2	0
Onions	List	Weeding	1	0.8	6.5
	Shape Beds	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
	Chisel	Discing	1	1.2	
	Disc & Roll	Discing	1	1.2	

Agricultural Land Preparation

Table F-73. Summary of Crop Profile, Acre-Pass, and Emission Factor

Crop profile	Land Preparation Operations	Category	Acre-Pass	Emission Factor: Operation (lbs PM10/Acre-pass)	Emission Factor: Crop (lbs PM10/Acre/year)
Rice	Chisel	Discing	1	1.2	20
	Land Maintenance	Land Planing	0.2	12.5	
	Post Burn/Harvest Disc	Discing	0.5	1.2	
	Roll	Weeding	1	0.8	
	3 Wheel Plane	Land Planing	1	12.5	
	Harrow Disc	Discing	1	1.2	
	Stubble Disc	Discing	1	1.2	
Safflower	List	Weeding	1	0.8	4.5
	Land Maintenance	Land Planing	0.2	12.5	
	Stubble Disc	Discing	1	1.2	
Sugar Beets	Disc	Discing	1	1.2	22.8
	Land Plane	Land Planing	1	12.5	
	Subsoil-deep chisel	Ripping	1	4.6	
	Stubble Disc	Discing	1	1.2	
	List	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
Tomatoes	Bed Preparation	Weeding	2	0.8	10.1
	Land Preparation	Discing	5	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
Vegetables	Land Maintenance	Land Planing	0.2	12.5	8.5
	Unspecified	Discing	5	1.2	
Wheat	Stubble Disc	Discing	1	1.2	3.7
	Land Maintenance	Land Planing	0.2	12.5	

Source:
CARB. 2003. Emission Inventory Documentation, Section 7.4: Agricultural Land Preparation. January.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
101999	WHEAT ALL	Wheat	Wheat/1	5.8
104999	RYE FOR GRAIN	Wheat	Wheat/1	5.8
106199	RICE, FOR MILLING	Rice	Cotton/2	1.68
106269	FIELD CROP BY PRODUCTS	Cotton	Cotton/20	0.17
108999	FOOD GRAINS, MISC	Corn	Cotton/2	1.68
111559	CORN, WHITE	Corn	Cotton/40	0.08
111991	CORN FOR GRAIN	Corn	Cotton/2	1.68
111992	CORN FOR SILAGE	Corn	Cotton/20	0.17
112999	OATS FOR GRAIN	Wheat	Wheat/1	5.8
113994	BARLEY, MALTING	Wheat	Wheat/1	5.8
113995	BARLEY, FEED	Wheat	Wheat/1	5.8
113999	BARLEY, UNSPECIFIED	Wheat	Wheat/1	5.8
114991	SORGHUM, GRAIN	Wheat	Wheat/1	5.8
121219	COTTON LINT, UPLAND	Cotton	Cotton/1	3.37
121229	COTTON LINT, PIMA	Cotton	Cotton/1	3.37
121299	COTTON LINT, UNSPEC	Cotton	Cotton/1	3.37
132999	SUGAR BEETS	Sugar Beets	Cotton/2	1.68
151999	COTTONSEED	Cotton	Cotton/1	3.37
153999	PEANUTS, ALL	Safflower	Cotton/2	1.68
158269	SAFFLOWER	Safflower	Wheat/1	5.8
158316	SUNFLOWER SEED, PLANTING	Corn	Wheat/1	5.8
158319	SUNFLOWER SEED	Corn	Wheat/1	5.8
158499	JOJOBA	Melon	Cotton/40	0.08
161131	BEANS, LIMAS, LG. DRY	DryBeans	Cotton/2	1.68
161132	BEANS, LIMAS, BABY DRY	DryBeans	Cotton/2	1.68
161199	LIMA BEANS, UNSPECIFIED	DryBeans	Cotton/2	1.68
161717	BEANS, RED KIDNEY	DryBeans	Cotton/2	1.68
161721	BEANS, PINK	DryBeans	Cotton/2	1.68
161741	BEANS, BLACKEYE (PEAS)	DryBeans	Cotton/2	1.68
161742	BEANS, GARBANZO	Garbanzo	Cotton/2	1.68
162399	BEANS, FAVA	DryBeans	Cotton/2	1.68
163999	PEAS, DRY EDIBLE	DryBeans	Cotton/20	0.17
169999	BEANS,UNSPEC. DRY EDIBLE	DryBeans	Cotton/2	1.68
171019	SEED WHEAT	Wheat	Wheat/1	5.8
171049	SEED RYE	Wheat	Wheat/1	5.8
171069	SEED RICE	Rice	Cotton/2	1.68
171129	SEED OATS	Wheat	Wheat/1	5.8
171139	SEED BARLEY	Wheat	Wheat/1	5.8
171519	SEED, COTTON FOR PLANTING	Cotton	Cotton/1	3.37
171582	SEED, SAFFLOWER, PLANTING	Safflower	Wheat/1	5.8
171619	SEED BEANS	DryBeans	Cotton/2	1.68
171639	SEED PEAS	DryBeans	Cotton/20	0.17
171949	SEED, MISC FIELD CROP	Corn	Cotton/20	0.17
171959	SEED, VEG & VINECROP	Vegetables	Cotton/20	0.17
172119	SEED, ALFALFA	Alfalfa	Zero/1	0
172289	CLOVER, UNSPECIFIED SEED	Alfalfa	Zero/1	0
173079	SEED, BERMUDA GRASS	Alfalfa	Zero/1	0
173669	SEED, SUDAN GRASS	Alfalfa	Zero/1	0
173999	SEED, GRASS, UNSPECIFIED	Alfalfa	Zero/1	0
178999	SEED, OTHER (NO FLOWERS)	Alfalfa	Cotton/20	0.17
181999	HAY, ALFALFA	Alfalfa	Zero/1	0
188499	HAY, GRAIN	Alfalfa	Cotton/2	1.68
188799	HAY, WILD	Alfalfa	Cotton/2	1.68
188899	HAY, SUDAN	Alfalfa	Zero/1	0
188999	HAY, OTHER UNSPECIFIED	Alfalfa	Cotton/2	1.68

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
194599	PASTURE, IRRIGATED	No Land	Zero/1	0
194699	PASTURE, RANGE	No Land	Zero/1	0
194799	PASTURE, MISC. FORAGE	No Land	Zero/1	0
195199	SILAGE	Wheat	Cotton/20	0.17
195299	HAY, GREEN CHOP	Alfalfa	Zero/1	0
195399	STRAW	Alfalfa	Wheat/1	5.8
198199	RICE, WILD	Rice	Cotton/2	1.68
198999	FIELD CROPS, UNSPEC.	Corn	Cotton/20	0.17
201119	ORANGES, NAVEL	Citrus	Cotton/40	0.08
201519	ORANGES, VALENCIAS	Citrus	Cotton/40	0.08
201999	ORANGES, UNSPECIFIED	Citrus	Cotton/40	0.08
202999	GRAPEFRUIT, ALL	Citrus	Cotton/40	0.08
203999	TANGERINES & MANDARINS	Citrus	Cotton/40	0.08
204999	LEMONS, ALL	Citrus	Cotton/40	0.08
205999	LIMES, ALL	Citrus	Cotton/40	0.08
206999	TANGELOS	Citrus	Cotton/40	0.08
207999	KUMQUATS	Citrus	Cotton/40	0.08
208059	CITRUS, MISC BY-PROD	Citrus	Cotton/40	0.08
209999	CITRUS, UNSPECIFIED	Citrus	Cotton/40	0.08
211999	APPLES, ALL	Citrus	Cotton/40	0.08
212199	PEACHES, FREESTONE	Citrus	Cotton/40	0.08
212399	PEACHES, CLINGSTONE	Citrus	Cotton/40	0.08
212999	PEACHES, UNSPECIFIED	Citrus	Cotton/40	0.08
213199	CHERRIES, SWEET	Citrus	Cotton/40	0.08
214199	PEARS, BARLETT	Citrus	Cotton/40	0.08
214899	PEARS, ASIAN	Citrus	Cotton/40	0.08
214999	PEARS, UNSPECIFIED	Citrus	Cotton/40	0.08
215199	PLUMS	Citrus	Cotton/40	0.08
215399	PLUMCOTS	Citrus	Cotton/40	0.08
215999	PRUNES, DRIED	Citrus	Cotton/40	0.08
216199	GRAPES, TABLE	Grapes-Table	Cotton/20	0.17
216299	GRAPES, WINE	Grapes-Wine	Cotton/20	0.17
216399	GRAPES, RAISIN	Grapes-Raisin	Cotton/20	0.17
216999	GRAPES, UNSPECIFIED	Grapes-Wine	Cotton/20	0.17
217999	APRICOTS, ALL	Citrus	Cotton/40	0.08
218199	NECTARINES	Citrus	Cotton/40	0.08
218299	PERSIMMONS	Citrus	Cotton/40	0.08
218399	POMEGRANATES	Citrus	Cotton/40	0.08
218499	QUINCE	Citrus	Cotton/40	0.08
218839	CHERIMOYAS	Citrus	Cotton/40	0.08
218889	ORCHARD BIOMASS	Almonds	Cotton/40	0.08
218899	FRUITS & NUTS, UNSPEC.	Citrus	Cotton/40	0.08
221999	AVOCADOS, ALL	Citrus	Cotton/40	0.08
224999	DATES	Citrus	Almonds/20	2.04
225999	FIGS, DRIED	Citrus	Almonds/20	2.04
226999	OLIVES	Citrus	Cotton/40	0.08
228019	GUAVAS	Citrus	Cotton/40	0.08
229999	KIWIFRUIT	Citrus	Cotton/40	0.08
230639	BERRIES, BLACKBERRIES	Grapes-Table	Cotton/40	0.08
230869	BERRIES, BOYSENBERRIES	Grapes-Table	Cotton/40	0.08
234799	BERRIES, LOGANBERRIES	Grapes-Table	Cotton/40	0.08
236199	BERRIES, RASPBERRIES	Grapes-Table	Cotton/40	0.08
237199	STRAWBERRIES, FRESH MKT	Melon	Cotton/40	0.08
237299	STRAWBERRIES, PROC	Melon	Cotton/40	0.08
237999	STRAWBERRIES, UNSPECIFIED	Melon	Cotton/40	0.08

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
239999	BERRIES, BUSH, UNSPECIFIED	Grapes-Table	Cotton/40	0.08
261999	ALMONDS, ALL	Almonds	Almonds/1	40.77
263999	WALNUTS, ENGLISH	Almonds	Almonds/1	40.77
264999	PECANS	Almonds	Almonds/10	4.08
265999	WALNUTS, BLACK	Almonds	Almonds/1	40.77
266999	CHESTNUTS	Almonds	Almonds/10	4.08
267999	MACADAMIA NUT	Almonds	Almonds/10	4.08
268079	PISTACHIOS	Almonds	Almonds/10	4.08
268099	ALMOND HULLS	Almonds	Almonds/1	40.77
301999	ARTICHOKES	Melon	Cotton/40	0.08
302199	ASPARAGUS, FRESH MKT	Melon	Cotton/2	1.68
302299	ASPARAGUS, PROC	Melon	Cotton/2	1.68
302999	ASPARAGUS, UNSPECIFIED	Melon	Cotton/2	1.68
303999	BEANS, GREEN LIMAS	DryBeans	Cotton/2	1.68
304199	BEANS, SNAP FR MKT	DryBeans	Cotton/20	0.17
304299	BEANS, SNAP PROC	DryBeans	Cotton/20	0.17
304399	BEANS FRESH UNSPECIFIED	DryBeans	Cotton/20	0.17
304999	BEANS, UNSPECIFIED SNAP	DryBeans	Cotton/20	0.17
305999	BEETS, GARDEN	Sugar Beets	Cotton/2	1.68
306999	RAPINI	Sugar Beets	Cotton/40	0.08
307189	BROCCOLI,FOOD SERV	Vegetables	Cotton/40	0.08
307199	BROCCOLI, FR MKT	Vegetables	Cotton/40	0.08
307299	BROCCOLI, PROC	Vegetables	Cotton/40	0.08
307919	BROCCOLI, UNSPECIFIED	Vegetables	Cotton/40	0.08
308999	BRUSSELS SPROUTS	Melon	Cotton/40	0.08
309999	CABBAGE, CH. & SPECIALTY	Lettuce	Cotton/40	0.08
310999	CABBAGE, HEAD	Lettuce	Cotton/40	0.08
313189	CARROTS, FOOD SERV	Sugar Beets	Cotton/20	0.17
313199	CARROTS, FR MKT	Sugar Beets	Cotton/20	0.17
313299	CARROTS, PROC	Sugar Beets	Cotton/20	0.17
313999	CARROTS, UNSPECIFIED	Sugar Beets	Cotton/20	0.17
314189	CAULIFLOWER, FOOD SERV	Vegetables	Cotton/40	0.08
314199	CAULIFLOWER, FR MKT	Vegetables	Cotton/40	0.08
314299	CAULIFLOWER, PROC	Vegetables	Cotton/40	0.08
314999	CAULIFLOWER, UNSPECIFIED	Vegetables	Cotton/40	0.08
316189	CELERY, FOOD SERV	Lettuce	Cotton/40	0.08
316199	CELERY, FR MKT	Lettuce	Cotton/40	0.08
316299	CELERY, PROC	Lettuce	Cotton/40	0.08
316999	CELERY, UNSPECIFIED	Lettuce	Cotton/40	0.08
318999	RADICCHIO	Lettuce	Cotton/40	0.08
320999	CHIVES	Lettuce	Cotton/40	0.08
322999	COLLARD GREENS	Lettuce	Cotton/40	0.08
323999	CORN, SWEET ALL	Corn	Cotton/40	0.08
325999	CUCUMBERS	Vegetables	Cotton/40	0.08
330999	EGGPLANT, ALL	Vegetables	Cotton/40	0.08
331999	ENDIVE, ALL	Lettuce	Cotton/40	0.08
332999	ESCAROLE, ALL	Lettuce	Cotton/40	0.08
333999	ANISE (FENNEL)	Lettuce	Cotton/2	1.68
335999	GARLIC, ALL	Garlic	Cotton/2	1.68
337999	KALE	Lettuce	Cotton/40	0.08
338999	KOHLRABI	Lettuce	Cotton/40	0.08
339196	LETTUCE, BULK SALAD PRODS.	Lettuce	Cotton/40	0.08
339999	LETTUCE, UNSPECIFIED	Lettuce	Cotton/40	0.08
340999	LETTUCE, HEAD	Lettuce	Cotton/40	0.08
341999	LETTUCE, ROMAINE	Lettuce	Cotton/40	0.08

Agricultural Harvest Operations

Table F-74. Summary of Crop Emission Factor Assumptions

CDFA Crop Code	CDFA Crop Description	Crop Profile	Assumption	Emission Factor (lbs PM10/acre/yr)
342999	LETTUCE, LEAF	Lettuce	Cotton/40	0.08
343999	MELON, CANTALOUPE	Melon	Cotton/40	0.08
348999	MELON, HONEYDEW	Melon	Cotton/40	0.08
354299	MELON, UNSPECIFIED	Melon	Cotton/40	0.08
354999	MELON, WATER MELONS	Melon	Cotton/40	0.08
355999	MUSHROOMS	No Land Prep.	Zero/1	0
356999	MUSTARD	Lettuce	Cotton/40	0.08
357999	OKRA	Lettuce	Cotton/40	0.08
358999	ONIONS	Onions	Cotton/2	1.68
359999	PARSLEY	Lettuce	Cotton/40	0.08
361299	PEAS, GREEN, PROCESSING	DryBeans	Cotton/20	0.17
361999	PEAS, GREEN, UNSPECIFIED	DryBeans	Cotton/20	0.17
363999	PEPPERS, BELL	Tomatoes	Cotton/40	0.08
364999	PEPPERS, CHILI, HOT	Tomatoes	Cotton/40	0.08
366999	PUMPKINS	Melon	Cotton/20	0.17
367999	RADISHES	Sugar Beets	Cotton/40	0.08
368999	RHUBARB	Lettuce	Cotton/40	0.08
370999	RUTABAGAS	Sugar Beets	Cotton/2	1.68
372999	ONIONS, GREEN & SHALLOTS	Onions	Cotton/40	0.08
374189	SPINACH, FOOD SERV	Lettuce	Cotton/40	0.08
374199	SPINACH, FR MKT	Lettuce	Cotton/40	0.08
374299	SPINACH, PROC	Lettuce	Cotton/40	0.08
374999	SPINACH UNSPECIFIED	Lettuce	Cotton/40	0.08
375999	SQUASH	Melon	Cotton/20	0.17
376999	SWISSCHARD	Lettuce	Cotton/40	0.08
378199	TOMATOES, FRESH MARKET	Tomatoes	Cotton/40	0.08
378299	TOMATOES, PROCESSING	Tomatoes	Cotton/20	0.17
378999	TOMATOES, UNSPECIFIED	Tomatoes	Cotton/20	0.17
380999	TURNIPS, ALL	Sugar Beets	Cotton/2	1.68
381999	GREENS, TURNIP & MUSTARD	Lettuce	Cotton/40	0.08
387999	LEEKS	Onions	Cotton/40	0.08
391999	POTATOES, IRISH ALL	Sugar Beets	Cotton/2	1.68
392999	SWEET POTATOES	Sugar Beets	Cotton/2	1.68
393999	HORSERADISH	Onions	Cotton/40	0.08
394199	SALAD GREENS NEC	Lettuce	Cotton/40	0.08
394999	PEAS, EDIBLE POD (SNOW)	DryBeans	Cotton/20	0.17
395999	VEGETABLES, ORIENTAL, ALL	Vegetables	Cotton/40	0.08
396999	SPROUTS, ALFALFA & BEAN	Lettuce	Cotton/40	0.08
398199	CUCUMBERS, GREENHOUSE	No Land Prep.	Zero/1	0
398299	TOMATOES, GREENHOUSE	No Land Prep.	Zero/1	0
398399	TOMATOES, CHERRY	Tomatoes	Cotton/40	0.08
398499	TOMATILLO	Tomatoes	Cotton/40	0.08
398559	CILANTRO	Lettuce	Cotton/40	0.08
398599	SPICES AND HERBS	Lettuce	Cotton/40	0.08
398899	VEGETABLES, BABY	Vegetables	Cotton/40	0.08
398999	VEGETABLES, UNSPECIFIED	Vegetables	Cotton/20	0.17
832919	POTATOES SEED	Sugar Beets	Cotton/2	1.68
892999	NURSERY TURF	No Land Prep.	Zero 1	0

Source:
CARB. 2003. Emission Inventory Documentation, Section 7.5: Agricultural Harvest Operations. January.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm.

Windblown Dust - Agricultural Lands

Table F-75. Windblown Dust - Agricultural Lands

Air Basin Code	County Name	Emission Factor (tons/acre/yr)	Process Rate (acres)	PM Emissions (tons/year)
NCC	Monterey	0.020478	279,178.00	5,717.07
	San Benito	0.015936	50,009.00	796.96
	Santa Cruz	0.002485	14,873.00	36.97
SCC	San Luis Obispo	0.006876	109,694.00	754.2
	Santa Barbara	0.00319	80,732.00	257.56
	Ventura	0.018418	54,568.00	1,005.02
SED	Imperial	0.141666	490,409.00	69,474.43
SJV	Fresno	0.013761	864,164.00	11,891.35
	Kern	0.008662	408,313.48	3,536.73
	Kings	0.012856	473,817.00	6,091.62
	Madera	0.008032	141,617.00	1,137.47
	Merced	0.013659	364,804.00	4,982.86
	San Joaquin	0.003527	387,278.00	1,365.96
	Stanislaus	0.009052	229,805.00	2,080.26
	Tulare	0.004693	471,664.00	2,213.29
SV	Butte	0.001154	116,869.00	134.87
	Colusa	0.004702	229,747.00	1,080.31
	Glenn	0.004957	186,067.00	922.39
	Placer	0.002172	6,962.90	15.12
	Sacramento	0.002479	117,770.00	291.92

Note:
Fraction of PM10 (FRPM10): 0.50
(PM10 Emissions = PM x FRPM10)

Table F-76. Windblown Dust - Pasture Lands

Air Basin Code	County Name	Emission Factor (tons/acre/yr)	Process Rate (acres)	PM Emissions (tons/year)
NCC	Monterey	0.00110562	1,108,000	1,225.03
	San Benito	0.00109336	512,000	559.8
	Santa Cruz	0.0001605	8,000	1.28
SCC	Santa Barbara	0.00021801	602,913	131.44
	San Luis Obispo	0.00046964	1,102,500	517.78
	Ventura	0.00050356	210,918	106.21
SED	Imperial	0.00867346	158,449	1,374.30
SJV	Fresno	0.00149089	907,300	1,352.69
	Kern	0.00082834	1,527,603	1,265.37
	Kings	0.00146875	142,777	209.7
	Madera	0.00116178	421,000	489.11
	Merced	0.00155578	642,700	999.9
	San Joaquin	0.0005228	167,700	87.67
	Stanislaus	0.00107875	434,300	468.5
	Tulare	0.00063424	713,400	452.47
SV	Butte	0.00014292	288,500	41.23
	Colusa	0.00046444	181,900	84.48
	Glenn	0.00048846	256,575	125.33
	Placer	0.00026499	65,656	17.4
	Sacramento	0.00019538	118,000	23.05
	Shasta	0.00034146	459,000	156.73
	Solano	0.00039453	131,360	51.83
	Sutter	0.00037084	71,500	26.51
	Tehama	0.00035146	955,350	335.76
	Yolo	0.00061919	136,870	84.75
	Yuba	0.00023892	207,600	49.6

Note:
Fraction of PM10 (FRPM10): 0.50
(PM10 Emissions = PM x FRPM10)

Source:
CARB. 1997. Emission Inventory Documentation, Section 7.12: Windblown Dust - Agricultural Lands. July.
Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocfugwbdst.htm.

Seasonal Profiles

Table F-77. Agricultural Land Preparation Seasonal Profile for Land Preparation

AB	ID #	County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SV	4	BUTTE	0.005	0.004	0.081	0.387	0.387	0.001	0.001	0.001	0.001	0.015	0.06	0.058
	6	COLUSA	0.009	0.016	0.079	0.355	0.355	0.002	0.002	0.002	0.002	0.035	0.074	0.07
	11	GLENN	0.018	0.013	0.094	0.331	0.331	0.003	0.004	0.004	0.004	0.028	0.087	0.082
	31	PLACER	0.005	0	0.076	0.415	0.415	0	0	0	0	0.026	0.031	0.031
	34	SACRAMENTO	0.078	0.014	0.123	0.117	0.123	0.016	0.016	0.016	0.016	0.071	0.205	0.205
	45	SHASTA	0.051	0	0.028	0.152	0.152	0	0.039	0	0	0.208	0.188	0.182
	48	SOLANO	0.075	0.039	0.089	0.003	0.004	0.004	0.004	0.004	0.004	0.128	0.328	0.318
	51	SUTTER	0.011	0.012	0.086	0.362	0.362	0.001	0.001	0.001	0.001	0.028	0.071	0.067
	52	TEHAMA	0.051	0.024	0.083	0.054	0.054	0	0	0	0	0.083	0.331	0.32
	57	YOLO	0.062	0.021	0.088	0.136	0.137	0.003	0.003	0.003	0.003	0.095	0.223	0.223
	58	YUBA	0.006	0	0.082	0.405	0.405	0	0	0	0	0.015	0.043	0.043

Source:

CARB. 2003. Emission Inventory Documentation, Section 7.4: Agricultural Land Preparation. January.

Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm

Table F-78. Seasonal Profile for Agricultural Harvest Emissions

AB	ID #	County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SV	4	BUTTE	0	0	0	0	0	0.003	0.004	0.001	0.483	0.484	0.025	0
	6	COLUSA	0	0	0.001	0.001	0.001	0.037	0.052	0.016	0.408	0.411	0.073	0
	11	GLENN	0	0	0.001	0.001	0.001	0.03	0.032	0.002	0.446	0.45	0.036	0
	31	PLACER	0	0	0.014	0.014	0.014	0.014	0.014	0.014	0.409	0.395	0.112	0
	34	SACRAMENTO	0.002	0.002	0.009	0.009	0.009	0.222	0.284	0.071	0.206	0.137	0.044	0.002
	45	SHASTA	0	0	0.059	0.059	0.059	0.083	0.083	0.059	0.316	0.258	0.025	0
	48	SOLANO	0	0	0.003	0.003	0.003	0.196	0.229	0.035	0.274	0.247	0.01	0
	51	SUTTER	0	0	0.001	0.001	0.001	0.025	0.05	0.026	0.427	0.407	0.059	0
	52	TEHAMA	0	0	0.002	0.002	0.002	0.005	0.006	0.002	0.489	0.489	0.002	0
	57	YOLO	0	0	0.002	0.002	0.002	0.111	0.155	0.046	0.348	0.308	0.026	0
	58	YUBA	0	0	0.002	0.002	0.002	0.005	0.005	0.002	0.471	0.469	0.042	0

Source:

CARB. 2003. Emission Inventory Documentation, Section 7.5: Agricultural Harvest Operations. January.

Accessed on: May 5, 2012. Available at: http://www.arb.ca.gov/ei/areasrc/arbmiscprocresfarmop.htm.

Table F-79. Final Normalized Monthly Emission Profiles: Nonpasture

Basin	County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SV	Butte	0.0114	0.0316	0.0333	0.2697	0.2156	0.0556	0.1253	0.0977	0.0498	0.0721	0.0227	0.0152
	Colusa	0.0037	0.0075	0.0171	0.1868	0.1818	0.1461	0.0998	0.1141	0.1099	0.1169	0.0106	0.0059
	Glenn	0.004	0.0116	0.0162	0.2311	0.0859	0.2114	0.0773	0.0466	0.0623	0.1652	0.0764	0.0122
	Placer	0.0052	0.0081	0.013	0.2733	0.261	0.0962	0.0877	0.0964	0.1024	0.0411	0.0107	0.0049
	Sacramento	0.0015	0.0025	0.0046	0.1199	0.1443	0.3286	0.13	0.1012	0.1297	0.0306	0.0046	0.0024
	Shasta	0.0019	0.0071	0.0082	0.0756	0.0984	0.3371	0.2219	0.1439	0.0436	0.055	0.0055	0.0018
	Solano	0.0008	0.0011	0.0021	0.0461	0.0884	0.1865	0.1423	0.145	0.1875	0.1902	0.0087	0.0013
	Sutter	0.0038	0.0057	0.0088	0.1846	0.2083	0.2042	0.0906	0.099	0.1433	0.0397	0.0084	0.0036
	Tehama	0.0021	0.0055	0.0059	0.0528	0.0666	0.3714	0.2149	0.157	0.0664	0.0505	0.0047	0.0021
	Yolo	0.0015	0.0022	0.0036	0.0787	0.1309	0.2377	0.1079	0.1054	0.1682	0.1528	0.0091	0.0019
	Yuba	0.0076	0.012	0.0182	0.2745	0.2564	0.1158	0.0768	0.0478	0.0804	0.066	0.0372	0.0073

Table F-80. Final Normalized Monthly Emission Profiles: Pasture

Basin	County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SV	Butte	0.001	0.0029	0.0031	0.0294	0.0515	0.094	0.3024	0.2379	0.2041	0.0688	0.0034	0.0015
	Colusa	0.0005	0.0009	0.0022	0.0291	0.0582	0.218	0.1974	0.161	0.2281	0.1018	0.0019	0.0008
	Glenn	0.0006	0.0018	0.0025	0.0412	0.0287	0.2338	0.1275	0.0827	0.2331	0.2277	0.0185	0.002
	Placer	0.0005	0.0008	0.0013	0.0314	0.0677	0.2348	0.1734	0.1379	0.3101	0.0399	0.0017	0.0005
	Sacramento	0.0004	0.0006	0.0012	0.036	0.0571	0.2216	0.1705	0.1299	0.331	0.0495	0.0016	0.0006
	Shasta	0.0007	0.0019	0.0021	0.0214	0.0365	0.3573	0.2451	0.144	0.1219	0.0665	0.0018	0.0007
	Solano	0.0002	0.0003	0.0007	0.0182	0.0447	0.1497	0.148	0.1119	0.2964	0.2266	0.0028	0.0004
	Sutter	0.0005	0.0007	0.0012	0.0286	0.0617	0.2125	0.1566	0.1249	0.3636	0.0477	0.0016	0.0005
	Tehama	0.0007	0.0019	0.0021	0.0217	0.037	0.3624	0.2488	0.1461	0.1147	0.0621	0.0018	0.0007
	Yolo	0.0003	0.0005	0.0009	0.0226	0.0528	0.1794	0.1598	0.1228	0.2924	0.1656	0.0025	0.0004
	Yuba	0.0004	0.0006	0.001	0.0169	0.0356	0.1527	0.1783	0.1611	0.4092	0.0405	0.0033	0.0004

Appendix G

Climate Change Analysis Emission Calculations

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Summary of Annual Groundwater Substitution GHG Emissions by County

Table G-1. GHG Emissions from Groundwater Substitution

Water Agency	Emissions (MTCO2e per year)			
	CO2	CH4	N2O	Total
Sacramento River of Analysis				
Anderson-Cottonwood Irrigation District	164	0.26	0.66	165
Conaway Preservation Group	2,360	3.33	8.30	2,371
Cordua Irrigation District	496	0.79	2.00	499
Cranmore Farms	272	0.44	1.10	274
Eastside Mutual Water Company	392	0.40	0.95	394
Glenn-Colusa Irrigation District	785	1.26	3.17	789
Natomas Central Mutual Water Company	376	0.51	1.29	378
Pelger Mutual Water Company	283	0.33	0.80	285
Pleasant Grove-Verona Mutual Water Company	1,890	2.32	5.69	1,898
Reclamation District 108	642	1.03	2.59	646
Reclamation District 1004	900	0.95	2.28	903
River Garden Farms	326	0.52	1.32	327
Sycamore Mutual Water Company	490	0.79	1.98	493
Te Velde Revocable Family Trust	202	0.32	0.82	203
American River Area of Analysis				
City of Sacramento	483	0.66	1.66	485
Sacramento County Water Agency	1,427	1.95	4.92	1,434
Sacramento Suburban Water District	4,379	4.31	9.69	4,393
Feather River Area of Analysis				
Butte Water District	356	0.57	1.44	358
Garden Highway Mutual Water Company	452	0.72	1.83	454
Gilsizer Slough Ranch	441	0.52	1.25	443
Goose Club Farms and Teichert Aggregates	341	0.55	1.38	342
Tule Basin Farms	374	0.32	0.66	375
Delta Region Area of Analysis				
Reclamation District 2068	184	0.29	0.74	185
Pope Ranch	119	0.19	0.48	120
Total	**18,134**	**23.34**	**57.03**	**18,215**

Groundwater Substitution GHG Emissions

Agency	Anderson-Cottonwood Irrigation District	
Transfer Volume	5,226	acre feet/year
Location	Shasta	County
	Tehama	County

Table G-2. Anderson-Cottonwood Irrigation District Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Barney Street	Barney Street	Electric	200	5,500	85%	4,422	4,366	651,702	n/a	131	0.0084	0.0018	131	0.21	0.53	132
Crowley Gulch	Crowley Gulch	Electric	50	1,000	15%	804	4,366	162,926	n/a	33	0.0021	0.0004	33	0.05	0.13	33
			Total	**6,500**	**100%**	**5,226**	**8,733**	**814,628**	**0**	**164**	**0.0105**	**0.0022**	**164**	**0.26**	**0.66**	**165**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Conaway Preservation Group
Transfer Volume	35,000 acre feet/year
Location	Yolo County

Table G-3. Conaway Preservation Group Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
ConawayPG12W-1	12W-1	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG12W-2	12W-2	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG12W-5	12W-5	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG13W-3	13W-3	Electric	200	3,500	4%	1,253	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPG16W-2	16W-2	Diesel	227	1,600	2%	573	1,944	n/a	24,751	253	0.0102	0.0020	253	0.26	0.61	254
ConawayPG17W-3	17W-3	Diesel	227	1,700	2%	608	1,944	n/a	24,751	253	0.0102	0.0020	253	0.26	0.61	254
ConawayPG1W-3	1W-3	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG20W-1	20W-1	Electric	100	2,500	3%	895	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG21W-1	21W-1	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG21W-3	21W-3	Electric	100	2,500	3%	895	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG24W-1	24W-1	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG31W-1	31W-1	Electric	100	2,300	2%	823	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG32NW-1	32NW-1	Electric	100	3,300	3%	1,181	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG32NW-2	32NW-2	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG32W-3	32W-3	Electric	250	2,500	3%	895	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG33NW-1	33NW-1	Electric	100	2,300	2%	823	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-2	33NW-2	Electric	100	2,200	2%	787	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-3	33NW-3	Electric	100	2,100	2%	752	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-4	33NW-4	Electric	100	3,400	3%	1,217	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-5	33NW-5	Electric	100	1,800	2%	644	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-6	33NW-6	Electric	100	2,100	2%	752	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-7	33NW-7	Electric	100	1,400	1%	501	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG33NW-8	33NW-8	Electric	100	2,200	2%	787	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG5W-2	5W-2	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG5W-3	5W-3	Electric	250	2,700	3%	966	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG6W-2	6W-2	Electric	100	3,500	4%	1,253	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPG7W-1	7W-1	Electric	75	1,800	2%	644	1,944	108,781	n/a	22	0.0014	0.0003	22	0.04	0.09	22
ConawayPG7W-2	7W-2	Electric	250	3,500	4%	1,253	1,944	362,604	n/a	73	0.0047	0.0010	73	0.12	0.30	74
ConawayPG7W-4	7W-4	Electric	200	3,500	4%	1,253	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPG7W-4S	7W-4S	Electric	200	3,500	4%	1,253	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPG8W-2	8W-2	Diesel	227	2,300	2%	823	1,944	n/a	24,751	253	0.0102	0.0020	253	0.26	0.61	254
ConawayPG8W-2N	8W-2N	Electric	200	1,500	2%	537	1,944	290,083	n/a	59	0.0037	0.0008	59	0.09	0.24	59
ConawayPGOW-1	OW-1	Electric	100	2,600	3%	930	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPGOW-2	OW-2	Electric	100	3,400	3%	1,217	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPGOW-3	OW-3	Electric	125	3,400	3%	1,217	1,944	181,302	n/a	37	0.0023	0.0005	37	0.06	0.15	37
ConawayPGOW-4	OW-4	Electric	100	1,700	2%	608	1,944	145,041	n/a	29	0.0019	0.0004	29	0.05	0.12	29
ConawayPGOW-5	OW-5	Electric	125	2,000	2%	716	1,944	181,302	n/a	37	0.0023	0.0005	37	0.06	0.15	37
			Total	**97,800**	**100%**	**35,000**	**71,912**	**7,941,021**	**74,253**	**2,360**	**0.1334**	**0.0279**	**2,360**	**3.33**	**8.30**	**2,371**

Legend

- (purple) Assumed to be electric (similar to 32W-2)
- (green) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Cordua Irrigation District	
Transfer Volume	12,000	acre feet/year
Location	Yuba	County

Table G-4. Cordua Irrigation District Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
COR1	COR1	Electric	60	1,000	3%	323	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR2	COR2	Electric	50	900	2%	291	1,757	65,545	n/a	13	0.0008	0.0002	13	0.02	0.05	13
COR3	COR3	Electric	60	1,000	3%	323	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR4	COR4	Electric	75	1,400	4%	453	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR5	COR5	Electric	75	1,300	4%	420	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR8	COR8	Electric	75	2,000	5%	647	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR9	COR9	Electric	60	1,000	3%	323	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR10	COR10	Electric	75	1,300	4%	420	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR11	COR11	Electric	60	1,800	5%	582	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR12	COR12	Electric	100	1,400	4%	453	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR13	COR13	Electric	100	2,100	6%	679	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR14	COR14	Electric	75	1,800	5%	582	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR18	COR18	Electric	100	2,000	5%	647	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR20	COR20	Electric	125	2,150	6%	695	1,757	163,863	n/a	33	0.0021	0.0004	33	0.05	0.13	33
COR21	COR21	Electric	75	1,250	3%	404	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR22	COR22	Electric	60	1,750	5%	566	1,757	78,654	n/a	16	0.0010	0.0002	16	0.03	0.06	16
COR23	COR23	Electric	75	1,150	3%	372	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR25	COR25	Electric	75	1,600	4%	518	1,757	98,318	n/a	20	0.0013	0.0003	20	0.03	0.08	20
COR26	COR26	Electric	100	1,800	5%	582	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR27	COR27	Electric	100	1,700	5%	550	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR16	COR16	Electric	100	2,300	6%	744	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR17	COR17	Electric	100	2,400	6%	776	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
COR24	COR24	Electric	100	2,000	5%	647	1,757	131,090	n/a	26	0.0017	0.0004	26	0.04	0.11	27
			Total	**37,100**	**100%**	**12,000**	**40,402**	**2,457,942**	**0**	**496**	**0.0318**	**0.0067**	**496**	**0.79**	**2.00**	**499**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Cranmore Farms
Transfer Volume	8,000 acre feet/year
Location	Sutter County

Table G-5. Cranmore Farms Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Cranmore Farms1	1	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms2	2	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms3	3	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms4	4	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms5	5	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
Cranmore Farms6	6	Electric	125	3,000	17%	1,333	2,414	225,160	n/a	45	0.0029	0.0006	45	0.07	0.18	46
			Total	**18,000**	**100%**	**8,000**	**14,482**	**1,350,958**	**0**	**272**	**0.0175**	**0.0037**	**272**	**0.44**	**1.10**	**274**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Eastside Mutual Water Company	
Transfer Volume	2,230	acre feet/year
Location	Colusa	County

Table G-6. Eastside Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
7631T	7631T	Diesel	215	3,800	100%	2,230	3,187	n/a	38,441	392	0.0159	0.0032	392	0.40	0.95	394
			Total	**3,800**	**100%**	**2,230**	**3,187**	**0**	**38,441**	**392**	**0.0159**	**0.0032**	**392**	**0.40**	**0.95**	**394**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Glenn-Colusa Irrigation District	
Transfer Volume	25,000	acre feet/year
Location	Glenn	County
	Colusa	County

Table G-7. Glenn-Colusa Irrigation District Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
GCID 1	GCID 1	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 2	GCID 2	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 3	GCID 3	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 4	GCID 4	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID 5	GCID 5	Electric	110	2,605	8%	2,067	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X1	GCID X1	Electric	110	2,389	8%	1,896	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X2	GCID X2	Electric	110	3,305	10%	2,622	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X3	GCID X3	Electric	110	2,605	8%	2,067	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X4	GCID X4	Electric	110	2,389	8%	1,896	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
GCID X5	GCID X5	Electric	110	2,605	8%	2,067	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
Test Hole 7	Test Hole 7	Electric	110	2,389	8%	1,896	4,309	353,744	n/a	71	0.0046	0.0010	71	0.11	0.29	72
			Total	**31,507**	**100%**	**25,000**	**47,402**	**3,891,180**	**0**	**785**	**0.0503**	**0.0106**	**785**	**1.26**	**3.17**	**789**

Legend
- (purple) Assumed to be electric (similar to other wells operated by water agency)
- (green) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Natomas Central Mutual Water Company
Transfer Volume	30,000 acre feet/year
Location	Sacramento County
	Sutter County

Table G-8. Natomas Central Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Natomas Central MWCWilley, Ed	Willey, Ed	Electric	250	5,500	2%	698	689	128,527	n/a	30	0.0017	0.0004	30	0.04	0.10	31
Natomas Central MWCOse, Mary-site 8, well 1	Ose, Mary-site 8, well 1	Electric	200	5,500	2%	698	689	102,821	n/a	24	0.0013	0.0003	24	0.03	0.08	24
Natomas Central MWCOse, Mary-site 9, well 2	Ose, Mary-site 9, well 2	Electric	150	5,500	2%	698	689	77,116	n/a	18	0.0010	0.0002	18	0.02	0.06	18
Natomas Central MWCLeal, Robert-site 1 well 2	Leal, Robert-site 1 well 2	Electric	100	5,500	2%	698	689	51,411	n/a	12	0.0007	0.0001	12	0.02	0.04	12
Natomas Central MWCDeWitt, Jack-1	DeWitt, Jack-1	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCDeWitt, Jack-2	DeWitt, Jack-2	Electric	80	5,500	2%	698	689	41,129	n/a	10	0.0005	0.0001	10	0.01	0.03	10
Natomas Central MWCDeWitt, Jack-3	DeWitt, Jack-3	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCDeWitt, Jack-4	DeWitt, Jack-4	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCDeWitt, Jack-5	DeWitt, Jack-5	Electric	20	5,500	2%	698	689	10,282	n/a	2	0.0001	0.0000	2	0.00	0.01	2
Natomas Central MWCDeWitt, Jack-6	DeWitt, Jack-6	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Electric	25	5,500	2%	698	689	12,853	n/a	3	0.0002	0.0000	3	0.00	0.01	3
Natomas Central MWCDeWitt, Jack-7	DeWitt, Jack-7	Electric	25	5,500	2%	698	689	12,853	n/a	3	0.0002	0.0000	3	0.00	0.01	3
Natomas Central MWCDeWitt, Jack--8	DeWitt, Jack--8	Electric	250	5,500	2%	698	689	128,527	n/a	30	0.0017	0.0004	30	0.04	0.10	31
Natomas Central MWCMorrison, Phil #2-site 5 well 14	Morrison, Phil #2-site 5 well 14	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCBianchi, John- site 2, well 10	Bianchi, John- site 2, well 10	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCBianchi, John-site 2 well 11	Bianchi, John-site 2 well 11	Electric	80	5,500	2%	698	689	41,129	n/a	10	0.0005	0.0001	10	0.01	0.03	10
Natomas Central MWCLauppe and Sons	Lauppe and Sons	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCWiley, Wane-site 7 , well 18	Wiley, Wane-site 7 , well 18	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCLeal, Robert L-1 (rice box)	Leal, Robert L-1 (rice box)	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert L-3	Leal, Robert L-3	Electric	50	5,500	2%	698	689	25,705	n/a	6	0.0003	0.0001	6	0.01	0.02	6
Natomas Central MWCLeal, Robert L-4	Leal, Robert L-4	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCLeal, Robert L-5	Leal, Robert L-5	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCLeal, Robert L-6	Leal, Robert L-6	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCLeal, Robert L-7	Leal, Robert L-7	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert L-8	Leal, Robert L-8	Electric	200	5,500	2%	698	689	102,821	n/a	24	0.0013	0.0003	24	0.03	0.08	24
Natomas Central MWCLeal, Robert L-9	Leal, Robert L-9	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert L-2	Leal, Robert L-2	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert #1	Leal, Robert #1	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCLeal, Robert #2	Leal, Robert #2	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCSpangler, Dan-site 4 well 13	Spangler, Dan-site 4 well 13	Electric	80	5,500	2%	698	689	41,129	n/a	10	0.0005	0.0001	10	0.01	0.03	10
Natomas Central MWCVestal, Sid	Vestal, Sid	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCVestal, Sid-1	Vestal, Sid-1	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Dewitt, Jack-9 Housley N	Dewitt, Jack-9 Housley N	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Dewitt, Jack-10 Housley	Dewitt, Jack-10 Housley	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Dewitt, Jack-11 Housley	Dewitt, Jack-11 Housley	Electric	20	5,500	2%	698	689	10,282	n/a	2	0.0001	0.0000	2	0.00	0.01	2
Natomas Central MWCMorrison, Phil-#3 site 5 well 15	Morrison, Phil-#3 site 5 well 15	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCMorrison, Phil-#4 site 5 well 16	Morrison, Phil-#4 site 5 well 16	Electric	40	5,500	2%	698	689	20,564	n/a	5	0.0003	0.0001	5	0.01	0.02	5
Natomas Central MWCNBC-Frazer	NBC-Frazer	Electric	50	5,500	2%	698	689	25,705	n/a	6	0.0003	0.0001	6	0.01	0.02	6
Natomas Central MWCNBC-Lucich North	NBC-Lucich North	Electric	75	5,500	2%	698	689	38,558	n/a	9	0.0005	0.0001	9	0.01	0.03	9
Natomas Central MWCNBC- Natomas Farm#1	NBC- Natomas Farm#1	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCNBC-Cummings	NBC-Cummings	Electric	20	5,500	2%	698	689	10,282	n/a	2	0.0001	0.0000	2	0.00	0.01	2
Natomas Central MWCMorrison, Phillip-#5	Morrison, Phillip-#5	Electric	60	5,500	2%	698	689	30,846	n/a	7	0.0004	0.0001	7	0.01	0.03	7
Natomas Central MWCPerry, Joe	Perry, Joe	Electric	125	5,500	2%	698	689	64,263	n/a	15	0.0008	0.0002	15	0.02	0.05	15
Natomas Central MWCNBC-Kismat-2	NBC-Kismat-2	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCNBC-Kismat-3	NBC-Kismat-3	Electric	30	5,500	2%	698	689	15,423	n/a	4	0.0002	0.0000	4	0.00	0.01	4
Natomas Central MWCNBC-Kismat-4	NBC-Kismat-4	Electric	110	5,500	2%	698	689	56,552	n/a	13	0.0007	0.0002	13	0.02	0.05	13
Natomas Central MWCNBC-Sliva	NBC-Sliva	Electric	50	5,500	2%	698	689	25,705	n/a	6	0.0003	0.0001	6	0.01	0.02	6
			Total	**236,500**	**100%**	**30,000**	**29,623**	**1,588,589**	**0**	**376**	**0.0205**	**0.0043**	**376**	**0.51**	**1.29**	**378**

Legend

Legend	
(purple)	Assumed to be electric
(green)	Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Pelger Mutual Water Company	
Transfer Volume	3,750	acre feet/year
Location	Sutter	County

Table G-9. Pelger Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Pelger MWCWell 1 Tucker	Well 1 Tucker	Electric	110	3,100	33%	1,224	2,144	175,980	n/a	35	0.0023	0.0005	35	0.06	0.14	36
Pelger MWCWell 2 Flopet	Well 2 Flopet	Diesel	173	2,100	22%	829	2,144	n/a	20,806	212	0.0086	0.0017	212	0.22	0.51	213
Pelger MWCWell 3 Klein	Well 3 Klein	Electric	110	4,300	45%	1,697	2,144	175,980	n/a	35	0.0023	0.0005	35	0.06	0.14	36
			Total	**9,500**	**100%**	**3,750**	**6,431**	**351,960**	**20,806**	**283**	**0.0132**	**0.0027**	**283**	**0.33**	**0.80**	**285**

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Pleasant Grove-Verona Mutual Water Company
Transfer Volume	18,000 acre feet/year
Location	Sutter County

Table G-10. Pleasant Grove-Verona Mutual Water Company Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
PGVMWCWill-Lee 4A	Will-Lee 4A	Diesel	160	1,500	2%	345	1,248	n/a	11,206	114	0.0046	0.0009	114	0.12	0.28	115
PGVMWCRiver Ranch #19	River Ranch #19	Diesel	200	2,500	3%	575	1,248	n/a	14,008	143	0.0058	0.0012	143	0.14	0.35	144
PGVMWCMLF #1	MLF #1	Electric	30	2,000	3%	460	1,248	27,951	n/a	6	0.0004	0.0001	6	0.01	0.02	6
PGVMWCMLF #2	MLF #2	Electric	250	5,000	6%	1,149	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCMLF Monster Well	MLF Monster Well	Electric	60	3,100	4%	713	1,248	55,902	n/a	11	0.0007	0.0002	11	0.02	0.05	11
PGVMWCMLF #17/12	MLF #17/12	Electric	50	1,500	2%	345	1,248	46,585	n/a	9	0.0006	0.0001	9	0.02	0.04	9
PGVMWCMLF #11	MLF #11	Diesel	250	4,200	5%	966	1,248	n/a	17,510	179	0.0072	0.0014	179	0.18	0.43	179
PGVMWCMLF #13/15	MLF #13/15	Electric	240	4,800	6%	1,103	1,248	223,607	n/a	45	0.0029	0.0006	45	0.07	0.18	45
PGVMWCMLF #16	MLF #16	Electric	240	1,700	2%	391	1,248	223,607	n/a	45	0.0029	0.0006	45	0.07	0.18	45
PGVMWCWilley #1	Willey #1	Diesel	168	3,000	4%	690	1,248	n/a	11,767	120	0.0049	0.0010	120	0.12	0.29	121
PGVMWCWilley #2	Willey #2	Electric	250	3,000	4%	690	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWilley #3	Willey #3	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWilley #4	Willey #4	Diesel	150	3,000	4%	690	1,248	n/a	10,506	107	0.0043	0.0009	107	0.11	0.26	108
PGVMWCScheidel&Osterli #18A	Scheidel&Osterli #18A	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWill-Lee 30	Will-Lee 30	Diesel	100	1,500	2%	345	1,248	n/a	7,004	72	0.0029	0.0006	72	0.07	0.17	72
PGVMWCWill-Lee 31	Will-Lee 31	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWill-Lee 32	Will-Lee 32	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCWill-Lee 33	Will-Lee 33	Electric	250	2,500	3%	575	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas Sand Field Well	Nicholas Sand Field Well	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCNicholas Filipino Camp #2	Nicholas Filipino Camp #2	Electric	40	2,000	3%	460	1,248	37,268	n/a	8	0.0005	0.0001	8	0.01	0.03	8
PGVMWCNicholas Filipino Camp South	Nicholas Filipino Camp South	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCNicholas Johnston Field Well #2	Nicholas Johnston Field Well #2	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas Johnston Well	Nicholas Johnston Well	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas 72-acre Field South	Nicholas 72-acre Field South	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCNicholas 72-Acre Field North	Nicholas 72-Acre Field North	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCNicholas BBC Well	Nicholas BBC Well	Electric	250	2,000	3%	460	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCKelly 190 Field Well #2	Kelly 190 Field Well #2	Electric	30	2,000	3%	460	1,248	27,951	n/a	6	0.0004	0.0001	6	0.01	0.02	6
PGVMWCKelly Windmill Field Well #2	Kelly Windmill Field Well #2	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCKelly Windmill North Field Well	Kelly Windmill North Field Well	Diesel	62.1	2,000	3%	460	1,248	n/a	4,350	44	0.0018	0.0004	44	0.05	0.11	45
PGVMWCKelly 306 Well	Kelly 306 Well	Electric	250	2,600	3%	598	1,248	232,924	n/a	47	0.0030	0.0006	47	0.08	0.19	47
PGVMWCScheidel&Osterli #16	Scheidel&Osterli #16	Diesel	234	3,400	4%	782	1,248	n/a	16,389	167	0.0068	0.0014	167	0.17	0.40	168
PGVMWCScheidel&Osterli #17	Scheidel&Osterli #17	Diesel	101	1,500	2%	345	1,248	n/a	7,074	72	0.0029	0.0006	72	0.07	0.17	72
			Total	**78,300**	**100%**	**18,000**	**39,951**	**3,437,954**	**117,213**	**1,890**	**0.0930**	**0.0191**	**1,890**	**2.32**	**5.69**	**1,898**

Legend

[shaded cell] Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors	
1 lb =	453.6 g
1 tonne =	1,000 kg
1 tonne =	1,000,000 g
1 MWh =	1,000 kWh
1 GWh =	1,000,000 kWh
1 kW =	1.34 hp
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential	
CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Reclamation District 108
Transfer Volume	15,000 acre feet/year
Location	Colusa County
	Yolo County

Table G-11. Reclamation District 108 Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
RD 108Well#1 Heidrick	Well#1 Heidrick	Electric	100	3,500	18%	2,749	4,265	318,288	n/a	64	0.0041	0.0009	64	0.10	0.26	65
RD 108Well #5 RiggsRanch	Well #5 RiggsRanch	Electric	150	1,700	9%	1,335	4,265	477,433	n/a	96	0.0062	0.0013	96	0.15	0.39	97
RD 108Well #6 CountyLine	Well #6 CountyLine	Electric	250	5,900	31%	4,634	4,265	795,721	n/a	160	0.0103	0.0022	160	0.26	0.65	161
RD 108Well#7 Tract 6	Well#7 Tract 6	Electric	250	4,000	21%	3,141	4,265	795,721	n/a	160	0.0103	0.0022	160	0.26	0.65	161
RD 108Well #4 Huff	Well #4 Huff	Electric	250	4,000	21%	3,141	4,265	795,721	n/a	160	0.0103	0.0022	160	0.26	0.65	161
			Total	**19,100**	**100%**	**15,000**	**21,325**	**3,182,885**	**0**	**642**	**0.0411**	**0.0087**	**642**	**1.03**	**2.59**	**646**

Conversion Factors

1 lb =	453.6 g
1 tonne =	1,000 kg
1 tonne =	1,000,000 g
1 MWh =	1,000 kWh
1 GWh =	1,000,000 kWh
1 kW =	1.34 hp
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Reclamation District 1004	
Transfer Volume		7,175 acre feet/year
Location		Colusa County
		Glenn County
		Sutter County

Table G-12. Reclamation District 1004 Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Gardener No. 374672	Gardener No. 374672	Diesel	215	3,500	5%	345	535	n/a	6,456	66	0.0027	0.0005	66	0.07	0.16	66
Gardener No. 498178	Gardener No. 498178	Diesel	215	3,500	5%	345	535	n/a	6,456	66	0.0027	0.0005	66	0.07	0.16	66
Stonewell #6 No. 11334	Stone Well #6 No.11334	Electric	40	1,800	2%	177	535	15,978	n/a	3	0.0002	0.0000	3	0.01	0.01	3
Drumheller Well #7	Drumheller Well No.7	Diesel	225	4,000	5%	394	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Myers Well #1 No. 3457	Myers Well #1 No.3457	Electric	40	2,200	3%	217	535	15,978	n/a	3	0.0002	0.0000	3	0.01	0.01	3
Myers Well #2 No. 340884	Myers Well #2 No. 340884	Electric	100	4,100	6%	404	535	39,944	n/a	8	0.0005	0.0001	8	0.01	0.03	8
Sikes & Parachini #1 No. 93124	Sikes & Parachini Well #1 WS No.93124	Diesel	173	4,000	5%	394	535	n/a	5,195	53	0.0022	0.0004	53	0.05	0.13	53
Sikes & Parachini #2 No. 374682	Sikes & Parachini Well #2 WS No. 374682	Diesel	150	4,000	5%	394	535	n/a	4,504	46	0.0019	0.0004	46	0.05	0.11	46
Rancho Caleta No. 726883	Rancho Caleta No. 726883	Diesel	170	4,500	6%	444	535	n/a	5,105	52	0.0021	0.0004	52	0.05	0.13	52
Behring Ranch Club House No. 496461	Behring Ranch Club House Well No.496461	Electric	125	3,400	5%	335	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Behring Ranch West Well No. 97863	Behring Ranch West Well No.97863	Electric	125	2,300	3%	227	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Behring Ranch 10 Field Well No. 496441	Behring Ranch 10 Field Well No. 496441	Diesel	225	5,800	8%	572	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Behring Ranch Pearl 20094	Behring Ranch Pearl Well No. 20094	Diesel	225	2,500	3%	246	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Behring Ranch Nursery Well No. 17N1W10H1	Behring Ranch Nursery Well No. 17N1W10H1	Diesel	225	1,000	1%	99	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Hall Well No. X	Hall Well No. X	Electric	125	4,500	6%	444	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Hall Well No. 369428	Hall Well No.369428	Electric	125	4,500	6%	444	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
East Morgan Well	East Morgan Well #1 No. 374667 17N01W14N001M	Diesel	225	2,600	4%	256	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
ast Morgan Well	East Morgan Well#2 No. 498195 17N01W15Q001M	Diesel	225	1,300	2%	128	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Mohammad No.	Mohammad No.e0084085 17N01W02D001M	Electric	125	4,500	6%	444	535	49,930	n/a	10	0.0006	0.0001	10	0.02	0.04	10
Southam Sartain	Southam Sartain Well 18N01W26D001M	Diesel	225	4,800	7%	473	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
Barale Well	Barale Well	Diesel	225	4,000	5%	394	535	n/a	6,756	69	0.0028	0.0006	69	0.07	0.17	69
			Total	**72,800**	**100%**	**7,175**	**11,240**	**321,551**	**81,767**	**900**	**0.0380**	**0.0076**	**900**	**0.95**	**2.28**	**903**

Legend

(shaded cell) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	River Garden Farms	
Transfer Volume	9,000	acre feet/year
Location	Yolo	County

Table G-13. River Garden Farms Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
River Garden FarmsField 65 PW	Field 65 PW	Electric	110	2,500	14%	1,293	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 71 PW	Field 71 PW	Electric	110	1,700	10%	880	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 98 PW	Field 98 PW	Electric	110	2,900	17%	1,500	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 104 PW	Field 104 PW	Electric	110	2,500	14%	1,293	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 104-09 PW	Field 104-09 PW	Electric	110	2,990	17%	1,547	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 91-09 PW	Field 91-09 PW	Electric	110	2,840	16%	1,469	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
River Garden FarmsField 117 PW	Field 117 PW	Electric	110	1,965	11%	1,017	2,810	230,661	n/a	47	0.0030	0.0006	47	0.07	0.19	47
			Total	**17,395**	**100%**	**9,000**	**19,669**	**1,614,626**	**0**	**326**	**0.0209**	**0.0044**	**326**	**0.52**	**1.32**	**327**

Legend

(shaded) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Sycamore Mutual Water Company	
Transfer Volume	15,000	acre feet/year
Location	Colusa	County

Table G-14. Sycamore Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Sycamore Family Trust1	1	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust2	2	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust3	3	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust4	4	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust5	5	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust6	6	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust7	7	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust8	8	Electric	125	3,000	9%	1,286	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
Sycamore Family Trust11	11	Electric	100	2,500	7%	1,071	2,328	173,695	n/a	35	0.0022	0.0005	35	0.06	0.14	35
Sycamore Family Trust14	14	Electric	100	2,500	7%	1,071	2,328	173,695	n/a	35	0.0022	0.0005	35	0.06	0.14	35
Sycamore Family Trust15	15	Electric	75	2,500	7%	1,071	2,328	130,271	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Sycamore Family Trust17	17	Electric	125	3,500	10%	1,500	2,328	217,118	n/a	44	0.0028	0.0006	44	0.07	0.18	44
			Total	**35,000**	**100%**	**15,000**	**27,930**	**2,431,724**	**0**	**490**	**0.0314**	**0.0067**	**490**	**0.79**	**1.98**	**493**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Te Velde Revocable Family Trust
Transfer Volume	7,094 acre feet/year
Location	Yolo County

Table G-15. Te Velde Revocable Family Trust Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Te VeldeGW1	GW1	Electric	127	4,656	29%	2,090	2,438	231,042	n/a	47	0.0030	0.0006	47	0.07	0.19	47
Te VeldeGW10	GW10	Electric	143	2,833	18%	1,272	2,438	260,150	n/a	52	0.0034	0.0007	52	0.08	0.21	53
Te VeldeGW9	GW9	Electric	104	2,200	14%	988	2,438	189,200	n/a	38	0.0024	0.0005	38	0.06	0.15	38
Te VeldeGW4	GW4	Electric	125	3,715	24%	1,668	2,438	227,404	n/a	46	0.0029	0.0006	46	0.07	0.19	46
Te VeldeGW3	GW3	Electric	52	2,400	15%	1,077	2,438	94,600	n/a	19	0.0012	0.0003	19	0.03	0.08	19
			Total	**15,804**	**100%**	**7,094**	**12,189**	**1,002,395**	**0**	**202**	**0.0130**	**0.0027**	**202**	**0.32**	**0.82**	**203**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency City of Sacramento
Transfer Volume 5,000 acre feet/year
Location Sacramento County

Table G-16. City of Sacramento Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	GHG Emissions (metric tons per year) CH4	GHG Emissions (metric tons per year) N2O	GHG Emissions (metric tons CO2e per year) CO2	GHG Emissions (metric tons CO2e per year) CH4	GHG Emissions (metric tons CO2e per year) N2O	GHG Emissions (metric tons CO2e per year) Total
City of Sacramento WSA83	WELL83	electric	30	373	2%	88	1,278	28,615	n/a	7	0.0004	0.0001	7	0.01	0.02	7
City of Sacramento WSA92	WELL92	electric	50	785	4%	185	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA93	WELL93	electric	50	411	2%	97	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA94	WELL94	electric	50	879	4%	207	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA107	WELL107	electric	50	727	3%	171	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA116	WELL116	electric	75	673	3%	158	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA120	WELL120	electric	50	572	3%	135	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA122	WELL122	electric	50	470	2%	111	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA124	WELL124	electric	50	541	3%	127	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA126	WELL126	electric	50	433	2%	102	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA127	WELL127	electric	50	592	3%	139	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA129	WELL129	electric	50	466	2%	110	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA131	WELL131	electric	50	431	2%	101	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA133	WELL133	electric	150	757	4%	178	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
City of Sacramento WSA134	WELL134	electric	60	676	3%	159	1,278	57,230	n/a	14	0.0007	0.0002	14	0.02	0.05	14
City of Sacramento WSA137	WELL137	electric	75	541	3%	127	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA138	WELL138	electric	75	505	2%	119	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA139	WELL139	electric	50	818	4%	193	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA142	WELL142	electric	75	940	4%	221	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA143	WELL143	electric	50	379	2%	89	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA144	WELL144	electric	50	549	3%	129	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA153	WELL153	electric	100	1027	5%	242	1,278	95,384	n/a	23	0.0012	0.0003	23	0.03	0.08	23
City of Sacramento WSA154	WELL154	electric	50	502	2%	118	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA155	WELL155	electric	50	675	3%	159	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA156	WELL156	electric	75	525	2%	124	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA157	WELL157	electric	50	781	4%	184	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA158	WELL158	electric	50	781	4%	184	1,278	47,692	n/a	11	0.0006	0.0001	11	0.02	0.04	11
City of Sacramento WSA159	WELL159	electric	75	535	3%	126	1,278	71,538	n/a	17	0.0009	0.0002	17	0.02	0.06	17
City of Sacramento WSA164	WELL164	electric	150	1101	5%	259	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
City of Sacramento WSAX1	WELLX1	electric	150	1400	7%	329	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
City of Sacramento WSAX2	WELLX2	electric	150	1400	7%	329	1,278	143,076	n/a	34	0.0018	0.0004	34	0.05	0.12	34
			Total	**21,245**	**100%**	**5,000**	**39,623**	**2,041,221**	**0**	**483**	**0.0264**	**0.0056**	**483**	**0.66**	**1.66**	**485**

Legend
- (purple) Assumed to be electric (similar to other wells operated by water agency)
- (green) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6 g
1 tonne =	1,000 kg
1 tonne =	1,000,000 g
1 MWh =	1,000 kWh
1 GWh =	1,000,000 kWh
1 kW =	1.34 hp
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Sacramento County Water Agency	
Transfer Volume	15,000	acre feet/year
Location	Sacramento	County

Table G-17. Sacramento County Water Agency Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Sacramento County WAW 040	W 040	Electric	115	1,160	2%	312	1,463	126,082	n/a	30	0.0016	0.0003	30	0.04	0.10	30
Sacramento County WAW 041	W 041	Electric	65	676	1%	182	1,463	71,349	n/a	17	0.0009	0.0002	17	0.02	0.06	17
Sacramento County WAW 042	W 042	Electric	77	727	1%	196	1,463	83,960	n/a	20	0.0011	0.0002	20	0.03	0.07	20
Sacramento County WAW 043	W 043	Electric	94	918	2%	247	1,463	103,064	n/a	24	0.0013	0.0003	24	0.03	0.08	25
Sacramento County WAW 044	W 044	Electric	73	515	1%	139	1,463	79,808	n/a	19	0.0010	0.0002	19	0.03	0.07	19
Sacramento County WAW 047	W 047	Electric	88	1,030	2%	277	1,463	95,585	n/a	23	0.0012	0.0003	23	0.03	0.08	23
Sacramento County WAW 049	W 049	Electric	92	853	2%	230	1,463	100,474	n/a	24	0.0013	0.0003	24	0.03	0.08	24
Sacramento County WAW 052	W 052	Electric	120	1,192	2%	321	1,463	130,941	n/a	31	0.0017	0.0004	31	0.04	0.11	31
Sacramento County WAW 056	W 056	Electric	200	3,000	5%	808	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 061	W 061	Electric	145	1,570	3%	423	1,463	158,061	n/a	37	0.0020	0.0004	37	0.05	0.13	38
Sacramento County WAW 062	W 062	Electric	100	455	1%	123	1,463	109,181	n/a	26	0.0014	0.0003	26	0.04	0.09	26
Sacramento County WAW 063	W 063	Electric	100	1,119	2%	301	1,463	109,181	n/a	26	0.0014	0.0003	26	0.04	0.09	26
Sacramento County WAW 064	W 064	Electric	141	1,205	2%	325	1,463	153,945	n/a	36	0.0020	0.0004	36	0.05	0.13	37
Sacramento County WAW 065	W 065	Electric	57	589	1%	159	1,463	62,670	n/a	15	0.0008	0.0002	15	0.02	0.05	15
Sacramento County WAW 066	W 066	Electric	125	1,700	3%	458	1,463	136,476	n/a	32	0.0018	0.0004	32	0.04	0.11	32
Sacramento County WAW 067	W 067	Electric	135	1,425	3%	384	1,463	147,820	n/a	35	0.0019	0.0004	35	0.05	0.12	35
Sacramento County WAW 068	W 068	Electric	141	1,624	3%	437	1,463	153,836	n/a	36	0.0020	0.0004	36	0.05	0.13	37
Sacramento County WAW 069	W 069	Electric	154	1,663	3%	448	1,463	168,019	n/a	40	0.0022	0.0005	40	0.05	0.14	40
Sacramento County WAW 070	W 070	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 073	W 073	Electric	175	2,000	4%	539	1,463	191,067	n/a	45	0.0025	0.0005	45	0.06	0.16	45
Sacramento County WAW 074	W 074	Electric	50	500	1%	135	1,463	54,591	n/a	13	0.0007	0.0001	13	0.02	0.04	13
Sacramento County WAW 076	W 076	Electric	150	1,500	3%	404	1,463	163,772	n/a	39	0.0021	0.0004	39	0.05	0.13	39
Sacramento County WAW 077	W 077	Electric	125	2,000	4%	539	1,463	136,476	n/a	32	0.0018	0.0004	32	0.04	0.11	32
Sacramento County WAW 078	W 078	Electric	125	2,400	4%	647	1,463	136,476	n/a	32	0.0018	0.0004	32	0.04	0.11	32
Sacramento County WAW 087	W 087	Electric	150	1,900	3%	512	1,463	163,772	n/a	39	0.0021	0.0004	39	0.05	0.13	39
Sacramento County WAW 092	W 092	Electric	75	1,160	2%	312	1,463	81,886	n/a	19	0.0011	0.0002	19	0.03	0.07	19
Sacramento County WAW 095	W 095	Electric	200	2,200	4%	593	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 096	W 096	Electric	150	1,500	3%	404	1,463	163,772	n/a	39	0.0021	0.0004	39	0.05	0.13	39
Sacramento County WAW 105	W 105	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 106	W 106	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 109	W 109	Electric	200	2,600	5%	700	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 110	W 110	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 112	W 112	Electric	100	1,500	3%	404	1,463	109,181	n/a	26	0.0014	0.0003	26	0.04	0.09	26
Sacramento County WAW 114	W 114	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 129	W 129	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 130	W 130	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 122	W 122	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 123	W 123	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
Sacramento County WAW 124	W 124	Electric	200	1,500	3%	404	1,463	218,362	n/a	52	0.0028	0.0006	52	0.07	0.18	52
			Total	**55,681**	**100%**	**15,000**	**57,058**	**6,030,151**	**0**	**1,427**	**0.0779**	**0.0165**	**1,427**	**1.95**	**4.92**	**1,434**

Legend

(shaded)	Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Sacramento Suburban Water District	
Transfer Volume	30,000	acre feet/year
Location	Sacramento	County

Table G-18. Sacramento Suburban Water District Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(MMBtu/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Sacramento Suburban WD5	5	Electric	110	330	1%	201	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD7	7	Electric	110	180	0%	110	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD9	9	Electric	110	625	1%	381	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD12	12	Electric	110	540	1%	329	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD13	13	Electric	110	820	2%	500	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD14	14	Electric	110	570	1%	348	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD18	18	Electric	110	840	2%	512	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD19	19	Electric	110	950	2%	579	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD22	22	Electric	110	650	1%	396	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD23	23	Electric	110	550	1%	335	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD24	24	Electric	110	590	1%	360	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD25	25	Electric	110	750	2%	457	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD26	26	Electric	110	650	1%	396	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD28	28	Electric	110	585	1%	357	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD30	30	Electric	110	650	1%	396	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD35	35	Electric	110	1000	2%	610	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD37	37	Natural Gas	190	700	1%	427	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD38	38	Natural Gas	190	500	1%	305	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD40	40	Natural Gas	190	675	1%	412	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD41	41	Electric/Natural Gas	190	600	1%	366	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD43	43	Electric/Natural Gas	190	850	2%	518	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD45	45	Natural Gas	190	750	2%	457	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD47	47	Electric/Natural Gas	190	885	2%	540	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD50	50	Electric	110	500	1%	305	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD51	51	Electric	110	285	1%	174	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD60	60	Electric	110	600	1%	366	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD65	65	Electric	110	1250	3%	762	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD66	66	Electric	110	1350	3%	823	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD69	69	Electric	110	450	1%	274	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD70	70	Electric	110	350	1%	213	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD71	71	Electric	110	2675	5%	1,631	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD72	72	Electric	110	1850	4%	1,128	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD73	73	Electric	110	3500	7%	2,134	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD74	74	Electric	110	2700	5%	1,647	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD75	75	Electric	110	1150	2%	701	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD76	76	Electric	110	250	1%	152	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD77	77	Electric	110	400	1%	244	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD20A	20A	Electric	110	1100	2%	671	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD2A	2A	Electric	110	995	2%	607	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD32A	32A	Electric	110	1905	4%	1,162	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD33A	33A	Electric	110	2675	5%	1,631	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD3A	3A	Electric	110	370	1%	226	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD40A	40A	Electric	110	2525	5%	1,540	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD46R	46R	Electric/Natural Gas	190	800	2%	488	3,312	n/a	4,405	234	0.004	0.000	234	0.11	0.13	234
Sacramento Suburban WD4B	4B	Electric	110	2675	5%	1,631	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD55A	55A	Electric	110	2000	4%	1,220	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
Sacramento Suburban WD68R	68R	Electric	110	1600	3%	976	3,312	271,867	n/a	64	0.004	0.001	64	0.09	0.22	65
			Total	**49,195**	**100%**	**30,000**	**155,656**	**10,602,801**	**35,238**	**4,379**	**0.1723**	**0.0325**	**4,379**	**4.31**	**9.69**	**4,393**

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr
Higher Heating Valu	1,020	Btu/scf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Butte Water District	
Transfer Volume	5,500	acre feet/year
Location	Butte	County
	Sutter	County

Table G-19. Butte Water District Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	**Well**	**Fuel Type**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(gal/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
Butte Water District#1	#1	Electric	300	4,000	49%	2,683	3,643	815,517	n/a	164	0.0105	0.0022	164	0.26	0.66	165
Butte Water District#2	#2	Electric	350	4,200	51%	2,817	3,643	951,437	n/a	192	0.0123	0.0026	192	0.31	0.78	193
			Total	**8,200**	**100%**	**5,500**	**7,285**	**1,766,954**	**0**	**356**	**0.0228**	**0.0048**	**356**	**0.57**	**1.44**	**358**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency Garden Highway Mutual Water Company
Transfer Volume 14,000 acre feet/year
Location Sutter County

Table G-20. Garden Highway Mutual Water Company Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Garden Highway MWC4	#4	Electric	110	2,300	12%	1,651	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC17	#17	Electric	110	3,100	16%	2,226	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC19	#19	Electric	110	2,800	14%	2,010	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC22	#22	Electric	110	2,700	14%	1,938	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC23	#23	Electric	110	2,200	11%	1,579	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC24	#24	Electric	110	3,200	16%	2,297	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
Garden Highway MWC25	#25	Electric	110	3,200	16%	2,297	3,899	320,073	n/a	65	0.0041	0.0009	65	0.10	0.26	65
			Total	**19,500**	**100%**	**14,000**	**27,294**	**2,240,511**	**0**	**452**	**0.0290**	**0.0061**	**452**	**0.72**	**1.83**	**454**

Legend

(shaded) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Gilsizer Slough Ranch	
Transfer Volume	3,900	acre feet/year
Location	Sutter	County

Table G-21. Gilsizer Slough Ranch Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	**Well**	**Fuel Type**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(gal/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
Gilsizer #1	Gilsizer #1	Diesel	162	2,016	33%	1,300	3,502	n/a	31,828	325	0.0132	0.0026	325	0.33	0.79	326
Gilsizer #2	Gilsizer #2	Electric	110	2,016	33%	1,300	3,502	287,481	n/a	58	0.0037	0.0008	58	0.09	0.23	58
Gilsizer #3	Gilsizer #3	Electric	110	2,016	33%	1,300	3,502	287,481	n/a	58	0.0037	0.0008	58	0.09	0.23	58
			Total	**6,048**	**100%**	**3,900**	**10,506**	**574,961**	**31,828**	**441**	**0.0206**	**0.0042**	**441**	**0.52**	**1.25**	**443**

Legend

Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Goose Club Farms and Teichert Aggregates	
Transfer Volume	10,000	acre feet/year
Location	Sutter	County

Table G-22. Goose Club Farms and Teichert Aggregates Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	GHG Emissions (metric tons per year) CH4	GHG Emissions (metric tons per year) N2O	GHG Emissions (metric tons CO2e per year) CO2	GHG Emissions (metric tons CO2e per year) CH4	GHG Emissions (metric tons CO2e per year) N2O	GHG Emissions (metric tons CO2e per year) Total
Goose Club1	1	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club2	2	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club3	3	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club4	4	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club5	5	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club6	6	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club7	7	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club8	8	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club9	9	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club10	10	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club11	11	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club12	12	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
Goose Club13	13	Electric	125	3,000	8%	769	1,393	129,900	n/a	26	0.0017	0.0004	26	0.04	0.11	26
			Total	**39,000**	**100%**	**10,000**	**18,103**	**1,688,697**	**0**	**341**	**0.0218**	**0.0046**	**341**	**0.55**	**1.38**	**342**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Tule Basin Farms	
Transfer Volume	7,320	acre feet/year
Location	Sutter	County

Table G-23. Tule Basin Farms Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	**Well**	**Fuel Type**	**(hp)**	**(gpm)**	**(% of Total)**	**(AF/year)**	**(hours/year)**	**(kWh/yr)**	**(MMBtu/yr)**	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	**Total**
Tule Basin1	1	Electric	125	3,050	27%	1,941	3,457	322,468	n/a	65	0.004	0.001	65	0.10	0.26	65
Tule Basin2	2	Natural Gas	190	3,600	31%	2,291	3,457	n/a	4,598	244	0.005	0.000	244	0.11	0.14	244
Tule Basin3	3	Electric	125	4,850	42%	3,087	3,457	322,468	n/a	65	0.004	0.001	65	0.10	0.26	65
			Total	**11,500**	**100%**	**7,320**	**10,371**	**644,935**	**4,598**	**374**	**0.0129**	**0.0022**	**374**	**0.32**	**0.66**	**375**

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Natural Gas Engine Fuel Consumption

Estimated BSFC =	7,000	Btu/bhp-hr
Higher Heating Value	1,020	Btu/scf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Reclamation District 2068
Transfer Volume	4,500 acre feet/year
Location	Solano County
	Yolo County

Table G-24. Reclamation District 2068 Criteria Pollutant Emissions

									Fuel	GHG Emissions						
			Power Rating	Pump Rate		Transfer Volume	Operation		Consumption	(metric tons per year)			(metric tons CO2e per year)			
Description	Well	Fuel Type	(hp)	(gpm)	(% of Total)	(AF/year)	(hours/year)	(kWh/yr)	(gal/yr)	CO2	CH4	N2O	CO2	CH4	N2O	Total
RD-2068TP-1	TP-1	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
RD-2068GW-2	GW-2	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
RD-2068GW-3	GW-3	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
RD-2068GW-4	GW-4	Electric	75	1,500	25%	1,125	4,073	227,974	n/a	46	0.0029	0.0006	46	0.07	0.19	46
			Total	**6,000**	**100%**	**4,500**	**16,293**	**911,896**	**0**	**184**	**0.0118**	**0.0025**	**184**	**0.29**	**0.74**	**185**

Legend

(shaded) Engine power rating not provided; assumed to be equal to maximum horsepower for all engines operating at the water agency with the same fuel type

Conversion Factors

1 lb =	453.6 g
1 tonne =	1,000 kg
1 tonne =	1,000,000 g
1 MWh =	1,000 kWh
1 GWh =	1,000,000 kWh
1 kW =	1.34 hp
1 hour =	60 minutes
1 acre-foot =	325,851 gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Groundwater Substitution GHG Emissions

Agency	Pope Ranch	
Transfer Volume	2,800	acre feet/year
Location	Yolo	County

Table G-25. Pope Ranch Criteria Pollutant Emissions

Description	Well	Fuel Type	Power Rating (hp)	Pump Rate (gpm)	Pump Rate (% of Total)	Transfer Volume (AF/year)	Operation (hours/year)	Operation (kWh/yr)	Fuel Consumption (gal/yr)	GHG Emissions (metric tons per year) CO2	CH4	N2O	GHG Emissions (metric tons CO2e per year) CO2	CH4	N2O	Total
Pope RanchX1	X1	Electric	110	2,117	50%	1,400	3,591	294,824	n/a	59	0.0038	0.0008	59	0.10	0.24	60
Pope RanchX2	X2	Electric	110	2,117	50%	1,400	3,591	294,824	n/a	59	0.0038	0.0008	59	0.10	0.24	60
			Total	**4,234**	**100%**	**2,800**	**7,183**	**589,648**	**0**	**119**	**0.0076**	**0.0016**	**119**	**0.19**	**0.48**	**120**

Legend

(shaded) Engine power rating not provided; assumed to be equal to average horsepower for all engines operating in the study area for fuel type

Conversion Factors

1 lb =	453.6	g
1 tonne =	1,000	kg
1 tonne =	1,000,000	g
1 MWh =	1,000	kWh
1 GWh =	1,000,000	kWh
1 kW =	1.34	hp
1 hour =	60	minutes
1 acre-foot =	325,851	gallons

http://www.water.ca.gov/pubs/dwrnews/california_water_facts_card/waterfactscard.pdf

Global Warming Potential

CO2	1
CH4	25
N2O	298

Engine Size Summary

Table G-26. Summary of Average Engine Horsepower by Fuel Type

Average of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		125		125
Butte Water District		325		325
City of Sacramento		60		60
Conaway Preservation Group	227	138		147
Cordua Irrigation District		82		82
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	129	118		124
Reclamation District 1004	191	76		145
Reclamation District 108		200		200
Reclamation District 2068		75		75
Sacramento County Water Agency		116		116
Sycamore Mutual Water Company		117		117
Te Velde Revocable Family Trust		110		110
Tule Basin Farms		125	190	147
Grand Total	**162**	**110**	**190**	**117**

Table G-27. Summary of Maximum Engine Horsepower by Fuel Type

Max of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		200		200
Butte Water District		350		350
City of Sacramento		150		150
Conaway Preservation Group	227	250		250
Cordua Irrigation District		125		125
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	250	250		250
Reclamation District 1004	225	125		225
Reclamation District 108		250		250
Reclamation District 2068		75		75
Sacramento County Water Agency		200		200
Sycamore Mutual Water Company		125		125
Te Velde Revocable Family Trust		143		143
Tule Basin Farms		125	190	190
Grand Total	**250**	**350**	**190**	**350**

Table G-28. Summary of Minimum Engine Horsepower by Fuel Type

Min of HP	Fuel Type			
Agency	**Diesel**	**Electric**	**Natural Gas**	**Grand Total**
Anderson-Cottonwood Irrigation District		50		50
Butte Water District		300		300
City of Sacramento		30		30
Conaway Preservation Group	227	75		75
Cordua Irrigation District		50		50
Cranmore Farms		125		125
Eastside Mutual Water Company	215			215
Goose Club Farms and Teichert Aggregates		125		125
Pelger Mutual Water Company	173			173
Pleasant Grove-Verona Mutual Water Company	62	30		30
Reclamation District 1004	150	40		40
Reclamation District 108		100		100
Reclamation District 2068		75		75
Sacramento County Water Agency		50		50
Sycamore Mutual Water Company		75		75
Te Velde Revocable Family Trust		52		52
Tule Basin Farms		125	190	125
Grand Total	**62**	**30**	**190**	**30**

GHG Emission Factors

Table G-29. GHG Emission Factors for Electric Pumps

County	Utility Company	Emission Factors CO2 (lbs/MWh)	CH4 (lbs/GWh)	N2O (lbs/GWh)
Colusa	Pacific Gas & Electric	444.62	28.49	6.03
Glenn	Pacific Gas & Electric	444.62	28.49	6.03
Merced	Pacific Gas & Electric	444.62	28.49	6.03
Placer	Pacific Gas & Electric	444.62	28.49	6.03
Sacramento	Sacramento Municipal Utility District	521.73	28.49	6.03
San Joaquin	Pacific Gas & Electric	444.62	28.49	6.03
Shasta	Pacific Gas & Electric	444.62	28.49	6.03
Solano	Pacific Gas & Electric	444.62	28.49	6.03
Sutter	Pacific Gas & Electric	444.62	28.49	6.03
Yolo	Pacific Gas & Electric	444.62	28.49	6.03
Yuba	Pacific Gas & Electric	444.62	28.49	6.03

Table G-30. Utility-Specific CO2 Emission Factors

2009 Emission Rates		
Utility	Factor Type	Emission Factor (lbs CO_2/MWh)
Modesto Irrigation District	Retail Power	1,036.17
	Special Power	0
	Wholesale Power	2,048.09
Pacific Gas & Electric	System Average	575.38
Bonneville Power Authority	System Average	93.17
2010 Emission Rates		
Utility	Factor Type	Emission Factor (lbs CO_2/MWh)
Sacramento Municipal Utility District	Retail Power	526.47
	Special Power	0.00
	Wholesale Power	828.58
Newmont Nevada Energy Investment	Wholesale Power	2,055.79
Pacific Gas & Electric	System Average	444.64
City of Vernon, Light and Power	System Average	775.83
Modesto Irrigation District	Retail Power	942.99
	Special Power	0.00
	Wholesale Power	2,026.12
Northern States Power Company (Xcel Energy)	System Average	1,047.20
Public Service Company of Colorado (Xcel Energy)	System Average	1,675.51
Southwestern Public Service Company (Xcel Energy)	System Average	1,552.05
Seattle City Light	Retail Power	45.57
	Special Power	0.00
	Wholesale Power	537.64
Bonneville Power Authority	System Average	134.70

2011 Emission Rates		
Utility	**Factor Type**	**Emission Factor ($lbs\ CO_2/MWh$)**
Pacific Gas & Electric	System Average	392.87
Bonneville Power Authority	System Average	47.86
Seattle City Light	Retail Power	13.77
	Special Power	0.00
	Wholesale Power	218.75
Sacramento Municipal Utility District	Retail Power	429.29
	Special Power	0.00
	Wholesale Power	795.14
City of Vernon, Light and Power	System Average	731.49
Northern States Power Company (Xcel Energy)	System Average	1,071.45
Public Service Company of Colorado (Xcel Energy)	System Average	1,618.19
Southwestern Public Service Company (Xcel Energy)	System Average	1,472.69
2012 Emission Rates		
Utility	**Factor Type**	**Emission Factor ($lbs\ CO_2/MWh$)**
City of Vernon, Light and Power	System Average	765.97
Pacific Gas & Electric	System Average	444.62
Sacramento Municipal Utility District	Retail Power	521.73
	Special Power	0.00
	Wholesale Power	799.77
Seattle City Light	Retail Power	25.62
	Special Power	0.00
	Wholesale Power	362.85
Metropolitan Water District of Southern California	Wholesale Power	658.73
	Self-consumed Power	157.87

Source:

The Climate Registry. 2014. Utility-Specific Emission Factors. Accessed on: May 12, 2014. Available at: http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/.

Table G-31. eGRID GHG Emission Factors

eGRID Subregion	eGRID Subregion Name	2010 Emission Rates (lbs CO2/MWh)	(lbs CH4/GWh)	(lbs N2O/GWh)
AKGD	ASCC Alaska Grid	1,256.87	26.08	7.18
AKMS	ASCC Miscellaneous	448.57	18.74	3.68
AZNM	WECC Southwest	1,177.61	19.21	15.72
CAMX	WECC California	610.82	28.49	6.03
ERCT	ERCOT All	1,218.17	16.85	14.07
FRCC	FRCC All	1,196.71	38.91	13.75
HIMS	HICC Miscellaneous	1,330.16	73.98	13.88
HIOA	HICC Oahu	1,621.86	99.3	22.41
MROE	MRO East	1,610.80	24.29	27.52
MROW	MRO West	1,536.36	28.53	26.29
NEWE	NPCC New England	722.07	71.76	12.98
NWPP	WECC Northwest	842.58	16.05	13.07
NYCW	NPCC NYC/Westchester	622.42	23.81	2.8
NYLI	NPCC Long Island	1,336.11	81.49	10.28
NYUP	NPCC Upstate NY	545.79	16.3	7.24
RFCE	RFC East	1,001.72	27.07	15.33
RFCM	RFC Michigan	1,629.38	30.46	26.84
RFCW	RFC West	1,503.47	18.2	24.75
RMPA	WECC Rockies	1,896.74	22.66	29.21
SPNO	SPP North	1,799.45	20.81	28.62
SPSO	SPP South	1,580.60	23.2	20.85
SRMV	SERC Mississippi Valley	1,029.82	20.66	10.76
SRMW	SERC Midwest	1,810.83	20.48	29.57
SRSO	SERC South	1,354.09	22.82	20.89
SRTV	SERC Tennessee Valley	*1,389.20*	17.7	22.41
SRVC	SERC Virginia/Carolina	1,073.65	21.69	17.64

Source: U.S. Environmental Protection Agency. 2014. eGRID 9th edition Version 1.0 Year 2010 GHG Annual Output Emission Rates. Accessed on: May 12, 2014. Available at: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-0_year_2010_GHG_Rates.pdf.

Table G-32. Diesel Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	10.21	kg/gallon	Table 12.1, Distillate Fuel Oil No. 2
CH4	0.003	kg/MMBtu	Table 12.9, Petroleum Products, Industrial
N2O	0.0006	kg/MMBtu	Table 12.9, Petroleum Products, Industrial
Heat Content	0.138	MMBtu/gallon	Table 12.1, Distillate Fuel Oil No. 2

Source: The Climate Registry. 2014. 2014 Climate Registry Default Emission Factors with U.S. EPA 11/29/2013 Update (Released: March 14, 2014). Accessed on: May 12, 2014. Available at: http://www.theclimateregistry.org/downloads/2014/03/2014-TCR-Default-EFs-with-EPA-11.29.2013-update.pdf

Table G-33. Natural Gas Emission Factors

Pollutant	Emission Factor	Unit	Emission Factor Description
CO2	53.06	kg/MMBtu	Table 12.1, US Weighted Average
CH4	0.001	kg/MMBtu	Table 12.9, Natural Gas, Industrial
N2O	0.0001	kg/MMBtu	Table 12.9, Natural Gas, Industrial
Heat Content	1,026	Btu/scf	Table 12.1, US Weighted Average

Source: The Climate Registry. 2014. 2014 Climate Registry Default Emission Factors with U.S. EPA 11/29/2013 Update (Released: March 14, 2014). Accessed on: May 12, 2014. Available at: http://www.theclimateregistry.org/downloads/2014/03/2014-TCR-Default-EFs-with-EPA-11.29.2013-update.pdf

Table G-34. Reduced Exhaust Emissions from Cropland Idling

Water Agency	Groundwater Substitution	Cropland Idling/ Crop	GW Pumping Equivalent	Annual Emissions (MT/year)			Annual Emissions (MTCO2e/year)			
	(acre-feet/year)	(acre-feet/year)	(acre-feet/year)	CO2	CH4	N2O	CO2	CH4	N2O	Total
Anderson-Cottonwood Irrigation District	5,226	0	0	--	--	--	--	--	--	--
Browns Valley Irrigation District	0	0	0	--	--	--	--	--	--	--
Butte Water District	5,500	11,500	2,706	205	0.009	0.002	205	0.24	0.58	205
City of Sacramento	5,000	0	0	--	--	--	--	--	--	--
Conaway Preservation Group	35,000	21,349	5,023	380	0.018	0.004	380	0.44	1.07	381
Cordua Irrigation District	12,000	0	0	--	--	--	--	--	--	--
Cranmore Farms	8,000	2,500	588	44	0.002	0.000	44	0.05	0.13	45
Eastside Mutual Water Company	2,230	0	0	--	--	--	--	--	--	--
Garden Highway Mutual Water Company	14,000	0	0	--	--	--	--	--	--	--
Gilsizer Slough Ranch	3,900	0	0	--	--	--	--	--	--	--
Glenn-Colusa Irrigation District	25,000	66,000	15,529	1,174	0.055	0.011	1,174	1.36	3.31	1,178
Goose Club Farms and Teichert Aggregates	10,000	10,000	2,353	178	0.008	0.002	178	0.21	0.50	179
Merced Irrigation District	0	0	0	--	--	--	--	--	--	--
Natomas Central Mutual Water Company	30,000	0	0	--	--	--	--	--	--	--
Pelger Mutual Water Company	3,750	2,538	597	45	0.002	0.000	45	0.05	0.13	45
Placer County Water Agency	0	0	0	--	--	--	--	--	--	--
Pleasant Grove-Verona Mutual Water Company	18,000	9,000	2,118	160	0.007	0.002	160	0.19	0.45	161
Pope Ranch	2,800	0	0	--	--	--	--	--	--	--
Reclamation District 1004	7,175	10,000	2,353	178	0.008	0.002	178	0.21	0.50	179
Reclamation District 108	15,000	20,000	4,706	356	0.017	0.003	356	0.41	1.00	357
Reclamation District 2068	4,500	7,500	1,765	133	0.006	0.001	133	0.15	0.38	134
River Garden Farms	9,000	0	0	--	--	--	--	--	--	--
Sacramento County Water Agency	15,000	0	0	--	--	--	--	--	--	--
Sacramento Suburban Water District	30,000	0	0	--	--	--	--	--	--	--
South Sutter Water District	0	0	0	--	--	--	--	--	--	--
Sycamore Mutual Water Company	15,000	10,000	2,353	178	0.008	0.002	178	0.21	0.50	179
Te Velde Revocable Family Trust	7,094	6,975	1,641	124	0.006	0.001	124	0.14	0.35	125
Tule Basin Farms	7,320	0	0	--	--	--	--	--	--	--
Total	**290,495**	**177,362**	**41,732**	**3,154**	**0.146**	**0.030**	**3,154**	**3.66**	**8.91**	**3,167**

Notes:

Pelger Mutual Water Company used to estimate emissions for other water agencies.

Engine power rating equal to 250 hp for Pelger Mutual Water Company engines.

The Byron Buck memo is based on diesel-fueled engines with sizes ranging from 121 to 225 hp; all engines are noncertified (Tier 0).

Pelger Mutual Water Company engines are therefore determined to be a sufficient proxy to estimate the difference in emissions between groundwater substitution and cropland idling.

1 acre-foot of groundwater pumped = 4.25 acre-feet produced by fallowing

Source: Byron Buck & Associates. 2009. "Comparison of Summertime Emission Credits from Land Fallowing Versus Groundwater Pumping."

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Appendix H

Biological Regulatory Setting

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Appendix H
Biological Resources Regulatory Setting

The following section describes laws, rules, regulations and policies that apply to the natural communities, common plants and wildlife, fisheries, and special-status species that occur within the area of analysis.

H.1 Federal

H.1.1 Endangered Species Act (ESA)

The Federal ESA defines "endangered" species as those in danger of extinction throughout all or a significant portion of their range. A "threatened" species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Additional special-status species include "candidate" species and "species of concern." Candidate species are those for which the U.S. Fish and Wildlife Service (USFWS), or National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) if applicable, has enough information on file to propose listing as endangered or threatened. A species that has been "delisted" is one whose population has met its recovery goal target and is no longer found to be in jeopardy of extinction. These agencies also may designate Critical Habitat for listed species.

Section 4 of the Federal ESA prohibits "take" of federally listed species without a permit that specifically authorizes that take. Take may be authorized through either a Section 10a1(a) permit for directed take of the species for scientific research, or through an incidental take permit, which allows an action to take of the species (under specifically prescribed conditions) where such take is incidental to the implementation of an otherwise lawful activity. Incidental take of a federally listed species may be addressed for a proposed project in one of two ways depending on whether the or not the project has a federal nexus. A federal nexus occurs when a project is authorized or funded by a federal agency. Projects without a federal nexus may address potential adverse impacts to species protected under Federal ESA Section 10, or (2) a federal lead agency regulates a proposed project in accordance with Federal ESA Section 7. As this project has a federal nexus, the Section 7 process will be followed. Section 7 defines a process for the federal lead agency to consult with the responsible federal resource agency (the USFWS or NOAA Fisheries), to determine whether proposed long-term water transfers are likely to adversely affect species that are listed or proposed for listing. The Section 7 process typically requires the preparation of a biological assessment (BA) by the federal lead agency followed by the preparation of biological opinion (BO) by the responsible federal resource agency.

H.1.2 Fish and Wildlife Coordination Act (FWCA)

The FWCA (16 U.S. Code [USC] 661 et seq.) requires Federal agencies to consult with USFWS, or, in some instances, with NOAA Fisheries and with State fish and wildlife resource agencies before undertaking or approving water projects that control or modify surface water. The purpose of this consultation is to ensure that wildlife concerns receive equal consideration water resource development projects and are coordinated with the features of these projects. The consultation is intended to promote the conservation of fish and wildlife resources by preventing their loss or damage and to provide for the development and improvement of fish and wildlife resources in connection with water projects. Federal agencies undertaking water projects are required to fully consider recommendations made by USFWS, NOAA Fisheries, and State fish and wildlife resource agencies in project reports and to include measures to reduce impacts on fish and wildlife in project plans.

The 1988 amendment to the Fish and Wildlife Conservation Act mandates USFWS to identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973. In 2008, USFWS issued the most recent version of the National list of *Bird Species of Conservation Concern.*

H.1.3 Magnuson-Stevens Fisheries Act of 2006

The Amended Magnuson-Stevens Fishery Conservation and Management Act, also known as the Sustainable Fisheries Act (Public Law 104-297) is the primary law governing the marine fisheries of the United States. The law establishes requirements to provide for the sustainable management of these fisheries and to promote the protection of essential fish habitat. This Act requires all Federal agencies to consult with the Secretary of Commerce on activities, or proposed activities, authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat. The Essential Fish Habitat provisions of the Sustainable Fisheries Act are designed to protect fisheries habitat from being lost due to disturbance and degradation.

H.1.4 Migratory Bird Treaty Act (MBTA)

The MBTA domestically implements a series of international treaties that provide for migratory bird protection. The MBTA authorizes the Secretary of the Interior to regulate the taking of migratory birds. The act further provides that it is unlawful, except as permitted by regulations, “to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird…” (16 USC 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by the MBTA can be found in the March 1, 2010 Federal Register (75 FR 9281). This list comprises several hundred species, including essentially all native birds. Permits for take of nongame migratory birds can be issued only for specific activities, such as scientific collecting, rehabilitation, propagation, education, taxidermy, and protection of human health and safety and of personal property. USFWS publishes a list of birds of conservation concern (BCC) to identify migratory nongame birds that are likely to become candidates for listing under ESA without additional conservation actions. The BCC list is intended to stimulate coordinated and collaborative conservation efforts among federal, state, tribal, and private parties.

H.1.5 Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (Protection of Wetlands) requires Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. Any agency considering a proposal that might affect wetlands must evaluate factors affecting wetland quality and survival. These factors should include the proposal's effects on the public health, safety, and welfare due to modifications in water supply and water quality; maintenance of natural ecosystems and conservation of flora and fauna; and other recreational, scientific, and cultural uses.

H.2 State

H.2.1 California Endangered Species Act (CESA)

CESA (California Fish and Game Code Sections 2050–2116) was implemented in 1984 to prohibit the take of species that are listed as endangered and or threatened. CESA defines "endangered" species as those whose continued existence in California is jeopardized. State-listed "threatened" species are those not presently threatened with extinction, but which may become endangered if their environments change or deteriorate. Section 86 of the California Department of Fish and Game Code defines take as to "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." California Department of Fish and Wildlife (CDFW) administers CESA and authorizes incidental take through either California Fish and Game Code Section 2080.1 (consistency determination) or Section 2081 (Incidental Take Permit).

H.2.2 Fully Protected Species

Sections 3511, 3513, 4700, and 5050 of the California Fish and Game Code pertain to fully protected wildlife species (birds in Sections 3511 and 3513, mammals in Section 4700, and reptiles and amphibians in Section 5050) and strictly prohibit the take of these species. CDFW cannot issue a take permit for fully protected species, except under narrow conditions for scientific research or the protection of livestock, or if a Natural Community Conservation Plan (NCCP) has been adopted. Specifically, Section 3513 prohibits any take or possession of birds designated by the MBTA as migratory nongame birds except as allowed by federal rules and regulations pursuant to the MBTA.

H.2.3 Protection of Birds and Raptors

Section 3503 of the Fish and Game Code prohibits the killing of birds and/or the destruction of bird nests. Section 3503.5 prohibits the killing of raptor species and/or the destruction of raptor nests. Typical violations include destruction of active bird and raptor nests as a result of tree removal, and failure of nesting attempts (loss of eggs and/or young) as a result of disturbance of nesting pairs caused by nearby human activity.

H.2.4 California Native Plant Protection Act (CNPPA)

The CNPPA of 1977 prohibits importation of rare and endangered plants into California, take of rare and endangered plants, or sale of rare and endangered plants. CESA defers to the CNPPA, which ensures that state-listed plant species are protected when state agencies are involved in projects subject to California Environmental Quality Act.

H.2.5 Natural Community Conservation Planning Act (NCCPA)

The NCCPA, California Fish and Game Code, Section 2800, et seq., was enacted to form a basis for broad-based planning to provide for effective protection and conservation of the State's wildlife heritage, while continuing to allow appropriate development and growth. The purpose of natural community conservation planning is to sustain and restore those species and their habitat identified by CDFW that are necessary to maintain the continued viability of biological communities impacted by human changes to the landscape. A NCCP identifies and provides for those measures necessary to conserve and manage natural biological diversity within the plan area while allowing compatible use of the land. CDFW may authorize the take of any identified species, including listed and non-listed species, pursuant to Section 2835 of the NCCPA, if the conservation and management of such species is provided for in an NCCP approved by CDFW. NCCPs in the planning area are described in greater detail in Section 3.6.1.2.5 Regional/Local Requirements. The proposed water transfers occurring in NCCP planning areas will not require separate incidental take permits pursuant to CESA for covered species if the project adheres to the requirements of the relevant plans.

H.2.6 Requirements of the 1995 Bay Delta Plan Water Quality Control Plan (1995 Delta WQCP) and Decision 1641

The State Water Resources Control Board (SWRCB) adopted its WQCP for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary in May 1995 and incorporated several elements of U.S. Environmental Protection Agency (USEPA), NOAA Fisheries, and USFWS regulatory objectives for water salinity and endangered species protection. The WQCP identifies the beneficial uses of the Bay-Delta that are to be protected and includes flow and water quality objectives that are intended to protect the beneficial uses. The plan also includes an implementation program for achieving the water quality objectives.

Under the Clean Water Act, the water quality standards comprise the uses and the quality objectives established to protect them.

Features of the current WQCP affect the proposed water transfers because they require certain Delta outflows and regulate actions that may be used to protect fish and benefit the environment.

H.3 State and Federal Laws and Regulations Governing Water Transfers and Water Acquisitions

H.3.1 The Water Code

Both State and Federal laws contain provisions that authorize, acknowledge, or support water transfers. The Water Code protects legal users of water and fish and wildlife during water transfers through the "no injury rule," analyses of impacts to fish and wildlife, evaluation of third-party impacts, and the 1707 process.

Water Code Sections 1435, 1725, and 1736 require that the SWRCB make a finding that certain proposed transfers not result in unreasonable effects on fish and wildlife or other instream beneficial uses. These Code Sections apply to specific types of water transfers (urgent, temporary, and long-term transfers) related to post-1914 water rights. Pre-1914 water rights are not subject to the permit system, although a change in use for instream flow may be permitted under Section 1707 on petition to the SWRCB. The proposed water transfers were conceived in compliance with these codes.

In the context of the proposed water transfers "third parties" are any persons and resources other than the entities transferring or receiving water. Although the Water Code does not define "third party impacts," they traditionally include impacts related to downstream water rights; adjacent groundwater users; fish and wildlife; and recreation, economic, and social impacts. Most third-party impacts are evaluated under Water Code Sections that protect prior rights and fish and wildlife as discussed above. However, Water Code Sections 386 and 1810 require evaluation of other third-party impacts for some specific transfers and prohibit such transfers from affecting the overall economy of the area or county from which the water is being transferred. Water Code Section 1810 states that transferors can utilize public water conveyance facilities as long as "this use of a water conveyance facility is to be made without injuring any legal user of water and without unreasonably affecting fish, wildlife, or other instream beneficial uses and without unreasonably affecting the overall economy or the environment of the county from which the water is being transferred."

Section 1707 of the Water Code allows water rights holders, including riparian rights holders, to dedicate their rights to instream uses "for the purpose of preserving or enhancing wetlands, fish and wildlife resources, or recreation in, or on, the water." These transfers, from a consumptive use to a non-consumptive use with an identified need, may be temporary or permanent. The transfer must meet the following requirements for the SWRCB to consider approving the change in use:

- Will not increase the amount of water the person is entitled to use;
- Will not unreasonably affect any legal user of water; and
- Otherwise meets the requirements of Division 2 of the Water Code.

The petitioner can request that the water subject to transfer approval be in addition to water required for "Federal, State, or local regulatory requirements governing water quantity, water quality, instream flows, fish and wildlife, wetlands, recreation and other instream beneficial uses." If the petitioner does not submit this request to the SWRCB, then the water shall be used to meet any of the above requirements.

H.4 Other Pertinent Programs, Documents, Laws, and Agreements

Potential biological effects of water transfers in the project area have been previously addressed in documents.

H.4.1 Central Valley Project Improvement Act (CVPIA)

The CVPIA is a Federal statute passed in 1992 with the following purposes:

> *"To protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California; To address impacts of the Central Valley Project on fish, wildlife and associated habitats; To improve the operational flexibility of the Central Valley Project; To increase water-related benefits provided by the Central Valley Project to the State of California through expanded use of voluntary water transfers and improved water conservation; To contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; To achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors."*

The CVPIA changed the relative priorities of the various project purposes of the Central Valley Project (CVP) by making fish and wildlife protection, as a project purpose, equal to water supply for agricultural and urban uses.

CVPIA Section 3406(b)(2) (CVPIA[b][2]) authorized and directed the Secretary to dedicate and manage 800,000 acre-feet (AF) of CVP yield annually for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes and measures authorized in CVPIA, to assist the State of California in its efforts to protect the waters of the Bay-Delta Estuary, and to help meet obligations legally imposed on the CVP under State or Federal law following the date of enactment of the CVPIA. This dedicated 800,000 AF of water, known as (b)(2) water, was included as a component of the CALFED Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/EIR) existing regulatory baseline for fishery protection conditions for environmental and fisheries protection measures.

The operation of CVP and the State Water Project (SWP) facilities is subject to BOs issued by USFWS and the NOAA Fisheries. These BOs are subject to ongoing litigation and are currently under review by the two services:

- Biological Opinion on Implementation of the CVPIA and Continued Operation and Maintenance of the Central Valley Project (NOAA Fisheries 2000),
- Biological Opinion on the Effects of the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan (NOAA Fisheries 2004),
- Consultation on Long-Term Renewal of Water Service Contracts in the Delta-Mendota Canal Unit (NOAA Fisheries 2005),
- Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the Central Valley Project and State Water Project and the Operational Criteria and Plan to Address Potential Critical Habitat Issues (USFWS 2005a),
- Conclusion of Consultation on Long-Term Renewal of Water Service Contracts in the Delta-Mendota Canal Unit (USFWS 2005b),
- Formal Endangered Species Consultation on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands within the South-Central California Area Office: Biological Opinion (USFWS 2005c),
- Biological opinions for CVP Water contracts,
- Biological Opinion on the Coordinated Operations of the CVP and SWP in California. (USFWS 2008), and
- Biological Opinion on California's Central Valley Water Project (NOAA Fisheries 2009).

H.5 Regional/Local Requirements

Both the ESA and the NCCPA include provisions for the development of conservation plans to protect vegetation and wildlife resources.

A Habitat Conservation Plan (HCP) is a planning document that is required for issuance of an incidental take permit under section 10 of the ESA. The HCP process provides opportunities to conserve listed species, while streamlining permitting for participants' development projects within the planning area. HCP documents typically includes the following information: the anticipated take of the proposed project; measures to avoid, minimize or mitigate impacts to the maximum extent practicable, and a funding mechanism for acquiring and managing lands containing the habitats on which the covered species depend. Covered species may include both listed and non-listed species. This may provide an extra level of certainty for permittees, given that no amendments to the plan would be required if a covered species becomes listed under the ESA before the completion of project activities.

A NCCP is a similar process provided under state law, with some key differences. While the federal and state ESAs focus on protection and recovery of species that have already declined, NCCPs take a broader approach, seeking to anticipate and avoid future conflicts between preservation and development, as well as compliance with the CESA. NCCPs focus on regional-scale protection of ecosystems along with compatible development. A local agency oversees cooperative development of an NCCP by landowners, environmental groups, and other stakeholders, with support provided by CDFW and USFWS.

Project actions within the HCP/NCCP areas will comply with applicable requirements for covered activities within plan areas for existing HCPs/NCCPs. A separate Section 7 Consultation will also be undertaken for the long-term water transfers.

There are 11 HCPs or NCCPs that are either adopted or under development for areas that overlap with, or occur in the vicinity of, the long-term water transfers area of analysis (CDFW 2014a):

- Butte Regional Conservation Plan (BRCP) – The BRCP is a cooperative planning effort between the Cities of Biggs, Chico, Gridley, Oroville, County of Butte, and Butte County Association of Governments. The plan will provide streamlined ESA permitting for transportation projects, land development and covered activities such as construction and maintenance of facilities and infrastructure, residential construction, and recreational activity-related construction. The BRCP also aims to provide comprehensive conservation of species, wetlands and ecosystems, specifically contributing to the protection of 41 plant, fish, and wildlife species within the 564,270 acre plan area (CDFW 2014b). The BRCP covers nine of the focal species for the long-term water transfers including Red Bluff dwarf rush, Sacramento River winter-run Chinook salmon, and green sturgeon. This plan is under development.

- Bay-Delta Conservation Plan (BDCP) – The BDCP is a comprehensive conservation strategy for the Sacramento–San Joaquin River Delta (Delta) to protect ecosystem health, water quality, water supply, and California's economy, while permitting the operation of the CVP and State Water Project (SWP). The BDCP covers 56 species, including 11 of the focal species for the long-term water transfers including Central Valley Spring-run Chinook salmon, longfin smelt, and greater sandhill crane. This plan is under development. The draft BDCP and its corresponding draft EIS/EIR were published for public review and comment in December 2013 (Reclamation et al. 2013).

- East Contra Costa County HCP/NCCP – The East Contra Costa County HCP/NCCP was developed partially to address indirect and cumulative effects on terrestrial species from development supported by increases in water supply provided by Contra Costa Water District. Activities covered under the plan include public infrastructure projects, construction of residential and business development, and public infrastructure projects. The plan has been adopted by Contra Costa County, the Cities of Brentwood, Clayton, Pittsburg, and Oakley. The HCP/NCCP provides regional conservation and development guidelines to protect natural resources while improving the permit process for endangered species and wetland regulations. The plan will encompass a preserve system covering 30,300 acres of land that will be managed for the benefit of 28 species and the natural communities they depend upon (East Contra Costa County HCP Association 2006). The East Contra Costa County HCP covers 4 of the focal species for the long-term water transfers including giant garter snake, San Joaquin kit fox, and Western pond turtle.

- Natomas Basin HCP (NBHCP) - The NBHCP establishes a multi-species conservation program to mitigate the expected loss of habitat and incidental take and/or loss of covered species that would result from planned urban development. The plan covers 53,537 acres within the levees surrounding the Natomas Basin and 22 plant and wildlife species (The Natomas Basin Conservancy 2003). Covered activities under the plan include urban development, public and drainage improvements, water agency projects, and approved activities of the Natomas Basin Conservancy. Plan participants include the City of Sacramento, Sutter County, Sacramento County, and the acting regulatory agencies. The NBHCP covers four of the focal species for the long-term water transfers including giant garter snake, Western pond turtle, and white-faced ibis.

- Placer County Conservation Plan (PCCP) HCP/NCCP – The PCCP HCP/NCCP is intended to address the impacts associated primarily with unincorporated growth in western Placer County in addition to growth associated with the build-out of Lincoln's updated General Plan. The PCCP is intended to protect 31 special status species and federally regulated wetlands, as well as indirectly protect the habitat of hundreds of plant and wildlife species across approximately 201,000 acres of Western Placer County (Placer County Planning Services Division 2011). Covered activities include: urban development, in-stream projects, capital projects, operation and maintenance, rural development, conservation strategy implementation, and other Placer County conservation programs. Participants include the City of Lincoln, Placer County, Placer County Water Agency and South Placer Regional Transportation Authority. PCCP covers five of the focal species for the long-term water transfers including Ahart's dwarf rush, Red bluff dwarf rush, and Central Valley Steelhead. This plan is under development.

- San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP) – The SJMSCP was developed to provide guidelines for converting open space to other land uses, preserving agriculture, and protecting plant and wildlife species. Activities covered under the plan include urban development, mining, non-agricultural activities occurring outside of urban boundaries, transportation projects, non-federal flood control projects, maintenance activities, and similar public agency projects. San Joaquin County, the Cities of Stockton, Lodi, Manteca, Tracy, Ripon, Escalon, and Lathrop are the plan participants. The plan addresses 97 special-status plant, fish and wildlife species in over 900,000 acres of the San Joaquin County (San Joaquin County 2000). The SJMSCP covers 12 of the focal species for the long-term water transfers including Sandford's arrowhead, Red Bluff dwarf rush, and Delta smelt.

- Santa Clara Valley (SCV) HCP/NCCP – The SCV HCP/NCCP is a regional partnership between the County of Santa Clara, Santa Clara Valley Transportation Authority, Santa Clara Valley Water District, and the Cities of San Jose, Gilroy and Morgan Hill, and regulatory agencies. The plan encompasses approximately 440,318 acres and will address impacts primarily associated with the future uses of land identified in the plan area (CDFW 2014c). Land preservation would mitigate for the environmental impacts of planned urban and rural development, instream activities, public infrastructure operations and maintenance activities (e.g. water, transportation, etc.) and would enhance the long term viability of 21 threatened or endangered plant and wildlife species (CDFW 2014c). SCV HCP/NCCP covers three of the focal species for the long-term water transfers including San Joaquin kit fox, Western pond turtle, and tricolored blackbird.

- Solano Multispecies HCP (SMSHCP) – The SMSHCP plan area covers 585,000 acres (Solano County Water Agency 2009). It was developed to address species conservation in conjunction with urban development, flood control/infrastructure improvement activities, and to support the issuance of an incidental take permit under the Federal ESA for the Bureau of Reclamation's Solano Project Contract Renewal. Activities covered under the plan include preservation, restoration, invasive species control, and water quality improvement. Covered species include federally and state-listed fish species and other wildlife species of concern. Plan participants include Solano County, a small portion of Yolo County, Solano County Water Agency's contract service area, including the Cities of Fairfield, Vacaville, Vallejo, Suisun City, Solano Irrigation District, and the Main Prairie Water District. The SMSHCP covers eight of the focal species for the long-term water transfers including winter-run Chinook salmon, Central Valley steelhead, and longfin smelt. This plan is still under development.

- South Sacramento HCP (SSHCP) – The proposed SSHCP would address issues related to species conservation, agricultural protection, and urban development in 341,000 acres of south Sacramento County. Activities covered under the plan include construction of residential, commercial, and industrial buildings, and associated infrastructure. The plan is being prepared by Sacramento County, the Cities of Sacramento, Elk Grove, and Galt, and Rancho Powers Authority. The plan would cover 40 plant and wildlife species, including ten species that are listed by the state or federal governments. The SSHCP covers five of the focal species for the long-term water transfers including Ahart's dwarf rush, Greater sandhill crane, and giant garter snake. This plan is still under development.

- Yolo Natural Heritage Program (YNHP) – This plan is still under development and the program released a draft plan on June 28, 2013 (Yolo Natural Heritage Program 2013). This 653,818-acre county-wide HCP/NCCP will provide for the conservation of 32 sensitive species in five habitat types: wetland, riparian, oak woodland, grassland, and agriculture (Yolo Natural Heritage Program 2013). No aquatic species will be addressed in the YNHP. The plan describes measures that local agencies will implement to conserve biological resources, obtain permits for urban growth and public infrastructure projects, maintain the agricultural heritage of the county, and acquire permanent conservation easements for sensitive plant and wildlife species in the plan area. Plan participants include Yolo County, the Cities of Davis, Woodland, West Sacramento, and Winters. The YNHP covers four of the focal species for the long-term water transfers including giant garter snake, Western pond turtle, and purple martin.

- Yuba-Sutter NCCP/HCP – This plan is still under development. The Yuba-Sutter NCCP/HCP is a cooperative planning effort initiated by Yuba and Sutter Counties in connection with improvements to Highways 99 and 70, as well as future development in the area surrounding those highways. The plan covers approximately 210,000 acres and provides for the regional protection and management of 31 listed and other special-status species and their habitats (CDFW 2014d). Plan participants include the Counties of Yuba and Sutter, Cities of Yuba, Live Oak, and Wheatland. The Yuba-Sutter HCP covers five of the focal species for the long-term water transfers including greater sandhill crane, Western pond turtle, and tricolored blackbird.

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Appendix I

Special-Status Animals and Plants

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Appendix I
Special-Status Animals and Plants with Potential to Occur in the Area of Analysis

Table I-1. Special-Status Animals with Potential to Occur in the Area of Analysis

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Invertebrates						
Bay checkerspot butterfly *Euphydryas editha bayensis*	T	--	Historically occurred east, west, and south of SF bay, to Mt. Diablo south to Hollister. Currently, restricted to six core areas on the west and southern edges of the SF bay - SF peninsula, San Mateo County, and Santa Clara County, Any site with appropriate habitat within historic range should be considered potentially occupied (The Xerces Society 2012)	Restricted to native grasslands on outcrops of serpentine soil. The primary host plant for this butterfly is *Plantago erecta (*Dwarf plantain*)*. Secondary host plant include *Othocarpus densiflorou*s, *O.purpurscens,* and Purple owl's clover. Prefers shallow, serpentine-derived soils.	Adult present in spring. Flight season late February to early May.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. However, no impacts are expected to native grasslands.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Conservancy fairy shrimp *Branchinecta conservatio*	E	--	Northern two-thirds of the Central Valley. It ranges from Vina Plains of Tehama County; Sacramento NWR in Glenn County; Jepson Prairie Preserve and surrounding area east of Travis Air Force Base, Solano County; Mapes Ranch west of Modesto, Stanislaus County.	Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grass or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat occurs within the area of analysis. No impacts to vernal pool or other habitats occupied by this species are anticipated. The species is not likely to occur to occur in rice fields and canals due to predators (i.e. fish).
Lange's metalmark butterfly *Apodemia mormo langei*	E	--	Restricted to sand dunes along the southern bank of the Sacramento-San Joaquin River. Within Contra Costa County, it is currently found only at Antioch Sand Dunes.	Inhabits stabilized dunes along the San Joaquin river and is endemic to Antioch sand dunes, Contra Costa county. The butterfly's primary host plant is *Eriogonum nudum var. auriculatum*. It feeds on nectar of other wildflowers, as well as host plant.	Breeding season is August - September, Larvae hatch during rainy months.	None. CNDDB occurrences have been documented within the Buyer Service Area, however no impacts to sand dunes are anticipated.
Longhorn fairy shrimp *Branchinecta longiantenna*	E	--	Restricted to northern, central, and portions of southern California; populations along the eastern margin of the Central Coast Mountains from Concord, Contra Costa County south to Soda Lake in San Luis Obispo County; the Kellogg Creek watershed; the Altamont Pass area; the western and northern boundaries of Soda Lake on the Carrizo Plain; and Kesterson National Wildlife Refuge in the Central Valley.	Endemic to the eastern marring of the central coast mountains in seasonally astatic grassland vernal pools. Found in ephemeral freshwater habitats, such as vernal pools and swales.	Has been observed from late December until late April.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat may occur within the area of analysis. The species is not likely to occur to occur in rice fields and canals due to predators (i.e. fish). Transfers are not expected to impact any suitable grassland vernal pools or swales.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
San Bruno elfin butterfly *Callophrys mossii bayensis*	E	--	Found in vicinity of San Bruno mountains, San Mateo County (ESSIG 2012b).	Found in coastal, mountainous areas with grassy ground cover. Colonies are located on steep, north-facing slopes within the fog belt. Larval host plant is *Sedum spathulifolium.*	Year round	None. Occurrences have been documented in the Buyer Service Area and suitable habitat is present in the area. No impacts are anticipated to mountainous areas near San Bruno. Therefore no impacts to the species are expected.
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	--	Occurs only in the Central Valley and surrounding foothills below 3,000 feet elevation (USFWS 1980).	Dependent on elderberry shrubs (host plant) as a food source. Potential habitat consists of shrubs with stems one inch in diameter within Central Valley.	Year round for host plant and exit holes; March to June for adults	None. Occurrences have been documented within the Seller Service Area. Suitable habitat may occur within the area. However, elderberry shrubs would not be impacted by transfers, therefore no impacts are anticipated to the species.
Vernal pool fairy shrimp *Branchinecta lynchi*	T	--	Endemic to the Central Valley, Central Coast Mountains, and South Coast Mountains of California. It ranges from the Vina Plains in Tehama County, through the Central Valley, and south along the Central Coast to northern Santa Barbara County.	Endemic to the grasslands of the Central Valley, central coast mountains, and south coast mountains. Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grassed or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented in both the Buyer and the Seller Service areas. Rice fields and canals are not likely to support this species due to the presence of predators (i.e. fish), therefore no impacts are anticipated to the species. Transfers are not expected to impact vernal pools or natural wetlands.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Vernal pool tadpole shrimp *Lepidurus packardi*	E	--	Endemic to the northern portion of the Central Valley of California. This species occurs from the Millville Plains and Stillwater Plains in Shasta County south throughout the Central Valley to Merced County.	Found in a variety of natural and artificial seasonally ponded Sacramento valley habitat types including: vernal pools, swales, ephemeral drainages, stock ponds, reservoirs, ditches, backhoe pits, and ruts caused by vehicular activities.	Has been collected from early December to early May.	None. Occurrences have been documented in both the Buyer and the Seller Service area. Suitable habitat is present in the area. Rice fields and canals are not likely to support this species due to the presence of predators (i.e. fish), therefore there is a low potential for impacts to the species. Transfers are not expected to impact vernal pools or natural wetlands. No impacts to the species are expected.
Zayante band-winged grasshopper *Trimerotropis infantilis*	E	--	Known only from Santa Cruz County. Found in local Santa Cruz mountains (the Zayanite Sand Hills ecosystem) (Santa Cruz Public Libraries 2012).	Found in isolated sandstone deposits. Inhabits mostly sand parkland habitat, but also in areas with well-developed ground cover and in sparse chaparral with grass.	Flight season from late May - Oct.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat is present in the area, however, no impacts to suitable habitat are anticipated.
Amphibians						
California red-legged frog *Rana aurora draytonii*	T	SSC	Northwestern California, from Mendocino County south to northwestern Baja California. May now be extirpated in the southern Sierra Nevada; other Sierra Nevada foothill populations are small and highly localized. Nearly all current Central Valley sites are on the Coast Range slope, usually below 1,200m (3,936 ft).	Usually found in or near quiet permanent water of streams, freshwater marshes, or (less often) ponds and other quiet bodies of water; also damp woods and meadows some distance from water. Occurs in sites with dense vegetation (e.g., willows) close to water.	Year round. Little movement away from streamside habitats. Occasionally found on roads at night during winter and spring rains.	None. Suitable habitat is present within the area and occurrences of this species have been previously documented in the Buyer Service Area. Environmental Commitments would cause potential impacts to California red-legged frog to beneglegible.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California tiger salamander *Ambystoma californiense*	T[1], E[2]	T	Found in annual grassland habitat, grassy understories of valley-foothill hardwood habitats, and uncommonly along stream courses in valley-foothill riparian habitats. Occurs from near Petaluma, Sonoma County, and east through the Central Valley to Yolo and Sacramento Counties and south to Tulare County.; and from the vicinity of San Francisco Bay south to Santa Barbara County. Occurs at elevations from 3m - 1,054m (3200ft).	Lives in vacant or mammal-occupied burrows, occasionally other underground retreats, throughout most of the year, in grassland, savanna, or open woodland habitats. Lays eggs on submerged stems and leaves, usually in shallow ephemeral or semi permanent pools and ponds that fill during heavy winter rains, sometimes in permanent ponds; breeding takes place in fish free pools and ponds.	Migrates up to two km between terrestrial habitat and breeding pond. Migrations may occur from November through April.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat may occur within the area, but would not be impacted by transfers. This species is not expected to occur in rice fields due to predatory fish. Existing Environmental Commitments would maintain flow and temperature in streams.
Foothill yellow-legged frog *Rana boylii*	--	SSC	This species is known from the Pacific drainages from Oregon to the upper San Gabriel River, Los Angeles County, California, including the coast ranges (west pf Cascade crest) and Sierra Nevada foothills in the United States. Isolated populations in San Joaquin County on the floor of the Central Valley. Elevation range extends from near sea level to 1940m (6370ft).	This species inhabits partially shaded, rocky streams at low to moderate elevations, in areas of chaparral, open woodland, and forest. Rarely encountered far from permanent water.	Year round. Significant seasonal movements for migrations from breeding area have not been reported.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat is present within the area. However Transfers are not expected to impact any suitable rocky stream and woodland habitats. No impact to the species is expected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Western spadefoot toad *Spea hammondii*	--	SSC	This species occurs in the Central Valley and bordering foothills of California and along the Coast Ranges into northwestern Baja California, Mexico. In the Coast Ranges it is found from Point Conception, Santa Barbara County, south to Mexican border. Elevation ranges from near sea level to 1,363m (4,460 ft).	Lowlands to foothills, grasslands, open chaparral, pine-oak woodlands. Prefers short grass plains, sandy or gravelly soil. It is fossorial and breeds in temporary rain pools and slow-moving streams that do not contain bullfrogs, fish, or crayfish.	Year round. Usually in underground burrows most of year, but will travel several meters on rainy nights. Movement is rarely extensive.	None. Occurrences have been documented from both the Buyer and Seller Service Areas. Suitable habitat is present in the area. Transfers would not impact suitable upland habitat types. The species is not likely to occur in rice fields due to the presence of predatory fish, bullfrogs etc. Environmental Commitments to maintain flows will protect Western spadefoot toad.
Reptiles						
Alameda whipsnake *Masticophis lateralis euryxanthus*	T	T	Seven populations (recovery units) are known from Alameda and Contra Costa Counties, including the Mt. Diablo area and other East Bay Regional Parks, south almost to the border of Alameda and Santa Clara Counties. Likely occurred historically within San Joaquin and northern Santa Clara Counties.	The species is typically found in chaparral and scrub habitats, but it will also use adjacent grassland, oak savanna and woodland habitats. It is mostly found on south-facing slopes & ravines, with rock outcrops, deep crevices or abundant rodent burrows.	Year round.	None. Occurrences have been documented within the Buyers and Sellers Service Areas. No impacts to suitable habitat for Alameda whipsnake are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
blunt-nosed leopard lizard *Gambelia sila*	E	E	Currently known from undeveloped land within the San Joaquin Valley and the Coast Range foothills. Historically, the blunt-nosed leopard lizard ranged from the San Joaquin Valley and foothills from Stanislaus County south to northern Santa Barbara and Ventura Counties, with observations below 800m elevation.	This species is a resident of sparsely vegetated alkali and desert scrub habitats in areas of low topographic relief. The lizard seeks cover in mammal burrows, under shrubs or structures such as fence posts.	Year round. Hibernates during winter and active from late-March - July.	None. Occurrences have been documented within the Buyer Service Area and suitable habitat is present within the area of analysis. No impacts to suitable habitat for blunt-nosed leopard lizard are anticipated.
coast horned lizard *Phrynosoma blainvillii*	--	SSC	Occurs in the Sierra Nevada foothills from Butte County to Kern County and throughout the central and southern California coast. Its elevational range extends up to 1200m (4000ft) in the Sierra Nevada foothills and up to 1800m (6000ft) in the mountains of southern California.	The species frequents a wide variety of habitats and is most commonly found in lowlands along sandy washes with scattered low bushes. It inhabits open areas for sunning, bushes for cover, patches of loose soil for burial & abundant supply of ants and other insects.	Year round.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. No potential impacts to suitable habitat are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
giant garter snake *Thamnophis gigas*	T	T	Endemic to wetlands in the Sacramento and San Joaquin Valleys from Chico, south to the Mendota Wildlife Area in Fresno County.	Marshes, sloughs, ponds, small lakes, streams and other waterways. Typically occurs in areas that provide adequate water during the active season with emergent wetland vegetation. Basking habitat consists of grassy areas or openings adjacent to aquatic habitat, and upland areas are also used for refuge from flood conditions (USFWS 2006)	Year round	High. Suitable habitat is present within the Buyer and Seller Service Areas. Suitable habitat in the Seller Service Area is intermittent based on normal variation in cropping. Direct impacts may include reduction in suitable aquatic habitat within the Seller Service Area. The greatest impact would occur during the breeding season. Conservation measures are in place to maintain aquatic habitat corridors within irrigation ditches.
San Francisco garter snake *Thamnophis sirtalis tetrataenia*	E	E	Historically occurred from north of the San Francisco-San Mateo County line south to Ano Nuevo State Reserve, west of the Santa Cruz Mountains (USFWS 2006b).	The species is found in the vicinity of freshwater marshes, ponds and slow moving streams in San Mateo county and the extreme northern Santa Cruz county. The snake prefers dense cover and water depths of at least 1ft. Upland areas near water are also very important for this species.	Year round	None. Suitable habitat may be present in a small portion of the Buyer Service Area within San Mateo County. No impacts to suitable San Francisco garter snake habitat are anticipated in association with the proposed Transfers.
San Joaquin whipsnake *Masticophis flagellum ruddocki*	--	SSC	Known from as far north as Arbuckle, Colusa County through the San Joaquin Valley and Coast Ranges south into Kern and Santa Barbara Counties.	The species is found in open, dry habitats with little or no tree cover, generally at elevations 20 - 900m. It is also found in valley grassland and saltbush scrub in the San Joaquin valley. The snake requires mammal burrows for refuge and oviposition sites.	Year round.	None. Suitable habitat is present within the Buyer Service Area in the San Joaquin Valley. There is a very low potential that this species could occur in or adjacent to agriculture within the Buyer Service Area, but no conversion of suitable habitat would occur in association with the proposed Transfers.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Silvery legless lizard *Anniella pulchra pulchra*	--	SSC	The silvery legless lizard ranges from Antioch in Contra Costa County south through the Coast, Transverse, and Peninsular Ranges along the western edge of the Sierra Nevada Mountains. It occurs in the San Joaquin Valley and Mojave Desert down into Baja California. In the Sierra Nevada foothills it may occur at elevations up to 1,800m asl. (Contra Costa County 2006).	Sandy or loose loamy soil. May occur under sparse vegetation of beaches, chaparral, or pine-oak woodland, or near sycamores, cottonwoods, or oaks that grow on stream terraces. Often found under logs, rocks, old boards, or compacted debris of woodrat nests. Requires refugia with soil moisture during hot conditions. Agriculture and disturbed sites are not known to support the species (Contra Costa County 2006).	Year round	None. Suitable habitat is present within both the Buyer and Seller Service Areas, and previous records exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for the silvery legless lizard.
Pacific pond turtle *Actinemys marmorata*	--	SSC	Ranged from extreme western Washington and British Columbia to northern Baja California, mostly to the west of the Cascade-Sierra crest.	The western pond turtle occupies a wide variety of wetland habitats including rivers and streams (both permanent and intermittent), lakes, ponds, reservoirs, permanent and ephemeral shallow wetlands, abandoned gravel pits, stock ponds, and sewage treatment.	Year round	High. Suitable habitat occurs within the area of analysis. Pond turtles may occur in ditches, canals, rice fields, etc. Environmental Commitments would cause potential impacts to California red-legged frog to be negligible.
Birds[3]						
Alameda song sparrow *Melospiza melodia pusillula*	--	SSC	Endemic, restricted to fringes of south San Francisco Bay (east to El Cerrito, south to Alviso and west to San Francisco). Largest concentration near Dumbarton Point salt marsh, Alameda County.	The species is a resident of salt marshes. It inhabits salicornia marshes, nests low in grindelia bushes and in salicornia.	Year round, non-migratory. Breeds late-Feb to mid-August.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat may occur within the area of analysis. However, Transfers are not expected to impact any suitable habitat (i.e. salt marshes).

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
American peregrine falcon *Falco peregrinus anatum*	D	E, FP	Throughout California. Uncommon resident that breeds along coast north of Santa Barbara, in the Sierra Nevada, and other northern CA mountains. Migrant birds occur along the coast and the western Sierra Nevada.	Breeds in woodland, forest and coastal habitats on protected cliffs and ledges. Riparian areas and coastal and inland wetlands are important habitats yearlong especially during the non-breeding season.	Year round. Coastal migrants occur in Spring and Fall.	None. Rice fields may provide suitable foraging habitat for the species, but birds could relocate to other habitat areas in the vicinity. No nesting habitat would be affected by Transfers.
Bald eagle *Haliaeetus leucocephalus*	D	E	Throughout California. Breeding mostly in Butte, Lake, Lassen, Plumas, Shasta, Siskiyou, and Trinity counties. Winter migrant at inland waters.	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance. In flooded fields, occasionally hunts for small mammals.	Year round. Local winter movements.	None. Occurrences have been documented within both the Buyer and Seller Service Area and both areas provide suitable habitat. No impacts to suitable nesting habitat are anticipated. Rice fields represent marginal foraging habitat. Birds would be able to relocate to other suitable habitat areas in the vicinity if fields were fallowed. Environmental commitments limit the amount of land that can be fallowed in a given county.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Bank swallow *Riparia riparia*	--	T	A neotropical migrant found primarily in riparian and other lowland habitats in California west of the deserts during the spring-fall period. Breeding population in California occurs along banks of the Sacramento and Feather rivers in the northern Central Valley. Casual in southern California in winter. Other colonies along the central coast from Monterey to San Mateo counties.	Requires vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, lakes, and the ocean for nesting. Feeds primarily over grassland, shrub land, savannah, and open riparian areas during breeding season and over grassland, brushland, wetlands, and cropland during migration.	March-mid-September	None. Known from both the Buyer and Seller Service Areas. No suitable nesting habitat (i.e. cliffs) would be affected. There is potential that Transfers would reduce the area of cropland habitat used for foraging during migration (wetlands and croplands) due to changes in water application. However, fallow cropland would still providing suitable foraging habitat, and birds could forage at other croplands in the vicinity. Environmental commitments limit the amount of cropland idling that would occur.
black swift *Cypseloides niger*	--	SSC	Breeds locally in Sierra Nevada and Cascade range, San Gabriel, San Bernardino and San Jacinto Mts. Also in coastal bluffs and mountains from San Mateo County to San Luis Obispo County.	The bird breeds in small colonies on cliffs behind or adjacent to waterfalls in deep canyons and sea-bluffs above the surf. Found in moist crevice or cave on sea cliffs above the surf. Forage widely over many habitats. Avoids arid regions such as Great Basin, southern deserts and Central Valley.	Absent from October - April.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat may occur within the area of analysis. Habitat within the Buyers Service Area would not be affected, as water in excess of their CVP contract amount could not be procured, nor could this water be used to grow permanent crops. Therefore any change in habitat would fall within the normal range expected under their existing contracts.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Black tern *Chlidonias niger*	--	SSC	Common spring and summer visitor to fresh emergent wetlands of California.	Uses fresh emergent wetlands, lakes, ponds, moist grasslands, and agricultural fields. In migration, some take coastal routes and forage offshore.	April-September	High. No occurrences have been documented within either the Buyer or Seller Service Areas. However, suitable habitat (i.e. rice fields) is present, and the area of analysis is within the known range for the species. Therefore it has moderate potential to occur Water transfers could reduce suitable habitat for the species within the Seller Service Area. Conservation strategies are in place that would make potential impacts to this species to negligible.
Black-crowned night heron *Nycticorax nycticorax* (rookeries)	--	--	Year round resident and common in lowlands and foothills throughout most of California, including the Salton Sea and Colorado River areas, and very common locally in large nesting colonies. Uncommon in northwestern and rare in northeastern CA in midwinter. Uncommon in winter in southern deserts.	Feeds along the margins of lacustrine, large riverine, and fresh and saline emergent habitats. Nests and roosts in dense-foliaged trees and dense emergent wetlands.	Year round. Common nesting species from April -August.	None. No occurrences of black-crowned night heron have been documented within either the Buyer or Seller Service Areas. Suitable habitat is present in the area of analysis; however, no nesting or roosting habitats would be affected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
cackling (=Aleutian Canada) goose *Branta hutchinsii leucopareia*	D	--	The species is found in during the winter in Del Norte County, San Francisco Bay-Delta, and South Central Valley.	Forages on natural pasture or pastures that are cultivated to grain. The species occurs on lakes, reservoirs and ponds. Preferred habitats include lacustrine, fresh emergent wetlands, moist grasslands, croplands, pastures, and meadows.	Year-round in northeastern California, except when water freezes. Wintering population in California migrates north and east to northeastern California. Winters on lakes and inland prairies.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. The species distribution does not overlap with the major area where fallowing would occur. Transfers are not expected to impact breeding habitat (i.e. prefers islands in lakes).
California clapper rail *Rallus longirostris obsoletus*	E	E	Common locally around San Francisco, Monterey, and Morro bay.	Found in salt-water and brackish marshes traversed by tidal sloughs. The bird is associated with abundant growths of pickle weed, but feeds on mud-bottomed sloughs.	Year round. Non-migratory in coastal wetlands. Juveniles may disperse to freshwater wetlands late summer and autumn.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat may occur within the area of analysis. However, Transfers are not expected to impact any suitable habitat (i.e. salt-water marshes).
California horned lark *Eremophila alpestris actia*	--	WL	Found on coastal regions, chiefly from Sonoma to San Diego county, but also found in the main parts of San Joaquin Valley and east to the foothills.	Prefers short-grass prairie, mountain meadows, open coastal plains, alkali flats, "bald" hills, and fallow grain fields.	Year round in California. Some movement along the coast. May leave mountains in winter.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat occurs within the area of analysis. No impacts to breeding or foraging habitat are anticipated within the Buyer Service Area.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California least tern *Sternula antillarum browni*	E	E	Nests along the coast from San Francisco Bay south to northern Baja California. Migratory in California. Breeding colonies in Southern California near marine and estuarine shores. In SF Bay found near salt ponds and estuarine shores.	Breeds on bare or sparsely vegetated, flat substrates, sand beaches, alkali flats, landfills or paved areas. Feeds in shallow, estuarine waters.	Late April in southern California to mid-May in northern California. Winters south of California. Absent from mid-October to late April.	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat may occur within the area of analysis. No impacts are expected to suitable foraging or breeding habitat (i.e. sand beaches, alkali flats).
California yellow warbler *Dendroica petechia brewsteri*	--	SSC	Throughout California. From coastal Del Norte County., east to Modoc, south along coast range to Santa Barbara and Ventura County. Also found along western slope of Sierra Nevada to Kern County.	Frequents open to medium-density woodlands and forests with a heavy brush understory in breeding season. In migration, found in a variety of sparse to dense woodland and forest habitats. Breeds in montane chaparral, ponderosa pine and mixed conifer habitats.	April-October.	None. No occurrences have been documented in the area of analysis. The species is not likely to occur in rice fields, and no suitable habitat would be impacted (i.e. dense woodland and forest habitats).
Cooper's hawk *Accipiter cooperii*	--	WL	Throughout California. Breeds in southern Sierra Nevada foothills, New York Mountains, Owens Valley and local areas in southern California.	Frequents landscapes where wooded areas occur in patches and groves- live oak, riparian deciduous, other forest habitat near water. Often uses patchy woodlands and edges with snags for perching. Dense stands with moderate crown-depths used for nesting.	Year round. Breeding resident throughout wooded portion of California.	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. No potential impacts to preferred foraging or nesting habitat are anticipated.
Double-crested cormorant *Phalacrocorax pelagicus*	--	WL	Along the entire coast of California and on inland lakes, in fresh, salt and estuarine waters. Uncommon from San Luis Obispo County south and very rare to the north. Common on Colorado River reservoirs and common in the Central Valley.	Open water with offshore rocks, islands, steep cliffs, dead branches of trees, wharfs, jetties, or even transmission lines. Requires undisturbed nest-sites beside water, on islands or mainland. Uses wide rock ledges on cliffs; rugged slopes; and live or dead trees, especially tall ones. Found on inland lakes, fresh, and estuarine waters.	Year round along coastal regions. Winters inland.	None. No occurrences have been documented within the area of analysis, but the species could occur at reservoirs and inland ponds. No negative impacts to foraging or breeding habitat are expected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
ferruginous hawk *Buteo regalis*	--	WL	Winter resident and migrant at lower elevations and open grasslands in Modoc Plateau, Central Valley, and Coast ranges. Common winter resident of grassland and agriculture areas in southwestern California. Casual in northeast in summer.	Found in open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon-juniper habitats.	Migratory. Present in CA from Sept. to mid-April.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat occurs within the area of analysis. No potential impacts to preferred habitat are anticipated.
Golden eagle *Aquila chrysaetos*	T	E	Throughout California. Uncommon permanent resident and migrant throughout California, except of Central Valley. More common in southern California.	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance. Also in foothills, mountain areas, sage-juniper flats and desert.	Year round. Mostly resident moves down slope for winter and upslope after breeding season.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat occurs within the area of analysis. No impacts to nesting habitat are expected.
grasshopper sparrow *Ammodramus savannarum*	--	SSC	Uncommon and local, summer resident and breeder in foothills and lowlands west of Cascade-Sierra Nevada crest from Mendocino and Trinity counties south to San Diego County Also found in Shasta Valley, Siskiyou County, coastal southern California.	Found in dense grasslands on rolling hills, lowland plains, in valleys and on hillsides on lower mountain slopes. Favors native grasslands with a mix of grasses, forbs and scattered shrubs.	Winters chiefly in southern California, in coastal areas. Summer resident March to May, migrates south in August and September. Fall migrants occur on the Farallon Islands in late September to early October.	None. Occurrences have been documented in the Seller Service Area. Suitable habitat may occur with the area of analysis. The species' habitat (i.e. dense grassland, lowland plain areas) would not be affect by Transfers.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Great blue heron *Ardea herodias* (rookeries)	--	--	Throughout California. Most rookeries are in southern California some scattered in northern California.	Found in shallow estuaries, fresh and saline emergent wetlands, along riverine and rocky marine shores, in croplands, pastures, salt ponds, and in mountains above foothills. Nests and roosts in large trees.	Year round. Near salt ponds from July to October. Near rookeries February to June or July.	None. Rookeries have been documented within the Buyer and Seller Service Areas. No impacts to rookeries are anticipated. Idling of cropland foraging habitat would be limited by the environmental commitments, and birds could use alternative suitable foraging areas in the vicinity.
Great egret *Ardea alba* (rookeries)	--	--	Throughout California, except for high mountains and deserts.	Feeds and rests in fresh, and saline emergent wetlands, along the margins of estuaries, lakes, and slow-moving streams, on mudflats and salt ponds, and in irrigated croplands and pastures. Nests roosts in large trees.	Year round	None. Occurrences have been documented in the Seller Service Area. No impacts to rookeries are anticipated. Idling of cropland foraging habitat would be limited by the environmental commitments, and birds could use alternative suitable foraging areas in the vicinity.
Greater sandhill crane *Grus canadensis tabida*	--	T, FP	Breeds only in Siskiyou, Modoc and Lassen counties and in Sierra Valley, Plumas and Sierra counties. Winters primarily in the Sacramento and San Joaquin valleys from Tehama south to Kings Counties.	In summer, this race occurs in and near wet meadow, shallow lacustrine, and fresh emergent wetland habitats. Frequents annual and perennial grassland habitats, moist croplands with rice or corn stubble, and open, emergent wetlands. It prefers relatively treeless plains.	Migration southward is September-October and northward is March-April.	High. No occurrences have been documented within the area of analysis, but occurrences have been recorded in Butte and Sutter Counties. Suitable foraging and winter roosting habitat is present within the area of analysis (i.e. rice fields). Conservation strategies are in place for this species and birds would have other suitable nesting sites available.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Least bell's vireo *Vireo bellii pusillus*	E	E	California to northern Baja. Rare, local, summer resident below about 600m (2000ft), mostly in San Benito and Monterey counties. Present in coastal southern CA from Santa Barbara County south.	Inhabits low, dense riparian growth along water or along dry parts of intermittent streams. Typically associated with willow, cottonwood, baccharis, wild blackberry, or mesquite in desert localities.	end of March to end of August	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat may occur within the area of analysis. Transfers are not expected to impact any suitable willow or dense riparian habitat, therefore no impacts to the species are anticipated.
LeConte's thrasher *Toxostoma lecontei*	--	SSC	Uncommon to rare local resident of southern California deserts from southern Mono County south to Mexican border, western and southern San Joaquin Valley. Also in Joshua tree. Formerly north to Fresno County, rare north of Kern County.	A desert resident primarily of open desert wash, desert scrub, alkali desert scrub, and desert succulent scrub habitats. Nests in dense, spiny shrub or densely branched cactus in desert wash habitat.	Year round. Non migratory.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in area of analysis. No impacts are anticipated to occur to suitable habitat (i.e. desert scrub).
Little willow flycatcher *Empidonax traillii brewsteri*	--	E	Migrant at lower elevations, primarily in riparian habitats throughout Sierra Nevada and Cascade Range. Not found in north coast.	Most numerous where extensive thickets of low, dense willows edge on wet meadows, ponds, or backwaters. Dense willow thicket required for nesting and roosting. Feeds in willow thickets or low perches adjacent to meadows.	Spring (mid-May to early June) and fall (mid-August to early September)	None. This species has not been documented within the area of analysis according to CNDDB. Suitable habitat may be present within the area of analysis (i.e. dense willows), but would not be impacted by Transfers.
Loggerhead shrike *Lanius ludovicianus*	--	SSC	Common resident and winter visitor in lowland and foothills throughout California,. Rare on coastal slopes north of Mendocino County, occurring only in winter.	Found in broken woodlands, savannah, pinyon-juniper, Joshua tree, riparian woodlands, desert oases, scrub and washes. Prefers open country with perches for hunting, and fairly dense shrubs and brush for nesting. Rarely found in urbanized areas, but often found in open cropland.	Year round. In Great Basin, south to Inyo County, pop declines Nov.-March. Winter pop. More widespread in winter than during breeding season.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat may be present within the area of analysis. No impacts are anticipated to breeding or foraging habitats.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Long-billed curlew *Numenius americanus*	--	WL	Along the California coast, and in the Central and Imperial valleys.	Upland short grass prairies and wet meadows are used for nesting; coastal estuaries, open grasslands, and croplands are used in winter.	Winter migrant from July-April	Low. No CNDDB occurrences have been documented within the area of analysis, but the species is known to occur within the action area during winter migration. There is potential for impacts to suitable foraging habitat (i.e. cropland), although this may be reduced by environmental commitments, which protect winter foraging habitat in Butte Sink, and other wildlife management areas downstream. Birds can relocate to other suitable habitats within the area.
Long-eared owl *Asio otus*	--	SSC	Throughout California, except for entire floor of the Central Valley and locally on the southern coast.	Frequents dense, riparian and live oak thickets near meadow edges, and nearby woodland and forest habitats. Also found in dense conifer stands at higher elevations.	Year round	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat occurs within the area of analysis. Transfers are not expected to impact any suitable habitat (i.e. forest and woodland habitats).
Merlin *Falco columbarius*	--	WL	Occurs in most of the western half of California below 3,900 ft. Rare in Mojave Desert and Channel Islands.	Frequents coastlines, open grasslands, savannahs, woodlands, lakes, wetlands, edges, and early successional stages. Ranges from annual grasslands to ponderosa pine and montane hardwood-conifer habitats.	Winter migrant from September-May	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in area of analysis. Foraging habitat may be altered, but Transfers would not decrease suitability. No negative impacts are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Mountain plover *Charadrius montanus*	--	SSC	Found in Central Valley from Sutter and Yuba counties southward, foothill valleys west of San Joaquin Valley, Imperial Valley, plowed fields of Los Angeles and western San Bernardino County, and central Colorado river valley. Does not breed in California.	Found in short grasslands, freshly plowed fields, newly sprouting grain fields, and sod farms. Prefers grazed areas and areas with burrowing rodents.	Winter resident Sept. - March.	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. Foraging habitat may be affected, but Transfers would not reduce suitability. Can relocate to other habitats within the area.
Northern harrier *Circus cyaneus*	--	SSC	Throughout lowland California, concentrated in the Central Valley and coastal valleys.	Breeds in annual grasslands and wetlands. Prefers marshes and grasslands for foraging and nesting. Also uses agricultural fields for nesting and foraging, although nests may be destroyed by agricultural activities.	Year round, nomadic	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in area of analysis. Foraging and breeding habitat may be affected, but fallow fields would still represent suitable habitat. Birds can relocate to other habitats within the area.
Osprey *Pandion haliaetus*	--	WL	Northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County.	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats.	Year round	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. Water transfers would be subject to flow requirements. Therefore no impacts to foraging area expected. No impacts to nesting sites are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
prairie falcon *Falco mexicanus*	--	WL	Found from southeastern deserts northwest throughout Central Valley and inner Coast Ranges and Sierra Nevada. Mostly absent from northern coastal fog belt. Not found in upper elevation of Sierra Nevada.	Inhabits dry, open level or hilly terrain. Breeds on cliffs, forages far afield. Annual grassland to alpine meadows, but primarily perennial grasslands, rangeland, agricultural fields and desert scrub.	Permanent resident. Northern migrants winter in California. Upslope in summer, down slope in winter.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present within the area of analysis. Foraging habitat (i.e. agricultural fields) may be altered, but Transfers would not reduce suitability.
purple martin *Progne subis*	--	SSC	In south, found on the coast and interior mountain ranges. Absent from higher desert regions. In north, found on coast and inland to Modoc and Lassen counties. Absent from higher slopes of Sierra Nevada. Current breeding populations are known from western Santa Clara and Alameda counties, and western Placer County.	Inhabits woodlands, low elevation coniferous forest of Douglas-fir, ponderosa pine and Monterey pine. Uses open habitats during migration, including grassland, wet meadows, and fresh emergent wetlands.	Summer resident throughout California.	Low. CNDDB occurrences have been documented in the Seller Service Area. This species is restricted to fairly limited nesting sites with suitable cavities free of brood parasites. When wetlands are unavailable, rice fields may represent relatively high quality foraging habitat. This habitat may be slightly reduced by Transfers, but the species can relocate to other suitable habitat in the vicinity. Crop idling limitations are in place in the environmental commitments.
saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	--	SSC	Resident and summer visitor in San Francisco Bay area. Winter south along coast to San Diego county. Found in No. CA in summer months.	Found in fresh and salt water marshes. Requires thick, continuous cover to water surface for foraging and tall grasses, tulle and willows for nesting.	Year-round in southern California and San Francisco Bay, Summer resident in northern California.	None. Occurrences have been documented in the Buyer Service area and suitable habitat may be present in the area of analysis. Not known from rice fields. Water transfers would not affect suitable breeding or foraging habitat.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
San Pablo song sparrow *Melospiza melodia samuelis*	--	SSC	Confined to emergent wetland along north side of San Francisco and San Pablo bay. Highest density at Petaluma River mouth.	A resident of salt marshes. The species inhabits tidal sloughs in salicornia marshes and nests in grindelia bordering slough channels.	Year round	None. Occurrences have been documented in the Buyer Service area and suitable habitat may be present in the area of analysis. However, no impacts are expected to salt water marshes.
Short-eared owl *Asio flammeus*	--	SSC	Endemic to marshes bordering the San Francisco, San Pablo Bays and Suisun Bay. Winter migrant in Central Valley, western Sierra Nevada foothills and coastline. Uncommon winter migrant in southern California. Breeding range includes: Del Norte, Humboldt, SF Bay Delta, northeastern Modoc plateau, south Lake Tahoe to Inyo County and San Joaquin valley.	Usually found in open areas with few trees, including grasslands, wet meadows, irrigated lands, saline and fresh emergent wetlands, and cleared forests. Occasionally in estuaries during breeding season. Ground nester in tall grasses, brush, ditches, and wetlands.	Year round. Migrants in CA from Sept. - April.	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat occurs within the area of analysis. No impacts to breeding habitat would occur. Fallow rice fields would still represent suitable foraging habitat for the species.
Snowy egret *Egretta thula* (rookeries)	--	--	Throughout California.	Found along shores of coastal estuaries, fresh and saline emergent wetlands, ponds, slow-moving rivers, irrigation ditches, and wet fields.	Year round	None. Occurrences have been documented in the Buyer Service Area, however suitable habitat is present in both the Buyer and Seller Service area. No impacts to rookeries are anticipated. Idling of cropland foraging habitat would be limited by the environmental commitments, and birds could use alternative suitable foraging areas in the vicinity.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Suisun song sparrow *Melospiza melodia maxillaris*	--	SSC	Endemic, restrict to Suisun Marsh from Carquinez Strait east to the confluence of the Sacramento and San Joaquin rivers near Antioch. Highest numbers near Benicia State Park and Martinez shoreline.	Resident of brackish-water marshes. Inhabits cattails, tulles, sedges, and salicornia.	Year round. Non-migratory. Breeds early March to July.	None. Occurrences have been documented in the Buyer Service area and suitable habitat may be present in the area of analysis. However, no impacts are expected to brackish-water marshes.
Swainson's hawk *Buteo swainsoni*	--	T	Lower Sacramento and San Joaquin Valleys, the Klamath Basin, Northeastern plateau, Lassen County, and Mojave desert.	Nests in mature trees, including valley oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain and row crop fields.	Spring and summer resident; small wintering population in the Delta. Moves south to southern and interior CA Sept.-Oct. Moves north March-May.	None. CNDDB occurrences have been documented within both the Seller and Buyer Service Area. Suitable habitat is present within the area of analysis. Transfers may alter the composition of foraging habitat in the Buyer and Seller Service Areas, but these areas would still be suitable for the species, and additional habitats in the vicinity would be available. No impacts to breeding habitat are expected.
Tricolored blackbird *Agelaius tricolor*	--	SSC	A resident in California found throughout the Central Valley and in coastal districts from Sonoma County south. Found locally in northeastern California,. In winter, more widespread along central coast and San Francisco Bay area.	Breeds near fresh water, preferably in emergent wetlands with tall, dense cattails or tulles, but also in thickets of willow, blackberry, wild rose, tall herbs. Feeds in grassland and cropland habitats.	Year round. Leaves northeastern CA in fall and winter.	Low. CNDDB occurrences have been documented within both the Seller and Buyer Service Area. Suitable habitat is present within the area of analysis. Foraging habitat may be affected by Transfers. Environmental commitments limit cropland idling and birds can relocate to other adjacent foraging habitats within the area.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Western burrowing owl *Athene cunicularia hypugaea*	--	SSC	Central and southern coastal habitats, Central Valley, Great Basin, and deserts. Formerly common in appropriate habitat throughout the state, excluding humid northwest coastal forests and high mountains. Present on larger offshore islands.	Open annual grasslands or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Dependent upon burrowing mammals (especially California ground squirrel) for burrows.	Year round	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. Agricultural ditches may be suitable habitat for burrowing owl burrow and nesting activity. Water transfers would not affect the suitability of habitat for burrowing owl in the area of analysis.
Western snowy plover *Charadrius alexandrinus*	T	SSC	Along the west coast states, with inland nesting taking place at the Salton Sea, Mono Lake, and at isolated sites on the shores of alkali lakes in northeastern California, in the Central Valley, and southeastern deserts.	Nests, feeds, and takes cover on sandy or gravelly beaches along the coast, on estuarine salt ponds, alkali lakes, and at the Salton Sea.	Migration is from July-March (some year round populations).	None. Occurrences have been documented in the Buyer Service Area. There is a CNDDB occurrence in Yolo County, however this species is not likely to occur in rice fields. Suitable habitat may occur within the area of analysis. However Transfers are not expected to impact any suitable breeding or foraging habitat (i.e. sandy beaches or estuarine salt ponds).
Western yellow-billed cuckoo *Coccyzus americanus*	C,	E	Uncommon to rare summer resident in scattered locations throughout California. Breeding population along Colorado river, Sacramento and Owen Valley, along South Fork of Kern River, Santa Ana River and Amargosa River. May be present along San Luis Rey River.	Deciduous riparian thickets or forests with dense, low-level or understory foliage, and which abut on slow-moving watercourses, backwaters, or seeps. Willow almost always a dominant component of the vegetation. In Sacramento Valley, also utilizes adjacent orchards, especially of walnut. Nests in sites with some willows, dense low-level or understory foliage, high humidity, and wooded foraging spaces.	Summer migration is from June-September.	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present within the area of analysis. However this species is not likely to occur in rice fields due to lack of suitable foraging and roosting habitat (i.e. dense riparian thickets). No impacts are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
White-faced ibis *Plegadis chihi*	--	WL	Uncommon summer resident in sections of southern California, a rare visitor in the Central Valley, and is more widespread in migration. Uncommon to common in small pockets.	Feeds in fresh emergent wetlands, shallow lacustrine waters, muddy grounds of wet meadows, and irrigated or flooded pastures and croplands. Nests in dense, fresh emergent wetlands.	Present from April-October.	Low. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in area of analysis. Low potential impact to foraging habitat in the Seller Service Area. No potential impacts are expected to roosting habitat. Can relocate to other habitats within the area. Environmental commitments would limit acreage of allowable cropland idling.
White-tailed kite *Elanus leucurus*	--	FP	Central Valley, coastal valleys, San Francisco Bay area, and low foothills of Sierra Nevada.	Savanna, open woodlands, marshes, partially cleared lands and cultivated fields, mostly in lowland situations. Rarely found away from agricultural areas. Feeds in open grasslands, meadows, farmlands and emergent wetlands. Nests located near open foraging area and placed on top of dense oak, willow or tree stands.	Year round	None. CNDDB occurrences have been documented within both the Seller and Buyer Service Area. Suitable habitat is present within the area of analysis. Foraging habitat may be altered, but would still be suitable for the species. No potential impacts to breeding habitat are anticipated.
yellow warbler *Dendroica petechia brewsteri*	--	SSC	Breeding range from coastal Del Norte County, east to Modoc plateau & Inyo County, south to coastal Santa Barbara and Ventura County., west to Kern County. Winters in Imperial and Colorado river valleys. Found up to 2500m (8000ft) in Sierra Nevada.	Associates with riparian habitats and prefers willows, cottonwood, aspens, sycamores, and alders. Nests in montane shrubbery in open conifer forests.	Summer resident throughout California.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat is present with the area of analysis. No potential impacts are anticipated to riparian habitats.

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yellow-headed blackbird *Xanthocephalus xanthocephalus*	--	SSC	Breeds east of Cascade range and Sierra Nevada, Imperial and Colorado River valley, in Central Valley and select locations in coast range west of Central Valley. Common in winter in Imperial Valley. Found as high as 2000m (6600ft) in San Bernardino Mountains.	Associated with freshwater emergent wetlands along lakes and ponds. Nesting timed with maximum emergence of aquatic insects. Feeds on cultivated grains, in emergent vegetation, and in nearby grasslands and croplands.	Year round, in parts of Central Valley. Summer range in eastern California, and parts of Central Valley. Present April through early May, and in September.	Low. Occurrences have been documented in the Buyer Service Area and suitable habitat is present within both the Buyer and Seller Service Area. Impacts to foraging habitat are expected in the Seller Service Area, but the birds can relocate to other habitat in the area. Environmental commitments would limit the amount of cropland idling in the area of analysis.
Mammals						
Alameda Island mole *Scapanus latimanus parvus*	--	WL	Only known from Alameda Island, Alameda County.	Found in a variety of habitats, especially annual and perennial grasslands. Prefers moist, friable soils and avoids flooded soils.	Year round	None. Occurrences have been documented in the Buyer Service Area. Transfers would not impact suitable habitat.
American badger *Taxidea taxus*	--	SSC	Throughout California.	Found in dry, open stages of most shrub, forest, and herbaceous habitats with friable soils.	Year round. Permanent resident except in North Coast area.	None. Occurrences have been documented in both the Buyer and Seller Service area and suitable habitat is present within the area of analysis. Suitable habitats are not expected to be impacted.
big free-tailed bat *Nyctinomops macrotis*	--	SSC	Rare in California. Vagrants found in San Diego County. and Alameda County (record is suspect).	Found in low-laying arid areas in Southern California and requires high cliffs or rocky outcrops for roosting sites.	Year round resident in San Diego County and Alameda County.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact suitable arid, rocky terrain habitat.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California wolverine *Gulo gulo*	PT	T, FP	A scarce resident of North Coast mountains and Sierra Nevada. Sightings range from Del Norte and Trinity counties. east through Siskiyou and Shasta counties., and south through Tulare County. A few possible sightings occur in the north coastal region as far south as Lake County. Habitat distribution in California is poorly known for the North Coast and northern Sierra Nevada.	In north coastal areas, has been observed in Douglas-fir and mixed conifer habitats. In the northern Sierra Nevada, have been found in mixed conifer, red fir, and lodge pole habitats, and probably use subalpine conifer, alpine dwarf-shrub, wet meadow, and montane riparian habitats. In the southern Sierra Nevada occur in red fir, mixed conifer, lodge pole, subalpine conifer, alpine dwarf-shrub, barren, and probably wet meadows, montane chaparral, and Jeffrey pine.	Year round (largely nocturnal)	None. Suitable habitat may occur within the area of analysis, however no CNDDB occurrences have been documented in the Buyer or Seller Service area. The species is not likely to occur in agriculture fields. No impacts are anticipated.
Fresno kangaroo rat *Dipodomys nitratoides exilis*	E	E	Western Fresno County. on the Alkali Sink Ecological Reserve and adjacent privately owned land.	Found in alkali sink-open grassland habitats. Prefers bare alkaline clay-based soils subject to seasonal inundation with more friable soil mounds around shrubs and grasses.	Year round. Breeds largely from March - June.	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat present in the area of analysis. Transfers would not impact suitable habitat for this species (i.e. alkali sink grasslands).
giant kangaroo rat *Dipodomys ingens*	E	E	Found along western side of San Joaquin Valley (e.g. Carrizo Plain, Panoche Valley)	Found in annual grasslands and on and marginal habitat in alkali scrub. The species requires level terrain and sandy loam soils for burrowing.	Year round	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat may be present in the area of analysis. However, no impacts are expected to suitable habitat (i.e. alkali desert scrub and annual grasslands).

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Greater western mastiff bat *Eumops perotis californicus*	--	SSC	Uncommon resident in southeastern San Joaquin Valley and Coastal Ranges from Monterey County southward through southern California, from the coast eastward to the Colorado Desert.	Occurs in many open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, annual and perennial grasslands, palm oases, chaparral, desert scrub, and urban areas. Crevices in cliff faces, high buildings, trees, and tunnels are required for roosting.	Year round (nocturnal activity)	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in the area of analysis, bur no impacts are anticipated.
Nelson's antelope squirrel *Ammospermophilus nelsoni*	--	T	Found in the western San Joaquin valley from 200-1,200 ft. elevation. Found from southern Merced County to Kern, Kings and Tulare counties. In eastern portions of San Luis Obispo and Santa Barbara counties.	Found on dry sparsely vegetated loam soils. Requires widely scattered shrubs, forbs and grasses in broken terrain with gullies and washes.	Year round.	None. Occurrences have been documented with the Buyer Service Area. Suitable habitat may occur within the area of analysis. No impacts are anticipated to suitable upland habitats.
Pacific fisher *Martes pennati (pacifica) DPS*	C	SSC	Northern California coastal ranges up to Oregon, and the Sierra Nevada's.	Found in mature, dense, coniferous or mixed coniferous hardwood forest with closed canopies.	Year round	None. Occurrences have been documented with the Seller Service Area. Suitable habitat may occur within the area of analysis. No potential impacts are anticipated to suitable habitat (i.e. mixed conifer habitats).
pallid bat *Antrozous pallidus*	--	SC	Throughout California,, except for high Sierra Nevada from Shasta to Kern counties, northwestern corner of state from Del Norte & western Siskiyou cos. To northern Mendocino County.	Found in deserts, grasslands, scrublands, woodlands and forests. Most common in open, dry habitats with rocky areas for roosting.	Year round.	None. Occurrences have been documented with the Buyer Service Area. Suitable habitat may occur within the area of analysis. No impacts would occur to suitable habitat.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Ring-tailed cat *Brassariscus astutus*	--	FP	Ringtails are found in a variety of habitats centered around the semi-arid to arid climates of the west and southwest. Little information available on distribution and relative abundance among habitats.	Occurs in various riparian habitats, and in brush stands of most forest and shrub habitats, at low to middle elevations. Uses hollow trees, logs, snags, cavities in talus and other rocky areas, and other recesses are for cover.	Year round (nocturnal)	None. No CNDDB records of this species have been documented in the area of analysis. Suitable habitat is present in the area of analysis, but the species is not likely to occur in rice fields. No potential impact to suitable habitat are expected.
Riparian brush rabbit *Sylvilagus bachmani riparius*	E	E	Isolated populations on Caswell Memorial State Park on the Stanislaus River and along an overflow channel of the San Joaquin River.	Riparian thickets	Year round	None. No CNDDB records of this species have been documented in the area of analysis. Suitable habitat is present in the area of analysis, however, no potential impacts are expected to suitable habitat (i.e. riparian thickets).
Riparian (San Joaquin Valley) woodrat *Neotoma fuscipes riparia*	E	SSC	Found along the lower portions of the San Joaquin and Stanislaus rivers in the northern San Joaquin Valley. Historical records for the riparian woodrat are distributed along the San Joaquin, Stanislaus, and Tuolumne rivers, and Corral Hollow, in San Joaquin, Stanislaus, and Merced Counties.	Most numerous where shrub cover is dense and least abundant in open areas. Dens are usually built in willow thickets with oak over story.	Year round (nocturnal activity)	None. Suitable habitat present (i.e. dense shrubs) in both the Buyer and Seller Service Areas, however no CNDDB occurrences have been documented. No potential impacts are expected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
salt-marsh harvest mouse *Reithrodontomys raviventris*	E	E	Found in San Francisco Bay and its tributaries.	Found in saline emergent wetlands. Pickle weed is the primary habitat for the species. Requires higher grassland areas for flood escape.	Year round.	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact saline wetlands and salt marshes.
salt-marsh wandering shrew *Sorex vagrans halicoetes*	--	SSC	Southern arm of the San Francisco Bay in San Mateo, Santa Clara, Alameda and Contra Costa counties (Bolster 1998).	Found in the salt marshes. Inhabits medium high marsh where abundant driftwood is scattered among salicornia.	Year round. Breeds February - June	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact salt marshes.
San Francisco dusky-footed woodrat *Neotoma fuscipes annectens*	--	SSC	Oregon, California and northwestern Baja California. Within California it is known from Alameda, Contra Costa, San Mateo, and Santa Clara, and Santa Cruz Counties.	Found in forest habitats of moderate canopy and moderate to dense understory. The species may prefer chaparral and redwood habitats. Nest sites include tree cavities, logs, and talus slopes (Carraway and Verts 1991; NatureServe 2011).	December - September	None. Occurrences have been documented within the Buyer Service area and suitable habitat may be present in the area of analysis. Transfers would not impact forest, chaparral and redwood habitat.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
San Joaquin kit fox *Vulpes macrotis mutica*	E	T	Found only in the Central Valley area of California. Kit foxes currently inhabit suitable habitat in the San Joaquin valley and in surrounding foothills of the Coast Ranges, Sierra Nevada, and Tehachapi Mountains; from southern Kern County north to Contra Costa, Alameda, and San Joaquin counties on the west; and near La Grange, Stanislaus County on the east.	Found in annual grasslands or grassy open stages of vegetation dominated by scattered brush, shrubs, and scrub. Build dens for cover. Some agricultural areas may support these foxes.	Year round (mostly nocturnal, but often active during daytime in cool weather)	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat is present within the area of analysis. San Joaquin kit fox have the potential to occur in inland and southern portions of the area of analysis. Changes in crop type could alter foraging habitat conditions in the Buyer Service Area, however buyers would not be allowed to buy more water than they were entitled to under their CVP contract. Transfer water would not be used to plant permanent crops, so cropping patterns would be within normal range considered under the CVP contracts and would be covered by the pertinent B.O. Conservation strategies are in place for this species.
San Pablo vole *Microtus californicus sanpabloensis*	--	SSC	Found in salt marshes of San Pablo creek on the south shore of San Pablo Bay.	Annual grassland, saline emergent wetlands, salt marsh.	Year round.	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact the wetlands and salt marshes of San Pablo Bay.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
short-nosed kangaroo rat *Dipodomys nitratoides brevinasus*	--	WL	Found in the western side of San Joaquin valley, near the mouth of Panoche Creek in western Fresno County, south to near the mouth of San Emigdio Creek, in southwestern Kern County, and to northeast of Bakersfield. Also occurs in eastern San Benito Valley and Cuyama Valley, and Santa Barbara County (Bolster 1998).	Found in grassland and desert shrub, especially a triplex. Inhabits highly alkaline soils around soda lake and prefers flat to gently sloping terrain.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact suitable habitat for this species.
Tipton kangaroo rat *Dipodomys nitratoides nitratoides*	E	E	Found in the Tulare Lake basin of southern San Joaquin Valley, from approximately Lemoore and Hanford in Kings County to Visalia, Tipton, Delano and Bakersfield on the east.	The species is found in saltbush scrub and sink scrub communities. Requires soft friable soils. Currently limited to uncultivated ground with alkaline soils.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact suitable habitat for this species.
Tulare grasshopper mouse *Onychomys torridus tularensis*	--	SSC	Foothill and floor of the southern San Joaquin Valley from western Merced and eastern San Benito counties, east to Madera County, and south to foothills of Tehachapi and San Emigdio Mts. Also found on Carrizo Plains, eastern San Luis Obispo County, Cuyama Valley, parts of Kern County, Tulare Basin and Panoche Valley (Bolster 1998).	Found in hot, arid valleys and scrub deserts. Favors compact soils with sparse growth of perennial grasses.	Year round.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present within the area of analysis. Transfers would not impact suitable habitat for this species.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
western mastiff bat *Eumops perotis californicus*	--	SSC	Found in southeastern San Joaquin Valley and Coastal ranges from Monterey County southward through southern California and from the coast eastward to Colorado Desert.	Found in open, semi-arid habitats, including conifer and deciduous woodlands, coastal scrub, grasslands, and chaparral. Roost in crevices in cliff faces, high buildings, trees and tunnels.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat is present within the area of analysis. No impacts are anticipated to feeding or roosting habitat.
western red bat *Lasiurus blossevillii*	--	SSC	Occurs from Shasta County to Mexican border, west of Sierra Nevada/Cascade crest and deserts. Winters in western lowlands and coastal regions south of SF bay. Not found in desert areas.	Found in trees 2-40ft above ground, from sea level up through mixed conifer forests. Prefers habitat edges and mosaics with trees. Feeds over a wide variety of habitats including grasslands, scrublands and croplands.	Year round. Migrates in spring (March-May) and autumn (Sept.-Oct). Migrates between summer and winter range.	None. Occurrences have been documented in the Buyer and Seller Service Area and suitable habitat is present within the area of analysis. No impacts to roosting habitat are anticipated. Transfers could alter the configuration of foraging habitat, but would not reduce suitability.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Fish						
Sacramento River Winter-run Chinook Salmon *Oncorhynchus tshawytcha*	E	E	Occurs on the mainstem Sacramento River from Keswick Dam, Shasta County (RM 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta; and in the Bay-Delta system. The area downstream of Red Bluff Diversion Dam is principally a migration corridor, although some rearing may occur during emigration.	Migrate to upstream freshwater habitat to mature and spawn. Once juveniles emerge from the gravel they seek low velocity, shallow-water areas to finish absorbing their yolk sac. Some disperse downstream when high-flow events correspond with emergence. In general, there is a shift in microhabitat use by juvenile Chinook to deeper, faster water as they grow larger. For juveniles, positive growth occurs at temperatures between 5-19 C. Temperatures greater than 24 C, even for short periods, is lethal. Salmon fry tend to move downstream, and smolts emigrate to the ocean, under conditions of increased flow, increased turbidity, and decreased temperatures.	Upstream Migration: Dec-Jul. Spawning: late Apr to early Aug Fry remain in river for five to ten months, prior to emigration. Emigration Sep.-Jan.	None. Species not present in the area of Analysis during period when transfers would occur. Potential impacts would not occur on the mainstem Sacramento River where flows are regulated by the Biological Opinions.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Central Valley Spring-run Chinook Salmon *Oncorhynchus tshawytcha*	T	T	Designated critical habitat for spring-run Chinook salmon includes San Francisco, San Pablo, and Suisun Bays, the Sacramento-San Joaquin Delta, and the Sacramento River from the Delta to Keswick Dam and the Feather River upstream to Thermalito Afterbay Dam. Spawning occurs above the valley floor in streams that have deep, cold pools where adult fish can hold over the summer before they spawn. Tributaries to the Sacramento River with independent spawning populations are Butte, Deer and Mill Creeks. Spawning may also occur on several other streams in the Area of Analysis including Thomes, Big Chico, and Antelope creeks, and the Yuba and Bear rivers. Rearing occurs in these streams and other the downstream portions of other streams tributary to the Sacramento, as well as in the Sutter and Yolo Bypasses, and in the Delta during outmigration of the young fish.	See Sacramento River winter-run Chinook salmon.	Upstream Migration and holding: Mar-Sep. Spawning: late Aug to Oct. Fry remain in river for three to 15 months, prior to emigration. Emigration Jan-Apr.	Low. Suitable habitat for over summer holding and spawning in the species primary spawning and rearing habitat is located upstream of the areas that would be affected by water transfers. Rearing habitat could potentially be affected by groundwater withdrawals in the lower sections of some streams. The sections of these waterways on the valley floor, where water transfers would occur, are typically too warm to support this species during the summer months. Potential impacts would not occur on the mainstem Sacramento River or the Feather River where the operating requirements specified in the Biological Opinions and D1641 would be met.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Fall/Late-fall Chinook Salmon *Oncorhynchus tshawytcha*	SC	SSC	Occur in the ocean from Alaska to California. Freshwater habitat use in the Central Valley occurs in the Sacramento River and all major tributaries and many minor ones, as well as in tributaries to the major tributaries to San Joaquin River, including the Merced River. In the Sacramento River, most spawning occurs between the Red Bluff Diversion Dam and Keswick Dam, although some fish spawn downstream of Red Bluff Diversion Dam. Small numbers also spawn in Battle Creek, Cottonwood Creek, Clear Creek, Mill Creek, as well as the Yuba and Bear rivers.	See Sacramento River winter-run Chinook salmon.	Fall Run: Upstream Migration: Jun-Dec. Spawning: late Sep to Dec. Fry remain in river one to seven months Emigration Dec-Mar. Late fall run: Upstream Migration: Oct-Apr. Spawning: Jan-Apr Fry remain in river seven to 13 months Emigration Dec-Mar.	Low. Operating requirements for all of the mainstem rivers would meet existing flow and temperature requirements as specified by the NMFS and USFWS BOs for the Long-term Operations of the State and Federal Water Projects and State Water Board Decision 1641. Water transfers from sellers upstream of the Delta may still result in some flow changes that would overlap spatially and temporally with the distribution of fall-run Chinook salmon emigrants, but flows would continue to meet regulatory requirements protective of this species. Transfers would not overlap the Chinook upstream migration, spawning or incubation periods.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California Central Valley DPS Steelhead *Oncorhynchus mykiss*	T	SSC	Designated critical habitat includes all waters tributary to the San Francisco Bay from confluence of the Sacramento and San Joaquin River to the lowest impassible barrier. Within these reaches it includes all areas within the ordinary high water mark of the water body. Found in all major rivers and tributaries and may use smaller tributaries, and ephemeral tributaries when available.	Immigration from the ocean into the Delta, the Sacramento and San Joaquin River watersheds occurs when large amounts of cold water is available from winter rains. Spawning occurs in mainstem rivers and their tributaries to. The first year or two of life is spent in cool, clear, fast-flowing permanent streams and rivers where riffles predominate over pools, where there is ample cover in the form of riparian vegetation of undercut banks, and where invertebrate prey is diverse and abundant. Habitat preferences depend on fish size/age, with fry concentrating in shallow water along stream edges with low water velocities, juveniles occurring in deeper, faster water among rocks or other cover, and larger fish seeking out a wide variety of deeper habitats close to fast water. Optimal temperatures for growth are approximately 15-18 C.	Central Valley steelhead are mainly winter-run steelhead, which mature in the ocean and arrive in freshwater nearly ready to spawn. Upstream Migration: Aug-Apr. Spawning: Dec to Apr. Fry generally remain in river for one to three years. Emigration Oct-Jul.	Moderate. Uses the upper Sacramento River above Red Bluff Diversion Dam and the portions of all accessible tributaries to the Sacramento and San Joaquin Rivers with suitable temperatures for spawning and rearing. The Sacramento River below RBDD is used primarily as a migratory corridor. Water transfers from July through September, from sellers upstream of the Delta could overlap spatially and temporally with California Central Valley steelhead rearing in this region where water temperatures are suitable. Stream sections on the valley floor, where transfers could affect stream flow, are generally too warm to support rearing during the summer months, but rearing may occur above the valley floor where suitable temperatures occur. Potential impacts would not occur on the mainstem Sacramento River or the Feather River where the operating requirements specified in the Biological Opinions and D1641 would be met.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
North American Green sturgeon *Acipenser medirostris*	T	SSC	Ranges from Mexico to Alaska. The southern DPS includes spawning population in the Sacramento River, fish living in the Sacramento River, the Sacramento-San Joaquin Delta, and the San Francisco estuary. Not known to occur in the San Joaquin River. Critical habitat include: coastal marine waters from Monterey Bay to the Washington/Canada boarder; coastal bays and estuaries in California, Oregon, and Washington; fresh water rivers in the Central Valley. Proposed inland critical habitat includes Sacramento River downstream of Keswick Dam, Feather River downstream of Thermalito Dam, Yuba River downstream of Daguerre Dam, portions of Sutter and Yolo Bypasses, and the legal Delta.	Southern DPS: Adults immigrate into the Delta from the ocean to begin spawning migration into the Sacramento River. Spawning occurs in the Sacramento River (upstream of Hamilton City and downstream of Keswick Dam), both downstream and upstream of RBDD; a small number have been observed spawning in the Feather River during high flow years. Moyle (2002). Preferred spawning habitat contain large cobble in deep and cool pools with turbulent water. Water temp in spawning and egg incubation are critical; temp greater than 19C are lethal. Rear in fresh and estuarine areas for one to four years before dispersing into salt water. Occur in shallow water and move to deeper more saline areas as they mature. Emigration occurs as larvae drift downriver from freshwater spawning/rearing areas of Sacramento River watershed through the Delta to the ocean. Subadults inhabit the Delta and bays during summer months, while adults are associated with seawater and mixing zones of bays and estuaries and found in lower stretches of some rivers. Adult and juvenile green sturgeon are thought to use the same migratory routes as Chinook salmon.	Immigration: late Feb. to Jun. Spawning: March to July. After spawning, adults over-summer in deep pools of the Sacramento River from June to Nov. and emigrate to the ocean in fall and early winter and flows increase and temperatures decrease. Rearing: year-round.	Low. Potential impacts would not occur on the mainstem Sacramento River or the Feather River where the operating requirements specified in the Biological Opinions and D1641 would be met.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Delta smelt *Hypomesus transpacificus*	T	E	Endemic to Bay-Delta estuary. Primarily distributed downstream of Isleton on the Sacramento River, downstream of Mossdale on the San Joaquin River, Suisun Bay and Suisun marsh, freshwater regions of the Delta. Designated critical habitat (59 FR 65256) extends throughout Suisun Bay, the length of Goodyear, Suisun, Cutoff, first Mallard and Montezuma sloughs, and the contiguous waters of the legal Delta.	Primarily inhabit low salinity waters of estuary prior to migrating into freshwater habitats to spawn. Spawning occurs in slough and shallow edge area in the Delta and Sacramento River; spawning can occur in the Sacramento River as far upstream as Sacramento and in the Cache Slough region, the Mokelumne River system, and the San Joaquin River upstream as far as Prisoner's Point. Spawning occurs at water temperatures ranging from approximately 7C to 22C. Rearing juveniles remain in spawning areas, near or just above the X2 region of the Delta. Adult delta smelt abundance in the fall has been in the northwestern Delta in the channel of the Sacramento River. Although delta smelt tolerate a wide range of temperatures (<6C to > 25C), warm water temperatures restrict their distribution more than colder water temperatures.	Delta and Suisun Bay – year round	Low. Potential impacts would not occur in the Delta as the operating requirements specified in the Biological Opinions and D1641 would be met. Minor changes in flow could occur in the Delta as a result of water transfers, but these flows would be small. Principal rearing areas during the summer and fall are in and around Suisun Bay and in the Cache Slough region.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Longfin smelt *Spirinchus thaleichthys*	C [4]	T	Occur along the Pacific coast of North America; widespread within the Bay-Delta estuary, in the lower Sacramento River (downstream of Rio Vista), in the San Joaquin River (downstream of Medford Island). Also common in nearshore coastal marine waters.	Spawns at the transition zone between freshwater and slightly brackish water over sandy or gravel substrates at temperatures from 7 C to 14.5 C. Spawning occurs in the Sacramento River mainstem, as far upstream as Rio Vista, the San Joaquin River as far upstream as Medford Island, and in other waterways within the Delta. Hatching coincides with annual peak Delta outflows, which coincide with high turbidity. Larval smelt concentrate in near-surface, fresh and brackish waters. Distribution of larval and juvenile smelt depends on freshwater outflows from the Delta during the late-spring, eventually inhabiting the bays as well as nearshore coastal marine habitats. Longfin smelt do not occupy areas with temperatures greater than 22 C in combination with salinities greater than 26 ppt.	Spawning: November to June. Fry and juveniles have generally left the Delta by May or June.	None. Potential impacts would not occur in the Delta as the operating requirements specified in the Biological Opinions and D1641 would be met. Minor changes in flow could occur in the Delta as a result of water transfers, but these flows would be small. Longfin smelt do not occur in the Delta during the transfer period.
Hardhead	--	SSC	Hardhead are widely distributed in low to mid elevation streams in the Main Sacramento-San Joaquin river drainage as well as the Russian River drainage. Their range extends from the Ken River, in Kern County to the Pit River south of the Goose Lake drainage but are absent in the valley reaches.	Hardhead are typically found in undisturbed areas of the larger middle- and low elevation streams. Elevational range of hardhead is 10-1,450 m. Most streams in which they occur have summer temperatures in excess of 20°C.	Year-round	Low. Hardhead are largely excluded from the valley floor reaches of the streams and rivers within the Area of Analysis due to warm summer temperatures and the abundance of introduced fish.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Sacramento splittail	--	SSC	Endemic to the lakes and rivers of the Central Valley. Current distribution generally restricted to the Delta, Suisun Bay, Suisun Marsh, the lower portions of the Napa and Petaluma rivers, and other parts of the San Francisco estuary. They may occur in the Sacramento River upstream as far as Red Bluff Diversion Dam and on the San Joaquin as far upstream as Salt Slough in wet years. They may also occur in the lower Feather and American rivers during these wetter periods. The Sutter and Yolo bypasses are important spawning areas today.	Inhabit estuarine to fresh waters. Spawning occurs primarily on inundated floodplains. Tend to be found in slow-moving sections of rivers and sloughs, and in the Delta and Suisun Marsh. YOY splittail are commonly found between Rio Vista and Chipps island indicating that juveniles prefer more riverine habitat.	Year round in the Delta, Sacramento and San Joaquin Rivers.	Low. Operating requirements for all of the mainstem rivers would meet existing flow and temperature requirements as specified by the NMFS and USFWS BOs for the Long-term Operations of the State and Federal Water Projects and State Water Board Decision 1641.

[1] Central CA DPS

[2] Santa Barbara and Sonoma Counties

[3] All bird species listed below and many other birds are protected during the nesting season under the federal Migratory Bird Treaty Act.

[4] USFWS has found that the San Francisco Bay-Delta Distinct Population Segment (DPS) of longfin smelt warrants protection under the federal Endangered Species Act, but higher priority listing actions currently preclude their listing.

*Status explanations:
F=Federal
E= listed as endangered under the federal Endangered Species Act
T= listed as threatened under the federal Endangered Species Act
PT= proposed for listing as threatened under the federal Endangered Species Act.
C = Candidate for listing under the federal Endangered Species Act
D= delisted.
S=State
E= listed as endangered under the California Endangered Species Act.
T= listed as threatened under the California Endangered Species Act.
SSC=Species of Special Concern

Table I-2. Special-Status Plants with Potential to Occur in the Area of Analysis

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
adobe sanicle *Sanicula maritima*	-/R/ 1B.1	Alameda, Monterey, San Francisco, and San Luis Obispo Counties.	Meadows and seeps, valley and foothill grassland, chaparral, coastal prairie. Moist clay or ultramafic soils from 30-240m asl.	February - May	**None.** Adobe sanicle has been previously documented in the Buyer Service Area. Water transfer may increase the area of marginal habitat for this species in the Buyer Service Area. No negative impacts are expected.
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	-/-/ 1B	Butte, Calaveras, Placer, Sacramento, Tehama, and Yuba Counties.	Valley and foothill grassland (mesic). May occur in disturbed areas including agricultural fields and locations with gopher digging activity (CNDDB 2012).	March-May	**Low.** Suitable grassland habitat occurs within the area of analysis and this species has been previously documented within the Seller Service Area. There is a low potential that this species would occur in managed rice fields.
Alkali milk-vetch *Astragalus tener var. tener*	-/-/ 1B.2	Central western California including Yolo County.	Subalkaline flats and areas around vernal pools.	March-June	**None.** Not likely to occur in rice fields, no suitable habitat (i.e. subalkali flats) would be affected by Transfers.
Anderson's manzanita *Arctostaphylos andersonii*	-/-/ 1B.2	Santa Clara, Santa Cruz, and San Mateo Counties.	Broadleaved upland forest, chaparral, North coast coniferous forest. Open sites in redwood forest from 180 - 800m asl.	November - May	**None.** Previously documented within the Buyer Service Area. No suitable habitat would be affected by the proposed Transfers.
Antioch Dunes evening-primrose *Oenothera deltoides* ssp. *howellii*	E/E/ 1B.1	Found only in Contra Costa and Sacramento Counties.	Occurs in inland dunes.	March-September	**None.** CNDDB records for this species have been documented within the Buyer Service Area. Not likely to occur in rice fields, and no inland dune habitat should be affected by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
arcuate bush-mallow *Malacothamnus arcuatus*	-/-/ 1B.2	Santa Clara, Santa Cruz, and San Mateo Counties.	Chaparral within gravelly alluvium from 80 - 335m asl.	April - September	**None.** Previously observed within the Buyer Service Area. No impacts to suitable habitat are anticipated in association with the proposed Transfers.
Baker's navarretia *Navarretia leucocephala* ssp. *bakeri*	-/-/ 1B.1	Colusa, Glenn, Lake, Lassen, Mendocino, Marin, Napa, Solano, Sonoma, Sutter, Tehama, and Yolo Counties.	Cismontane woodland, meadows and seeps, vernal pools, valley and foothill grassland, lower montane coniferous forest. Vernal pools and swales, adobe or alkaline soils from 5 - 950m.	April - July	**None.** The CNDDB contains records of this species within the Seller Service Area. It is very unlikely that Baker's navarretia would establish in rice fields, given the lack of adobe or alkaline soils.
bearded popcorn-flower *Plagiobothrys hystriculus*	-/-/ 1B.1	Napa, Solano, and Yolo Counties.	Vernal pools, valley and foothill grassland in wet sites from 10-50m. This species is only known from a few very limited occurrences at the edges of vernal pools, such as at Jepson Prairie and in the Montezuma Hills.	April - May	**None.** Previous records of bearded popcorn-flower exist within the Seller Service Area. This species is not expected to occur in rice fields. No vernal pools or grassland habitats would be affected by the proposed Transfers.
Ben Lomond buckwheat *Eriogonum nudum* var. *decurrens*	-/-/ 1B.1	Alameda, Santa Clara, and Santa Cruz Counties.	Chaparral, cismontane woodland, lower montane coniferous forest. Ponderosa pine sandhills in Santa Cruz County from 50 - 800m asl.	June - October	**None.** The CNDDB contains occurrences of this species in the Buyer Service Area. No chaparral or woodland habitats would be affected by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
bent-flowered fiddleneck *Amsinckia lunaris*	-/-/ 1B.2	Alameda, Contra Costa, Colusa, Lake, Marin, Napa, San Benito, Santa Clara, Santa Cruz, San Mateo, Sonoma, and Yolo Counties.	Cismontane woodland, valley and foothill grassland from 50 - 500m.	March - June	**None.** Bent-flowered fiddleneck has been previously documented within the Buyer Service Area. Although suitable habitat occurs within the area of analysis, none would be affected by the proposed actions.
big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	-/-/ 1B.2	Alameda, Butte, Colusa, El Dorado, Lake, Mariposa, Napa, Placer, Santa Clara, Solano, Sonoma, Tehama, and Tuolumne Counties.	Valley and foothill grassland, cismontane woodland. Sometimes on serpentine. 35 - 1000m	March - June	**None.** This species has been previously documented within both the Buyer and Seller Service Areas. However it is not expected to occur in rice fields due to lack of suitable habitat.
big tarplant *Blepharizonia plumosa*	-/-/ 1B.1	Alameda, Contra Costa, San Joaquin, Solano, and Stanislaus Counties.	Valley and foothill grassland. Dry hills and plains in annual grassland. Clay to clay-loam soils, usually on slopes and often in burned areas 15 - 455m asl.	July - October	**None.** Big tarplant has been observed within the Buyer Service Area. Transfers would not affect suitable habitat for this species.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Boggs Lake hedge-hyssop *Gratiola hetersepela*	-/E/1B	Dispersed throughout the Sacramento and Central Valley. Also in Oregon.	Marshes, swamps, and vernal pools (clay).	April - August	**None.** A CNDDB occurrence has been documented within the Seller Service Area. This species may withstand some disturbances, such as cattle. However, modifications of natural hydrology by agriculture or other activities are considered a threat to the species, and Boggs Lake hedge-hyssop is not expected to occur within planted rice fields. No marsh or vernal pool habitat would be affected by the proposed Transfers.
Bolander's water-hemlock *Cicuta maculata var. bolanderi*	-/-/ 2.1	Occurs within California, Arizona, New Mexico, and Washington. In California it is found in Contra Costa, Los Angeles, Marin, Sacramento, Santa Barbara, San Luis Obispo, and Solano Counties.	Marshes, fresh or brackish water 0 - 200m asl.	July - September	**None.** Bolander's water hemlock has been previously documented within the Buyer Service Area. No marsh, fresh or brackish water habitat would be affected by the proposed Transfers.
Brandegee's clarkia *Clarkia biloba* ssp. *brandegeeae*	-/-/ 1B.2	Butte, El Dorado, Nevada, Placer, Sacramento, Sierra, and Yuba Counties.	Chaparral, cismontane woodland, often in roadcuts 295 - 885m asl.	May - July	**None.** This species has been previously recorded within the Seller Service Area. No impacts to suitable habitat are expected.
Brandegee's eriastrum *Eriastrum brandegeeae*	-/-/ 1B.2	Contra Costa, Colusa, Glenn, Lake, Santa Clara, Shasta, San Mateo, Tehama, and Trinity Counties.	Chaparral, cismontane woodland. On barren volcanic soils, often in open areas from 345 - 1000m asl.	April - August	**None.** Records of Brandegee's eriastrum exist for the Buyer Service Area. Suitable habitat would not be affected by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Brewer's western flax *Hesperolinon breweri*	-/-/ 1B.2	Contra Costa, Napa and Solano Counties.	Chaparral, cismontane woodland, valley and foothill grassland. Often in rocky serpentine soils in serpentine chaparral and serpentine grassland from 30 - 885m asl.	May - July	**None.** Brewer's western flax has been previously observed within the Buyer Service Area. Suitable habitat would not be affected by Transfers.
Brittlescale *Atriplex depressa*	-/-/1B.2	Western Central Valley and valleys of adjacent foothills.	Alkali grassland, alkali meadow, alkali scrub, and vernal pools. Usually in alkali scalds or alkaline clay in meadows or annual grassland. Rarely associated with riparian areas, marshes, or vernal pools 1 - 320m asl.	April-October	**None.** Occurrences of this species have been documented in both the Buyer and Seller Service Areas in the CNDDB. This species is not likely to occur in rice fields due to lack of suitable habitat (i.e. alkali and vernal pools).
Butte County fritillary *Fritillaria eastwoodiae*	-/-/3.2	Butte, El Dorado, Nevada, Placer, Placer, Shasta, Tehama and Yuba Counties.	Chaparral, cismontane woodland, lower montane coniferous forest. Usually on dry slopes but also found in wet places. Soils can be serpentine, red clay, or sandy loam 40 - 1500m asl.	March - June	**None.** Butte County fritillary has been previously observed within the Seller Service Area. Rice fields do not provide suitable habitat for this species, and it is therefore not expected to be impacted by Transfers.
California jewel-flower *Caulanthus californicus*	E/E/ 1B.1	Fresno, Kings, Kern, Santa Barbara, San Luis Obispo, and Tulare Counties.	Chenopod scrub, valley and foothill grassland, pinyon-juniper woodland. From various valley habitats in both the Central Valley and Carrizo Plain 65 - 900m asl.	February - May	**None.** CNDDB records of this species exist for the Buyer Service Area. Suitable habitat would not be affected by Transfers.
California seablite *Suaeda californica*	E/-/ 1B.1	Alameda, Contra Costa, Santa Clara, San Francisco, and San Luis Obispo Counties.	Marshes and swamps. Margins of coastal salt marshes 0 - 5m asl.	July - October	**None.** California seablite has been previously observed within the Buyer Service Area. No impacts to suitable habitat within the Buyer Service Area are expected to occur.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
caper-fruited tropidocarpum *Tropidocarpum capparideum*	-/-/ 1B.1	Alameda, Contra Costa, Fresno, Glenn, Monterey, Santa Clara, San Joaquin, and San Luis Obispo Counties.	Valley and foothill grassland in alkaline clay 0 - 455m asl.	March - April	**None.** CNDDB records exist for the Buyer Service Area. Transfers are not expected to impact suitable habitat for this species.
Carquinez goldenbush *Isocoma arguta*	-/-/ 1B.1	Occurs in Solano County.	Valley and foothill grassland. Alkaline soils, flats, lower hills. On low benches near drainages and on tops and sides of mounds in swale habitat 1 - 20m asl.	August - December	**None.** Previously documented within the Buyer Service Area. Transfers would not affect water levels in the Seller Service Area and would only increase the levels in the Buyer Service Area.
chaparral harebell *Campanula exigua*	-/-/ 1B.2	Alameda, Contra Costa, San Benito, Santa Clara, and Stanislaus Counties.	Chaparral on rocky sites, usually on serpentine soils 300 - 1250m asl.	May - June	**None.** Chaparral harebell has been observed within the Buyer Service Area. However, Transfers are not expected to affect suitable habitat for this species.
chaparral ragwort *Senecio aphanactis*	-/-/ 2.2	California and Baja California. Within California, the species occurs in Alameda, Contra Costa, Fresno, Los Angeles, Merced, Monterey, Orange, Riverside, Santa Barbara, Santa Clara, the Channel Islands, San Diego, San Luis Obispo, Solano and Ventura Counties.	Cismontane woodland, coastal scrub. Drying alkaline flats 20 - 575m asl.	January - April	**None.** Previous records of this species exist within the Buyer Service Area. Transfers are not expected to affect suitable habitat for chaparral ragwort.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Choris' popcorn-flower *Plagiobothrys chorisianus* var. *chorisianus*	-/-/ 1B.2	Alameda, Santa Cruz, San Francisco, and San Mateo Counties.	Chaparral, coastal scrub, coastal prairie (mesic sites) 15 - 100m asl.	March - June	**None.** Choris' popcorn flower has been documented within the Buyer Service Area. No impacts to suitable habitat are anticipated in association with the proposed Transfers.
Colusa grass *Neostapfia colusana*	T/E/1B.1	Southern Sacramento Valley, and northern San Joaquin Valley.	Vernal pools.	May-July	**None.** According to the CNDDB, this species has been previously documented in the Seller Service Area. However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Colusa layia *Layia septentrionalis*	-/-/ 1B.2	Colusa, Glenn, Lake, Mendocino, Napa, Sonoma, Sutter, Tehama, and Yolo Counties.	Chaparral, cismontane woodland, valley and foothill grassland. Scattered colonies in fields and grassy slopes in sandy or serpentine soil 145 - 1095m asl.	April - May	**None.** CNDDB records exist for the Seller Service Area. Transfers are not expected to impact suitable habitat for this species given that rice fields do not provide appropriate conditions.
Congdon's tarplant *Centromadia parryi* ssp. *congdonii*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo, and Solano Counties.	Valley and foothill grassland. Alkaline soils, sometimes described as heavy white clay 1 - 230m asl.	May - November	**None.** Although this species has been documented within the Buyer Service Area (CNDDB), no impacts to suitable habitat are expected.
Contra Costa goldfields *Lasthenia conjugens*	E/-/1B.1	San Francisco Bay Delta Regions, and scattered coastal areas.	Cismontane woodlands, playas, valley and foothill grasslands, and vernal pools. Often occurs in vernal pools, swales, and low depressions in open grassy areas 1 - 445m asl.	March-June	**None.** According to the CNDDB, this species has been previously documented within the Buyer Service Area. No impacts to suitable habitat (i.e. vernal pools, playas) are expected.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Contra Costa manzanita *Arctostaphylos manzanita* ssp. *laevigata*	-/-/1B.2	Contra Costa County.	Chaparral on rocky slopes 500 - 1100m asl.	January - April	**None.** Contra Costa manzanita has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
Contra Costa wallflower *Erysimum capitatum* var. *angustatum*	E/E/1B.1	Contra Costa County	Inland dunes. Stabilized dunes of sand and clay near Antioch along the San Joaquin River 3 - 20m asl.	March - July	**None.** Records of this species exist within the Buyer Service Area. Suitable habitat would not be affected by Transfers.
coyote ceanothus *Ceanothus ferrisiae*	E/-/1B.1	Santa Clara County	Chaparral, valley and foothill grassland, coastal scrub. Serpentine sites in the Mt. Hamilton Range 120 - 455m asl.	January - May	**None.** The CNDDB contains records of this species within the Buyer Service Area. No suitable habitat for coyote ceanothus is expected to be impacted by the proposed Transfers.
Crampton's tuctoria (Solano grass) *Tuctoria mucronata*	E/E/1B	Located only in Yolo and Solano Counties.	Valley and foothill grassland (mesic), and vernal pools.	April-August	**None.** Occurrences have been documented outside of the area of analysis. Not likely to occur in rice fields. Suitable habitat within the Seller Service Area would not be impacted by Transfers.
Delta coyote-thistle(button celery) *Eryngium racemosum*	-/E/1B	Calaveras, Contra Costa, Merced, San Joaquin, and Stanislaus Counties.	Riparian scrub and vernally mesic clay depressions.	June-October	**None.** No occurrences have been documented within the area of analysis, but the species is known from Contra Costa, Merced, San Joaquin and Stanislaus Counties. No suitable habitat would be impacted by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Delta mudwort *Limosella subulata*	-/-/ 2.1	Contra Costa, Marin, Sacramento, San Joaquin, Solano Counties.	Riparian scrub, freshwater marsh, brackish marsh. Usually on intertidal flats and muddy banks of the Delta in marshy or scrubby riparian associations, often with Lilaeopsis masonii 0 - 3m asl. Typically occurs with other rare plant species.	May - August	**None.** Previous CNDDB records exist within the Buyer Service Area, and suitable habitat is also present within the Seller Service Area. This species is not expected to occur within rice fields given that it is sensitive to alteration of natural hydrology and other disturbances (SCWA 2007).
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	-/-/ 1B.2	Contra Costa, Napa, Sacramento, San Joaquin, Solano, Sonoma, Yolo Counties.	Coastal salt marsh. In coastal salt marsh with Distichlis, Salicornia, Frankenia, etc. from 0-3m asl.	May - September	**None.** Suitable habitat is present within the area of analysis, and CNDDB records exist for the Buyers Service Area. Transfers are not expected to impact suitable habitat for this species (i.e. coastal salt marshes).
Diablo helianthella *Helianthella castanea*	-/-/ 1B.2	Alameda, Contra Costa, Marin, San Francisco, San Mateo.	Broadleaved upland forest, chaparral, cismontane woodland, coastal scrub, riparian woodland, valley and foothill grassland. Usually in chaparral/oak woodland interface in rocky, azonal soils. Often in partial shade 25-1150m asl.	March - June	**None.** Diablo helianthella has been previously documented within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.
diamond-petaled California poppy *Eschscholzia rhombipetala*	-/-/ 1B.1	Alameda, Contra Costa, Colusa, San Joaquin, San Luis Obispo, Stanislaus Counties.	Valley and foothill grassland. Alkaline clay slopes and flats. 0 - 975m asl.	March - April	**None.** This species has been previously documented within the Buyer Service Area. No impacts to suitable habitat are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
dubious pea *Lathyrus sulphureus* var. *argillaceus*	-/-/ 3	Calaveras, El Dorado, Nevada, Placer, Shasta, Tehama Counties.	Cismontane woodland, lower montane coniferous forest, upper montane coniferous forest 150-305m asl.	April - May	**None.** CNDDB records of dubious pea exist within the Seller Service Area. Transfers actions would not affect suitable habitat for this species.
dwarf downingia *Downingia pusilla*	-/-/ 2.2	Occurs in California and South America. Within California: Amador, Fresno, Merced, Napa, Placer, Sacramento, San Joaquin, Solano, Sonoma, Stanislaus, Tehama, Yuba.	Vernal pools. Many historical occurrences are extirpated. In beds of vernal pools 1 - 880m asl.	March - May	**None.** Previously observed within the Seller Service Area. Not likely to establish in rice fields, due to lack of suitable habitat (i.e., vernal pools).
elongate copper moss *Mielichhoferia elongata*	-/-/ 2.2	Occurs in California, Colorado and Oregon. Within California, occurs in Fresno, Humboldt, Lake, Mariposa, Marin, Nevada, Placer, Plumas, Santa Cruz, Trinity, and Tulare Counties.	Cismontane woodland on very acidic, metamorphic rock or substrate, usually in higher portions in fens.	--	**None.** CNDDB records exist for the Seller Service Area. Transfers are not expected to affect suitable habitat for this species.
Ferris' milk-vetch *Astragalus tener* var. *ferrisae*	-/-/1B.1	Sacramento Valley.	Subalkaline flats and areas around vernal pools.	March-June	**None.** The species has been previously documented within the Seller Service Area. Not likely to occur in rice fields, due to lack of suitable habitat.
fragrant fritillary *Fritillaria liliacea*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Marin, San Benito, Santa Clara, San Francisco, San Mateo, Solano, Sonoma Counties.	Cismontane woodland, valley and foothill grassland. Grassy areas from 635 - 855m asl.	February - April	**None.** Previous records exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for fragrant fritillary.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Franciscan onion *Allium peninsulare* var. *franciscanum*	-/-/ 1B.2	Mendocino, Santa Clara, San Mateo, Sonoma Counties.	Cismontane woodland, valley and foothill grassland. Clay soils, often on serpentine. Dry hillsides from 100 - 300m asl.	May - June	**None.** Previous records of franciscan onion exist for the Buyer Service Area. The proposed Transfers is not expected to impact suitable habitat for this species.
Franciscan thistle *Cirsium andrewsii*	-/-/ 1B.2	Contra Costa, Marin, San Francisco, San Mateo, Sonoma Counties.	Coastal bluff scrub, broadleaved upland forest, coastal scrub. Sometimes serpentine seeps 0 - 135m asl.	March - July	**None.** Has been observed within the Buyer Service Area. No impacts to suitable habitat for Franciscan thistle are anticipated.
Greene's tuctoria *Tuctoria greeni*	E/R/1B.1	Butte, Colusa, Fresno, Glenn, Madera, Merced, Modoc, Shasta, San Joaquin, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	May-July	**None.** There is a CNDDB occurrence within the Seller Service Area, however this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
hairless popcorn-flower *Plagiobothrys glaber*	-/-/ 1A	Alameda, Marin, San Benito, Santa Clara Counties.	Meadows and seeps, marshes and swamps. Coastal salt marshes and alkaline meadows 5-180m asl.	March - May	**None.** This species has been documented by CNDDB within the Buyer Service Area. Transfers are not expected to impact suitable habitat for this species within the Buyer Service Area.
hairy Orcutt grass *Orcuttia pilosa*	E/E/1B.1	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento counties.	Vernal pools.	May - September	**None.** Hairy Orcutt grass has previously been documented by the CNDDB in the Seller Service Area. However this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Hall's bush-mallow *Malacothamnus hallii*	-/-/ 1B.2	Contra Costa, Lake, Mendocino, Merced, Santa Clara, San Mateo, Stanislaus Counties.	Chaparral. Some populations on serpentine 10 - 550m asl.	May - October	**None.** Previous records exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for Hall's bush-mallow.
Hall's tarplant *Deinandra halliana*	-/-/ 1B.1	Fresno, Monterey, San Benito, San Luis Obispo Counties.	Cismontane woodland, valley and foothill grassland, vernal pools. In grassland and not necessarily in vernal pools 200 - 1000m asl.	April - May	**None.** Hall's tarplant has been observed within the Buyer Service Area. Transfers are not expected to impact vernal pools or other suitable habitat for this species within the Buyer Service Area.
Hartweg's golden sunburst *Pseudobahia bahiifolia*	E/E/1B	Found in El Dorado, Fresno, Madera, Merced, Stanislaus, Tuolumne, and Yuba Counties.	Cismontane woodland, valley and foothill grassland, often acidic.	April - May	**None.** There are CNDDB occurrences within Yolo County outside of the area of analysis. This species is not likely to be affected by Transfers given that it is not likely to occur in rice fields.
Heartscale *Atriplex cordulata*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, alkali meadows, and alkali scrub.	May - October	**None.** CNDDB occurrences have been documented within the Seller Service Area (Butte, Colusa, Yolo, and Glenn Counties). However this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. alkali areas).

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Heckard's pepper-grass *Lepidium latipes* var**.** *heckardii*	-/-/1B	Glenn, Solano, and Yolo Counties.	Valley and foothill grassland alkaline flats.	March-May	**None.** This species has been previously documented within the Seller Service Area. However it is not likely to occur in rice fields due to lack of suitable habitat (i.e. alkali flats).
Henderson's bent grass *Agrostis hendersonii*	- /-/ 3.2	Found in Butte, Calaveras, Merced, Placer, Shasta, and Tehama Counties. Also found in Oregon.	Vernal pools.	March- June	**None.** CNDDB records for this species occur within the Seller Service Area. Not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Hispid bird's beak *Cordylanthus mollis* ssp. *hispidus*	-/-/1B.1	Alameda, Kern, Fresno, Merced, Placer, and Solano Counties.	Meadows and seeps, playas, valley and foothill grasslands (alkali).	June-September	**None.** Previously observed within the Seller Service Area according to CNDDB records. Not likely to occur in rice fields, no suitable habitat present.
hooked popcorn-flower *Plagiobothrys uncinatus*	-/-/ 1B.2	Monterey, San Benito, Santa Clara, San Luis Obispo, and Stanislaus Counties.	Chaparral, cismontane woodland, valley and foothill grassland, coastal bluff scrub. Sandstone outcrops and canyon sides, often in burned or disturbed areas 300 - 820m asl.	April - May	**None.** Hooked popcorn-flower has been documented within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.
Hoover's button-celery *Eryngium aristulatum* var. *hooverii*	-/-/ 1B.1	Alameda, San Benito, Santa Clara, San Diego, San Luis Obispo Counties.	Vernal pools. Alkaline depressions, vernal pools, roadside ditches and other wet places near the coast 5 - 45m asl.	July - August	**None.** This species has been documented within the Buyer Service Area. Suitable habitat for the species is present (e.g. irrigated agriculture and ditches), but no impacts to suitable habitat are expected within the Buyer Service Area.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Hoover's cryptantha *Cryptantha hooveri*	-/-/ 1A	Contra Costa, Kern, Madera, Stanislaus Counties.	Valley and foothill grassland in coarse sand up to 150m asl.	April - May	**None.** Hoover's cryptantha has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.
Hoover's eriastrum *Eriastrum hooveri*	D/-/ 4.2	Contra Costa, Kern, Madera, Stanislaus Counties.	Chenopod scrub, valley and foothill grassland, pinyon-juniper woodland. On sparsely vegetated alkaline alluvial fans, also in the Temblor Range on sandy soils 50 - 915m asl.	April - May	**None.** This species has previously been documented within the Buyer Service Area. No suitable habitat for this species would be impacted by the proposed Transfers.
Hoover's spurge *Chamaesyce hooveri*	T/-/ 1B.2	Scattered in Glenn, Butte, Colusa, Merced, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	July-September	**None.** According to the CNDDB occurrences have been documented in the Seller Service Area. However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Hospital Canyon larkspur *Delphinium californicum* ssp. *interius*	-/-/ 1B.2	Alameda, Contra Costa, Merced, Monterey, San Benito, Santa Clara, San Joaquin, and Stanislaus Counties.	Cismontane woodland, chaparral. In wet, boggy meadows, openings in chaparral and in canyons 225 - 1060m asl.	April - June	**None.** Hospital Canyon larkspur has been observed within the Buyer Service Area. There is suitable habitat for this species in the area of analysis, but the proposed actions are not expected to impact these habitat in the Buyer Service Area.
Indian valley brodiaea *Broiaea coronaria* ssp. *rosea*	-/E/1B	Scattered in Glenn, Lake, Colusa, and Tehama Counties.	Closed cone coniferous forest, chaparral, valley and foothill grasslands (serpentinite).	May-June	**None.** CNDDB occurrences have been documented outside of the area of analysis. This species is not likely to occur in rice fields due to lack of suitable habitat.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Indian Valley bush-mallow *Malacothamnus aboriginum*	-/-/ 1B.2	Alameda, Contra Costa, Merced, Monterey, San Benito, Santa Clara, San Joaquin, and Stanislaus Counties.	Cismontane woodland, chaparral. Granitic outcrops and sandy bare soil, often in disturbed soils 150 - 1700m asl.	April - June	**None.** Indian Valley bush-mallow has been observed within the Buyers Service Area. The proposed Transfers should not affect suitable habitat for this species.
Jepson's milk-vetch *Astragalus rattanii var. jepsonianus*	-/-/1B.2	Colusa, Glenn, Lake, Napa, Tehama, and Yolo Counties.	Chaparral, cismontane woodland, valley and foothill grassland, often serpentinite.	April-June	**None.** Although suitable habitat exists, no CNDDB records have been documented within the area of analysis. This species is not likely to be impacted as rice fields do not provide suitable habitat.
Keck's checkerbloom *Sidalcea keckii*	E/-/1B.1	Colusa, Fresno, Merced, Napa, Solano, Tulare, and Yolo Counties.	Cismontane woodlands, foothill and valley grasslands (serpentinite).	April-May	**None.** No CNDDB occurrences of this species are known for the area of analysis. Suitable habitat is present, but would not be impacted by the proposed Transfers.
Kellogg's horkelia *Horkelia cuneata* ssp*. sericea*	-/-/ 1B.1	Alameda, Monterey, Marin, Santa Barbara, Santa Cruz, San Francisco, San Luis Obispo, and San Mateo Counties.	Closed-cone coniferous forest, coastal scrub, chaparral. Within old dunes, coastal sandhills, openings from 10 - 200m asl.	April - September	**None.** Records of Kellog's horkelia exist in the Buyer Service Area. Transfers are not expected to affect suitable habitat for this species within the area of analysis.
Kings Mountain manzanita *Arctostaphylos regismontana*	-/-/ 1B.2	Santa Clara, Santa Cruz, and San Mateo Counties.	Broadleaved upland forest, chaparral, north coast coniferous forest. Granitic or sandstone outcrops 305 - 730m asl.	January - April	**None.** This species has been previously observed within the Buyer Service Area. Suitable habitat is presented but would not be impacted by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
large-flowered fiddleneck *Amsinckia grandiflora*	E/E/ 1B.1	Alameda, Contra Costa, and San Joaquin Counties.	Cismontane woodland, valley and foothill grassland. Annual grassland in various soils 275 - 550m asl.	April - May	**None.** Large-flowered fiddleneck has been recorded by the CNDDB within the Buyer Service Area. No impacts would occur to suitable habitat.
Layne's ragwort *Packera layneae*	T/-/1B	Butte, El Dorado, Tuolumne, and Yuba Counties.	Chaparral and cismontane woodland, rocky and often serpentinite.	April-August	**None.** There is a CNDDB occurrence within Butte County, outside the area of analysis. Although suitable habitat is present within the area of analysis, it is not expected to be impacted by the proposed Transfers.
Legenere *Legenere limosa*	-/-/1B.1	Sacramento Valley and south of the North Coast Ranges.	Vernal pools from 1-880m asl.	April-June	**None.** Legenere has been documented within both the Buyer and Seller Service Areas. Not likely to occur in rice fields, no suitable habitat present (i.e. vernal pools).
Lesser saltscale *Atriplex minuscula*	-/-/1B	Found in Butte, Fresno, Kern, Madera, Merced, Stanislaus, and Tulare Counties.	Chenopod scrub, playas, valley and foothill grasslands (alkali and sandy).	May-October	**None.** No CNDDB records exist for the area of analysis, but it has been documented within some of the counties. Suitable habitat occurs within the Buyer Service Area, but would not be impacted by the proposed Transfers.
Lime Ridge navarretia *Navarretia gowenii*	-/-/ 1B.1	Occurs within Contra Costa and Stanislaus Counties in California.	Chaparral on calcium carbonate rich soil with high clay content, 180 - 305m asl.	May - June	**None.** Previously documented within the Buyer Service Area. No suitable habitat for Lime Ridge navarretia would be affected by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Loma Prieta hoita *Hoita strobilina*	-/-/ 1B.1	Alameda, Contra Costa, Santa Clara, Santa Cruz Counties.	Chaparral, cismontane woodland, riparian woodland. Within serpentine at mesic sites.	May - October	**None.** CNDDB records of Loma Prieta hoita exist for the Buyer Service Area. No impacts are expected within suitable habitat for this species.
Lone buckwheat *Eriogonum apricum* var. *apricum*	E/E/1B	Found in Amador and Sacramento Counties.	Chaparral.	July-October	**None.** Although it has been documented, no CNDDB records exist within the area of analysis. This species is not likely to occur in rice fields due to lack of suitable habitat.
Lost Hills crownscale *Atriplex coronata* var. *vallicola*	-/-/ 1B.2	Fresno, Kings, Kern, Merced, and San Luis Obispo Counties.	Chenopod scrub, valley and foothill grassland, vernal pools. In powdery, alkaline soils that are vernally moist with Frankenia, Atriplex spp. And Distichlis. 0 - 605m asl.	April - August	**None.** This species has been documented within the Buyer Service Area. No impacts to suitable habitat are expected.
lost thistle *Cirsium praeteriens*	-/-/ 1A	Little information exists on this plant. San Mateo and Santa Clara Counties. Little information exists on this species. It was collected from the Palo Alto area at the turn of the 20th century. Not observed since 1901.	0 - 100m asl.	June - July	**None.** CNDDB records of lost thistle exist for the Buyer Service Area. Very limited information is available. Based on status information it is likely to be extirpated and would therefore be unlikely to occur within an area impacted by transfers.
maple-leaved checkerbloom *Sidalcea malachroides*	-/-/ 4.2	Occurs within California and Oregon. In California the species occurs in Del Norte, Humboldt, Mendocino, Monterey, Santa Clara, Santa Cruz, and Sonoma Counties.	Broadleafed upland forest, coastal prairie, coastal scrub, North Coast coniferous forest. Woodlands and clearings near coast, often in disturbed areas 2 - 760m asl.	March - August	**None.** This species has been previously documented within the Buyer Service Area. No impacts to areas of suitable habitat are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Marsh checkerbloom *Sidalcea oregana* ssp. *hydrophila*	-/-/1B	Glenn, Lake, Mendocino, and Napa Counties.	Meadows and seeps, and riparian forest.	June-August	**None.** Suitable habitat present within Glenn County in the area of analysis. This species is not expected to establish in rice fields, and therefore no impacts are anticipated.
Mason's lilaeopsis *Lilaeopsis masonii*	-/R/ 1B.1	Alameda, Contra Costa, Marin, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Freshwater and brackish marshes, riparian scrub. Tidal zones, in muddy or silty soil formed through river deposition or river bank erosion 0 - 10m asl. Populations may be ephemeral, using freshly deposited or exposed sediments (SCWA 2007).	April - November	**None.** Previous records of this species exist within the Buyer Service Area. This species is not expected to establish within rice fields.
Merced phacelia *Phacelia ciliata var. opaca*	-/-/ 1B.2	Merced County.	Valley and foothill grassland. Adobe or clay soils of valley floors, open hills or alkaline flats 60 - 150m asl.	February - May	**None.** Merced phacelia has been documented within the Seller Service Area. Transfers are not expected to affect suitable habitat for this species.
Metcalf Canyon jewel-flower *Streptanthus albidus* ssp. *albidus*	E/-/ 1B.1	Santa Clara County.	Valley and foothill grassland. Relatively open areas in dry grassy meadows on serpentine soils 45 - 245m asl.	April - July	**None.** This species was previously observed within the Buyer Service Area according to CNDDB. No Transfers-related impacts to suitable habitat for Metcalf Canyon jewel-flower are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Milo Baker's lupine *Lupinus milo-bakeri*	-/T/1B	Glenn and Mendocino Counties.	Cismontane woodlands, foothill and valley grasslands.	June-September	**None.** Although suitable habitat is present within the area of analysis, no CNDDB records have been documented in either the Buyer or Seller Service Areas. This species is not likely to occur in rice fields due to lack of suitable habitat.
most beautiful jewel-flower *Streptanthus albidus* ssp. *peramoenus*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Santa Clara, and San Luis Obispo Counties.	Chaparral, valley and foothill grassland, cismontane woodland, serpentine outcrops, on ridges and slopes 120 - 730m asl.	March - October	**None.** Most beautiful jewel-flower has been previously observed within the Buyer Service Area. No Transfers-related impacts to suitable habitat for this species are expected.
Mount Day rockcress *Boechera rubicundula*	-/-/ 1B.1	Santa Clara County.	Rocky slopes in chaparral at 1200m asl.	April - May	**None.** According to CNDDB, this species was documented within the Buyer Service Area. No suitable habitat for this species would be affected by Transfers.
Mt. Diablo buckwheat *Eriogonum truncatum*	-/-/ 1B.1	Alameda, Contra Costa, and Solano Counties.	Chaparral, coastal scrub, valley and foothill grassland. Dry, exposed clay or sandy substrates 100 - 600m asl.	April - December	**None.** This species has been observed within the Buyer Service Area. No suitable habitat would be affected by Transfers.
Mt. Diablo fairy-lantern *Calochortus pulchellus*	-/-/ 1B.2	Alameda, Contra Costa, and Solano Counties.	Chaparral, cismontane woodland, riparian woodland, valley and foothill grassland on wooded and brushy slopes 200 - 800m asl.	April - June	**None.** Mt. Diablo fairy-lantern has been documented within the Buyer Service Area. No impacts to suitable habitat for this species are expected.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Mt. Diablo jewel-flower *Streptanthus hispidus*	-/-/ 1B.3	Contra Costa County.	Valley and foothill grassland, chaparral, talus or rocky outcrops 275 - 970m asl.	March - June	**None.** The Mt. Diablo jewel-flower has been documented in the Buyer Service Area. No impacts to suitable habitat area anticipated.
Mt. Diablo manzanita *Arctostaphylos auriculata*	-/-/ 1B.3	Contra Costa County.	Chaparral in canyons and on slopes. On sandstone 120 - 500m asl.	January - March	**None.** This species was previously observed within the Buyer Service Area according to CNDDB. No Transfers-related impacts to suitable habitat for Mt. Diablo phacelia are anticipated.
Mt. Diablo phacelia *Phacelia phacelioides*	-/-/ 1B.2	Contra Costa, San Benito, Santa Clara, and Stanislaus Counties.	Chaparral, cismontane woodland. Adjacent to trails, on rock outcrops and talus slopes, sometimes on serpentine 500 - 1370m asl.	April - May	**None.** Mt. Diablo phacelia has been documented within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
Mt. Hamilton coreopsis *Leptosyne hamiltonii*	-/-/ 1B.2	Alameda, Santa Clara, and Stanislaus Counties.	Cismontane woodland. On steep shale talus with open southwestern exposure 530 - 1300m asl.	March - May	**None.** CNDDB records of Mt. Hamilton coreopsis exist within the Buyer Service Area. Transfers would not affect suitable habitat for this species.
Mt. Hamilton fountain thistle *Cirsium fontinale* var. *campylon*	-/-/ 1B.2	Alameda, Santa Clara, and Stanislaus Counties.	Cismontane woodland, chaparral, valley and foothill grassland. In seasonal and perennial drainages on serpentine soil 95 - 890m asl.	February - October	**None.** This species has been documented within the Buyers Service Area. No impacts to suitable habitat within the area of analysis are anticipated.
Mt. Hamilton jewel-flower *Streptanthus callistus*	-/-/ 1B.3	Santa Clara County.	Chaparral, cismontane woodland. Open talus slopes on shale with grey pine and/or black oak 600 - 790m asl.	April - May	**None.** Mt. Hamilton jewel-flower has been documented within the Buyers Service Area by CNDDB. Transfers would not impact suitable habitat for this species.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Mt. Hamilton lomatium *Lomatium observatorium*	-/-/ 1B.2	Santa Clara and Stanislaus Counties.	Cismontane woodland. Open to partially shaded openings in Pinus coulteri - Oak woodland. Sedimentary Franciscan rocks and volcanic soils 1219 - 1330m asl.	March - May	**None.** Mt. Hamilton lomatium has been documented within the Buyers Service Area by CNDDB. Transfers would not impact suitable habitat for this species.
Munz's tidy-tips *Layia munzii*	-/-/ 1B.2	Fresno, Kern, and San Luis Obispo Counties.	Chenopod scrub, valley and foothill grassland. Hillsides in white-grey alkaline clay soils with grasses and chenopod scrub associates 45 - 760m asl.	March - April	**None.** This species has been observed within the Buyer Service Area. No suitable habitat would be affected by Transfers.
Norris' beard moss *Didymodon norrisii*	-/-/ 2.2	Butte, Contra Costa, Colusa, Humboldt, Lake, Los Angeles, Madera, Monterey, Mariposa, Nevada, Plumas, San Benito, Santa Cruz, Shasta, Sierra, Sonoma, Tehama, Tulare, and Tuolumne Counties.	Cismontane woodland, lower montane coniferous forest. Moss from seasonally wet sheet drainages on exposed rock slabs or terraces that completely dry in summer.	--	**None.** Records of Norris' beard moss exist for the Buyer Service Area. Transfers would not impact suitable habitat for this species.
Northern California black walnut *Juglans hindsii*	-/-/1B	Native stands reported in Napa and Contra Costa Counties.	Riparian woodland.	April-May	**None.** Previously documented within the Buyer Service Area. Transfers would not impact suitable habitat for this species.
Oregon meconella *Meconella oregana*	-/-/ 1B.1	Occurs in California, Oregon and Washington. Within California occurs in Contra Costa and Santa Clara Counties.	Coastal prairie and coastal scrub in open, moist places 250 - 500m asl.	March - April	**None.** Oregon meconella has been observed within the Buyer Service Area. Transfers would not affect suitable habitat for this species.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
oval-leaved viburnum *Viburnum ellipticum*	-/-/2.3	Occurs in California, Oregon and Washington. Within California occurs in Contra Costa, El Dorado, Fresno, Glenn, Humboldt, Mendocino, Napa, Placer, Shasta, Sonoma and Tehama Counties.	Chaparral, cismontane woodland, and lower montane coniferous forest 215 - 1400m asl.	May - June	**None.** This species has been previously documented within the Buyer Service Area. Suitable habitat for oval-leaved viburnum is not expected to be affected by Transfers.
pallid manzanita *Arctostaphylos pallida*	T/E/1B.1	Alameda and Contra Costa Counties.	Broadleafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, coastal scrub. Grows on uplifted marine terraces on siliceous shale or thin chert at 185 - 465m asl. May require fire.	December - March	**None.** Pallid manzanita has been observed within the Buyer Service Area. No Transfers-related impacts to suitable habitat are anticipated.
Palmate-bracted bird's-beak *Cordylanthus palmatus*	E/E/1B.1	Found in Glenn and Colusa Counties and within the Central Valley.	Alkali meadow, alkali scrub, valley and grasslands.	May-October	**None.** CNDDB records of this species exist for the Seller Service Area. Not likely to occur in rice fields; no suitable habitat is present (i.e. alkali areas).
Panoche pepper-grass *Lepidium jaredii* ssp. *album*	-/-/ 1B.2	Fresno, San Benito, and San Luis Obispo Counties.	Valley and foothill grassland. White or grey clay lenses on steep slopes. Incidental in alluvial fans and washes. Clay and gypsum-rich soils 65 - 910m asl.	February - June	**None.** Panoche pepper-grass has previously been documented within the Buyer Service Area. The proposed Transfers would not impact suitable habitat for this species.
Peruvian dodder *Cuscuta obtusiflora* var. *glandulosa*	-/-/ 2.2	Known from California, Baja California, Sonora and Texas. Within California records exist from Butte, Los Angeles, Merced, Sacramento, San Bernardino, Sonoma and Sutter Counties.	Marshes and swamps (freshwater). Freshwater marsh 15 - 280m asl.	July - October	**None.** CNDDB records of this species exist for the Seller Service Area. Peruvian dodder is unlikely to become established within rice fields.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Pincushion navarretia *Navarretia myersii* ssp. *myersii*	-/-/1B.1	Alamdor, Calaveras, Merced, Placer, and Sacramento Counties.	Vernal pools (often acidic).	May	**None.** Previously documented in the Seller Service Area. No vernal pools would be affected by Transfers.
pink creamsacs *Castilleja rubicundula* ssp. *rubicundula*	-/-/ 1B.2	Butte, Contra Costa, Colusa, Glenn, Lake, Napa, Plumas, San Benito, Santa Clara, and Shasta Counties.	Chaparral, meadows and seeps, valley and foothill grassland. Openings in chaparral or grasslands. On serpentine 20 - 900m asl.	April - June	**None.** Pink creamsacs has been previously documented within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.
Point Reyes bird's-beak *Chloropyron maritimum* ssp. *palustre*	-/-/ 1B.2	California and Oregon. Within California it occurs in Alameda, Humboldt, Marin, Santa Clara, San Francisco, San Mateo, and Sonoma Counties.	Coastal salt marsh, usually in coastal salt marsh with Salicornia, Distichlis, Jaumea, Spartina, etc. 0 - 15m.	June - October	**None.** CNDDB records of this species exist for the Buyer Service Area. Suitable habitat for this species is not expected to be affected by Transfers.
Presidio clarkia *Clarkia franciscana*	E/E/1B.1	Alameda and San Francisco Counties	Coastal scrub, valley and foothill grassland. Serpentine outcrops in grassland or scrub 20 - 335m.	May - July	**None.** Presidio clarkia has been previously observed within the Buyer Service Area. Suitable habitat exists in the area of analysis, but would not be affected by the proposed Transfers.
Recurved larkspur *Delphinium recurvatum*	-/-/1B	Disbursed throughout the Sacramento and Central Valley.	Chenopod scrub, cismontane, valley and foothill grasslands (alkali).	March-June	**None.** According to the CNDDB this species has been previously recorded in the Buyer Service Area. Suitable habitat exists (i.e. alkali areas) in the area of analysis, but would not be affected by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Red Bluff dwarf rush *Juncus leiospermus* var. *leiospermus*	-/-/1B.1	Butte, Placer, Shasta, and Tehama Counties.	Chaparral, valley and foothill grassland, cismontane woodlands, vernal pools. Vernally mesic sites. Sometimes on edges of vernal pools 30 - 1020m asl. The species has also been documented within intermittent drainages and in areas with pocket gopher and ground squirrel activity (BRCP 2011).	March - May	**Low.** Red Bluff dwarf rush has been previously documented within the Seller Service Area. Given that the species has some tolerance for disturbance, is a low potential for red bluff dwarf rush to establish within rice fields, which may represent marginal habitat.
Red Hills soaproot *Chlorogalum grandiflorum*	-/-/1B.2	Amador, Butte, Calaveras, El Dorado, Placer and Tuolumne Counties.	Cismontane woodland, chaparral, lower montane coniferous forest. Occurs frequently on serpentine or gabbro, but also on non-ultramafic substrates, often on historically disturbed sites.	May - June	**None.** CNDDB records of this species exist within the Seller Service Area. This species is not expected to occur within rice fields due to lack of suitable habitat (i.e., serpentine areas).
Red mountain catchfly *Silene campanulata* ssp. *campanulata*	-/E/1B	Found in Colusa, Glenn, Mendocino, Shasta, Tehama, and Trinity Counties.	Chaparral and lower montane coniferous forest, usually sepentinite and rocky.	April-July	**None.** There is a CNDDB occurrences in the vicinity, within counties in the area of analysis. However this species is not likely to occur in rice fields due to lack of suitable habitat.
robust spineflower *Chorizanthe robusta* var. *robusta*	E/-/1B.1	Alameda, Monterey, Marin, Santa Clara, Santa Cruz, San Francisco, and San Mateo Counties.	Cismontane woodland, coastal dunes, coastal scrub. Sandy terraces and bluffs or in loose sand 3 - 120m asl.	April - September	**None.** Robust spineflower has been documented within the Buyer Service Area. Transfers are not expected to affect suitable habitat for this species.
rock sanicle *Sanicula saxatilis*	-/-/ 1B.2	Contra Costa and Santa Clara Counties.	Broadleafed upland forest, chaparral, valley and foothill grassland. Bedrock outcrops and talus slopes in chaparral or oak woodland habitat 625 - 1215m asl.	April - May	**None.** CNDDB records of this species exist within the Buyer Service Area. Suitable habitat for rock sanicle is not expected to be affected by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
round-leaved filaree *California macrophylla*	-/-/1B.1	California, Baja California, Oregon.	Cismontane woodland, valley and foothill grassland. Clay soils 15 - 1200m asl.	March - May	**None.** Round-leaved filaree has been previously documented within both the Buyer and Seller Service Areas. No Transfers-related impacts to suitable habitat for the species are anticipated.
Sacramento Orcutt grass *Orcuttia viscida*	E/E/1B.1	Valley grasslands and freshwater wetlands.	Vernal pools.	May-June	**None.** CNDDB records of this species exist for the Seller Service Area. Sacramento Orcutt grass is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
saline clover *Trifolium hydrophilum*	-/-/ 1B.2	California's Central coast and Bay Area.	Marshes and swamps, valley and foothill grassland, vernal pools. Mesic, alkaline sites 0 - 300m asl.	April - June	**Low.** Records of saline clover exist within both the Buyer and Seller Service Areas. Rice fields may represent marginally suitable habitat for this species. There is a low potential for impacts within the Seller Service Area (Colusa, Solano, and Yolo Counties).
San Benito pentachaeta *Pentachaeta exilis* ssp. *aeolica*	-/-/ 1B.2	Monterey, San Benito, and Santa Clara Counties.	Cismontane woodland, valley and foothill grassland. Grassy areas from 635 - 855m asl.	March - May	**None.** This species has previously been documented within the Buyer Service Area. No suitable habitat for this species would be impacted by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
San Francisco Bay spineflower *Chorizanthe cuspidata* var. *cuspidata*	-/-/ 1B.2	Alameda, Marin, San Francisco, San Mateo, and Sonoma Counties.	Coastal bluff scrub, coastal dunes, coastal prairie, coastal scrub. Sandy soil on terraces and slopes 5 - 550m asl.	April - August	**None.** San Francisco Bay spineflower has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated in association with the proposed Transfers.
San Francisco collinsia *Collinsia multicolor*	-/-/ 1B.2	Monterey, Marin, Santa Clara, Santa Cruz, San Francisco, and San Mateo Counties.	Closed-cone coniferous forest, coastal scrub. On decomposed shale (mudstone) mixed with humus 30 - 250m asl.	March - May	**None.** This species has been documented within the Buyer Service Area. No impacts to suitable habitat are expected.
San Francisco popcorn-flower *Plagiobothrys diffusus*	-/E/1B.1	Alameda, Santa Cruz, San Francisco, and San Mateo Counties.	Valley and foothill grassland, coastal prairie. Historically known from grassy slopes with marine influence 60 - 485m asl.	March - June	**None.** San Francisco popcorn-flower has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated in association with the proposed Transfers.
San Joaquin spearscale *Atriplex joaquiniana*	-/-/1B.2	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, and alkali scrub.	April-September	**None.** Has been previously documented within both the Buyer and Seller Service Areas. Not likely to occur in rice fields, no suitable habitat present (i.e. alkali areas).
San Joaquin woollythreads *Monolopia congdonii*	E/-/1B.2	Fresno, Kings, Kern, Santa Barbara, San Benito, San Luis Obispo, and Tulare Counties.	Chenopod scrub and valley and foothill grassland. Alkaline or loamy plains, sandy soils 60 - 800m asl.	February - May	**None.** San Joaquin woollythreads was previously documented within the Buyer Service Area. No impacts to suitable habitat are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Sanford's arrowhead *Sagittaria sanfordii*	-/-/1B	Central Valley.	Freshwater marshes, shallow streams, and ditches.	May-August	**Moderate.** Sanford's arrowhead has been previously documented within the Seller Service Area. Not likely to establish in rice fields, but ditches represent suitable habitat. There is a moderate potential that this species would be affected by the proposed Transfers.
Santa Clara red ribbons *Clarkia concinna ssp. automixa*	-/-/ 4.3	Alameda and Santa Clara Counties.	Cismontane woodland, chaparral on slopes and near drainages 90-970m asl.	April - July	**None.** CNDDB records for this species exist for the Buyer Service Area. No suitable habitat for this species should be affected by Transfers.
Santa Clara Valley dudleya *Dudleya abramsii* ssp. *setchellii*	E/-/ 1B.1	Santa Clara County.	Valley and foothill grassland, cismontane woodland. On rocky serpentine outcrops and on rocks within grassland or woodland 80 - 335m asl.	April - October	**None.** Santa Clara Valley dudleya has been previously documented within the Buyer Service Area. Suitable habitat for this species would not be impacted by the proposed Transfers.
Santa Cruz tarplant, *Holocarpha macradenia*	T/E/1B.1	Alameda, Contra Costa, Monterey, Marin, Santa Cruz, and Solano Counties.	Coastal prairie, valley and foothill grassland. Light, sandy soil or sandy clay, often with non-natives 10 - 260masl.	June - October	**None.** Santa Cruz tarplant has been observed within the Buyer Service Area, according to CNDDB records. No impacts to suitable habitat are anticipated.
Santa Cruz Mountains beardtongue *Penstemon rattanii* var. *kleei*	-/-/ 1B.2	Santa Clara and Santa Cruz Counties	Chaparral, lower montane coniferous forest. Sandy shale slopes, sometimes in the transition between forest and chaparral 400 - 1100m asl.	May - June	**None.** This species has been observed within the Buyer Service Area. No suitable habitat would be affected by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Santa Cruz Mountains pussypaws *Calyptridium parryi* var. *hesseae*	-/-/ 1B.1	Monterey, Santa Clara, Santa Cruz, San Luis Obispo, and Stanislaus Counties.	Chaparral, cismontane woodland, sandy or gravelly openings 305 - 1530m asl.	May - August	**None.** CNDDB records of Santa Cruz Mountains pussypaws exist for the Buyer Service Area. Suitable habitat for this species is not expected to be affected by Transfers.
Santa Cruz tarplant, *Holocarpha macradenia*	T/E/1B.1	Alameda, Contra Costa, Monterey, Marin, Santa Cruz, and Solano Counties.	Coastal prairie, valley and foothill grassland. Light, sandy soil or sandy clay, often with non-natives 10 - 260masl.	June - October	**None.** Santa Cruz tarplant has been observed within the Buyer Service Area, according to CNDDB records. No impacts to suitable habitat are anticipated.
Scadden Flat checkerbloom *Sidalcea stipularis*	-/E/ 1B.1	Nevada County. Known from two occurrences near Grass Valley.	Marshes and swamps. Typical habitat includes montane marshes fed by springs 700 - 740m asl.	July - August	**None.** This species has been previously documented within the Seller Service Area. It is not likely to establish in rice fields due to lack of suitable habitat (i.e. montane marsh).
Sharsmith's harebell *Campanula sharsmithiae*	-/-/ 1B.2	Santa Clara and Stanislaus Counties.	Chaparral. Serpentine barrens 480 - 1820m asl.	April - June	**None.** Sharsmith's harebell has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
Sharsmith's onion *Allium sharsmithiae*	-/-/ 1B.3	Alameda, Santa Clara, and Stanislaus Counties.	Cismontane woodland. Rocky, serpentine slopes 400 - 1200m asl.	March - May	**None.** CNDDB records for this species occur within the Buyer Service Area. Suitable habitat for this species should not be impacted by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Sheldon's sedge *Carex sheldonii*	-/-/2.2	Occurs in California, Idaho, Nevada, Oregon, Utah and Washington. Within California the species occurs in Lassen, Modoc, Placer, and Plumas Counties.	Lower montane coniferous forest, marshes and swamps, riparian scrub. Mesic sites along creeks and in wet meadows 1065 - 1755m asl.	May - August	**None.** Sheldon's sedge has been observed within the Seller Service Area. Although rice fields may provide the appropriate moisture conditions, this species occurs at very high elevations and is therefore not expected to be impacted by the proposed Transfers.
shining navarretia *Navarretia nigelliformis* ssp. *radians*	-/-/1B.2	Alameda, Contra Costa, Fresno, Merced, Monterey, San Benito, San Joaquin, and San Luis Obispo Counties.	Cismontane woodland, valley and foothill grassland, and vernal pools 200 - 1000m asl. Known from grassland, and may not necessarily occur in vernal pools.	April - July	**None.** Previous CNDDB records of shining navarettia exist for the Seller Service Area. This species is unlikely to establish within rice fields due to lack of suitable habitat (i.e., vernal pools and native grassland).
Sierra blue grass *Poa sierrae*	-/-/1B.3	Butte, Madera, Nevada, Placer, Plumas, Shasta Counties.	Lower montane coniferous forest. Shady, moist, rocky slopes often in canyons 365 - 1160m asl.	April - June	**None.** This species has been documented within the Seller Service Area. This species is not likely to be impacted, given that it requires shaded rocky slope habitat not provided in rice fields.
showy golden madia *Madia radiata*	-/-/1B.1	Contra Costa, Fresno, Kings, Kern, Monterey, Santa Barbara, San Benito, Santa Clara, San Joaquin, San Luis Obispo, and Stanislaus Counties.	Valley and foothill grassland, cismontane woodland, chenopod scrub. Mostly on adobe clay in grassland or among shrubs 25 - 1125m asl.	March - May	**None.** Showy golden madia has been observed within the Buyer Service Area. No project impacts to suitable habitat for this species are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Slender Orcutt grass *Orcuttia tenuis*	T/E/1B.1	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento Counties.	Vernal pools.	May-October	**None.** The CNDDB contains records of slender Orcutt grass in the Seller Service Area. However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
slender-leaved pondweed *Stuckenia filiformis*	-/-/ 2.2	Occurs in California, Arizona, Nevada, Oregon, and Washington.	Marshes and swamps. Shallow, clear water of lakes and drainage channels 15 - 2310m asl.	May - July	**None.** Slender-leaved pondweed has been previously documented within the Buyer Service Area. It is not expected to occur within rice fields in the Seller Service Area given the lack of suitable natural lake and stream habitat.
slender silver moss *Anomobryum julaceum*	-/-/ 2.2	California and Oregon. Within California it occurs in Butte, Contra Costa, Humboldt, Los Angeles, Mariposa, Santa Barbara, Santa Cruz, Shasta, and Sonoma Counties.	Broadleafed upland forest, lower montane coniferous forest, north coast coniferous forest. Grows on damp rocks and soil in acidic substrates and on roadcuts 100 - 1000m asl.	--	**None.** CNDDB records of slender silver moss exist for the Buyer Service Area. Suitable habitat for this species is not expected to be affected by Transfers.
smooth lessingia *Lessingia micradenia var. glabrata*	-/-/ 1B.2	Santa Clara County.	Chaparral. Serpentine often on roadsides 120 - 485m asl.	July - November	**None.** This species has been previously documented within the Buyer Service Area. No impacts to chaparral or serpentine areas are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Soft bird's beak *Cordylanthus mollis* ssp. *mollis*	E/R/1B.2	Located in Contra Costa, Marin, Napa, Sacramento, Solano, and Sonoma Counties.	Coastal salt marshes and swamps.	July-November	**None.** CNDDB occurrences exist for the Buyer Service Area, however this species is not likely to be affect by Transfers due to lack of suitable habitat (i.e. coastal salt marshes).
stinkbells *Fritillaria agrestis*	-/-/ 4.2	Occurs in Central and Northern California, including Alameda, Contra Costa, Fresno, Kern, Mendocino, Merced, Monterey, Mariposa, Placer, Sacramento, Santa Barbara, San Benito, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo, Stanislaus, Tuolumne, Ventura, and Yuba Counties.	Cismontane woodland, chaparral, valley and foothill grassland. Sometimes on serpentine, mostly in non-native grassland or in grassy openings in clay soil 95 - 890m asl.	March - June	**None.** This species has been documented within both the Buyer and the Seller Service Areas. No impacts to suitable habitat for stinkbells are anticipated.
Succulent owl's clover *Castilleja campestris* ssp. *succulenta*	T/E/1B.2	Fresno, Madera, Merced, Mariposa, San Joaquin, and Stanislaus Counties.	Vernal pools.	April-May	**None.** Succulent owl's clover has been documented in the Seller Service Area, however this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Suisun Marsh aster *Symphyotrichum lentum*	-/-/ 1B.2	Contra Costa, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Saline and freshwater marshes and swamps. Most often seen along sloughs with Phragmites, Scirpus, blackberry, Typha, etc at 0-3m asl.	May - November	**None.** This species has been previously documented within both the Buyer and Seller Service Areas. This species is not expected to occur within rice fields given its sensitivity to habitat alteration and agricultural amendments. Environmental commitments would require that downstream flows are maintained, such that no impacts are anticipated in the natural habitats for the species.
talus fritillary *Fritillaria falcata*	-/-/ 1B.2	Alameda, Monterey, San Benito, Santa Clara, and Stanislaus Counties.	Chaparral, cismontane woodland, lower montane coniferous forest. On shale, granite, or serpentine talus 300 - 1525m asl.	March - May	**None.** Talus fritillary has been observed within the Buyer Service Area. Suitable habitat for this species is not expected to be affected.
Temblor buckwheat *Eriogonum temblorense*	-/-/ 1B.2	Fresno, Kern, Monterey, and San Luis Obispo Counties.	Valley and foothill grassland. Barren clay or sandstone substrates 300 - 1000m asl.	April - September	**None.** Records of temblor buckwheat exist within the Buyer Service Area. Transfers are not expected to impact any suitable habitat for this species.
Tiburon buckwheat *Eriogonum luteolum var. caninum*	-/-/ 1B.2	Alameda, Contra Costa, Marin, Sonoma Counties.	Chaparral, valley and foothill grassland, cismontane woodland, coastal prairie. Serpentine soils on sandy to gravelly sites 0 - 700m asl.	May - September	**None.** Has been observed within the Buyer Service Area. No impacts to suitable habitat for Tiburon buckwheat are expected.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Tiburon paintbrush *Castilleja affinis* ssp. *neglecta*	E/T/ 1B.2	Marin, Napa, and Santa Clara Counties.	Valley and foothill grassland. Rocky serpentine sites 75 - 400m asl.	April - June	**None.** CNDDB records of Tiburon paintbrush exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for this species.
Tracy's eriastrum *Eriastrum tracyi*	-/R/ 1B.2	Colusa, Fresno, Glenn, Kern, Santa Clara, Shasta, Stanislaus, Tehama, Trinity, and Tulare Counties.	Chaparral, cismontane woodland. Gravelly shale or clay, often in open areas 315 - 760m asl.	June - July	**None.** Previously documented within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
vernal pool smallscale *Atriplex persistens*	-/-/ 1B.2	Colusa, Glenn, Madera, Merced, Solano, Stanislaus, and Tulare Counties.	Vernal pools. Alkaline vernal pools 10 - 115m asl.	June - October	**None.** Vernal pool smallscale has been documented within the Seller Service Area. This species is not likely to establish within rice fields given the lack of vernal pool and alkaline habitat.
western leatherwood *Dirca occidentalis*	-/-/ 1B.2	Alameda, Contra Costa, Marin, Santa Clara, San Mateo, and Sonoma Counties.	Broadleafed upland forest, chaparral, closed-cone coniferous forest, cismontane woodland, north coast coniferous forest, riparian forest, riparian woodland. On mesic sites on brushy slopes 30-550m asl within mixed evergreen and foothill woodland communities.	January - April	**None.** CNDDB records of this species exist within the Buyer Service Area. Suitable habitat for western leatherwood is not expected to be affected by Transfers.
white-flowered rein orchid *Piperia candida*	-/-/ 1B.2	California, Oregon, Washington. Within California the species occurs in Del Norte, Humboldt, Mendocino, Santa Clara, Santa Cruz, Siskiyou, San Mateo, Sonoma, and Trinity Counties.	North coast coniferous forest, lower montane coniferous forest, broad leafed upland forest. Coast ranges from Santa Cruz County North on serpentine. Forest duff, mossy banks, rock outcrops and muskeg 0 - 1200m asl.	March - September	**None.** White-flowered rein orchid has been documented within the Buyer Service Area. However, no impacts to suitable habitat for this species are anticipated in the Buyer Service Area.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
woodland woollythreads *Monolopia gracilens*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Santa Clara, Santa Cruz, San Luis Obispo, and San Mateo Counties.	Chaparral, valley and foothill grassland (serpentine), cismontane woodland, broad leafed upland forests, north coast coniferous forest. Grassy sites in openings, sandy to rocky soils. Often seen on serpentine after burns but may have only a weak affinity to serpentine.	February - July	**None.** Has been observed within the Buyer Service Area. No impacts to suitable habitat for woodland woolly threads are anticipated.
woolly rose-mallow *Hibiscus lasiocarpos* var. *occidentalis*	-/-/ 1B.2	Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties.	Marshes and swamps (freshwater). Moist, freshwater-soaked river banks and low peat islands in sloughs. Known from the Delta watershed 0 - 150m asl.	June - September	**None.** Previously observed in the Buyer Service Area. Not likely to establish in rice fields given the lack of suitable habitat (marsh and swamp). This species is sensitive to habitat disturbance and agricultural amendments.
Wright's trichocoronis *Trichocoronis wrightii* var. *wrightii*	-/-/ 2.1	Colusa, Merced, Riverside, San Joaquin, and Sutter Counties.	Marshes and swamps, riparian forest, meadows and seeps, vernal pools. Mud flats of vernal lakes, drying river beds and alkali meadows 5 - 435m asl.	May - September	**Low.** According to the CNDDB, this species has previously been recorded in the Seller Service Area. Rice fields are not expected to support this species given the lack of suitable natural habitats.

RPR=California Rare Plant Rank
1B= Rare, threatened, or endangered in California and elsewhere
2= Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
3= Plants about which we need more information - A review list
*Status explanations:
F=Federal
E= listed as endangered under the federal Endangered Species Act
T= listed as threatened under the federal Endangered Species Act
S=State
E=Endangered
T=Threatened
R=Rare
SSC=Species of Special Concern

Appendix J

Comments and Responses

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Appendix J
Comments and Responses

This appendix contains responses to comments received on the Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR), including all written comments received during the comment period and oral comments submitted at public meetings. The comment letters are included in Appendix O.

Table J-1 presents commenters and associated agencies or groups that submitted comments on the Draft EIS/EIR.

Table J-1. List of Commenters

Commenter	Agency/Group	Date	Comment ID
Federal Agencies			
Kathleen Martyn Goforth	United States Environmental Protection Agency	12/15/2014	FA01
State Agencies			
Helen Birss	California Department of Fish and Wildlife	12/1/2014	SA01
Cindy Messer	Delta Stewardship Council	12/1/2014	SA02
Diane Riddle	State Water Resources Control Board	12/1/2014	SA03
Local Agencies			
Doug Teeter	Butte County Board of Supervisors	11/25/2014	LA01
Brendan Vieg	Chico, City of	12/1/2014	LA02
Jim Wallace	Colusa Drain Mutual Water Company	12/1/2014	LA03
Jennifer Buckman	Friant Water Authority	12/1/2014	LA04
Thaddeus Bettner	Glenn-Colusa Irrigation District	10/14/2014	LA05
Thaddeus Bettner	Glenn-Colusa Irrigation District	11/18/2014	LA06
Ricardo Ortega	Grassland Water District	12/1/2014	LA07
Osha Meserve	Local Agencies of the North Delta	12/1/2014	LA08
Lewis Bair	RD 108	12/1/2014	LA09
Karen Huss	Sacramento Metropolitan Air Quality Management District	11/25/2014	LA10
Garth Hall	Santa Clara Valley Water District	12/1/2014	LA11
John Herrick	South Delta Water Agency, Central Delta Water Agency	12/1/2014	LA12
Terry Erlewine	State Water Contractors	12/1/2014	LA13

Commenter	Agency/Group	Date	Comment ID
Patrick Blacklock	Yolo County	12/1/2014	LA14
e-PUR	South Delta Water Agency, Central Delta Water Agency	12/1/2014	LA15
Non-Governmental Organizations			
Kit Custis	AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group	11/25/2014	NG01
ECONorthwest	AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group	12/1/2014	NG02
Barbara Vlamis, Bill Jennings, Jason Flanders	AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group	12/1/2014	NG03
Kyran Mish	AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group	12/1/2014	NG04
Tom Cannon	AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group	12/1/2014	NG05
Robyn Difalco, Carol Perkins	Butte Environmental Council, Citizens Water Watch of Northern California, Butte-Sutter Basin Area Groundwater Users	12/1/2014	NG06
Jeffrey Volberg	California Waterfowl	12/1/2014	NG07
Chelsea Tu	Center for Biological Diversity	12/1/2014	NG08
Rachel Zwillinger	Defenders of Wildlife	10/23/2014	NG09
Rachel Zwillinger	Defenders of Wildlife	12/1/2014	NG10
Joni Stellar	Frack-Free Butte County	12/1/2014	NG11
Grace Marvin	Sierra Club, Yahi Group	12/1/2014	NG12
Jay Ziegler	The Nature Conservancy, California Chapter	12/1/2014	NG13
Individuals			
Bob Adams	n/a	10/21/2014	IN01
Geoffrey Baugher	n/a	10/22/2014	IN02
Linda Calbreath	n/a	11/25/2014	IN03
Lynne Elhardt	n/a	10/25/2014	IN04
Virginia Freeman	n/a	10/31/2014	IN05
Heather Gray	n/a	10/21/2014	IN06
Steven Hammond	n/a	11/30/2014	IN07
Scott Lape	n/a	10/21/2014	IN08
Linda Lohse	n/a	10/21/2014	IN09
John MacTavish	n/a	11/5/2014	IN10
H. Elena Middleton	n/a	10/21/2014	IN11
MBK Engineers	n/a	12/1/2014	IN12
Mary McCluskey	n/a	11/24/2014	IN13
Peter Ratner	n/a	10/21/2014	IN14

Commenter	Agency/Group	Date	Comment ID
Edwin Roland McNutt	n/a	11/25/2014	IN15
Margaret Rader	n/a	10/24/2014	IN16
Sherri Scott	n/a	11/28/2014	IN17
Amalie Sorenson	n/a	10/27/2014	IN18
Tony St. Amant	n/a	10/24/2014	IN19
Tony St. Amant	n/a	11/3/2014	IN20
Karen Stinson	n/a	12/1/2014	IN21
Paula Sunn	n/a	10/23/2014	IN22
Melinda Teves	n/a	10/21/2014	IN23
Sally Wallace	n/a	10/27/2014	IN24
Suzette Welch	n/a	11/27/2014	IN25
Seamus Yeo	n/a	12/1/2014	IN26
Julian Zener	n/a	11/24/2014	IN27
John Scott	n/a	12/3/2014	IN28

Key:
n/a = not applicable

Common Responses

Multiple comments were received on some issues. The Common Responses below provide responses to these groups of comments.

Common Response 1: CEQA Lead Agency

Commenters questioned whether San Luis & Delta-Mendota Water Authority (SLDMWA) is the appropriate California Environmental Quality Act (CEQA) lead agency, and several commenters opined the California Department of Water Resources (DWR) would be more appropriate. In Public Resources Code Section 21067, the CEQA statute defines a lead agency as "the public agency which has the principal responsibility for carrying out or approving a project which may have a significant effect upon the environment." For the range of potential transfer activities analyzed in the EIS/EIR, SLDMWA is anticipated to be negotiating transfer agreements with potential sellers on behalf of the Participating Members, and as such, would be a key party in the range of potential transfers analyzed in the EIS/EIR. Each seller would be a key party to a transfer from their agency, but they would not be involved in any other transfer. Under the current regulatory framework, no single California public agency has regulatory responsibility for reviewing and approving all Central Valley Project (CVP) water transfers. As a potential facilitator, SLDWMA is a common party and has undertaken the responsibility to evaluate a range of potential transfers under CEQA in order to provide a more comprehensive and coordinated analysis as commenters have requested in the past.

Water transfers are voluntary actions proposed by willing buyers and sellers, and are not initiated by state agencies. DWR will not be a party involved in negotiating transfers, nor will the agency be a party to any of the transfer contracts. Some commenters suggest that DWR will approve transfers, but that is not accurate. Potential sellers identified in this EIS/EIR will submit transfer information to Reclamation for review and consideration for approval under federal and state law. DWR will have a coordination role in the process because it will coordinate with Reclamation on review of potential transfer information packages (to help ensure consistency between CVP-related transfers and non-CVP-related transfers). DWR may also help facilitate transfers through State Water Project (SWP) facilities in some years. This is not a role with "principal responsibility" such that DWR should be the CEQA lead agency. More information regarding management of water transfers in California and DWR's role can be found on DWR's website: http://wwwdwr.water.ca.gov/watertransfers/.

Common Response 2: Project Opposition

Commenters expressed opposition to transfers from the Sacramento Valley. The Lead Agencies (Reclamation and SLDMWA) recognize the range of potential transfer activities that are the subject of this EIS/EIR are of interest to many people, and opinions and viewpoints about water transfers vary; many are opposed to them. Reclamation and SLDMWA will consider all public input regarding the potential transfer activities analyzed in the EIS/EIR, as well as federal and state policies and regulations concerning water transfers, when evaluating transfer proposals and deciding how to proceed.

Common Response 3: Sacramento Valley Impacts

Commenters expressed concerns that potential effects of transfers on the Sacramento Valley must be considered, including effects on groundwater resources, terrestrial resources, fisheries, and local economies. The Draft EIS/EIR includes substantial analysis on these issues:

- Groundwater resources are analyzed in detail in Section 3.3. The impact analysis finds that Alternative 2 (Full Range of Transfers) and Alternative 3 (No Cropland Modifications) could result in potentially significant impacts related to groundwater levels and subsidence. Mitigation Measure GW-1, Mitigation and Monitoring Plans, includes monitoring and mitigation to avoid significant effects.

- Fisheries resources are analyzed in detail in Section 3.7. The analysis considers flow changes from transfer operations and streamflow depletion caused by groundwater basins refilling after groundwater substitution transfers. The flow changes in streams and rivers would be insubstantial, and they would not occur at times or in locations that would have significant adverse effects on sensitive fish species.

- Terrestrial resources are analyzed in detail in Section 3.8. Cropland idling transfers have the potential to affect giant garter snakes that use rice fields and irrigation ditches as habitat, but these potential effects are avoided by the environmental commitments included in the action alternatives. Streamflow depletion from groundwater substitution transfers would have the potential to affect riparian vegetation in four creeks, but Mitigation Measure GW-1 includes monitoring and mitigation to avoid significant effects.

- Economic resources are analyzed in detail in Section 3.10. The economics analysis estimates direct, indirect, and induced economic effects of cropland idling on regional economies in participating areas. The analysis also considers increased income associated with transfer payments to sellers.

Common Response 4: Groundwater Existing Conditions

Commenters expressed concerns that the Groundwater Affected Environment section does not adequately represent the current drought conditions.

Recent groundwater levels in the Sacramento Valley

Section 3.3.1.3.2 has been revised to include additional information clarifying recent groundwater level trends within the Sacramento Valley. The following figures and discussion have been included in the Groundwater Resources section:

1. Spring 2013 to Spring 2014 change in groundwater elevation in shallow (<200 feet below ground surface [bgs]), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells.

2. Spring 2004 to Spring 2014 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells.

3. Spring 2010 to Spring 2014 change in groundwater levels in wells.

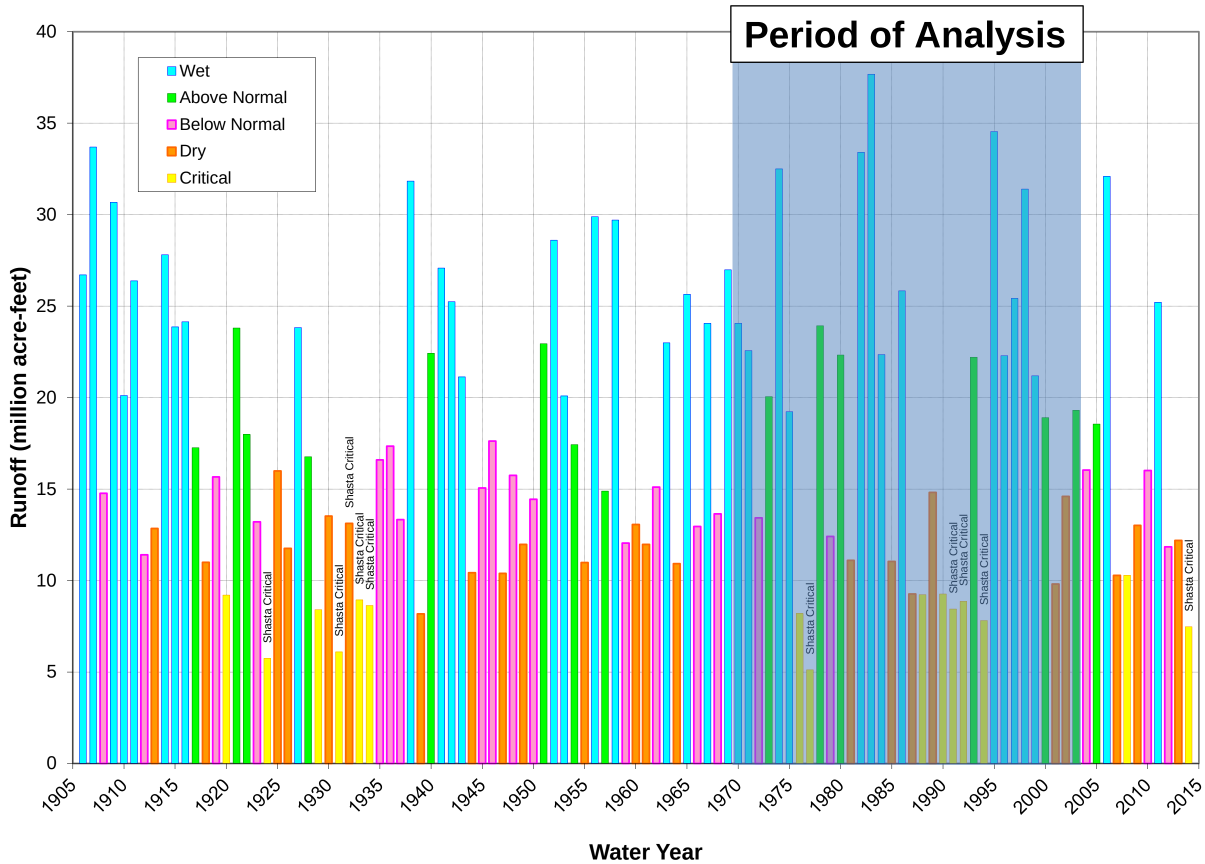
4. Spring 2010 to Spring 2011 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells.

5. Fall 2010 to Fall 2011 change in groundwater elevation in shallow (<200 feet bgs), intermediate (200-600 feet bgs), and deep (>600 feet bgs) wells.

6. Hydrographs for shallow and deep wells in Colusa, Corning, East Butte, West Butte, Solano, North American, South American, and Yolo subbasins.

Change in groundwater elevation figures for (a) Spring 2013 to Spring 2014, (b) Spring 2004 to Spring 2014, and (c) Spring 2010 to Spring 2014 indicate groundwater levels have decreased within the Sacramento Valley. As shown in Figure J-1 below, water year (WY) 2014 was one of the driest years on record since 1977 and it was preceded by a dry and a critical year. Spring 2014 groundwater levels have changed between +5 and -20 feet within the Sacramento Valley in comparison to Spring 2013. Comparisons of spring groundwater levels in the last decade (Spring 2004 to Spring 2014) indicate groundwater levels have declined as much as 40 feet in parts of Glenn, Colusa and Tehama County within the Sacramento Valley.

Change in groundwater elevation figures between Spring 2010 and Spring 2011 indicate an increase of up to eight feet in groundwater levels within the Sacramento Valley. This increase occurred after four consecutive years of dry weather conditions in the Sacramento Valley (two dry years, one critical dry year and one below normal year). Though the Sacramento Valley and other parts of California are currently noticing declining groundwater level trends, past groundwater trends are indicative of groundwater levels declining moderately during extended droughts and recovering to pre-drought levels after subsequent wet periods. Implementation of monitoring and mitigation measures as set forth in GW-1 would avoid potential significant adverse environmental effects. Refer to Common Response 6 for a discussion of revisions to GW-1 in response to public comments.



Source: DWR 2015

Figure J-1. Historical Sacramento Valley Water Year Runoff and 40-30-30 Index Year Types

Wells going dry within the Sacramento Valley

Comments were received about wells going dry in the Sacramento Valley region, particularly in Butte County. Information on this point has been added in the discussion of Groundwater Resources Affected Environment. As shown in Table J-2 below, the number of wells reported dry in Butte County is substantially higher than in other counties within the area of analysis. (The action alternatives do not include groundwater substitution transfers in Butte County.) As discussed in Section 3.3.4.1, Mitigation Measure GW-1 will monitor groundwater levels during transfers of water made available from groundwater substitution actions to avoid potentially significant effects to other legal users of water. Refer to Common Response 6 for a discussion of revisions to Mitigation Measure GW-1 in response to public comments.

Table J-2. Summary of Dry Wells Reported in 2014

Counties	Number of wells reported dry in 2014	Information received as of
Shasta	3	9/16/2014
Tehama	34	10/2/2014
Glenn	26	10/23/2014
Butte	60	12/4/2014
Colusa	8	7/7/2014
Sutter	Data not available	Data not available
Yuba	Data not available	Data not available
Solano	1	11/12/2014
Yolo	2*	10/21/2014
Sacramento	1	10/16/2014

Source: Data collected by UC Davis

*Number of dry wells reported includes data only for October; data for prior months not reported

Concerns regarding pumping in the Tuscan Formation

Commenters expressed concerns that transfer-related pumping would be concentrated in the Tuscan Formation. As shown in Figure J-2, groundwater substitution pumping associated with the range of potential activities analyzed under the Proposed Action would occur primarily outside the Tuscan formation, either from the Tehama Formation or other formations not identified in Figure J-2. Some of the groundwater substitution pumping wells for Glenn-Colusa Irrigation District, Reclamation District 1004, and Butte Water District lie within (or near) the potentially disputed Tuscan and Tehama subsurface formations. Pumping from these wells will be closely monitored through the implementation of Mitigation Measure GW-1 to avoid potentially adverse effects. Refer to Common Response 6 for a discussion of revisions to Mitigation Measure GW-1 in response to public comments.

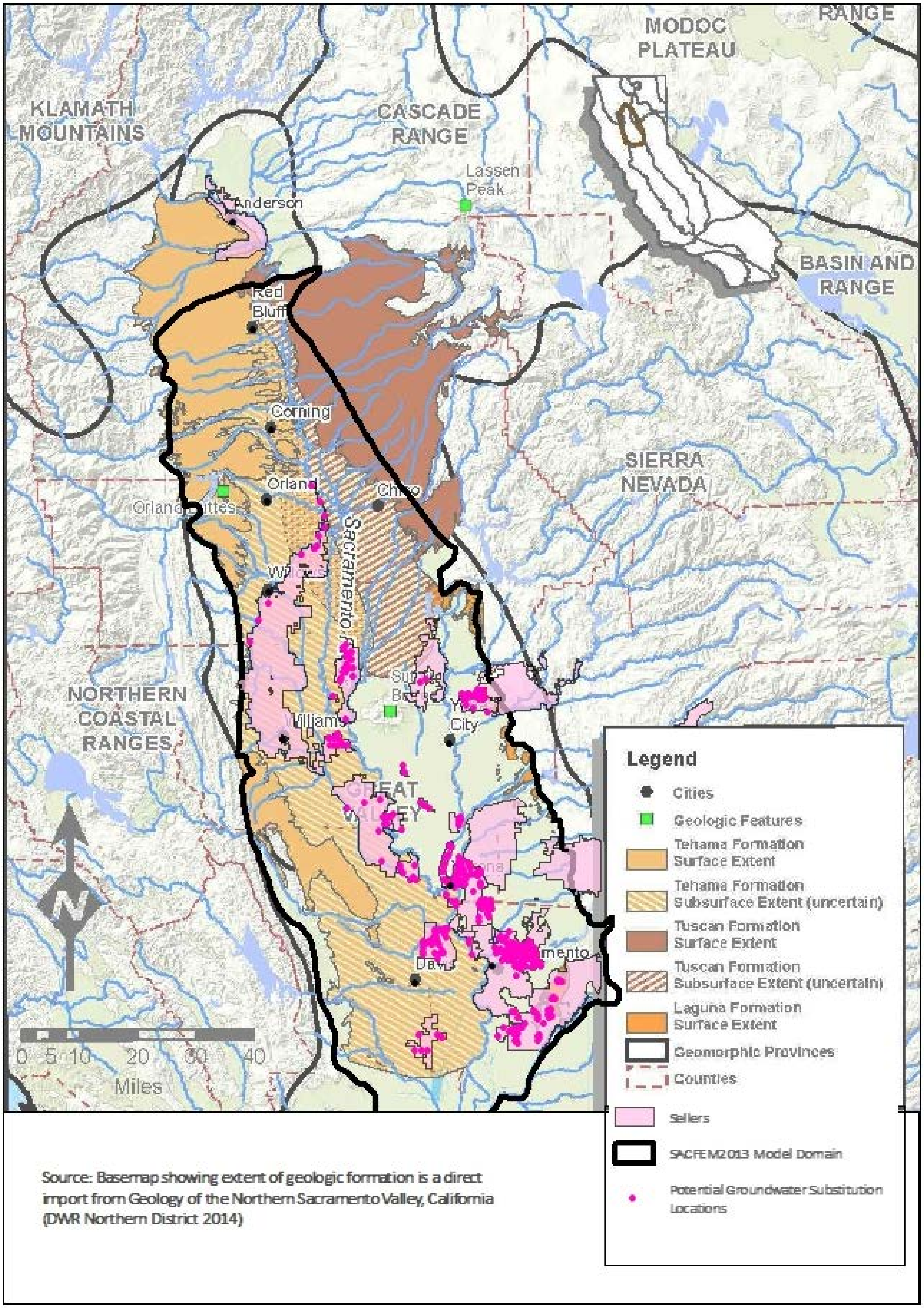


Figure J-2. Extent of Tuscan and Tehama Formations with respect to groundwater substitution pumping under Proposed Action

Common Response 5: Model Timeframe

Comments were received on the period of analysis for the various models used to analyze the environmental effects of transfers. The period of analysis for the Sacramento Valley Finite Element Groundwater Model (SACFEM2013), CalSim II, and the Transfer Operations Model (TOM) was water years (WY) 1970 through 2003. This period was used because it is common to both SACFEM2013 and CalSim II. The full simulation period for SACFEM2013 is WY 1970 through 2010 while the full simulation period for CalSim II is WY 1922 through 2003. TOM was developed, and the analysis conducted, for the common 34-year period of WY 1970 through 2003.

Several commenters asserted that the period was inadequate because it ended in 2003 and did not include the most recent 11 years when (1) the hydrology in the Sacramento Valley was drier than average, (2) hydrological factors were potentially affected by climate change, and (3) there were frequent transfers. Other comments focused on the changes that have occurred in population, water demand, regulations, and CVP and SWP operations since 2003. Each of these concerns is addressed in the following paragraphs.

Recent hydrology was drier than average

Sacramento Valley hydrology has been drier than average since 2003. Figure J-1 shows the observed Sacramento Valley river runoff in millions of acre-feet (MAF) for the complete available record, as calculated by DWR. Runoff illustrated in this figure is the sum of the Sacramento River at Bend Bridge, the Feather River inflow to Lake Oroville, the Yuba River at Smartville, and the American River inflow to Folsom Lake. Runoff is used to calculate the Sacramento Valley Water Year Type Index (40-30-30 Index) to define the year type as either wet, above normal, below normal, dry, or critical. The water year runoff of these four rivers provides a good indicator of the range and variability of the hydrology of the Sacramento Valley.

Additional information illustrated in Figure J-1 includes years in the historical record that were classified as “Shasta Critical” per the definition contained in Sacramento River Settlement Contracts. These years are identified in the figure because in such years the availability of surface water for many areas in the Sacramento Valley is further limited, beyond that in other critical years. The period of analysis used to support the EIS/EIR is shaded.

The long-term average annual runoff from these four rivers is approximately 17.8 MAF. The average annual runoff for the period 2004 through 2014 is 15.7 MAF, while the average annual runoff for the period of analysis is 18.6 MAF. While it is true that the period from 2004 through 2014 has been drier than both the long-term average and the average for the period of analysis, this does not invalidate the analysis supporting the discussions in the environmental document. Hydrology in the period of analysis adequately represents the historical range and the variability that has occurred in the Sacramento Valley, and includes two multi-year droughts: 1976-77 and 1987-92. The drought of

1976-77 was more severe than any single year or 2-year period from 2004 through 2014, and the 1987-92 drought was more prolonged than any recent 6-year period.

Additionally, the EIS/EIR is intended to assess environmental conditions resulting from implementation of the range of potential transfer activities under the Proposed Action for a 10-year period. A key consideration, therefore, is whether there exists within the period of analysis any 10-year period that is representative of a reasonable worst-case condition for Sacramento Valley hydrology. Within the period of analysis, there are several 10-year periods that are considerably drier than the 2004 through 2014 period. For example, the average annual runoff for the 10-year period 1985 through 1994 is 12.7 MAF. This is comparable to the minimum average annual runoff, 12.3 MAF in 1928 through 1937, for any 10-year period in the available record. The analysis includes a period similar to the driest 10 years on record, and drier than the period from 2004 through 2014.

Climate change

Some commenters suggested that not including the most recent 11-year period ignored the effects of climate change that have occurred since 2003, and will occur over the life of the project. Based on a review of the historical hydrology for the Sacramento Valley, any climate change effects that may have occurred since 2003 are difficult to discern within the historical variability. The most recent 11-year period is not outside the range of the historical record or the period analyzed in the EIS/EIR. While it is possible that the next 10 years may become the driest on record, potentially influenced to some unknown extent by climate change, it would be speculative to develop hydrology for the 2015 through 2024 period as a series of 10 consecutive critical years based on potential climate change or as a worst-case condition. Additionally, the mitigation measure to protect groundwater resources (Mitigation Measure GW-1) was developed to avoid or reduce impacts based on actual conditions at the time of transfer rather than predicted conditions from the modeling effort. If climate change does result in different conditions in the next ten years, Mitigation Measure GW-1 would continue to protect the resource (but may require reduced pumping or other actions to reduce effects more often).

Transfer frequency

Comments were received asserting the Lead Agencies did not analyze transfers occurring at the same frequency as they occurred in recent years. These comments compared the average frequency of transfers throughout the entire simulation period to shorter periods in the recent past. Commenters suggested that the frequency of transfers analyzed was approximately 36 percent of all years, or 12 out of 33 years analyzed. This frequency was compared to transfers in more recent years. However, because the EIS/EIR is intended to assess environmental conditions resulting from implementation of the range of potential transfer activities under the Proposed Action for a 10-year period, a more appropriate comparison is to look at the frequency of transfers analyzed over specific 10-year periods. For example, analysis for the period 1987 through 1994 included transfers in seven out of eight years, including transfers in six consecutive years, which is similar to what has occurred in recent years. The frequency and volume of transfers were determined based on assumptions for three primary factors that limit transfers: demand for transfer water, supply of transfer water, and capacity to convey transfer water from seller to buyer.

Changes in demands, regulations, and operations since 2003

Commenters also suggested that the period of analysis was inadequate because it does not represent existing demands, regulations, and CVP/SWP operations. On this issue there were differences in the understanding of model inputs and assumptions across the range of commenters. Some commenters suggested the models (SACFEM2013 and CalSim II) operated under "historical" assumptions rather than reflecting current conditions (e.g., the demands, regulations, and operations of the model in a particular year of simulation reflect what historically occurred). These included comments that modeling ignored the effects of biological opinions issued in 2008 and 2009 on the operation of the CVP/SWP. Other commenters suggested that the level of demand assumed in CalSim II and SACFEM2013 was not appropriate because demands have changed since model demands were developed.

Both CalSim II and SACFEM2013 simulate demands that are developed to approximate a fixed level of development. CalSim II demands approximate a 2005 level of development while demands in SACFEM2013 approximate a 2010 level of development. This means that population, land use, and agricultural demands used in the models are representative of demands that existed in those years. These demands are then used with historical hydrology inputs, primarily precipitation, reservoir inflows, and unregulated flows, in model simulations. Therefore, demands simulated for WY 1970 in the models are representative of approximately 2005 and 2010 levels of development, not 1970.

Actual demand for water within the Sacramento Valley changes every year based on numerous factors. Since 2005, demand on water supplies, and particularly demands on groundwater, have likely increased. The most significant demand changes in the Sacramento Valley since 2005 include development of additional irrigated lands, particularly in permanent crops, and increases in population. Both of these changes primarily affect groundwater resources as new irrigated lands and many municipalities meet their demands using groundwater. Therefore, it is more important that these changes be considered in SACFEM2013 than in CalSim II. Demands in SACFEM2013 are based on land use data and surveys taken as recently as 2010 (see Appendix M for more information). These land use surveys show an increase in permanent crops and a slight increase in the total irrigated acreage. Additionally, recently developed agricultural lands are in areas outside of existing water districts and away from surface water sources where groundwater is the only source of water. This information is incorporated in SACFEM2013 by combining recent land use surveys with the historical precipitation record to develop demands that vary in each year of the simulation, with higher demands for groundwater in drier years. While there have been changes in demand since 2010, the range of demands simulated in SACFEM2013 is representative of existing conditions in the Sacramento Valley.

Sacramento Valley agricultural demands in CalSim II approximate a 2005 level of development and vary in each year of the simulation. The focus of CalSim II is simulation of the surface water system and operations of the CVP and SWP. Demands for surface water within the Sacramento Valley have been relatively stable since 2005. This can be seen through review of Reclamation delivery data to Sacramento River Settlement Contractors, other water service contractors, and diversion data from other river systems. The majority of surface water demands and the associated water rights and contracts were developed many decades ago and have been stable over the most recent decade.

The regulatory constraints on CVP and SWP operations have changed significantly since 2005 and CalSim II modeling used in preparation of the EIS/EIR was modified to reflect these changes. The most notable change since 2005 was the incorporation of the reasonable and prudent alternatives contained in the U.S. Fish and Wildlife Service's 2008 biological opinion on Delta smelt and the National Marine Fisheries Service's 2009 biological opinion on Chinook salmon and other species. The regulatory constraints described in these biological opinions are included in the CalSim II simulation of existing CVP and SWP operations. CalSim II simulates the current regulatory conditions and a fixed level of development demand as the existing condition, and uses the historical hydrology for the period 1922 through 2003 to help understand CVP/SWP operations under a range of hydrologic conditions.

Common Response 6: Groundwater Mitigation

Commenters indicated they would like more specificity in the required groundwater monitoring and mitigation in Mitigation Measure GW-1. In particular, they wanted to understand the monitoring triggers that would cause mitigation actions in the Mitigation Plans to go into effect.

The primary triggers used to establish impacts to groundwater levels are the Basin Management Objectives (BMOs) set by Groundwater Management Plans (GMPs). In the Sacramento Valley, several counties have established GMPs to provide guidance in managing the resource. While the GMPs aid in establishing best practices, not all of the GMPs set quantitative groundwater elevation triggers for their BMOs. Table J-3 lists the counties in the Sacramento Valley with existing GMPs. The table also provides a description of the BMOs as described in each GMP. This list is provided for the entire Sacramento Valley; however, in addition to listing counties that contain potential groundwater substitution pumping sellers, the list also contains counties that do not (e.g., Butte).

Table J-3. Groundwater Management Plans and BMOs in the Sacramento Valley

County	Basin Management Plan	Groundwater Basin Management Objective
Shasta (Anderson Cottonwood Irrigation District Groundwater Management Plan)	http://www.andersoncottonwoodirrigationdistrict.org/uploads/2/7/2/8/2728665/acid_gwmp.pdf	Pg. 3-2: No set elevation thresholds.
Shasta County (Shasta County Water Agency)	http://www.co.shasta.ca.us/index/pw_index/engineering/water_agency.aspx	No elevation thresholds.
Tehama County (Tehama County Flood Control and Water Conservation District)	http://www.tehamacountypublicworks.ca.gov/Flood/ Groundwater trigger levels for each sub-basin located here: http://www.tehamacountypublicworks.ca.gov/Flood/groundwater.htm	Trigger levels vary based on groundwater measurements in each monitoring well. Trigger levels generally follow a pattern of: • Historical low of spring measurements plus 20% of the range of spring measurements: notify and inform public. • Second consecutive year of groundwater levels at or below spring trigger level 1: monitor and investigate cause. • Historical low of spring measurements: consider management options. • Historical low of late groundwater measurements: notify public and begin investigations.
Glenn County	http://www.glenncountywater.org/documents/GlennCoBMOdocument_000.pdf	There are 17 basin management sub-areas in the basin. BMOs for groundwater levels are established separately for each sub-area. No clear BMOs have yet been established. Objectives for the sub-areas are qualitative and relate to maintaining groundwater surface elevations at a level that will assure an adequate and affordable irrigation water supply; sustainable agricultural water supply; and adequate groundwater supply for all domestic users. Additionally, some BMOs state that the objective is to develop an understanding of groundwater levels in the sub-area. Elevation thresholds vary depending on the sub-area and monitoring well within each sub-area.
Butte County	http://www.buttecounty.net/Portals/26/GWMP/Section_3__1-7-05_2.pdf	Pg. 3-4: Groundwater level declines in many areas of the county have been observed. These range from 0.8 to 2.0 feet per year. Declining groundwater levels are used as a trigger for close observation of groundwater level trends.
Colusa County	http://colusagroundwater.ucdavis.edu/Technical%20Materials%20for%20Posting/ColusaCo_GMP_Volume-1_9-10-08.pdf	Pg. 34: From a review of the groundwater level hydrographs on Figure II.5, it can be seen that the extent to which the groundwater basin is utilized throughout the County varies significantly. Accordingly, the assessment of changes in groundwater levels in the respective areas must be performed with full consideration of the historic levels. It is premature to attempt to set groundwater level targets or thresholds in Colusa County. It is, however, very important to evaluate the groundwater level data in relation to historic data and report the results of that evaluation together with an assessment of overall hydrologic conditions, known changes in land use, etc.

County	Basin Management Plan	Groundwater Basin Management Objective
Sutter County	http://www.co.sutter.ca.us/pdf/pw/wr/gmp/Sutter_County_Final_GMP_20120319.pdf	There are three BMOs for groundwater levels. One is related to low groundwater levels: • Avoid ongoing declines in groundwater levels during water year types identified by DWR to be "above normal" or "wet" for the Sacramento Valley. The BMO also states "groundwater levels are to be managed to ensure adequate water supplies while avoiding adverse impacts and mitigating them if and when they do occur. Adverse impacts related to groundwater levels can occur from excessively high or low groundwater levels. What constitutes an excessively high or low groundwater level may change over time, and will also vary by land use and hydrologic and climatic conditions.
Yuba County Water Agency	http://www.ycwa.com/documents/943	Pg. 3-12: No specific threshold. Qualitative objectives: • Avoid potential unreasonable impacts that may occur from changes in groundwater surface elevations because of external transfers. • Monitor any lowering of groundwater surface elevations that may occur as a result of groundwater extraction to meet local demands in drier years.
Nevada County (Martis Valley Groundwater Management Plan)	http://www.pcwa.net/files/docs/enviro/MartisValleyGMPFinal07.22.2013.pdf	Very general BMO about protecting groundwater quantity. Plan includes details on the establishment of a groundwater elevation monitoring program.
Placer County Water Agency (Western Placer County Groundwater Management Plan)	http://www.pcwa.net/general-information/environmental-and-planning-documents.html and http://www.pcwa.net/files/docs/enviro/WPCGMP_Groundwater_Management_Plan_07.pdf	Pg. 3-8: discusses the need to create a uniform groundwater elevation monitoring program. No thresholds are set because, historically, data have not been collected consistently.
El Dorado County	No plan available.	
Sacramento Groundwater Authority	http://www.sgah2o.org/sga/files/2008-SGA-GMP-FINAL-20090206-print_ready.pdf	Pg. 29: "SGA members intend that overall groundwater elevations in the basin be improved over time, and that the groundwater basin be managed such that the impacts during drier years will be minimized when surface water supplies are curtailed and are replaced by increased groundwater supplies. This is accomplished, similar to what is done in the Central Sacramento Basin, by measuring groundwater levels in more than 30 wells throughout the SGA. A similar 5 square mile grid pattern is used to monitor groundwater levels over time throughout the basin. SGA monitors groundwater elevations twice a year.

County	Basin Management Plan	Groundwater Basin Management Objective
Central Sacramento County	http://www.amwater.com/files/CSCGMP_final.pdf	Pg. 3-3: An operating range for groundwater elevations in the basin defines the upper and lower groundwater elevation thresholds. Upper and lower elevation limits are defined for 5 square mile polygons throughout the basin. Each polygon represents its own management unit with lower and upper elevation attributes. Groundwater elevation contour maps are found on pages 3-4 and 3-5 of the plan. Lower groundwater thresholds range from -90 feet msl in the southwestern part of the basin to 150 feet msl in the northeastern part of the basin. Upper groundwater thresholds range from -70 feet msl in the southwestern part of the basin to 200 feet msl in the northeastern part of the basin.
South Area Water Council	http://www.water.ca.gov/groundwater/docs/GWMP/SJ-20_SouthBasin_GWMP_2011.pdf	Similar to the Sacramento Groundwater Authority and Central Sacramento County, the South Area Water Council's groundwater management plan uses several wells throughout the basin to gather groundwater elevation data and high/low thresholds would be based on individual wells. The BMO, on p. 2-2, states generally: Maintain or enhance groundwater elevations to meet the long-term needs of groundwater users within the Groundwater Management Area.
Yolo County	http://www.water.ca.gov/groundwater/docs/GWMP/SR-35_YoloCountyFCWCD_GWMP_2006.pdf	p. 12: "when ¾ of monitoring wells reach within 25% of the lowest water level recorded for that well. Spring and fall measurements will be analyzed separately."

In areas where quantitative BMOs do not exist, Reclamation, SLDMWA, and the potential seller(s) will coordinate closely with potentially affected third parties to collect and monitor groundwater data. If warranted, additional groundwater level monitoring to address concerns from third parties will be incorporated in the monitoring and mitigation plans required by Mitigation Measure GW-1. The monitoring plan, which must be reviewed and approved by Reclamation, includes the seller's plan to monitor groundwater levels to avoid any potentially significant impacts that may result from the proposed transfer. If a third party has a concern that warrants the inclusion of additional monitoring, Reclamation and the seller will adjust the plan to address the concern.

Common Response 7: Subsidence

Commenters expressed concern that utilizing groundwater in lieu of the surface water made available for transfer from groundwater substitution actions could cause subsidence, and the mitigation measures should be clarified to be certain they would reduce or avoid this subsidence. While Section 3.3 of the EIS/EIR addresses the potential for subsidence to the degree reasonable and appropriate based on available data, the lead agencies recognize that in many areas of the Sacramento Valley the potential for subsidence remains unclear. While monitoring efforts may not have detected historic subsidence, the potential exists for future subsidence. This uncertainty has caused the lead agencies to develop a process to help clarify how mitigation to avoid significant subsidence impacts would be implemented. This process requires monitoring for subsidence and identifies a multi-stage process to help address the uncertainty in the potential effects.

Stage 1: Groundwater Levels

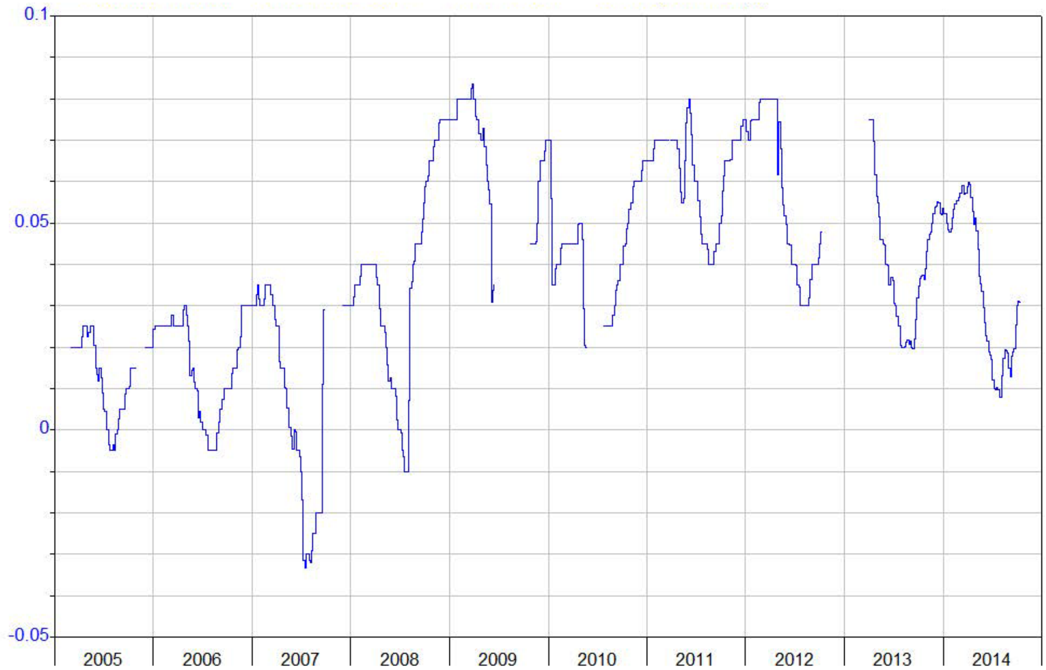
Irreversible subsidence would not occur if groundwater levels stay above historic low levels for the entire transfer period. As groundwater is pumped from an aquifer, the pore water pressure in the aquifer is reduced. This reduction in pore water pressure increases the effective stress on the structure of the aquifer itself. This increase in effective stress can cause the aquifer structure to deform, or compress, resulting in the subsidence of the ground surface elevation. Subsidence can be irreversible if the reduced effective stress is lower than the historically low effective stress. Typically this would be the result of groundwater levels reaching levels lower than the historical low level.

Before a transfer, each seller will examine local groundwater conditions and groundwater level changes based on past pumping events or groundwater substitution transfers. This existing information will be the basis to estimate if groundwater levels are likely to decline below historic low levels as a result of the proposed transfer. If the pre-transfer assessment indicates that groundwater levels will stay above historic low levels, and this finding is confirmed by monitoring during the transfer-related pumping period, then no additional actions for subsidence monitoring or mitigation are necessary. Sellers would need to proceed to stage 2 for land surface elevation monitoring if the pre-transfer estimates indicate that groundwater levels are anticipated to decline below historic low levels. If monitoring during the transfer-related pumping period (confirmed by two measurements within seven days) indicates that groundwater levels have fallen below historic low levels, sellers must immediately stop pumping from transfer wells in the area that is affected or proceed to stage 2.

Stage 2: Ground Surface Elevations

Stage 2 includes monthly ground surface monitoring during transfer-related pumping if pumping could cause groundwater levels to fall below historic low levels, as described in Stage 1. If ground surface elevations decrease between 0.1 and 0.2 foot, the seller will evaluate the accuracy of the information based on the current limitations of technology, professional engineering/surveying judgment, and any other data available in or near the transferring area. If the elevations decline more than 0.2 foot, this change could indicate inelastic subsidence, which would trigger a shift to Stage 3.

The threshold of 0.1 foot was chosen as this value is typical of the elastic (i.e., recoverable) portion of subsidence; the threshold of 0.2 foot was selected considering limitations of current land survey technology. This threshold is supported by a review of data from extensometers within the Sacramento Valley. Figure J-3 shows the subsidence data from extensometer 22N02W15C002M, in Glenn County. This extensometer has not been identified as having long-term declining trends, but exhibits a small amount of movement (up to about 0.1 foot).



Source: DWR Water Data Library 2014

Figure J-3. Measured Ground Surface Displacement at Extensometer 22N02W15C002M in Glenn County

Stage 3: Local Investigation

If the threshold of 0.2 foot of ground surface elevation change is exceeded, the seller shall cease groundwater substitution pumping for the transfer until one of the following occurs: (1) groundwater levels recover above historic low groundwater levels; (2) seller completes a more detailed local investigation identifying hydrogeologic conditions that could potentially allow continued transfer-related pumping from a subset of wells (if the seller can provide evidence that this pumping is not expected to cause additional subsidence); or (3) seller completes an investigation of local infrastructure that could be affected by subsidence (such as water delivery infrastructure, water supply facilities, flood protection facilities, highways, etc.) indicating the local threshold of subsidence that could be experienced before these facilities would be adversely affected. Any option should also consider the effect of non-transfer pumping that may be causing subsidence.

Stage 4: Mitigation

If subsidence effects to local infrastructure occur despite monitoring efforts, then the sellers must work with the lead agencies to determine whether the measured subsidence may be caused by transfer-related pumping. Any significant adverse subsidence effects caused by transfer pumping activities must be addressed. A contingency plan must be developed in the event that a need for further corrective action is necessary. This contingency plan must be approved by Reclamation before transfer-related pumping could continue after Stage 3.

Stage 5: Continued Monitoring

The sellers will continue to monitor for subsidence while groundwater levels remain below historic low levels. If the seller has ceased transfer-related pumping but groundwater levels remain below historic lows, subsidence monitoring will need to continue until the spring following the transfer. The results of subsidence monitoring will be factored into monitoring and mitigation plans for future transfers.

Common Response 8: Streamflow Depletion Factor

Commenters had questions about the streamflow depletion factor described in Mitigation Measure WS-1. Some of the comments reflected confusion about the purpose of this mitigation measure. These commenters indicated that Mitigation Measure WS-1 should help with potential streamflow depletion impacts to small streams and their biological resources. This mitigation measure, however, is specific to CVP and SWP water supplies. Section 3.1, Water Supply, assessed the potential impacts from streamflow depletion to surface water supplies. The assessment found that Reclamation and DWR would take actions to continue to meet water quality and flow standards during and after water transfers, and these actions would result in decreased water supply deliveries to CVP and SWP contractors that receive Delta exports. Supply impacts to other users in the Sacramento Valley were not identified. Mitigation Measure WS-1 is focused on avoiding the supply effects to CVP and SWP contractors that receive Delta exports. Section 3.7 analyzed streamflow depletion impacts to fisheries, and determined that the changes in flows on small creeks and streams would be small and would not be at times or locations that would have significant effects on sensitive fish species. Section 3.8 assessed streamflow depletion impacts on riparian vegetation, and found the potential for significant impacts. These potential impacts would be reduced through the groundwater monitoring and mitigation requirements in Mitigation Measure GW-1.

Specific questions and comments are discussed below in more detail.

Process to develop the streamflow depletion factor

Several commenters wanted to better understand the process to develop and enforce the streamflow depletion factor. Reclamation and DWR will develop the streamflow depletion factor in cooperation with buyers and sellers, based on the best available technical information. The process will be generally similar to the process used in past years to develop the Draft Technical Information for Preparing Water Transfer Proposals (also known as the Water Transfer White Paper). As part of this process, Reclamation and DWR identify new information, consider monitoring information from past transfers, and edit the Water Transfer White Paper.

Reclamation and DWR have established regular meetings throughout the year to review transfer proposals and assess how ongoing transfers are working. Any changes or updates to streamflow depletion factors for future water transfers would work within this existing interagency structure. This group receives monitoring data from transfers and feedback from the CVP and SWP operators throughout the year, and can identify when new information is available and when updates to the streamflow depletion factor would be appropriate. They would raise this issue to management levels at both organizations.

At this point, Reclamation and DWR would work with the buyers and sellers to review the most recent monitoring or modeling information to identify potential refinements to the streamflow depletion factor. The resulting refinements would be published in an update to the technical information papers on DWR's water transfer website.

Monitoring and modeling

Commenters asked what type of monitoring and modeling would be used to update the streamflow depletion factor. Mitigation Measure GW-1 requires extensive groundwater monitoring for groundwater substitution transfers under the action alternatives. In addition to this transfer-specific monitoring, Reclamation, DWR, and other state and federal agencies monitor streamflows throughout the Sacramento Valley.

During development of this EIS/EIR, the lead agencies updated the SACFEM2013 groundwater model and applied this model to assess the action alternatives. This model could be used in the future to investigate whether monitoring information is consistent with the projected changes to the groundwater aquifer, or whether the modeling parameters should be modified based on monitoring. Additionally, the SACFEM2013 model includes some uncertainties about hydraulic properties that could be clarified through monitoring efforts. The lead agencies are planning to work with the sellers to solicit grant funds to obtain additional information about key hydraulic factors related to groundwater/surface water interaction. If this monitoring information becomes available, it would be used to update the groundwater model and may lead to modifications to the streamflow depletion factor.

Timing

The EIS/EIR explained in multiple places that groundwater utilized in lieu of the surface water made available from groundwater substitution actions could affect groundwater levels and recharge for multiple years after a transfer. Commenters wanted to understand how the streamflow depletion factor could mitigate for transfer-related streamflow effects in years following transfers. Additionally, commenters mentioned that if water is "backed up" into storage before it can be moved through the Delta, the groundwater pumped in lieu of diverting the surface water could cause streamflow effects before the transfer occurs, which should also be addressed through the streamflow depletion factor.

As discussed at the beginning of this common response, the streamflow depletion factor is focused on mitigating impacts to CVP and SWP water users. The impacts disclosed in Section 3.1 consider the impacts to supplies from when pumping begins until the groundwater aquifer recovers. The streamflow depletion factor equates to a percentage of the total groundwater substitution transfer that will not be available for transfer to the transferee, and is intended to offset the streamflow effects of the added groundwater pumping due to transfer. This percentage would account for supply impacts in transfer years and years following transfers. The CVP and SWP would be responsible for using this retained water to account for current and future supply impacts.

Size of the streamflow depletion factor

Several commenters wanted to know more about the specific percentage for the streamflow depletion factor. Specifically, several commenters asked if the percentage would stay the same, and what a minimum percentage would be. The streamflow depletion percentage could vary based on monitoring and modeling data.

The analysis for Mitigation Measure WS-1, to address potential streamflow depletion effects on CVP and SWP water supplies, identified several issues relevant to development of a streamflow depletion factor. Analysis indicates that the effect of groundwater substitution transfers on CVP/SWP water supplies varies depending on hydrology and system conditions after the transfer. For example, when the post-transfer hydrology is dry the effect on CVP/SWP water supply can be greater than when the post-transfer hydrology is wet. This difference in the effect can generally be explained by the fact that during drier conditions the Delta is more likely to be in balance; therefore, streamflow depletions are more likely to affect CVP/SWP water supplies. Additionally, sensitivity analyses were conducted to better understand how uncertainty in key model inputs, those inputs that are likely to have the largest effect on streamflow depletion, may affect the streamflow depletion factor. Results of these analyses indicate that the minimum streamflow depletion factor for the purpose of Mitigation Measure WS-1 is approximately 13 percent of the volume pumped as a groundwater substitution transfer. This minimum streamflow depletion percentage has been added to the text of Mitigation Measure WS-1 to help clarify the measure.

Public Involvement

Commenters asked if the public would have a chance to comment if the streamflow depletion factor changes in the future. Reclamation and DWR would consider public feedback when identifying if refinements to the streamflow depletion factor are necessary, including any potential third party concerns. The Water Transfer White Paper is reviewed annually and updated as needed; new versions are published in draft form on DWR's water transfer website.

Common Response 9: Refuge Water Supplies

Some commenters questioned Reclamation's ability to meet requirements to provide Level 4 (Level 2 [L2] and Incremental Level 4 [IL4]) water supplies as stipulated under the Central Valley Project Improvement Act (CVPIA) and were concerned about possible adverse effects on refuge habitat if Reclamation were unable to comply. Reclamation is committed to meeting their requirements to work with U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and the Grassland Water District/Grassland Resource Conservation District to attempt to provide Level 4 water when possible.

Inclusion of refuge transfers in action alternatives

Several commenters suggested that the action alternatives should include transfers to refuges. Reclamation, however, views refuge-related water purchases and transfers as a separate federal action having independent utility from all other potential voluntary water transfers. For such refuge water transfers, Reclamation (as a "willing buyer"), in cooperation with willing sellers, negotiates and develops agreements to purchase water for transfer to CVPIA refuges and prepares the associated National Environmental Policy Act/Endangered Species Act (NEPA/ESA) environmental compliance documents, as applicable.

For the range of potential water transfers evaluated under the Long-Term Water Transfers EIS/EIR, Reclamation's federal action would be to approve and facilitate transfers initiated by non-governmental buyers and sellers. This difference is not a sign of a difference in priority, but rather a difference in the type of federal action taken by Reclamation.

Pumping priority through the Delta

Commenters expressed concern that refuge north-to-south water transfers may have a lower priority for conveyance through the Delta than water transfers under the action alternatives, which could decrease the amount of water received. Before Reclamation can facilitate water transfers, it must first provide CVP water to meet all regulatory requirements mandated by the State Water Resources Control Board (Delta flow and water quality standards), CVPIA (specifically the "(b)(2) water" and refuge L2 water), and the Reasonable and Prudent Alternative actions listed in the USFWS's (2008) and National Oceanic and Atmospheric Administration (NOAA) Fisheries' (2009) respective Biological Opinions on the Coordinated Operations of the CVP and SWP. Reclamation must then meet its contractual obligations to CVP agricultural and municipal and industrial (M&I) water service contractors. If all these requirements are satisfied and excess pumping capacity is available, only then will Reclamation facilitate potential north-to-south water transfers. Water transfers under this EIS/EIR cannot affect Reclamation's ability to deliver allocated CVP L2 water to refuges.

Table J-4 shows Reclamation's refuge related water transfers ("re-allocation" regarding L2 supplies) from 2009 through 2013. Most of these transfers do not need to be moved through the Delta. Merced Irrigation District (ID) is one exception, but Merced ID has multiple means of delivering transferred water and it does not need to be conveyed through the Delta (see Section 2.3.2.3 of the EIS/EIR for more information). Additionally, Reclamation has permanently purchased water from Corning, Thames, and Proberta Water Districts (WDs) that is moved through the Delta in some years; however, this water is more frequently used for refuges in the Sacramento Valley and is not conveyed through the Delta. Because the Level 4 refuge transfers typically do not rely on through-Delta conveyance, the action alternatives are not expected to affect the potential for refuges to receive these supplies.

Table J-4. Refuge Transferred Water Supplies, 2009-2013

Seller	Water Transferred (AF)[1]	Notes
WY 2013		
Corning, Thames, and Proberta WDs	3,308	Permanently purchased NOD IL4 water transferred to the Kern NWR SOD
SJRECWA	19,500	Purchased IL4
Merced ID	7,256	Purchased for the East Bear Creek Unit of the San Luis NWR Complex as L2, then exchanged to meet SOD IL4 demands
WY 2012		
SJRECWA	25,000	Purchased IL4
Santa Clara Valley WD	10,000	Purchased IL4
Merced ID	3,480	Purchased for the East Bear Creek Unit of the San Luis NWR Complex as L2, then exchanged to meet SOD IL4 demands
WY 2011		
SJRECWA	50,333	Purchased IL4
Panoche WD	4,250	Purchased IL4
San Luis WD	5,000	Purchased IL4
Santa Clara Valley WD	10,000	Purchased IL4
Merced ID	1,627	Purchased for the East Bear Creek Unit of the San Luis NWR Complex as L2, then exchanged to meet SOD IL4 demands
East Side Canal and Irrigation Company	3,291	Purchased as L2, then exchanged to meet IL4 demands
WY 2010		
Corning, Thames, and Proberta WDs and Sacramento Valley NWR Complex	4,506	Permanently purchased NOD IL4 water and reallocated NOD conserved L2 water delivered to Kern NWR and GRCD

Seller	Water Transferred (AF)[1]	Notes
SJRECWA	35,714	Purchased IL4
Kern-Tulare WD	7,000	Purchased IL4
Panoche WD	10,000	Purchased IL4
Merced ID	500	Purchased for the East Bear Creek Unit of the San Luis NWR Complex as L2, then exchanged to meet SOD IL4 demands
Stevinson WD	4,080	Purchased for the East Bear Creek Unit of the San Luis NWR Complex as L2, then exchanged to meet SOD IL4 demands
WY 2009		
Sacramento Valley NWR Complex	5,342	NOD Conserved L2 water delivered to Kern NWR and the GCRD
SJRECWA	18,687	Purchased IL4
Stevinson WD	4,280	Purchased as L2, then exchanged to meet IL4 demands

Key:
AF – Acre-feet, GRCD – Grasslands Resource Conservation District, ID – Irrigation District, IL4 – Incremental Level 4, L2 – Level 2, NOD – North of Delta, NWR – National Wildlife Refuge, SJRECWA – San Joaquin River Exchange Contractors Water Authority, SOD – South of Delta, WD – Water District, WY – Water Year
Note 1: Gross amount of transferred water (IL4) and re-allocated L2. Conveyance losses from source to destination were incurred and are not represented here; therefore, the amount total does not reflect the amount delivered to the refuges.

Ongoing shortages in Incremental Level 4 water supplies

Commenters expressed concern that IL4 water supplies have not been met in recent years. Reclamation is committed to providing refuge water supplies, and is working to meet that objective through efforts independent of the water transfer activities evaluated in this EIS/EIR. As discussed above, Reclamation purchases for refuge water supplies are wholly separate actions implemented by Reclamation and are not part of the purpose and need/project objectives for the range of potential water transfer activities evaluated in this EIS/EIR.

Potential to affect northern California refuges

Commenters mentioned the potential for water transfers to affect northern California refuges, either through decreased groundwater levels or by affecting forage areas for wildlife that lives in the refuge. These potential effects are analyzed in Section 3.8. The analysis finds that groundwater substitution transfers would not likely have significant effects on refuge areas, but Mitigation Measure GW-1 has been clarified (see Common Responses 6, 7, and 10) to further ensure that such potential effects are avoided.

Increased transfer costs

Several commenters discussed the action alternatives to cause increased demand for transfers, which could increase the price of transfers for the refuges. As shown in Table J-4, the sellers for Refuge IL4 supplies differ from those under the action alternatives. The exception is Merced ID, which is required to deliver water (L2 and IL4) to the Merced National Wildlife Refuge as a condition under its Federal Energy Regulatory Commission (FERC) permit.

Merced ID must fulfill this FERC provision before it could sell water to other buyers.

The range of potential transfers evaluated in this EIS/EIR would not affect the prices for the main source of water for refuge transfers. The single main seller of water supplies for refuge transfers is the San Joaquin River Exchange Contractors Water Authority (SJRECWA). The SJRECWA and Reclamation have negotiated a five-year contract for refuge water supplies, which is expected to be fully executed in Spring 2015, which includes quantities and prices. These quantities and prices have been negotiated, and the prices are independent of the potential future transfers evaluated in this document. In the past, five-year contracts have been extended for additional years, so the contract terms (including price) may stay in effect for longer than five years.

Cumulative impacts

Commenters suggested that refuge transfers should be included as a cumulative project. Most of the transfers under this EIS/EIR are from sellers concentrated in the Sacramento Valley, while most refuge transfers would be from sellers in the San Joaquin Valley. Therefore, most of the refuge transfers would not produce cumulative impacts in conjunction with the range of potential transfer activities associated with the action alternatives. Refuge transfers have been added as a cumulative project in Chapter 4.

Mitigation measures needed to protect refuges

Commenters suggested that mitigation measures are necessary to reduce perceived impacts to refuges, and these measures should include a portion of the transfer supply being delivered to refuges. The EIS/EIR analyzed potential impacts but did not identify significant impacts to refuges or the species that depend on them; therefore, mitigation was not necessary.

Common Response 10: Environmental Commitments/Mitigation Measures

The following revisions to certain environmental commitments and mitigation measures have been proposed in response to comments.

GW-1 (revised)

In section 3.3.4.1.2 Monitoring Program, the following text changes are proposed: (New text is shown as underlined; deleted text is shown as ~~strikethrough~~.)

Vegetation Effects

Sellers will monitor groundwater depth data to verify that significant adverse effects to deep-rooted vegetation are avoided or allow sellers to modify actions before significant effects occur. If monitoring data indicate that water levels have dropped below root zones (i.e., more than 10 feet where groundwater was 10 to 25 feet below ground surface prior to starting the transfer of surface water made available from groundwater substitution actions), the seller must implement actions set forth in the mitigation plan. If historic data show that groundwater elevations in the area of transfer have typically varied by more than this amount annually during the proposed transfer period, then the transfer may be allowed to proceed. If there is no deep-rooted vegetation (i.e., oak trees and riparian trees that would have tap roots greater than 10 feet deep) within one-half mile of the transfer wells or the vegetation is located along waterways that will continue to have water during the transfer, the transfer may be allowed to proceed. If no existing monitoring points exist in the shallow aquifer, monitoring would be based on visual observations of the health of these areas of deep-rooted vegetation. If significant adverse impacts to deep-rooted vegetation (that is, loss of a substantial percentage of the deep-rooted vegetation as determined by Reclamation based on site-specific circumstances in consultation with a qualified biologist) occur as a result of the transfer despite the monitoring efforts and implementation of the mitigation plan, the seller will prepare a report documenting the result of the restoration activity to plant, maintain, and monitor restoration of vegetation for 5 years to replace the losses.

GGS Measures (revised)

- As part of the approval process for long-term water transfers, Reclamation will have access to the land to verify how the water transfer is being made available and to verify that actions to protect the giant garter snake are being implemented. At the end of each water transfer year, Reclamation will prepare a monitoring report that contains the following:

  - Maps of all cropland idling actions that occurred within the range of potential transfer activities analyzed in this EIS/EIR,
  - Results of any newly available scientific research and monitoring results pertinent to water transfer actions, and
  - A discussion of conservation measure effectiveness.

  The report will be submitted to USFWS and shared with California Department of Fish and Wildlife (CDFW) in February, prior to the next year of potential transfers. Reclamation will coordinate with USFWS and CDFW on the contents and findings of the annual report prior to additional transfers.

- Reclamation will establish annual meetings with the Service to discuss the contents and findings of the annual report. These meetings will be scheduled following the distribution of the monitoring report and prior to the next transfer season.

- Reclamation will establish annual meetings with the Service to discuss the contents and findings of the annual report. These meetings will be scheduled following the distribution of the monitoring report and prior to the next transfer season.

- Reclamation will provide a map(s) to the USFWS in June of each year showing the parcels of riceland that are ~~idled~~ proposed for the purpose of transferring water for that year. These maps will be prepared to comport with Reclamation's geographic information system (GIS) standards.

- Movement corridors for aquatic species (including pond turtle and giant garter snake) include major irrigation and drainage canals. The water seller will keep adequate water in major irrigation and drainage canals. Canal water depths should be similar to years when transfers do not occur or, where information on existing water depths is limited, at least two feet of water will be considered sufficient.

- Districts proposing water transfers made available from idled rice fields will ensure that adequate water is available for giant garter snake priority habitat with a high likelihood of giant garter snake occurrence. The determination of priority habitat will be made through coordination with giant garter snake experts, GIS analysis of proximity to historic tule marsh, and GIS analysis of suitable habitat. The priority habitat areas are indicated on the priority habitat maps for participating water agencies and will be maintained by Reclamation. As new information becomes available, these maps will be updated in coordination with USFWS and CDFW. In addition to mapped priority habitat, fields abutting or immediately adjacent to federal wildlife refuges will be considered priority habitat.

- Maintaining water in smaller drains and conveyance infrastructure supports key habitat attributes such as emergent vegetation used by giant garter snakes for escape cover and foraging habitat. If crop idling/shifting occurs in priority habitat areas, Reclamation will work with contractors to document that adequate water remains in drains and canals in those priority areas. Documentation may include flow records, photo documentation, or other means of documentation agreed to by Reclamation and USFWS.

- ~~Areas with known priority giant garter snake populations~~ Mapped priority habitat known to be occupied by giant garter snake and priority habitats with a high likelihood for giant garter snake occurrence (60 percent or greater probability) will not be permitted to participate in cropland idling/shifting transfers. Water sellers can request a case-by-case evaluation of whether a specific field would be precluded from participating in long-term water transfers. These areas include lands adjacent to naturalized lands and refuges and corridors between these areas, including:

  - Fields abutting or immediately adjacent to Little Butte Creek between Llano Seco and Upper Butte Basin Wildlife Area, Butte

Creek between Upper Butte Basin and Gray Lodge Wildlife areas, Colusa Basin drainage canal between Delevan and Colusa National Wildlife Refuges, Gilsizer Slough, Colusa Drainage Canal, the land side of the Toe Drain along the Sutter Bypass, Willow Slough and Willow Slough Bypass in Yolo County, Hunters and Logan Creeks between Sacramento and Delevan National Wildlife Refuges, and

– Lands in the Natomas Basin.

- Sellers will ~~continue to voluntarily~~ perform giant garter snake best management practices, including educating maintenance personnel to recognize and avoid contact with giant garter snake, ~~cleaning~~ <u>dredging</u> only one side of a conveyance channel per year, and implementing other measures to enhance habitat for giant garter snake. <u>Implementation of best management practices will be documented by the sellers and verified by Reclamation and</u> ~~information on the effectiveness of these measures, along with recommendations for additional measures~~ will be <u>included in the annual monitoring report.</u>

Birds (revised)

- In order to limit reduction in the amount of over-winter forage for migratory birds, including greater sandhill crane, cropland idling transfers will be minimized near known wintering areas <u>that support high concentrations of waterfowl and shorebirds, such as wildlife refuges and established wildlife areas</u>. ~~in the Butte Sink.~~

Common Response 11: Surface Water/Groundwater Interactions and Vegetation/Wildlife

Several commenters questioned the basis for the 1 cubic feet per second (cfs) and 10 percent thresholds used in this portion of the analysis, others questioned the validity of the analysis regarding surface water-groundwater interactions to support local vegetation communities, and some questioned the overall appropriateness of the modeled data. The following response includes information regarding these factors. Additional information can also be found in Section 3.3 Groundwater Resources.

Thresholds

The 10 percent screening threshold for instream flow in rivers and creeks is one of multiple criteria used to determine whether there could be potentially significant impacts on aquatic and terrestrial resources. Use of the 10 percent threshold is described in Section 3.7.2.1.3 of the EIS/EIR. As stated in the text, the use of the 10 percent value is to distinguish between effects that are a result of "model noise" and actual impacts of an alternative. Experts in the field often use this criterion to evaluate potential impacts to Central Valley fisheries.

The effects analysis in this EIS/EIR also evaluates whether an alternative changes instream flows more than 1 cfs. This threshold was more biological in nature and was applied to every month of modeling. If a change of greater than 1 cfs occurred in any single month during the entire modeled period (1976-2003), the waterway was examined further for potential biological effects. The combination of the1 cfs and 10 percent threshold criteria provides an extremely conservative screening process through which each river or stream was analyzed. If either criterion was not met for a river or stream, a further analysis was conducted to evaluate the biological significance of the flow change, such as those conducted for the Bear River, Cache Creek, Stony Creek, Coon Creek, and Little Chico Creek.

Flows in smaller waterways with less than 1 cfs are expected to be within the normal range of annual fluctuation; some of these waterways are ephemeral and are subject to a wide range of flow conditions dependent on annual hydrology. Other smaller waterways are part of a managed system (i.e., canals) that also results in variation in flows. These small waterways were not analyzed further as groundwater substitution impacts on surface waterways are expected to be within this annual variation.

Groundwater table effects on vegetation

The analysis acknowledges that there are groundwater and surface water interactions, and focuses the analysis primarily on surface water where terrestrial ecosystems are most likely to be affected. The flow regime (i.e., ephemeral, seasonal, perennial) within rivers and creeks would remain unchanged and groundwater replenishment would occur naturally; therefore, riparian vegetation would continue to have access to water and is not expected to be substantially affected by groundwater transfers. Farther from creeks and rivers, the groundwater levels are substantially below the surface in many areas (i.e., typically between 30-70 feet in depth, as discussed in Appendix E), as described in Section 3.8.2.1 Assessment/Evaluations Methods of the EIS/EIR. Therefore, groundwater table effects were considered and were not expected to result in substantial impacts on vegetation because groundwater depths are greater than the rooting depth of typical vegetation associated with upland communities, which is expected to be substantially less than 15 feet.

Changes in surface water flows

Creeks and rivers where modeling predicted more than a 10 percent reduction and more than a 1 cfs reduction in streamflows were analyzed in more detail to determine potential effects on vegetation and wildlife. Section 3.8.2.4 of the EIS/EIR acknowledges that there are potentially significant impacts to natural communities and wildlife associated with periodic reductions in creek flows of more than 10 percent. These impacts would be mitigated to a less-than-significant level through implementation of Mitigation Measure GW-1.

Vegetation effects in the North Delta area

Several commenters refer to text in Section 3.8.2.1.1 that analyzes the potential for shallow groundwater changes to affect vegetation. In this area of the North Delta, groundwater levels are high. The groundwater model estimated a maximum modeled reduction of 0.3 to 0.8 feet over the growing season, and plants are expected to adjust to this small reduction. It is true that plants may not be able to respond quickly to sudden large changes in depth to groundwater; however, large changes are only expected to occur in areas where the groundwater table is already too deep for tree roots. The modeling covered a wide range of groundwater levels, including relatively low levels associated with the 1976-77 drought. Although areas in the North Delta could experience maximum modeled reductions of groundwater levels between 0.3 to 0.8 feet, these reductions are expected to occur slowly and would not substantially alter the suitability of shallowly-flooded habitat for wildlife. Further, the modeled change showed that these areas recovered from year to year and, therefore, were not expected to be substantially changed. Sacramento Valley wetlands are generally supplied by surface water (e.g., rice fields, agricultural ditches, and duck clubs), and not by groundwater. Therefore, vegetation and wildlife that occur in these wetlands would not be affected by changes in groundwater levels. Mitigation Measure GW-1 has been reworded to better explain how potentially significant vegetation effects would be avoided. See Common Responses 6, 7, 8, and 10 for additional information.

Appropriateness of modeled data

The CalSim II simulation was based on historic hydrology for 1970 through 2003; additional information on the appropriateness of the modeled data is described in Common Response 5.

Common Response 12: Wildlife - Giant Garter Snake

Several commenters noted that environmental commitments contained in the Draft EIS/EIR are not identical to information in past Biological Opinions issued by USFWS for water transfer projects or in the *2013 Draft Technical Information for Preparing Water Transfer Proposals.* The commenters further question why the Draft EIS/EIR does not include previously approved commitments to ensure protection of giant garter snake (i.e., limiting parcel size for idling and prohibiting the same field from being idled more than two consecutive seasons). The commenters are correct that environmental commitments in the Draft EIS/EIR are modified from past water transfer documents, including the 2013 Draft Technical Information. However, commitments in the EIS/EIR are consistent with the recent 2014 Water Transfer Biological Opinion. Guidance for preparation of water transfer proposals will be revised annually (as necessary) to reflect how transfers would be implemented, and includes the prescribed measures in project-specific CEQA/NEPA and Section 7 documents that cover the area where transfers are proposed. Refinement of prior year's environmental commitments was based on best available scientific data that provides better information on where giant garter snake populations are likely to be found. Commitments that broadly restrict idling across the service area were refined to focus on cropland idling restrictions in areas where giant garter snake have a high likelihood of occurrence.

Giant garter snake priority habitat areas have been identified by Reclamation and maps have been developed (Halstead 2014) for each water district using the best available scientific information on habitat use, known populations, and historic tule marsh zones. The purpose of these maps is to identify areas with the highest probability of giant garter snake occurrence so that water transfer actions can be avoided within these areas. The range of transfer activities in the action alternatives could result in up to 10.5 percent of rice field idling throughout the sellers' service area; however, idling would be focused in areas where giant garter snake occurrence probability is low. These habitat restrictions, along with retaining water within conveyance structures that provide habitat movement corridor, avoid potentially significant impacts from cropland idling.

Commenters also expressed concern over the ability to enforce the environmental commitments, lack agency oversight, and opportunities for adaptive management of habitat over the 10-year term of analysis. The environmental commitments have been clarified and refined to address these concerns, including requirement of an annual monitoring report to the USFWS and CDFW that includes maps of idled fields in the previous year, results of current giant garter snake surveys, new scientific research, and recommendations for future protection measures. The monitoring report will be followed by coordination efforts between Reclamation and the wildlife agencies.

Common Response 13: Migratory Birds

Several commenters asserted that the Draft EIS/EIR lacks adequate discussion of cropland idling effects on migratory bird populations, particularly waterfowl.

Sections 3.8.2.1.2 and 3.8.2.4.3 of the Draft EIS/EIR identify and evaluate potential impacts of cropland idling/shifting on terrestrial wildlife species that use seasonally flooded agriculture for some portion of their lifecycle, including wintering waterfowl and shorebirds. To address commenters' concerns regarding impacts specific to migratory birds, additional information was added to the section to further describe these potential impacts.

The Draft EIS/EIR acknowledges the importance of agricultural lands within the project area for migratory birds, particularly those traveling on the Pacific Flyway. Section 3.8.2.4.1 (including Tables 3.8-8 and 3.8-9) describes and quantifies the maximum potential loss of residual feed for migratory birds, which in all cases was insubstantial and would amount to a maximum two percent reduction of upland cropland in Glenn, Colusa, and Yolo Counties and a maximum nine percent reduction of upland cropland in Sutter and Solano Counties. This section also identifies the maximum reductions in rice acreage, which again would be insubstantial in all cases and could amount to up to 10.5 percent across the sellers' service area. Although the project may reduce the availability of cropland, it would not affect post–harvest practices (i.e., flooding, burning, disking, or rolling). Specifically, the project would not include transfers of rice decomposition water and so would not reduce the availability of water for post-harvest flooding. The majority of forage available to migratory birds in the project area is in the form of decomposing waste grains during post-harvest flooding. Farmers in the Sacramento Valley only flood-up a fraction of the cropland planted; typically around 60 percent in normal water years (Miller et al 2010, Central Valley Joint Venture 2006) and as little as 15 percent in critically dry years (Buttner 2014). The decision on whether to flood is not based on what was produced for the year but instead is determined by the availability of fall and winter water. Therefore, the project would not result in a reduction of winter forage for migrating birds, specifically waterfowl and shorebirds, because it would not affect the availability of water for post-harvest flooding.

Several commenters alleged that the environmental commitment for migratory birds, including Sandhill Crane, is specific to the Butte Sink and neglects other important habitat outside the Butte Sink. To further ensure there are no significant adverse impacts on migratory birds, including greater sandhill crane, the environmental commitment pertaining to the Butte Sink has been refined to limit water transfer activities near all wildlife refuges and established wildlife areas within the seller's service area that support high concentrations of waterfowl and shorebirds.

Several commenters recommended using TRUEMET bioenergetics modeling to determine the impacts of the project on wintering waterfowl (i.e., reduction in carry capacity) based on changes in the availability of winter forage. However, this modeling approach is not applicable to the range of transfer actions in the alternatives because fallowing is expected to be within the annual variation experienced for forage and because water transfers are not expected to reduce the availability of forage for wintering waterfowl. Therefore, TRUMET bioenergetics modeling will not be used.

Common Response 14: Water Transfers Approval Process

As described in Chapters 1 and 2 of the Draft EIS/EIR, Reclamation and SLDMWA are preparing an EIS/EIR for a range of potential water transfer activities in an effort to streamline and facilitate the process for reviewing and approving yearly temporary transfers, and to accommodate transfers that may extend over multiple years. Water transfers are one of the critical elements integrated into the California Water Action Plan for dealing with or managing critically dry periods. Appropriate water transfers are promoted under federal and state water policies as an effective incentive for improved water management, as well as a way to promote water conservation, particularly in drought years, as long as transfers are consistent with state and federal law. The Governor's emergency drought proclamations and executive orders have recognized the importance of water transfers for effective water management by including provisions to streamline and expedite transfers.

The purpose of this EIS/EIR is to provide a streamlining tool by providing a comprehensive, long-range, project-level view of the potential environment impacts associated with a range of potential transfer activities over a ten-year period, to both expedite approval of water transfers and to reduce participant uncertainty. The Lead Agencies recognize, throughout the EIS/EIR, that each transfer is unique and must be considered on its individual factual merits, using all the information that is available at the time of transfer approval and execution of the conveyance or letter of agreement with the respective project agency in accordance with the applicable legal requirements. Annual approval of transfers is required by Reclamation, irrespective of the EIS/EIR term or the duration of a water transfer contract.

The Lead Agencies are not managing a bank or program. The participating potential willing buyers and sellers will continue to negotiate and propose individual water transfers, including the transfer quantity, method, and use. Individual transfers would be voluntary, independent transactions between willing buyers and sellers subject to review and approval by Reclamation, the selling entity, and the buying entity (or SLDMWA on the buyer's behalf). Each transfer has independent utility and is not dependent on, nor does it dictate the nature and scope of, the potential for long-term transfers that are analyzed in the EIS/EIR. Implementation of the range of potential water transfers analyzed in this EIS/EIR (annual and multiyear, if any) would be subject to Reclamation's annual review and approval.

Reclamation's Potential Action is to review and approve potential transfer activities, if appropriate, based on detailed review of the specific proposed transfer. Reclamation is not soliciting potential buyers or sellers for transfers. The potential buyers and sellers listed in this document could seek to transfer up to the maximum quantities analyzed in this EIS/EIR using this document for NEPA and CEQA compliance, or could propose other transfers outside of this range subject to appropriate environmental review and compliance with any other applicable requirements. Buyers and sellers must implement measures incorporated into the Proposed Action to avoid or reduce potential environmental impacts to obtain Reclamation approval of the transfer. Reclamation technical experts review all proposed transfers prior to approval of the transfer to ensure that impacts of the proposed transfer are within the scope of analysis in this EIS/EIR (or require the preparation of further environmental documentation in the event that new or substantially more severe adverse impacts are presented by the proposed transfer). Reclamation ensures that the identified mitigation measures are implemented through review of monthly reports, field visits, and necessary coordination with transfer participants. Reclamation and SLDMWA have developed a Mitigation, Monitoring, and Reporting Plan, which is included in Appendix K of the Final EIS/EIR. The requirements of monitoring and mitigation as they apply to each individual transfer will be included in the transfer approval.

Reclamation will review each water transfer proposal with a view to the proposal's adequacy in addressing the technical information needed. To fully consider the proposal, site specific conditions may require additional information and considerations beyond that described in current guidance (such as including the Technical Information Document for Preparing Water Transfer Proposals, which is jointly prepared by DWR and Reclamation). This EIS/EIR does not predetermine those needs or those facts and does not foreclose the requirement and consideration of additional information (or further environmental review if necessary based on the potential for new or more severe environmental effects). The final quantity of water, if any, to be transferred is dependent on numerous factors, including future changes in hydrologic conditions, export capacity available for transfer water, negotiations between buyers and sellers, and Reclamation approval. Additional information regarding the process by which individual transfer proposals would be presented, evaluated, and potentially approved, can be found on Reclamation's website at http://www.usbr.gov/mp/watertransfer/ and DWR's website at http://www.water.ca.gov/watertransfers/proposals.cfm.

Detailed Comments and Responses

Individual responses to comments are presented in the following section.

Comment Letter FA01, Kathleen Martyn Goforth, United States Environmental Protection Agency

Comment FA01-1

Comment
The Environmental Protection Agency has reviewed the Draft Environmental Impact Statement (DEIS) for the above referenced document. Our review is pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and our NEPA review authority under Section 309 of the Clean Air Act.

The Long Term Water Transfer Project would implement a 10-year water transfer program to move water from willing sellers upstream of the Sacramento/San Joaquin Delta to willing buyers south of the Delta. Long-term water transfers have the potential to provide improved flexibility in the allocation, management, and use of water resources. When implemented in conjunction with a water management system that include efficiency improvement, conservation, and environmental protection, they can be an important tool for ensuring that California's scarce water supplies are put to their highest priority use.

While EPA supports the goal of improving water management flexibility, we also recognize that the Delta faces interrelated problems of inadequate water supplies, instream flow deficits, water quality impairments, and degraded aquatic habitats. Many of the groundwater aquifers that previously supported ecosystem processes across the estuary and provided water consumers with a hedge against drought have been overdrawn and depleted to historic levels. The extreme drought of the past 3 years has produced precipitous declines in groundwater elevations statewide, including level decreases of more than 10 feet for some monitored wells in the project area. Land subsidence associated with groundwater overdraft not only impacts infrastructure, water quality, and ecosystems, but also permanently reduces the State's capacity to store water underground. Water transfers would affect each of these conditions; therefore, they must be carefully designed and implemented, based upon the best available data, to ensure that adverse impacts are minimized and the interest of all affected parties and the environment are appropriately considered.

Response
The Lead Agencies agree that adverse impacts from groundwater subsidence must be minimized. For that reason, Section 3.2 includes an analysis of

potential impacts to groundwater levels and subsidence. It also includes Mitigation Measure GW-1 to avoid potential effects to groundwater resources.

Comment FA01-2

Comment
In the DEIS, BOR concludes that, after mitigation, the proposed project would result in less than significant or beneficial environmental impacts for all resources. Based on our review, EPA finds that the DEIS does not contain sufficient information to support this conclusion for many resource areas, particularly groundwater, air quality, fisheries, and wildlife.

Response
The EPA's subsequent comments focus on lack of clarity for the mitigation measures in these resources. Based on comments from the EPA and other reviewers, the Lead Agencies have clarified and strengthened Mitigation Measures WS-1, GW-1, AQ-1, and AQ-2. These mitigation measures support the Lead Agencies' conclusions regarding the impacts.

Comment FA01-3

Comment
The DEIS identifies potentially significant impacts to groundwater levels and land subsidence associated with groundwater substitution water transfers. It states that proposed mitigation would reduce these impacts to less than significant for all groundwater basins in the seller's service area. However, the proposed mitigation is vague and defers the responsibility for developing detailed mitigation plans to the water transfer applicants. This precludes meaningful evaluation of the viability and effectiveness of BOR's proposed approach to mitigation.

Response
Refer to Common Responses 6 and 7.

Comment FA01-4

Comment
Furthermore, the modeling performed to assess groundwater-related impacts depends upon a data set spanning 1970 to 2003. The use of this truncated data set means that recent trends and current existing conditions are not appropriately taken into account in the impact analysis. Absent sufficient information regarding both mitigation and existing conditions, the DEIS does not demonstrate that the proposed project would not adversely affect groundwater levels.

Response
See Common Response 5.

Comment FA01-5

Comment
Similarly, while the DEIS concludes that mitigation measures would render potential impacts to air quality to less than significant levels, the two mitigation measures proposed for air impacts essentially amount to a guarantee from BOR that emissions will not be allowed to exceed applicable thresholds. Without information on how these measures would be implemented and enforced on a transfer by transfer basis, it is not clear that the mitigation would successfully prevent exceedance of de minimis value under EPA's General Conformity rule or local air quality thresholds.

Response
The mitigation measures in the EIS/EIR have been modified to clarify enforcement provisions that will ensure implementation of the action alternatives would not result in significant adverse impacts to air quality.

Comment FA01-6

Comment
Finally, the DEIS analysis with regard to fisheries and terrestrial wildlife understates a number of potentially significant adverse impacts upon these resources, thereby rendering unsupportable the conclusion that these impacts will be less than significant. For both fisheries and wildlife impacts, significance thresholds identified in the DEIS are focused around special status species, with insufficient regard for other native communities. It is not clear why the DEIS concludes that most potential impacts to non-special-status species are inherently less than significant.

Response
The DEIS does not conclude or assume that most potential impacts to non-special-status species are inherently less than significant. Sections 3.7.2.1.5 and 3.8.2.1.7 of the Draft EIS/EIR describe assessment methods for fish and terrestrial wildlife, respectively. Impacts on terrestrial wildlife were assessed based on how the range of potential transfer activities evaluated in this document may affect natural communities and aquatic habitats that are used by wildlife during all or part of their lifecycle. Where impacts to natural communities were determined to be less than significant, impacts to terrestrial species were also determined to be less than significant. The impacts analysis for fish looked at the full range of potential effects to all target species in all waterways that could potentially be affected by each alternative using the best available science and analytical tools possible. The approach is described in Sections 3.7.2.1 and 3.8.2.1, significance thresholds are listed in Sections 3.7.2.2 and 3.8.2.2, and the results for each alternative are provided in Sections 3.7.2.3 through 3.7.2.6 and 3.8.2.3 through 3.8.2.6. The methodology and supporting information behind the findings of less than significant for biological impacts are summarized in these sections.

Comment FA01-7

Comment

Even where special status species are concerned, the impact analysis frequently depends upon conjecture, without sufficient justification or citation for significance thresholds established and impact assessments made. For example, potential impacts to migratory bird species receive only a summary consideration. Wintering waterfowl in the Sacramento Valley gather as much as 50 percent of their nourishment from rice farms, yet the DEIS concludes that the 16% reduction in flooded rice field in some regions along the Sacramento River (11% when averaged across the entire sellers' service area) would be a less than significant project effect. The DEIS states that migrating species will simply choose appropriate habitat upon arrival. Neither this assumption, nor the conclusion that follows from it are well founded.

Response

The EIS/EIR analysis of biological resources covers a very large study area and incorporates data from a variety of sources. Conclusions regarding impacts were made by highly-qualified experts based on review and analyses of those data, taking into consideration the stated thresholds of significance. Notwithstanding, Section 3.8.2.4.3 for special-status bird impacts has been expanded to include all migratory bird use of flooded agricultural lands. To further ensure that any potentially substantial impacts on migratory birds are avoided, environmental commitments have been refined to minimize crop idling in known wintering areas that support high concentrations of waterfowl and shorebirds, such as refuges and established wildlife areas. The EIS/EIR acknowledges the importance of rice fields for wintering waterfowl; however, the project does not include transfers of rice decomposition water. Water transfers would not reduce the availability of water for post-harvest flooding; while different fields may be flooded, water transfers would not substantial reduce forage for wintering waterfowl. See Common Response 10 (Environmental Commitments/Mitigation Measures) and Common Response 13 (Migratory Birds) for additional discussion of migratory birds.

Comment FA01-8

Comment

Similar data gaps and unsupported conclusions are common throughout the DEIS and warrant substantial revision prior to the publication of the Final EIS. The level of detail missing from the DEIS, particularly with regard to the specific provisions of likely transfer actions and the expected requirements of future mitigation, results in an EIS document more appropriate to a programmatic analysis. Without further details regarding these aspects of the proposed project, EPA believes that the FEIS will not be sufficient to support project-level decision-making.

Response
The Lead Agencies have addressed EPA's requests as described in the comment responses to allow project-level decision-making. See Common Response 14.

Comment FA01-9

Comment
Based on EPA's review of the Draft EIS, we have rated the Proposed Action as Environmental Concerns - Insufficient Information (EC-2). This rating reflects the potentially significant adverse environmental impacts that the project, as proposed, may have upon the terrestrial and aquatic environments of the Delta and Sacramento Valley, the lack of consideration of appropriate mitigation for some project impacts, and the need for improved disclosure related to air quality, water quality, groundwater, fisheries, vegetation/wildlife, economics, project alternatives, and mitigation. Please see the enclosed Summary of EPA Rating Definitions for a description of the rating system. Further discussion of our concerns is provided in the enclosed Detailed Comments.

EPA appreciates the opportunity to provide comments for this project. When the Final EIS is released for public review, please send one hard copy and one CD to the address above (Mail Code: ENF 4-2). If you have any questions, please contact me at (415) 972-3873 or contact Carter Jessop, the lead reviewer for this project. Carter can be reached at (415) 972-3815 or jessop.carter@epa.gov.

Response
The Final EIS/EIR includes responses to the EPA's comments, and edits to the EIS/EIR where appropriate to address concerns. See Common Response 14.

Comment FA01-10

Comment
The proposed project spans five air basins, including numerous attainment, nonattainment, and maintenance areas for a number of National Ambient Air Quality criteria pollutants. Groundwater substitution water transfers would necessitate the use of diesel, natural gas, or electrically powered pumps. According to the DEIS (p. 3.5-38), and as referenced in Appendix F (page F-1), the emissions from these pumps, in particular those powered by diesel fuel, have the potential to exceed the applicable de minimis value for nitrogen oxide (NOx) established under EPA's General Conformity Rule for the Sacramento Metro non-attainment area. Table F-1 indicates that unmitigated emissions would exceed the de minimis threshold nearly fourfold. In addition, groundwater substitution pumping has the potential to emit criteria pollutants at levels that exceed local air district significance thresholds for volatile organic compounds (VOCs) and NOx in the Feather River Air Quality Management District and for NOx for the Sacramento Metropolitan AQMD.

In order to address these potential impacts, the DEIS includes mitigation measure AQ-1: "Reduce pumping at diesel or natural gas wells to reduce pumping below significance levels." (p. 3.5-43) It indicates that, following application of this measure, all project emissions are modeled to fall below applicable thresholds. EPA is concerned that measure AQ-1 is very vague. The single paragraph description provided is insufficient to determine whether this measure is capable of achieving the described emission reductions. It is unclear how BOR would limit diesel or natural gas well pumping and manage individual transfer permit to ensure cumulative compliance. The mechanisms for both emissions accounting and enforcement are similarly unclear.

Response
The mitigation measures in the EIS/EIR have been modified to clarify recordkeeping requirements that will ensure implementation of the action alternatives would not result in significant or adverse impacts to air quality.

Comment FA01-11

Comment
Measure AQ-1 also stipulates that "if an agency is transferring water through cropland idling and groundwater substitution, the reduction in vehicle emissions can partially offset groundwater substitution pumping at a rate of 4.25 acre-feet for water produced by idling to one acre-foot of groundwater pumped." The DEIS provides no citation or explanation for how the 4.25 AF/1 AF ratio was determined. Given the range of potential emissions rates associated with pumps of various ages/tiers and fuel types, plus the differing water needs of various crops, it is unclear how a single ratio of groundwater pumping to cropland idling was derived and deemed universally applicable.

Response
The ratio of 4.25 acre-feet of water produced by idling to one acre-foot of groundwater pumped is not reflective of emissions from the groundwater pumps, but rather of emissions that would occur from farm equipment operating on the field. The reference for Byron Buck & Associates 2009 (as cited in Section 3.5, Air Quality) provides detailed information on how the ratio was calculated. The ratio represents the best available information to estimate emission reductions from cropland idling.

Comment FA01-12

Comment
EPA's guidance on the General Conformity applicability analysis states, "the Federal agency can take measures to reduce its emissions from the proposed action to in fact below de minimis levels and, thus, the rule would not apply. The change must be State or Federally enforceable to guarantee that emissions would be below de minimis in the future." While California Environmental Quality Act mitigation measures may be enforceable under state law, the vague

language of AQ-1 falls short of guaranteeing the de minimis thresholds will not be exceeded. Without additional information regarding the mechanism and enforcement for mitigation measure AQ-1, the DEIS does not demonstrate that emissions of NOx in the Sacramento Metro non-attainment area would be limited to below the de minimus threshold.

Response
The mitigation measures in the EIS/EIR have been modified to clarify enforcement provisions that will ensure implementation of the action alternatives would not result in significant adverse impacts to air quality.

Comment FA01-13

Comment
Recommendation: Include in the FEIS a detailed description of the processes by which BOR would approve, disapprove or approve with conditions those transfer applications within the Sacramento Metro AQMD such that emissions are maintained below the applicable de minimis and local significance thresholds; similarly for the Feather River AQMD. In order to demonstrate compliance with the General Conformity Rule, the FEIS should clearly show how the proposed mitigation measure would be implemented and enforced. Describe the mechanism for compliance assurance and enforcement, and clearly demonstrate the calculation leading to the 4.25 AF of water produced by idling to one AF of groundwater pumped ratio. Explain why this value is appropriate for all pumping/idling scenarios.

Response
The mitigation measures in the EIS/EIR have been modified to clarify enforcement provisions that will ensure implementation of the action alternatives would not result in significant adverse impacts to air quality. Additionally, the discussion on the 4.25 AF of water produced by idling to one AF of groundwater pumped ratio was expanded.

Comment FA01-14

Comment
The Department of Agriculture's Natural Resource Conservation Service has a program to promote agricultural production and environmental quality as compatible goals, optimize environmental benefits and help farmers and ranchers meet Federal, State, Tribal, and local environmental regulations. Through the Environmental Quality Improvement Program (EQIP), NRCS provide incentive funding to agricultural producers specifically to reduce NOx, VOCs, PM10 and PM2.5. Currently, incentive funds are available throughout California. The funded conservation practices include the replacement of internal combustion engines in irrigation pumps. For more information, go to http://www.nrcs.usda.gov/wps/portal/nrc/detail/ca/programs/financial/eqip/?cid=stelprdb1247003. As the DEIS notes, a California Air Resources Board

airborne toxic control measure contain a schedule for the replacement of older and dirtier diesel agricultural engines.

Recommendation: Work with irrigation districts to ensure that individual growers participating in the project are aware of NRCS incentive funding to reduce project related air quality impacts. The FEIS should describe this program and the benefits it might offer for reducing potentially significant air quality impacts with regard to General Conformity.

Response
The individual growers are operating in compliance with ATCM, including any necessary retrofitting and repowering to meet the emission reduction requirements. The EIS/EIR has been clarified to include a discussion of the incentive program described in this comment. The mitigation measures have been modified to include a requirement to notify individual growers about the incentive program.

Comment FA01-15

Comment
The proposed project has the potential to cause or exacerbate overdraft of groundwater in the sellers' service area if groundwater substitution transfers are not carefully managed, and if mitigation is not aggressively enforced. One of the primary mechanisms whereby water transfers would be made possible under the proposed action is by groundwater substitution. A seller would pump groundwater in lieu of drawing that same volume of surface water from canal or stream flow. That surface water allocation (less carriage water) would then be sold downstream to a willing buyer in the buyer service area. California's limited regulation of groundwater resources has allowed overdraft of groundwater in part of the State. When groundwater elevations fall below historic lows, aquifer of certain geologies are subject to collapse, resulting in land subsidence. Areas subject to land subsidence have experienced particularly severe financial and ecological repercussion from groundwater overdraft. These impacts stretch far beyond the individuals pumping the groundwater, impacting entire communities and ecosystems. Furthermore, in dry and critical years, a lack of available water lead a greater proportion of water users to pump groundwater to supplement diminished surface water supplies. These circumstances are likely to co-occur with periods of the greatest number of groundwater substitution transfers.

Response
The monitoring and mitigation plans that are required by Mitigation Measure GW-1 include aspects related to water levels and subsidence. Groundwater levels are required to be monitored before, during, and after a groundwater substitution pumping transfer. The location and type of testing will be dependent on the area of the potential transfer. In areas that may be prone to subsidence because groundwater levels could fall below historic low levels,

additional monitoring to ensure compliance with performance criteria will be required (see Common Response 7 for additional information). The plans will also include mitigation for issues related to substantial declines in groundwater levels and for significant subsidence impacts related to the projects in this EIS/EIR. The plans include mitigation measures such as reducing transfer pumping if warranted based on monitoring data. Reclamation will review the available data prior to approving the monitoring and mitigation plans. These plans are required prior to initiating a groundwater substitution transfer.

Comment FA01-16

Comment

The analysis of groundwater impacts assumes that transfers would occur at a rate of 12 out of 33 years, or 36% of the time (p. 2-13), based upon the period of record from 1970 to 2003. This data set is truncated to this period due to the limitation of the CalSim II model used, not because this period was deemed to be the most appropriate to represent future conditions. In fact, according to the DEIS (p. 1-17), north-of-delta to south-of-delta water transfers have taken place in 9 of the past 15 water years -- a rate of 60%. This is nearly double the transfer frequency assumed by the modeling performed.

The proposed project would likely ease and expedite the water transfer process during its 10-year term by removing the need for independent environmental review for transfer approval. The available data suggest that drought frequency will increase and water supply reliability decrease in coming decades as the effects of global climate change take hold of the State (p. 3.6-12). For this reason, it seems reasonable to assume that the frequency of water transfers during the 10-year project term would be at least equivalent to the past 15 years, if not more frequent. This discrepancy could potentially have very substantial influence on the predicted environmental impact of the project. The conclusion reached in the DEIS regarding impact upon groundwater elevations, land subsidence, streamflow, water quality, fisheries, wildlife, and economics are predicated on the assumption that natural recharge in non-transfer years will replenish groundwater aquifers. If the modeling performed were based upon the past 15 years of record, the environmental outcomes predicted for each of these resource areas would likely differ from those described in the DEIS.

Response

See Common Response 5.

Comment FA01-17

Comment

Recommendations: Complete additional modeling that is more representative of current and future reasonably foreseeable conditions with regard to transfer frequency. These results should be incorporated into each major resource area so potential adverse effects can be properly characterized. If the framework of

CalSim II does not accommodate such modeling, we recommend that BOR perform a sensitivity analysis to determine the effect of this discrepancy upon overall conclusions regarding project impacts. In addition, BOR should consider what additional tools might be available for more accurately predicting likely project impacts in the event that transfer frequency occurs closer to the rate observed in the past 15 years.

Response
See Common Response 5.

Comment FA01-18

Comment
The DEIS is internally inconsistent in defining and treating baseline/existing groundwater elevations. The characterization of existing groundwater conditions uses data sets that conclude at dates ranging from 1995 to 2013, and none include data from the 2013-2014 critical drought year. Where older, outdated data are used, it is possible that recent trends in groundwater elevation or land subsidence are not represented in the analysis. The current drought is perhaps the most severe the state has ever experienced and would be the relevant baseline for additional impact from the proposed action, slated to commence in 2015. According to the California Department of Water Resources' November 2014 Drought Update, over 50 percent of monitored wells in the Central and Sacramento Valleys have experienced groundwater level decreases of 2.5 feet or more from spring of 2013 to spring of 2014, with over 20% experiencing decreases of more than 10 feet. For the period from spring 2010 to spring 2014, nearly 30% of monitored wells have experienced declines in excess of 10 feet. While the most severe declines occur in the San Joaquin basin, precipitous declines are none-the-less prevalent across a majority of the sellers' service area. Due to these recent declines, some of the monitored wells in the sellers' service area may have reached historic low levels. Consequently, we are concerned that the extent of, or potential for, land subsidence may be greater than is reflected in the DEIS.

Response
See Common Response 4, Common Response 6, and Common Response 7.

Comment FA01-19

Comment
According to the DEIS, five of eleven extensometers placed in the Sacramento Valley Groundwater Basin to monitor land subsidence are showing some amount of subsidence on an annual basis. This suggests that groundwater elevations are likely falling below historic lows in some portions of the Sacramento Basin. Analysis of data from the National Aeronautics and Space Administration (NASA) Gravity Recovery and Climate Experiment (GRACE) satellite mission suggests that, in the Central Valley, including the Sacramento

basin, substantial loss of groundwater storage has occurred across the period of 2003 to 2010.

Response
Section 3.3.1.3.2 has been revised to include monthly groundwater storage estimates for Sacramento and San Joaquin Valley from the NASA effort (Famiglietti et al. 2011).

Comment FA01-20

Comment
Recommendation: Ensure that the most current groundwater elevation and land subsidence data available are used in the characterization of existing conditions and the determination of likely project effects in the FEIS. The FEIS should examine all available data source regarding groundwater elevations in the seller's service area and include a more thorough consideration of alternate data sources, given data limitation at some monitoring points. We recommend that the FEIS include specific requirements that prohibit the pumping of groundwater below historic lows where the risk of subsidence is present.

Response
See Common Response 4 and Common Response 7.

Comment FA01-21

Comment
The DEIS outlines a monitoring and mitigation measure for ensuring that potentially significant impacts to groundwater are offset; however, this measure (GW-1, p. 3.3-88) largely defers the specific to a required monitoring and mitigation plan to be developed by the water seller for approval by DWR and BOR in an independent post-NEPA permitting process. While a general framework is offered in the DEIS for how mitigation would be constructed, greater detail is needed to sufficiently demonstrate that environmental harm would be offset. The DEIS states that measure GW-1 will mitigate all impacts from groundwater pumping, placing responsibility for mitigating any "significant adverse impacts" of groundwater pumping on the water seller. Beyond the statement that mitigation "could include… curtailment of pumping until water levels raise above historic lows if non-reversible subsidence is detected," no more specific mitigation threshold or trigger are provided. Inelastic subsidence is a permanent impact. Implementation of mitigation after it has been monitored to occur mean that an irreversible and irretrievable commitment of resources will have occurred. The measure also does not include monitoring or mitigation specifically related to minimizing harm to the aquatic environment. It is not clear what action could or would be taken if groundwater substitution pumping were found to be dewatering a stream or water body (see comment on stream flow and fisheries impacts).

Response
Groundwater Mitigation Measure GW-1 requires the development of an approved monitoring and mitigation plan to identify and deal with potential impacts from groundwater substitution pumping. In counties where BMOs currently exist, the BMOs will be used as monitoring criteria. In counties where BMOs do not exist, critical changes to groundwater levels will be established through coordination with and feedback from third parties. Potential groundwater substitution sellers are required to develop monitoring and mitigation plans as part of Mitigation Measure GW-1. These plans are subject to review and approval prior to commencing a transfer. The seller will be required to successfully implement GW-1 in order to transfer water. Common Responses 6 and 7 include additional information.

Comment FA01-22

Comment
Measure GW-1 includes language placing financial responsibility on the transferring party for any repercussions of their pumping on others, including the cost to neighbors if the neighbors' pumping expenses increase, and the costs of infrastructure repair or improvements that may be required due to lower groundwater elevations or non-reversible land subsidence. However, as presented in the DEIS, these provisions are unlikely to be enforceable. The DEIS does not include metrics by which claims would be judged and processed, and responsibility apportioned, nor timeframes in which decisions would be made. Also, the DEIS does not define how "assurances that adequate financial resources are available to cover reasonably anticipated mitigation needs" would be made. Where offsetting a neighbor's pumping expenses or replacing public infrastructure is concerned, the expense to the transferring party could easily exceed the financial benefit of the water transfer by many times over.

Response
Common Responses 6 and 7 discuss groundwater mitigation and subsidence, respectively. Sellers must indicate that they understand the financial commitments associated with potential mitigation and they can meet those commitments.

Comment FA01-23

Comment
Recommendation: Provide greater detail about monitoring and mitigation measure GW-1 in the FEIS. The FEIS should include clearly defined mitigation triggers for the foreseeable range of potential environmental impacts associated with groundwater substitution transfers, including potential impacts to groundwater elevations, land subsidence, streamflow, fisheries, vegetation, and wildlife. We recommend that Measure GW-1 be revised to improve its enforceability, including providing metrics by which claims would be judged and responsibility would be apportioned, and timeframes in which decisions and

distribution of reimbursement would be made. The FEIS should also define what constitutes "adequate financial resources to cover reasonably anticipated mitigation needs" and how their availability would be ensured.

Response
Groundwater Mitigation Measure GW-1 requires the development of an approved monitoring and mitigation plan to identify and deal with potential impacts from groundwater substitution pumping. Common Response 6 provides additional information. In counties where BMOs currently exist, the BMOs will be used as monitoring criteria. In counties where BMOs do not exist, critical changes to groundwater levels will be established through coordination with and feedback from third parties. Potential groundwater substitution sellers are required to develop monitoring and mitigation plans as part of Mitigation Measure GW-1. These plans are subject to review and approval prior to commencing a transfer. The seller will be required to successfully implement GW-1 in order to transfer water. Common Response 7 also includes additional information related to subsidence monitoring and mitigation.

Comment FA01-24

Comment
Page 3.7-26 of the DEIS states that stream flow reductions as the result of groundwater declines would have a less than significant impact upon fisheries and riparian resources because they "would be observed at monitoring wells in the region and adverse effects on riparian vegetation would be mitigated by implementation of Mitigation Measure GW-1." The principle mitigation for this impact is the curtailment of pumping until natural recharge corrects the environmental impact. The DEIS overestimates the effectiveness of this measure in avoiding harm to fisheries and riparian resources. Following the curtailment of pumping, a lag time would exist between when the effects of groundwater on streamflows are detected and when the curtailment of pumping would result in the augmentation of stream flows. This lag time could be months to years depending on specific ground and surface water conditions. During this lag time, significant adverse impacts to fisheries could occur.

Response
All references to mitigation measures in Section 3.7, Fisheries, have been removed. Mitigation measures are unnecessary because the effects of the range of potential activities analyzed under the action alternatives would be less than significant without them.

Comment FA01-25

Comment
Recommendation: Define, in the FEIS, triggers that would be used to make the decision to continue pumping or to cease pumping. For example, define at what

depth below historic lows groundwater pumping would be curtailed, and at what point land subsidence measures are considered to be too great to be elastic and pumping would cease. The FEIS should more accurately characterize the potential for harm to fisheries resources during the lag time between impact observation and mitigation benefit.

Response
See Common Responses 6 and 7. Section 3.7 determines there are no significant effects to fisheries.

Comment FA01-26

Comment
In September of this year, Governor Jerry Brown signed a suite of three bills -- AB 1739, SB 1168, and SB 1319 -- collectively called the Sustainable Groundwater Management Act, with the intended goal of moving toward the sustainable management of unadjudicated groundwater basins throughout the state. This legislation will be enacted across the term of the Long Term Water Transfers project and has the potential to affect the proposed project.

Recommendation: Discuss the Sustainable Groundwater Management Act in the FEIS. The stipulations of this legislation should be identified in the "Regulatory Framework" portion of section 3.3. The FEIS should also discuss the potential effects of this legislation on the actions proposed for this project.

Response
Section 3.3.1.2 has been revised to include summaries of the sustainable groundwater management acts (AB 1739, SB 1168, and SB 1319).

Comment FA01-27

Comment
Streamflow Impacts and Water Quality. The proposed project would affect the quantity and timing of streamflow throughout the sellers' service area and downstream into the Sacramento/San Joaquin Delta. In an aquatic ecosystem that has already been severely degraded by reduced instream flows related to freshwater diversion and groundwater overdraft, any action with the potential to further reduce flows has the potential to significantly impair water quality. The DEIS states that, due to the timing and magnitude of potential impacts to streamflow, the project will not cause violation of any Delta water quality standards (p. 3.2-40).

Response
Changes in the flow resulting from transfer alternatives were modeled to assist in the evaluation of potential impacts due to changes in flow in the seller's and buyer's service areas. Appendix C presents a DSM2 modeling analysis of Delta conditions for the alternatives. The modeling addresses regulated parameters to

determine the magnitude of changes to these parameters that could occur if the system operations defined by any of the alternatives were implemented instead of base operations. The flow analysis included changes in south Delta stage heights. Based on water quality standards and objectives, it was determined that any changes in operations resulting from the action alternatives would not significantly affect the quantity and timing of streamflow such that water quality would be impacted.

Comment FA01-28

Comment

The release of transfer carriage water, defined as the "portion of the transfer that is not diverted in the Delta and becomes Delta outflow" (p. 2-29), has the potential to increase outflows by an average of 1.8% (p. 3.2-47) between October and June. The DEIS states that streamflow losses associated with reservoir refilling, groundwater recharge, and loss of irrigation return water are modeled to reduce Delta outflows by up to 0.3 percent during the spring and winter months (3.2-47). However, as discussed in our comments on groundwater resources, the DEIS analysis assumes that water transfers will take place in approximately 35% of water years, while in the past 15 years, transfers have occurred at almost double this frequency. In the event that transfers occur as often as, or perhaps more often than, observed in recent history, groundwater aquifers may not fully recharge between transfers, resulting in greater impacts to streamflow. Furthermore, it is unclear how the increase in Delta outflow was calculated given that the percent of a given water transfer that will be required for carriage is variable – assumed for some transfers to be as much as 20% (Sacramento River) and for others to not apply at all (EBMUD diversions) (p. B-18). If the data presented in the DEIS are average values, it is necessary to understand the maximum possible streamflow loses in order to determine the range of possible project impacts.

Response

See Common Response 5 for a discussion of transfer frequency.

Comment FA01-29

Comment

Recommendations: Describe in the FEIS how an increase in transfer frequency might affect expected streamflow and water quality impacts. Clarify how the proportion of a transfer deemed "carriage water" is determined and how these values were used to calculate expected change in streamflow resulting from project actions.

Response

See Common Response 5 for a discussion of transfer frequency.

Comment FA01-30

Comment

The California State Water Resources Control Board (State Board) has proposed flow criteria for the lower San Joaquin River Basin [Footnote: State Water Resources Control Board, December 2012, Public Draft Substitute Environmental Document in Support of Potential Changes to the Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary: San Joaquin River Flows and Southern Delta Water Quality. http://www.waterboards.ca.gov/waterrights/water_isues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/2012_sed/] and is in the process of preparing a comprehensive update of the Bay Delta Water Quality Control Plan (Bay Delta WQCP) that will include flow criteria for the Delta as a whole. [Footnote: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/] The State Board's 2010 Flows Report [Footnote: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf] underscores the need to increase flows to and through the estuary to support ecosystem processes, safeguard aquatic life, and protect imperiled species. It is not clear whether or how the proposed project would comply with these new requirement at all times.

Response

The exact content of future flow and water quality requirements in the Delta is not known at this time. Requirements for increased flow and improved water quality could require Reclamation, DWR, and other water rights holders to make changes in operations and diversions to meet standards. Reclamation would need to consider these requirements and determine how best to meet them, but the requirements would not be met through independent water transfers (as described in this EIS/EIR). The purpose and need/project objectives for this effort addresses the need for water supplies during years with shortages under current conditions. The water transfers described in this EIS/EIR would not contribute to meeting any new flow standards, but they would be operated so that they did not reduce the ability of Reclamation, DWR, and other water rights holders to meet the standards.

Comment FA01-31

Comment

Any water transfer program will have to be designed for operational flexibility so it can comply with existing water quality standards (such as the X2 salinity standard within D-1641 [Footnote: http://www.waterboards.ca.gov/waterrights/water_isues/programs/bay_delta/decision_1641/index.shtml. X2 refers to the distance from the Golden Gate up the axis of the estuary to the point where daily average salinity is 2 parts per thousand at 1 meter off the bottom. X2 provides a surrogate measure for the low salinity zone favored by an assemblage of native fish where abundance and survival is statistically greater than in other parts of the estuary. http://online.sfsu.edu/modelds/Files/References/JassbyEtAl1995EcoApps.pdf]), and potentially more stringent standards once the comprehensive Bay Delta WQCP is completed. On the whole, these new requirements are anticipated to necessitate that less water be diverted for human consumption and more be left in the river for aquatic life. While Appendix B provides detailed analysis of the project's potential effects on the X2 salinity standard, the current text of the DEIS constitutes an insufficient summary of these data (p. 3.2-40). In addition, the modeling performed for assessing impacts to the position of X2 relies upon monthly averages of that position. Monthly averages are not the appropriate “time step” as they can mask violations and standards. Impacts to the position of X2 must be analyzed and evaluated in the units in which the standard is written in order to demonstrate compliance.

Response
Additional information regarding a summary of Delta conditions resulting from the transfer alternatives has been added to Section 3.2. Water transfers are a flexible tool (as required by the purpose and need and project objectives). Appendix C includes additional information on Delta conditions, including water quality.

Comment FA01-32

Comment
Recommendations: Recent proposals by the State Board to include specific flow requirements in future Water Quality Control Plans for the Sacramento/San Joaquin River Delta should be discussed in the FEIS. Explain how the proposed project would be designed and operated with the flexibility needed to achieve compliance with current water quality standards and future standards that might be significantly more stringent.

Response
See Response to Comment FA01-30.

Comment FA01-33

Comment
Streamflow modeling data should be analyzed to determine any change in the position of X2 on a daily basis through time in order to demonstrate that water transfers would not cause the X2 standard to be violated. Include in the FEIS a fuller summary of the data contained in Appendix B to properly support the assertion that the proposed project would not violate the existing X2 standard. If any violations of the X2 standard are found in the modeling to occur on a daily basis, the FEIS should identify this significant impact, indicate the frequency of modeled exceedance, and discuss mitigation that would prevent this impact.

Response
Additional information regarding a summary of Delta conditions resulting from the transfer alternatives has been added to Section 3.2. Appendix C includes more detail.

Comment FA01-34

Comment
The DEIS states that changes in streamflow of less than ten cubic feet per second (cfs) are assumed to have no impact upon water quality (p. 3.2-27). This assumption is not supported with appropriate citation or data. The explanation that changes of less than 10 cfs are outside the accuracy of the model employed is insufficient to demonstrate that this threshold is physically or chemically appropriate. Depending on water levels and flow conditions, a loss of 10 cfs could degrade water quality.

Response
This standard has been removed from the Assessment Methods section. The impact analysis previously presented changes in flows that were below this threshold.

Comment FA01-35

Comment
Recommendation: Explain, in the FEIS, the basis for the assumption that streamflow changes of less than 10 cfs would not affect water quality. If data supporting such an assumption are not available, we recommend that BOR reconsider its use of this assumption for its analysis. If a lower threshold for significance is deemed appropriate, but the available modeling tools lack the resolution to predict all impacts at this threshold, we recommend that the remaining uncertainty be clearly identified in the FEIS and a precautionary approach be taken with regard to permitting water transfer related actions.

Response
This standard has been removed from the Assessment Methods section. The impact analysis previously presented changes in flows that were below this threshold.

Comment FA01-36

Comment
The DEIS consider potential streamflow impacts to smaller tributaries in Section 3.7. It states that, for rivers and their major tributaries, groundwater and streamflow modeling was compared against historical flow data to assess impacts to surface water flows. For smaller streams and water bodies, where insufficient data were available to allow this approach, the analysis assumed that streamflow response was similar to that of larger adjacent modeled

waterways. This approach is significantly flawed. Model resolution is not the appropriate basis for excluding smaller waterways from a more detailed examination. Smaller water bodies will respond differently to changes in groundwater contributions than will larger water bodies and are potentially much more sensitive to small changes in f1ow magnitude and frequency. Where a loss or reduction in groundwater contributions to a section of a large water way may result in a small reduction in flow, but no loss of ecological function, the same reduction in groundwater contributions to a smaller tributary stream could result in near or complete dewatering and a significant degradation of ecological function.

Response
The analysis uses the best available modeling and analysis tools. No such tools were available for these smaller streams, therefore a more quantitative analysis could not be conducted for them. A qualitative assessment based on best professional judgment, inferences predicated on facts, and the reasonable assumption that changes in flow in smaller streams were similar to those of adjacent larger streams were used to analyze these smaller streams. Overall, the analysis is very conservative. The assertion by the commenter that smaller water bodies respond differently from larger water bodies may be true under some site-specific circumstances, but the opposite may also be true under other site-specific circumstances. Due to the uncertainty of potential responses and based on available data, Reclamation and SLDMWA assume, for the purposes of this EIS/EIR, that the smaller streams respond similarly to larger streams. As specific transfers are proposed, and if warranted under site-specific conditions, additional quantitative analysis of smaller streams may be appropriate. See responses to Comments FA01-37 and NG10-28 for additional discussion of site-specific streamflow data. See Common Response 14 for additional discussion regarding consideration of specific transfer proposals.

Comment FA01-37

Comment
Recommendations: Additional site specific information, including streamflow data and the likely proportion of flow contributed by groundwater, is needed in order to determine the likely effect of groundwater substitution transfers on smaller streams and waterbodies in the seller's service area. The FEIS should explicitly identify where uncertainty exists due to model limitations, and describe the range of potential impacts contained within that uncertainty. In the absence of the necessary site specific data for a more comprehensive analysis, we recommend that BOR consider taking a precautious approach to minimize potential ecological risk.

Response
Site specific information was gathered for each stream. When limited or no information was available, the analysis considered the size of the stream, whether it was ephemeral, and the effects of groundwater substitution pumping

on other neighboring waterways. Overall, the analysis is very conservative. See response to Comment NG10-28 for more information.

Comment FA01-38

Comment

The DEIS states that changes in stream flows on the San Joaquin River and in the Sacramento/San Joaquin Delta will be less than significant because total reductions in flow will be only a fraction of a percent. A two percent reduction in flow is identified as the threshold for significance for this impact. A more refined analysis of impacts to species would have to be conducted to determine whether this significance threshold is biologically appropriate. According to the State Board, [Footnote: State Water Resources Control Board, 3 Aug. 2010, Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem Prepared Pursuant to the Sacramento-San Joaquin Delta Reform Act of 2009, (2010 Flows Report), available at http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf] U.S. Fish and Wildlife Service, [Footnote: "Interior remains concerned that the San Joaquin Basin salmonid populations continue to decline and believes that flow increases are needed to improve salmonid survival and habitat." USFWS May 23, 2011 Phase I Scoping Comments: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/cmmnts052311/amy_aufdemberge.pdf] NMFS, [Footnote: "Inadequate flow to support fish and their habitats is directly and indirectly linked to many stressors in the San Joaquin river basin and is a primary threat to steelhead and salmon." NMFS Feb. 4, 2011 Phase I Scoping Comments: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control _planning/cmmnts020811/010411dpowell.pdf] and the California Department of Fish and Wildlife, [Footnote: "…current Delta water flows for environmental resources are not adequate to maintain, recover, or restore the functions and processes that support native Delta fish." Executive Summary of California Department of Fish and Game, November 23, 2010, Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta.] existing conditions in the San Joaquin River basin are not adequate to protect aquatic life. All three fisheries agencies identified salmon and steelhead populations as declining under current flow conditions. The DEIS does not provide sufficient support for the conclusion that this further reduction in flow would not adversely affect these species or other native aquatic species.

Response

The analysis compares conditions under each action alternative to existing conditions to determine the potential for significant adverse effects. The analysis found that the incremental effect of the range of potential transfer activities analyzed under the action alternatives would be less than significant.

See Section 3.7.2.4 of the EIS/EIR for a detailed explanation of the bases of this conclusion.

The commenter would like the thresholds of significance under CEQA to be zero such that any change, no matter how small, would be significant. The preparers of the EIS/EIR who model hydrology have indicated the changes to the environment are barely perceptible. As such, they are within the range of normal operations of existing facilities and are less than significant under CEQA.

Comment FA01-39

Comment
The DEIS indicates that, under the proposed project, the many waterways in the project area are likely to experience higher flows during some portions of the year but lower flows during wetter periods. There are many benefits to maintaining flood flows in rivers in wet years as they inundate floodplains and initiate ecosystem processes that support aquatic life. Juvenile salmon will rear on seasonally inundated floodplains when available. This has been found to increase growth and survival in the Central Valley, specifically in the Yolo Bypass and the Cosumnes River floodplain. [Footnote: T.R. Sommer, M.L Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer, 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Can. J. Fish. Aquat. Sci. 58: 325-333.] [Footnote: C.A. Jeffres, J.J. Opperman, and P. Moyle. 2008. Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in California river. Environmental Biology of Fishes, Published online June 6, 2008: www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/exhibits/usdoi/spprt_docs/doi_jeffres_2008.pdf] These benefits to the ecosystem would be lost if peak flows and flood pulses are suppressed, and contribute increased stress on fish populations that are already adversely affected by flow diversions (e .g., loss of spawning gravels, reduced foraging habitat, loss of cold water).

Response
Reclamation and SLDMWA do not disagree with this statement and do not see any conflict between the analysis and this statement. The ten percent screening threshold for instream flow in rivers and creeks is one of multiple criteria used to determine whether there were significant impacts on aquatic and terrestrial resources. Use of the ten percent threshold is described in Section 3.7.2.1.3. See response to Comment NG10-28 for additional information.

The analysis used two screening criteria to determine whether there were substantial flow reductions in waterways: a greater than 1 cfs reduction criterion and a greater that 10 percent reduction criterion. Flow reductions in the majority of waterways did not meet either of these criteria (see Table 3.7-3). Because there is high environmental heterogeneity in these Central Valley streams, a change of 1 cfs, either higher or lower, is not uncommon. This is why the 1 cfs criterion, in combination with the 10 percent criterion, were used and were considered highly conservative for detecting substantial flow changes. For those waterways with changes greater than the criteria, Section 3.7.2 includes a further biological analysis that considers the types of biological benefits discussed in the comment. Flow changes during wet periods represent a very small percent of flow during these periods (a barely perceptible change), and would not alter floodplain inundation. See response to Comment NG10-28 for additional information.

Comment FA01-40

Comment
Recommendation: More thoroughly analyze the project's potential impacts on native ecosystems, including sensitive and endangered species, from changes in streamflow. Clearly define, in the FEIS, the criteria used for defining harm to species. Where significant impacts are found to occur, the FEIS should discuss potential mitigation measures.

Response
See response to Comment FA01-39. Because streamflow changes associated with the range of potential transfer activities analyzed under the action alternatives are insubstantial, no significant impacts on native ecosystems from changes in streamflow are anticipated.

Comment FA01-41

Comment
The idling of cropland has the potential to result in increased sediment runoff to local waterbodies. The document contends that this impact is expected to be less than significant due to the crust-like surface formed on rice fields after they are drained and the assumption that farmers idling upland crops will employ soil retention measures (p. 3.2-29). The DEIS does not discuss the possible benefits of planting cover crops toward preventing sediment runoff, especially where landowners choose not to employ other erosion control techniques.

Response
The commenter is correct that runoff from idling of cropland was not found to have a significant impact on water quality. As a result, mitigation measures such as cover crops were not evaluated as part of this study. However, additional information was added to Section 2.3.2.1 to describe how non-irrigated vegetation left on idled fields may improve the existing condition and habitat value of these fields.

Comment FA01-42

Comment
Recommendations: Discuss, in the FEIS, the feasibility and benefit of planting or encouraging the growth of cover vegetation for reducing soil erosion and sediment runoff into waterways.

Response
The analysis of runoff from idled fields found this type of action was not necessary to reduce soil erosion, but it could improve existing conditions and habitat value. Text has been added in Section 2.3.2.1 to describe how non-irrigated vegetation left on idled fields may improve the habitat value of these fields.

Comment FA01-43

Comment
Fisheries. Chapter 3.7 of the DEIS assesses the project's potential impacts upon fisheries. EPA finds that the analysis performed lacks the resolution necessary to identify the full range of potentially significant adverse impacts the project may have upon fisheries, including potential impacts on special status species. The modeling performed for this analysis relied upon the flawed assumptions that a transfer action would have no adverse impact upon fisheries if modeled flow reduction were of less than one cubic foot per second (cfs) or less than a ten percent change in mean flow by water year type (p. 3.7-20). These assumptions inappropriately limit the scope of the impact analysis and undermine the accuracy of the conclusions reached.

Response
The EIS/EIR employs the best available tools. When tools were not available, the analysis required assumptions, inference, and best professional judgment. There were several steps to the analysis, including the screening analysis of 1 cfs and 10 percent, followed by a biological analysis. The 10 percent assumption used was based on previous legally certified documents (as discussed in Section 3.7.2.1.3) and is, therefore, appropriate for use. The 1 cfs assumption was an additional criterion needed for larger streams. Ultimately, the range of potential activities under the Proposed Action, throughout the many analyses conducted, was found to be less than significant in all waterways for fisheries resources.

Comment FA01-44

Comment
The DEIS contends that any change in flow of less than ten percent falls within the "noise of model outputs and beyond the ability to measure actual changes" (pg. 3.7-20). It is not logical nor acceptable for purposes of this analysis to conclude that biological impacts are limited to the range of flow changes

capable of being represented by the model employed. Research has examined the effects of implementing freshwater flow prescriptions for rivers and estuaries that mimic the pattern of the natural hydrographs in order to protect aquatic species with life histories adapted to such flow patterns. [Footnote: “Major researchers involved in developing ecologically protective flow prescriptions concur that mimicking the unimpaired hydrographic conditions of a river is essential to protecting populations of native aquatic species and promoting natural ecological functions”. (Sparks 1995; Walker et al. 1995; Richter et al. 1996: Poff et al. 1997: Tharme and King 1998: Bunn and Arthington 2002: Richter et al. 2003; Tharme 2003: Poff et al. 2006; Poff et al. 2007: Brown and Bauer 2009). SED. Appendix C. p. 116] For example, work performed by Richter, et. al. [Footnote: Richter, B.D., Davis, M., Apse, C., and Konrad, C. P. 2011. A presumptive standard for environmental flow protection. River Research and Applications. DOI: 10.1002/rra.1511. http://eflownet.org/downloads/documents/Richter&al2011.pdf] on riverine systems in Florida, Michigan, Maine, and the European Union found that the maximum cumulative depletion of flows allowable to ensure adequate protection of aquatic species ranged from 6- 20% year-round or in low-flow months and 20-35% in higher flow months. These scientists recommended the equivalent of no less than 90% of natural flow to achieve a high-level of ecological protection, and no less than 80% of natural flow to achieve a moderate level of ecological protection. Central Valley watersheds experience a much higher proportion of flow alteration than these scenarios. For example, during a median year in the San Joaquin River system, only 31% of the natural flow is allowed to remain in the river channel. [Footnote: EPA Comments on the Bay Delta Water Quality Control Plan, Phase I SED. March 28, 2013. Available at: http://www.epa.gov/sites/production/files/documents/sfdelta-epa-comments-swrcb-wqcp-phase1-sed3-28-2013.pdf] In a system that is so severely impacted with regard to streamflow, additional reductions in flow of less than ten percent have the potential to cause significant adverse impacts.

Response

The ten percent screening threshold for instream flow in rivers and creeks is one of multiple criteria used to determine whether there were significant impacts on aquatic and terrestrial resources. Use of the ten percent threshold is described in Section 3.7.2.1.3. See response to Comment NG10-28 for additional information. While the hydrologic models used for the analysis are considered to be the best available, they are not perfect and a certain amount of “noise” is associated with them. It is not reasonable or appropriate to consider any model as having perfect predictive power.

Comment FA01-45

Comment

Similarly, because streams and stream flows vary greatly at the reach scale due to environmental heterogeneity, changes of less than 1 cfs can have significant adverse effects on fishes and amphibians, depending on the specific reach affected and the conditions in that reach at the time of impact. Fishes, especially special status species, rely on high quality reaches as refugia for population persistence. Any degradation of reach quality has the potential to affect population vitality.

Response
Reclamation and SLDMWA agree that there is high environmental heterogeneity in these Central Valley streams. As a result, a change in 1 cfs, either higher or lower, is not uncommon. This is why the 1 cfs criterion, in combination with the 10 percent criterion, were used and were considered highly conservative for detecting substantial flow changes. See responses to Comments FA01-39 and NG10-28 for additional information. The commenter would like the thresholds of significance under CEQA to be zero such that any change, no matter how small, would be significant. The preparers of the EIS/EIR have indicated the changes to the environment are barely perceptible. As such, they are within the range of normal operations of existing facilities and are less than significant under CEQA.

Comment FA01-46

Comment
According to the DEIS, the Central Valley Project Improvement Act of 1992 requires that a transfer "will not adversely affect water supplies for fish and wildlife purposes" (p. 1-11). Based upon the information provided in the DEIS, it is not clear that this provision would be met if the "Full Range of Transfer Measures" project alternative (the preferred alternative) is implemented as currently described.

Response
See response to Comment NG10-36.

Comment FA01-47

Comment
Recommendations: Perform additional modeling and analysis to more accurately assess potential impacts of the project upon fisheries. We recommend discarding the flawed assumptions that underpin the analysis performed for the DEIS. The FEIS should disclose when model resolution is too coarse to capture flow changes with the potential to adversely impact fisheries, and identify measures that would avoid or mitigate adverse impacts to fisheries and the aquatic environment in connection with actions authorized by the proposed project. Explain how and when the need for implementation of such measures would be determined.

Response
The EIS/EIR contains a complete analysis of fisheries resources impacts. See response to Comment NG10-36 for a more detailed description of the analysis.

Comment FA01-48

Comment

The bulk of the analysis presented in section 3.7 of the DEIS focuses primarily upon the proposed project's potential impacts upon a short list of “species of management concern”. It is unclear why the numerous other native fishes potentially affected by the proposed project are not more thoroughly examined. For example, page 3.7-9 provides a list of waterways that do not contain special-status fish species, followed by the statement, “as a result, no further biological analysis was conducted in these waterways". It is not clear why the DEIS concludes that potential impact to non-special-status species are inherently less than significant. Numerous native species may inhabit these waterways and may be exposed to adverse conditions as a consequence of this project. Furthermore, the DEIS does not demonstrate that potential impact to fish assemblages or communities were considered, only impacts upon individual species. While protection of individual special status species is important, the project's potential impacts upon fisheries at the ecosystem scale may be equally significant and worthy of consideration.

Response

A discussion of effects to native species and conclusion of no impacts have been added to the section.

Comment FA01-49

Comment

Recommendations: Discuss, in the FEIS, the proposed project's potential impact upon all native species, rather than focusing solely upon “species of management concern”; this should include analysis of potential impacts upon waterways previously eliminated from analysis for fisheries impacts. We recommend that the FEIS analyze potential impacts to multi-species communities, rather than focus solely on single-species impacts.

Response

A discussion of effects to native species and conclusion of no impacts have been added to the section.

Comment FA01-50

Comment

The DEIS explains that native fishes assemblages in the deep-bodied fishes zone have been replaced largely by non-native assemblages, citing "Moyle (2002)" (page 3.7-6). While this is generally true for the San Joaquin River, it is not an accurate characterization for the Sacramento River system. Many more recent studies of fishes in the Sacramento River system have been produced since 2002 that more accurately characterize the current condition of fisheries in that system.

Response
Reclamation contacted EPA and requested they provide the references offered in this comment. EPA suggested that Reclamation contact one or more of the four fisheries biologists whose names and employers were provided by EPA in their response. All four individuals were contacted and Reclamation received responses from Peter Moyle, Michael Marchetti, and Larry Brown with the information needed to address this comment. The text has been updated based on their responses.

Comment FA01-51

Comment
Recommendations: A review of available scientific literature related to the fish assemblages of the Sacramento River should be conducted and the most current reliable data should be employed for defining existing conditions and determining potential project impacts. Based on this review, clarify the potential for the proposed project to adversely affect native fish assemblages in the deep-bodied fishes zone. EPA would be willing to assist BOR in acquiring the relevant literature, if needed.

Response
See response to Comment FA01-50.

Comment FA01-52

Comment
The DEIS understates potentially significant impacts to anadromous fish species by focusing on peak habitation times and locations, without regard for the potentially substantial number of individuals who may occur in waterways outside of peak times. For instance, water transfers, which would occur from July through September, would coincide with the spawning period of winter-run Chinook salmon. The DEIS states that "spawning occurs upstream of the areas potentially affected by the transfers. Due in part to elevated water temperatures in these downstream areas during this period, emigration would be complete before water transfers commence in July." (pg. 3.7-12) While most winter-run emigration is completed between Sept-June, not all emigration is complete by the end of June, and this is important for such a diminished species because every individual counts. Depending on the water year and river conditions, some fish continue to emigrate beyond June. Therefore, the conclusion that no potential effect to winter-run Chinook salmon emigration would occur is not supported. Similarly, the DEIS indicates that impacts to spring-run Chinook salmon would be less than significant because "the bulk of upstream migration (March-September, peaking May-June) and emigration (November-June) would be complete before water transfers commence in July" (pg. 3.7-13 to 14).

Response
The section referred to by the commenter is an initial discussion of potential effects. Later in the document (Section 3.7.2.4 for the Proposed Action), there is a full analysis of potential impacts to flows in the Sacramento River for all months and water year types, including those that were suggested by the commenter. The analysis concludes that impacts would be less than significant because there are no substantial changes in flows in waterways that winter- and spring-run Chinook salmon inhabit except Little Chico Creek, which is discussed separately.

Comment FA01-53

Comment
While most migration may occur outside the proposed transfer period, the DEIS does not discuss in sufficient detail the potential adverse effects of the proposed project upon those migrating or emigrating fish that would be present in waterways affected by transfer actions. Furthermore, the DEIS contends that, while summer rearing of Central Valley steelhead would overlap with water transfers in the Seller Service Area, "the majority of rearing ... would occur in the cooler sections of rivers and creeks above the influence for the water transfers." (page 3.7-15). This statement requires a citation if it is to serve as the basis for concluding that potential adverse effects on Central Valley steelhead summer rearing is unlikely to occur. Again, while most of the rearing may occur outside the area to be adversely affected by water transfers, the DEIS suggests that this is not the case for all rearing, and this potential adverse effect is not quantified or analyzed in sufficient detail.

Response
The text has been changed and reference provided, although it is not the basis for conclusions drawn later. The lack of changes in flows in the rivers is the basis for these conclusions.

Comment FA01-54

Comment
Recommendation: The FEIS should accurately characterize the potential impact upon winter-run Chinook salmon and Central Valley steelhead. Where adverse impacts are likely to occur, potential mitigation measures should be proposed and analyzed.

Response
See response to Comment NG10-36 for a more detailed description of the analysis. No mitigation was necessary because the analysis shows no significant impacts are anticipated.

Comment FA01-55

Comment
The discussion of potential impacts to steelhead and hardhead understates potential impacts and ignores the potential consequence for these populations where consecutive dry or critically-dry water years occur. The DEIS states that, although juvenile steelhead and hardhead could be present in some rivers affected by reduction in flows, those reductions occur "only one month and one water year type in one month," and therefore this impact is not expected to have a substantial effect on these species (page 3.7-28), but the potential adverse effects on these species during this one month period are not clearly characterized. If mortality is possible due to adverse stream conditions, then the brief duration of this impact does not necessary ensure minimal harm. Furthermore, if a dry or critically-dry year follows one of the same, the adverse effects during this one month period could be compounded.

Response
The text has been clarified to address this comment. Reclamation and SLDMWA have provided further biological information to support the conclusion that there would be less than significant impacts to fisheries resources in Stony Creek.

Comment FA01-56

Comment
Recommendations: Clearly explain the criteria used to conclude that these potential effects on steelhead and hardhead would be less than significant. The cumulative effect analysis should encompass consecutive dry and critically-dry years.

Response
As described in Section 3.7.2.4, a reduction of 10.0 percent in one water year type and one month is infrequent and, therefore, not considered a "substantial" effect to the habitat of target species, which is the significance criterion used in the EIS/EIR.

Comment FA01-57

Comment
Migratory Birds. With the large-scale conversion of Central Valley riparian forests and wetlands to agriculture and suburban development, birds and other wildlife have become increasingly dependent on agricultural lands for food and cover. Ricelands serve as essential breeding and wintering habitat for nearly 187 species of birds, 27 species of mammals, and 15 species of reptiles (of which 30 are considered special-status species) [Footnote: "Wildlife Known to Use California Ricelands," 2011. Prepared for California Rice Commission http://calrice.org/pdf /wildlife/Species-Report.pdf]. The DEIS focuses almost

exclusively on the proposed project's potential adverse effects upon special status species while potentially significant adverse effects upon migratory birds are either discounted or ignored altogether. Ricelands provide a high-value food source from the 75,000 tons of grain estimated to remain on the ground each year due to harvesting inefficiencies. As a result, wintering waterfowl are estimated to gather more than 50% of their nourishment from ricelands.

Response
See response to Comment FA01-7.

Comment FA01-58

Comment
The DEIS contends that a reduction in acres of flooded agricultural fields in the Delta resulting from the idling of cropland and the shifting of crops would not affect species migrating to the project area during spring because these species would simply select suitable habitat upon arrival (Section 3.8.2.4.1). But the proposed project could remove up to 51,473 acres (p. 3.8-64) of valuable farmed wetlands from the landscape and the DEIS' apparent conclusion that migratory bird population can quickly adapt to a radically altered mosaic of fallowed fields and farmed wetlands seems flawed and not supported by scientific documentation. Furthermore, the DEIS appears to incorrectly assume that all other factors will be held equal while cropland idling and water transfers take place. This is not the case. The critically-dry water years in which the maximum amount of water transfers are likely to take place are also the years when Delta farmers are most likely to fallow their lands, either voluntarily or due to water shortage, and these outcomes could greatly compound the adverse effects of the proposed project. For instance, the California Rice Commission reports that while farmers flood between 150,000 and 350,000 acres of ricelands annually in the Southern Sacramento Valley and Delta, farmers planted ~20% fewer acres during 2014 and may flood as little as 50,000 acres of ricelands in the 2014-2015 season due to the ongoing drought and water shortages. [Footnote: "Wintering Waterfowl Habitat Concerns Looms Large," California Rice Commission, September 16 2014, http://calrice.org/blog/?id=1410890340&author=California+Rice+Commission]

Response
See response to Comment FA01-7.

Comment FA01-59

Comment
Recommendations: The FEIS should thoroughly characterize the potential reduction in resting and forage habitat for migratory bird species resulting from cropland idling and crop shifting. The FEIS should consider these potential impacts in the context of current trends regarding habitat availability and anticipated future conditions resulting from climate change and changes in

farming practices. The FEIS should discuss means for ensuring that sufficient wetted habitat (natural wetland or flooded field) is available for migrating bird species.

Response

Habitat variability due to changes in farming practices is common within the potential transfer areas and is reasonably certain to continue into the future. The range of potential transfer activities analyzed in this EIS/EIR will not significantly affect the degree of change within this highly variable landscape. Effects from climate change, although reasonably certain to occur, are not expected to result in substantial changes to existing habitat conditions during the 10-year term of analysis.

Comment FA01-60

Comment

Riparian Communities. The project has the potential to have significant adverse effects on riparian systems, but the DEIS discounts these potential effects, in part because "changes in stream flow attributable to the Proposed Action would fall within historical ranges" (page 3.8-52). It should be recognized, however, that water management practices administered by federal and State agencies and local irrigation districts have already caused great stress on riparian systems and their associated fish and wildlife species. Recent consumptive patterns involving surface water diversions and groundwater pumping have, in effect, simulated, for fish and wildlife, severe and prolonged drought conditions whether or not drought conditions are actually present. The shift in hydrological conditions has caused a shift in species composition as native fishes have been overwhelmed and replaced by introduced and invasive aquatic species. Additional stress on these aquatic ecosystems could reinforce these adverse effects and potentially cause permanent, unmitigable impacts. The DEIS identified impacts to Cache, Stony, Coon, and Little Chico creeks that would be significant, with Little Chico Creek going to zero flow under some project scenarios. By their nature, no-flow conditions can lead to long-term and irreplaceable losses of ecosystem function.

Response

See Common Response 11. As described and analyzed in Section 3.8 of the EIS/EIR, the range of potential transfer activities analyzed in this EIS/EIR would not result in significant losses in ecosystem functions.

Comment FA01-61

Comment

Recommendation: Revise the EIS to more accurately characterize potential impacts to riparian communities. Identify robust mitigation measures that would ensure that the proposed project would not diminish instream flows in waterbodies affected by the proposed project.

Response
See Common Response 10 and Common Response 11 related to effects to vegetation communities.

Comment FA01-62

Comment
The DEIS identifies GW-1 as a mitigation measure for off-setting the potential adverse effects on stream flows from groundwater substitution, but the proposed measure may not provide full compensation for the potential significant adverse effects on riparian systems. Based on the information provided in the DEIS, it appears that the proposed project does not contain provisions for preventing the complete dewatering of smaller streams near groundwater pumping zones. As mitigation measure GW-1 is designed to be reactionary, dewatered stream conditions might persist for extended periods before natural recharge to aquifers could restore base flows. This could result in serious indirect costs, such as the loss of mature riparian vegetation essential to the structure and function of riparian systems. Even if measures are taken to restore the riparian forests, the genetic losses could be permanent and full restoration may not be possible.

Response
The monitoring requirements of Mitigation Measure GW-1 have been clarified. See Common Response 10 for additional information.

Comment FA01-63

Comment
Recommendations: Revise measure GW-1 to address potentially irreversible adverse effects to riparian systems and related habitats from the implementation of the proposed project. Include, in the proposed monitoring plan, monitoring of any small tributary streams near the point of groundwater extraction. We recommend that specific mitigation triggers be established identifying the percent reduction in flow outside the natural range that would require a cessation of pumping.

Response
See response to Comment FA01-62.

Comment FA01-64

Comment
Range of Alternatives. In the development of project alternatives, BOR employed a screening criterion that all alternatives must be immediate, flexible, and provide new water to the buyers' service area. The requirement that all project alternatives provide water was used to screen out potential project components involving the conservation or transfer of water within the seller service area (Table 2-1). It is unclear why this screening criterion was deemed

necessary and how it relates to the project "need" of immediately implementable and flexible water supplies to alleviate shortages (p. 1-2). The restriction imposed that the alternatives need to “provide water” screens out all alternatives that would promote reducing demand in the buyer area and having water rights holders operate within the limit of their existing legal water rights. Some of the alternatives screened out by this criterion might be found to be environmentally and economically preferable. For example, retirement of drainage impaired areas that leach selenium into the San Joaquin River has been documented to have environmental and economic benefits in a National Economic Development Analysis conducted as part of the San Luis Drainage Feature Re-evaluation FEIS. [Footnote: San Luis Drainage Feature Re-evaluation Final EIS (2007) available at: http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=61] It is unclear why within basin transfers in the buyers service area, considered in conjunction with demand reducing measures, such as conservation and land fallowing, would not meet the underlying project need to supply water to meet shortages.

Response
The Lead Agencies established the purpose and need and project objectives to best describe their underlying reasons for considering an action. The objective to "develop supplemental water supply for member agencies during times of CVP shortages to meet existing demands" reflects the water shortages felt by transfer recipients and their desire to receive additional water during these shortages.

Reclamation, as an agency, has multiple planning efforts ongoing to satisfy their directives. The San Luis Drainage Feature Re-Evaluation reflects different objectives, and is being carried forward as a different project to achieve those objectives. See responses to Comments NG03-125 and NG03-141 for additional information.

Comment FA01-65

Comment
It is also unclear why groundwater storage ("Build new facilities to recharge and extract groundwater for use in buyer service area") in the buyers service area was deemed as not providing new water supply. If aquifers are recharged in wet years, then that water is pumped and used in dry years, it seems this alternative would offer "new supply" in circumstances similar to those when pumping of groundwater from the seller's service area would enable groundwater substitution transfers.

Response
The detailed reasons for screening out the Groundwater Storage Alternative are explained in Appendix A, Section 4.1.13. Groundwater storage could provide water during dry or critical years, but that supply depends on having an

available source of water to recharge. Agencies in the buyer service area face water shortages in most years and would not have additional water available for recharge. Without an adequate source of recharge water, this measure would not provide sufficient water to reduce CVP shortages.

Comment FA01-66

Comment
Recommendation: Explain how the screening criteria were developed and why the requirement that a project component provide new water was deemed appropriate and necessary. A number of the measures eliminated from further consideration in Table 2-1 warrant further consideration and discussion. The FEIS should explain why measures to limit demand and enable within basin exchange of water in the buyer service area, considered in conjunction with one another, would not meet the screening criteria identified.

Response
Appendix A includes additional detail on how the screening criteria were developed and why measures were eliminated from further consideration.

Comment Letter SA01, Helen Birss, California Department of Fish and Wildlife

Comment SA01-1

Comment
The California Department of Fish and Wildlife (CDFW) has reviewed the Bureau of Reclamation and San Luis & Delta-Mendota Water Authority (SLDMWA) Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Long-Term Water Transfers Project (Project). Thank you for providing CDFW the opportunity to address its area of statutory responsibility in the EIS/EIR (Cal. Code Regs., tit. 14, §§15086 & 15088).

The goal of the Project is to reduce Central Valley Project (CVP) supply shortages caused by dry hydrologic years by transferring water from entities upstream from the Sacramento-San Joaquin Delta to SLDWMA Participating Members and other CVP water contractors south of the Delta. Water would be made available for transfer through groundwater substitution, cropland idling, crop shifting, reservoir release, and conservation. The EIS/EIR evaluates potential impacts of water transfers over a 10-year period, 2015 through 2024.

CEQA Role: CDFW is a Trustee Agency as defined in the Guidelines for the Implementation of the California Environmental Quality Act (Cal. Code Regs., tit. 14, § 15000 et seq.; hereafter CEQA Guidelines) with responsibility for commenting on projects that could affect fish and wildlife resources (CEQA Guidelines, § 15386). CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of those species (i.e., biological resources).

As a Trustee Agency, CDFW is responsible for providing, as available, biological expertise to review and comment upon environmental documents and impacts arising from project activities, as those terms are used under CEQA (Fish & G. Code, § 1802). CDFW anticipates that it may use the final EIS/EIR and act as a Responsible Agency as part of possible future consideration and issuance of discretionary approvals, described below.

Discretionary Approvals: State Threatened, Endangered, and Candidate Species: CDFW has discretionary authority over activities that could result in the "take" of any species listed as candidate, threatened, or endangered pursuant to the California Endangered Species Act (CESA; Fish & G. Code, § 2050 et seq.). DFW considers most adverse impacts on CESA listed species, for the purposes of CEQA, to be significant without mitigation. Take of any CESA-listed species is prohibited except as authorized by state law (Fish & G. Code, §§ 2080 & 2085). Consequently, if Project activities result in take of CESA-listed species, CDFW recommends that the Project proponent seek appropriate authorization prior to Project implementation. This may include an incidental take permit (ITP) or a consistency determination in certain circumstances (Fish & G. Code, §§ 2080.1 & 2081 subd. (b)).

Rivers, Lakes, and Streams: An entity may not: substantially divert or obstruct the natural flow of; substantially change or use any material from the bed, channel, or bank of; or dispose of any debris, waste, or other material into, any river, stream, or lake unless certain conditions are met. For such activities, the entity must provide written notification to CDFW. Based on the written notification and site specific conditions, CDFW will determine if the activity may substantially adversely affect an existing fish or wildlife resource and issue a Lake or Streambed Alteration (LSA) Agreement to the entity that includes reasonable measures necessary to protect the resource (Fish & G. Code, § 1600 et seq.).

Note that CDFW must comply with CEQA prior to issuance of an ITP or LSA Agreement for a project. As such, CDFW may consider the Lead Agency's CEQA documentation for the project. To minimize additional requirements by CDFW and/or under CEQA, the final EIR should fully disclose potential Project impacts on CESA-listed species and any river, lake, or stream, and provide adequate avoidance, minimization, mitigation, monitoring and reporting measures for issuance of an ITP or LSA agreement.

Response

The action alternatives do not include actions that would trigger the need for a Lake or Streambed Alteration Agreement with CDFW. The EIS/EIR addresses potential effects to both federal- and state-listed species in Sections 3.7, Fisheries and 3.8, Vegetation and Wildlife.

Comment SA01-2

Comment
Section ES.2.2, Page ES-6, Table ES-2:

The EIS/EIR states that Merced Irrigation District (ID) is a Potential Seller of 30,000 acft of water. However, Merced ID is seeking a new license from the Federal Energy Regulatory Commission (FERC) for continued operation of the Merced River Hydroelectric Project, and in July 2014, CDFW submitted to FERC recommended mitigation measures for the new license, including significant changes to in stream flow releases and reservoir operations. In September 2014, Merced ID responded to CDFW's recommendations in a document filed with FERC as part of the FERC Project No. 2179 administrative record titled, "Merced ID's Reply to Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions." On pages 106-107 of this document, Merced ID predicted that compliance with CDFW flow recommendations "increases the average annual water supply shortage by more than 100,000 ac-ft and creates shortages in most year types. [CDFW's] recommendation reduces average annual carryover capacity storage by ... 73,000 ac-ft compared to the Merced ID's Proposed Project." Analogous recommendations by the U.S. Fish and Wildlife Service (USFWS) and other agencies to modify flow releases and reservoir operations received similar responses from Merced ID, all indicating significant water supply shortages and reduced carryover volumes if the recommended mitigation measures were implemented. There appears to be a substantive disconnect between these kinds of water supply evaluations in the FERC administrative record and the Project EIS/EIR which lists Merced ID as a willing seller of up to 30,000 ac-ft annually.

CDFW recommends that the EIS/EIR scope reference the ongoing FERC relicensing and incorporate the water supply and carryover volume analyses submitted by Merced ID to FERC. A Draft Environmental Impact Statement prepared by FERC for Merced ID's Hydroelectric Project is estimated to be issued in March 2015 and finalized in August 2015.

Response
Merced ID's FERC relicensing process is ongoing, and the license terms are not yet finalized. The FERC license requirements will have to be met before water could be transferred under the action alternatives. See Common Response 14.

Comment SA01-3

Comment
Section ES.3.2, Page ES-9, Table ES-3:

This section states, "[i]n the No Action/No Project Alternative the Buyer Service Area would experience shortages and could increase groundwater pumping, idle cropland, or retire land to address those shortages." However, this may not be an accurate description of this alternative because the Buyer Service Area currently utilizes short-term transfers to address their water needs. Further, due to existing transfers, the Central Valley Project Improvement Act Refuge Water Supply Program, which maintains and improves wetland habitat areas, is currently experiencing water transfer capacity issues concerning its already limited water supply, even without implementation of the Project. For example, this year at the Volta Wildlife Area, the last known population of giant garter snake (Thamnophis giga, GGS) in the western San Joaquin Valley was threatened with incidental take pursuant to CESA due to surface water supply limitations and likely operational constraints of conveyance systems needed to provide water needed for habitat. Cumulative impacts from short-term transfers and long term transfers proposed by the Project may have a significant impact on fish and wildlife that utilize refuges by resulting in a substantial adverse impact on sensitive species or interfering substantially with the movement of native migratory species.

CDFW recommends that that EIS/EIR describe the relationship between the existing short-term water transfers and long term transfers proposed by the Project, including an analysis of cumulative impacts from these activities, and any potentially significant impacts on fish and wildlife resources. Mitigation should be proposed if warranted.

Response
This EIS/EIR analyzes a range of potential transfer activities that may be proposed during the period 2015-2024. The transfers could be either short-term (single year) or long-term, as discussed in Section 2.3.2.7. The No Action/No Project Alternative assumes that theses short-term and long-term transfers would not move forward, which would mean that buyers included in this EIS/EIR would not purchase transfers that would need to be conveyed through the Delta.

Additional information about refuge-related issues is included in Common Response 9.

Comment SA01-4

Comment
Section 2.3.2.4, Page 2-30:

This section references, but does not clearly define, "protected aquatic habitats." Project activities could result in substantial adverse impacts on aquatic habitats that are not clearly designated as "protected aquatic habitats."

CDFW recommends that the EIS/EIR expand the definition of "protected aquatic habitats" to include public lands under conservation easement, State wildlife areas and ecological reserves, federal refuges, and private managed wetlands because management efforts to protect GGS occur on these lands.

Also identify how and to whom the seller will demonstrate that any impacts to special-status species have been addressed, including through coordination with CDFW and USFWS.

Response
Protected aquatic habitats include those lands with aquatic habitat and natural resource protections such as those identified by the commenter. See Common Response 14 for water transfer process.

Comment SA01-5

Comment
Section 2.3.2.4, Page 2-30:

This section states that the determination of Priority GGS habitat will be made through coordination with GGS experts, Geographic Information System (GIS) analysis of habitat proximity to historic tule (*Schoenoplectus sp*.) marsh, and GIS analysis of suitable habitat. However, this may not be sufficient to ensure appropriate identification of GGS habitat or areas that should be "prioritized" for species conservation. This could result in a substantial adverse impact on the species should appropriate habitat be overlooked.

CDFW recommends that the EIS/EIR state that consultation with CDFW and USFWS is required to ensure appropriate identification of GGS habitat and to evaluate which fields to fallow, through review of the CDFW's California Natural Diversity Database (CNDDB), review of rice fields which will be in production, and fallowing away from canals in a patchwork fashion to maximize habitat connectivity.

Response
Existing priority habitat areas have been identified based on the best available information on habitat use, known populations, and historic marsh habitat. Reclamation has prepared a Biological Assessment for the USFWS on the program. The water agencies requesting transfers will need to consult with CDFW if there is the potential to take listed species as a result of their transfers. See Common Response 14 for water transfer process.

Comment SA01-6

Comment
Section 2.4, Page 2-41, Table 2.9:

This table states that use of transfer water in the Buyer Service Area may result in increased irrigation on drainage impaired lands in the Buyer Service Area which could affect water quality, but that this impact is less than significant. However, significant environmental damage to fish and wildlife resources has occurred in the past from discharge of drainage from impaired lands. Many federal, state, and private managed wetland areas in the Central Valley are located at the lower end of watershed drainage areas and receive irrigation return flows as part of their water supply.

CDFW recommends the EIS/EIR analyze potentially significant impacts from increased irrigation on drainage impaired lands on Central Valley managed wetland public trust fish and wildlife resources.

Response
Table 2-9 a summary of potential impacts, but Section 3.2 of the EIS/EIR includes a more detailed analysis of the potential effects of irrigation return flows on water quality. Though there is the potential for transfer water in the buyer service area to result in increased irrigation runoff in the buyer service area, the effects to water quality were determined to be less than significant. Effects on wildlife are therefore anticipated to be less than significant. While there are and have been contaminant issues in some portions of the buyer service area (e.g., selenium contamination), the action alternatives are not expected to exacerbate these existing conditions.

Comment SA01-7

Comment
Table 2.9 of this section states that cropland idling/shifting could alter the amount of suitable habitat for natural communities and special-status wildlife species associated with seasonally flooded agriculture and associated irrigation waterways. This impact is identified as less than significant. However, cropland idling/shifting could have a significant impact on habitat availability for shorebirds, resident and migratory waterfowl, and special-status species in the Central Valley, especially if shifting reduces the amount of seasonally flooded post-harvest rice and corn. Seasonal flooding of postharvest rice and corn provides a substantial percentage of habitat and food supplies for migratory waterfowl. The 2006 Central Valley Joint Venture Implementation Plan estimates that 170,000 acres of post-harvest rice is needed for wintering waterfowl and wintering shorebirds in order to meet bird conservation goals.

CDFW recommends that the EIS/EIR address potentially significant impacts of cropland/idling shifting on fish and wildlife resources. Impacts could be mitigated if buyers of transfer water created equivalent habitat or habitat values to those that would be lost.

Response
Cropland idling would not affect fish. Section 3.8.2.4.3 of the Draft EIS/EIR evaluates potential impacts of cropland idling/shifting on terrestrial wildlife species, including migratory birds. As stated in Section 2.7.2.4.1, cropland idling is not likely to affect fisheries resources because this action would not substantially affect flows within natural waterways. Mitigation is not proposed to compensate for the temporary loss of terrestrial wildlife habitat because the Draft EIS/EIR concludes that impacts to wildlife are less than significant. The

commenter is concerned with the reduction of post-harvest forage for migratory waterfowl. The project does not include transfers of rice decomposition water and would not reduce the availability of water for post-harvest flooding. See response to Comment FA01-7 and Common Response 13 (Migratory Birds) for additional discussion of migratory bird impacts.

Comment SA01-8

Comment
Section 3.1.2.1, Page 3.1-14:

SACFEM2013 was used to model streamflow depletion from groundwater substitutions. Outputs from this model were used in a post-processing tool to simulate transfers and delta exports in order to analyze potential impacts to surface water supplies. However, it is unclear why monitoring data collected from 2007-2010 transfers were not used to support the models.

CDFW recommends that the EIS/EIR explain what type of data (i.e., surface flow depletions from groundwater substitution pumping) were collected by the Sellers from all years that transfers took place, and specifically from the recent four consecutive years of transfers (2007 -2010). The document should discuss why these data were not used in the analysis of impacts to streamflow from groundwater substitution pumping.

Response
See Common Response 5.

Comment SA01-9

Comment
Section 3.3.4.1, Page 3.3-88 to 3.3-91:

Groundwater substitution transfers can create time delays between additional groundwater pumping and potential impacts on stream systems. These delays may have significant impacts on timing and availability of surface flow to resident and anadromous fish species, special status species, and other fish and wildlife resources. The Department of Water Resources has been studying stream flow depletions as they relate to Sacramento Valley groundwater substitution transfers for several years.

CDFW recommends that the EIS/EIR include the results of the Department of Water Resources studies and analyze potential impacts on fish and wildlife resources resulting from time delays.

Response
The regional groundwater model used, SACFEM2013, incorporates the latest information about how groundwater pumping can alter the timing and amount of stream flows (see Section 3.1.2.1 and Appendix D for more information on

SACFEM). The effects of any changes to the timing and amount of stream flow on resident and anadromous fish were then analyzed in Section 3.7.2.4. Reclamation has coordinated with DWR throughout the process of developing the EIS/EIR, including model development.

Comment SA01-10

Comment
Section 3.7.1.3.2, Page 3.7-9:

This section lists the names of five creeks where no sampling information is available to indicate the presence of special-status fish species. Presence was assumed and further biological analyses were conducted in these waterways. However, this section inconsistently lists four of the five same creeks (along with 15 others) and states that a review of field sampling data and reports indicates that there is no evidence of the presence of special-status fish species in these waterways and, as a result, no further biological analysis was conducted.

CDFW recommends that the EIS/EIR clarify whether these five creeks may support special-status fish species.

Response
This section has been corrected. Biological analyses were conducted on the five creeks for which it was assumed special status species were present.

Comment SA01-11

Comment
Section 3.8, Page 3.8-20, Table 3.8-1:

The EIS/EIR includes western pond turtle (Actinemys marmorata, WPT) as a "listed" species. However, WPT is a Species of Special Concern (SSC), and is not CESA-listed or listed under the federal Endangered Species Act. Pacific pond turtle is used throughout the EIS/EIR in reference to WPT.

CDFW recommends that WPT be described as an SSC and moved to the following rows that describe SSC in Table 3.8-1. The species should be consistently referred to as "western pond turtle (WPT)" throughout the EIS/EIR.

Response
In the Draft EIS/EIR, the western pond turtle was inadvertently included under listed wildlife species and was also identified as a species of special concern, when in fact it is only the latter. The pond turtles' common name has changed many times and will be retained as pacific pond turtle. The document refers to the common name as pacific pond turtle and this will be reflected in Table 3.8-1 as only a species of special concern.

Comment SA01-12

Comment
Section 1.3.2.4, Page 1-14:

This section addresses impacts on fish and wildlife resources, and states that Water Code sections 1725 and 1736 require the State Water Resources Control Board to make a finding that proposed transfers would not result in unreasonable impacts on fish and wildlife or other instream beneficial uses prior to approving a change in post-1914 water rights.

CDFW recommends adding the following information is to Section 1.3.2.4 for regulatory consistency and clarity: California Code of Regulations Title 23 section 794 requires the petitioner to 1) provide information identifying any effects of the proposed changes on fish, wildlife, and other instream beneficial uses, and 2) request consultation with CDFW and the Regional Water Quality Control Board regarding potential effects of the proposed changes on water quality, fish, wildlife and other in stream beneficial uses. The petition for change will not be accepted by the State Water Resources Control Board unless it contains the required information and consultation request. Early communication with CDFW would streamline the consultation process through "up front" coordination regarding assessment of the potential impact to fish and wildlife resources. The State Water Resources Control Board will use this information in making their finding that proposed transfers do not result in unreasonable impacts on fish and wildlife or other instream beneficial uses.

Response
This text has been added.

Comment SA01-13

Comment
Section 2.3.2.1, Page 2-10:

CDFW recommends that the EIS/EIR clarify if water transferred via forbearance agreements were analyzed as part of the Project. If not, impacts from potential increases in groundwater pumping by seller agencies forbearing CVP water should be analyzed as a reasonably foreseeable future action/probable future project in the cumulative impacts analysis of each section.

Response
As described in Section 2.3.2.1, the transfers analyzed in the EIS/EIR could involve forbearance agreements of base supply or transfer agreements for CVP project water. Both transfer mechanisms would involve the same methods to make water available and move it; therefore, the environmental effects would not vary with the contract vehicle selected.

Comment SA01-14

Comment
Section 2.3.2.4, Page 2-29 to 2-30:

It is common for CDFW to review proposed water transfer CEQA documents, typically Negative Declarations, which do not address Environmental Commitments. Data may not be available to support the transfer request relative to potential impacts to fish and wildlife.

CDFW recommends that all proposed water transfers address Environmental Commitments and potential impacts on fish and wildlife. Include analysis of any previous transfers, monitoring, and mitigation efforts, and identification of how much water was actually transferred in previous years. Annual review of mapped acreage, diverted acre feet of water and monitoring and reporting results would provide a basis to develop baseline information on potential impacts of future proposed transfers.

This section states that Bureau of Reclamation would provide maps to USFWS in June of each year showing the parcels of riceland that are idled for the purpose of transferring water for that year.

CDFW recommends that the EIS/EIR state that these maps would also be provided to CDFW and the GGS interagency management team in order to provide coordination for conservation and management of Central Valley GGS populations.

Response
See Common Response 14 for water transfer process. All transfers that could occur under this environmental document would need to incorporate the environmental commitments as part of the way water transfers are identified and operated. Reclamation will share the maps with riceland idling with the CDFW and the giant garter snake (GGS) interagency management team.

Comment SA01-15

Comment
Section 3.7.1.3.3, Page 3.7-15:

Summer rearing of Central Valley steelhead would overlap with water transfers occurring in the Seller Service Area (July-September), both in the Sacramento and San Joaquin River and their tributaries. Thus, water transfers have the potential to impact steelhead. The majority of rearing, however, would occur in the cooler sections of rivers and creeks above the influence for the transfers. Earlier in the Draft EIS/EIR, it is stated that water made available from groundwater substitution transfers may start as early as April (Page 2-10).

CDFW recommends that the EIS/EIR clarify when groundwater substitution transfers could begin and, if necessary, analyze impacts on Central Valley steel head that may be impacted by groundwater transfers occurring in April, May and June.

Response
This section has been corrected to include the April-September period.

Comment SA01-16

Comment
Section 3.7.2.1.3, Page 3.7-20:

For smaller tributaries, the impact analysis compared modeled groundwater depletion flow rates to available data on mean flow rates for the historical period of record and identified changes to these monthly average flow rates that would result from water transfer actions. Significant impacts on fisheries resources due to stream flow depletions are more likely to occur during low-flow periods of any given month.

CDFW recommends that the EIS/EIR analyze the impacts from groundwater pumping on the low-flow period of each month, rather than the average stream flow for the entire month, in order to determine the significance of impacts on fisheries resources and special-status fish species during this sensitive period.

Response
While Reclamation and SLDMWA recognize the importance of low flow periods, limitations to the model's precision preclude such types of analysis. Mean monthly flows provide a reasonable and appropriate basis to characterize impacts for disclosure and decision-making purposes.

Comment SA01-17

Comment
This section states that development of the impact analysis involved literature review, review of known occurrences of special-status species based on the CNDDB, USFWS regional species lists, information from National Oceanic and Atmospheric Association fisheries website, and results of hydrologic modeling.

CDFW recommends that the EIS/EIR also include a discussion of how monitoring plans and monitoring data from previous years were used to show that transfers did not adversely affect fisheries resources.

Response
The analysis did use past monitoring data and a description was added to Section 3.7.2.1

Comment SA01-18

Comment
This section states that historical stream flow information for small streams were gathered where available and used as the measure of baseline flow. For locations for which historical flow data were limited or unavailable, a qualitative discussion of potential impacts is included for these locations.

CDFW recommends that the EIS/EIR include a table or an appendix to show which streams used available historic flow data, what this data included, and which streams lacked historic data and were subject to a qualitative analysis. This information will guide where additional stream flow efforts are needed relative to fisheries resource needs.

Response
This information has been added to Table 3.7-3 for streams for which it was used. For all other small streams, the use of historical data was not necessary.

Comment SA01-19

Comment
Section 3.7.2.4.1, Page 3.7-26 – 3.7-27:

Eastside/Cross Canal and Salt Creek have the potential for impacts on special-status fish species due to flow reductions, although no data were available to determine the proportional reduction in base flows (i.e., if a greater than 10 percent reduction would occur). This section states that these waterways are 1) "generally" not immediately adjacent to groundwater substitution transfers; 2) other "nearby" small waterways are not experiencing flow decreases that are causing significant impacts to aquatic resources; and 3) flow reductions would be observed at monitoring wells in the region and any adverse effects would be mitigated by implementation of Mitigation Measure GW-1. The mitigation plan would include curtailment of the pumping until natural recharge corrects the environmental impact. Therefore, the impacts on fisheries resources would be less than significant. However, it is unclear what the trigger for pumping curtailment would be and how cessation of pumping to allow natural recharge to "correct the environmental impact" mitigates this impact to a less than significant level if the impact has already occurred.

CDFW recommends that the EIS/EIR define "generally not immediately adjacent," explain how the determination was made that other "nearby" small waterways are not experiencing flow decreases that are impacting aquatic resources, and how these surrogate waterways relate to the potentially impacted streams. Additionally, the EIS/EIR should identify 1) how the placement and use of monitoring wells would be able to observe instream flow reductions, 2) how the trigger for curtailment of pumping that causes an adverse impact was derived, and 3) if the time from observation of streamflow reductions that result in adverse impacts to the cessation of groundwater pumping would be responsive enough to mitigate for impacts (Barlow and Leake 2012). This recommendation also applies to Section 3.7.6.1.1, which analyzes the cumulative impacts on fisheries resources and special-status fish species in Cache Creek, Stony Creek, Coon Creek, Little Chico Creek, Bear River, Eastside/Cross Canal and Salt Creek and Section 3.8.2.4.1, which analyzes the effects of substantially reduced stream flows as a result of groundwater substitution pumping on the riparian natural communities in Cache and Stony Creeks.

Response
No effects on fisheries were found and mitigation measures are unnecessary. All references to environmental commitments were removed from the fisheries section (Section 3.7) to avoid confusion, except in Section 3.7.4 which indicates that environmental commitments are unnecessary. Additional vegetation monitoring requirements have been added to GW-1 (see Common Response 10).

Comment SA01-20

Comment
This section lists 21 waterways where the Project would have a less than significant impact on fisheries resources and special-status fish species. The basis for this determination is that modeled flow changes would be small and no substantial effect on water quality would result from implementing the Proposed Action.

CDFW recommends that "water quality" in the previous sentence be replaced with "fisheries resources" and tables similar to Tables 3.8-5 and 3.8-7, which show the average monthly flow by water year type in Cache Creek and Stony Creek, respectively, under the No Action/No Project alternative (using historical data) and the Project (using the groundwater model's prediction of reduced flows from the Proposed Action), be included for all streams that have the potential to be impacted by the Proposed Action. As stated above, CDFW recommends that the analysis of potential impacts from groundwater pumping use data from the low-flow period of each month, rather than the average stream flow for the entire month, to determine the significance of impacts to fisheries resources and special-status fish species during this sensitive period.

Response
This text was changed as requested.

Regarding an examination of intra-monthly modeling outputs: While the lead agencies recognize the importance of low flow periods, limitations to the model's precision preclude such types of analysis. Mean monthly flows provide a reasonable and appropriate basis to characterize impacts for disclosure and decision-making purposes.

Comment SA01-21

Comment
Section 3.7.2.4.1, Pages 3.7-28 to 3.7-29:

This section states that due to incomplete baseline flow data, modeling results were compared to only three years (2003-2005) of existing stream gage data for Coon Creek, indicating that there would be one water year in one month in which flows could potentially be reduced by more than 10 percent. This modeled reduction to baseline flows is stated to be a "worst case scenario" because flows used in this calculation are at the low end (20 cfs) of existing flow data range (20-40 cfs). Modeling shows that flows in all other months and water year types would be reduced by less than 10 percent of baseline flows and, therefore, impacts on fisheries resources would be less than significant. Omitted from this analysis is that the Water Year types for 2003, 2004 and 2005 were categorized as above normal, below normal, and above normal, respectively. It is unclear how this analysis of reductions is considered a "worst case scenario" if the low end of the baseline flow data range (20 cfs) was observed in either an above normal or below normal water year. Regardless of available gage data, it is rational to expect lower flows in Coon Creek in a dry or critically dry year, which would result in the Project reducing baseline flows by more than 10 percent.

CDFW recommends that the EIS/EIR explain how stream gage data taken from only above normal and below normal water years, which is then used as baseline flows for comparing to model results, captures the full extent of the potential impacts to fisheries resources in Coon Creek that may occur in dry or critically dry years. This explanation should also be included for impacts on natural communities and wildlife species habitat (Page 3.8-59).

Response
Using 3 years of baseline data, the analysis looked at modeling results for each month for every water year type. The worst-case scenario assumes the low end of flow data observed during the 3-year period. Although water years 2003-2005 do not include a dry or critically dry water year, flows in Coon Creek are heavily regulated by Nevada Irrigation District for purposes of water delivery and are expected to be relatively consistent across different water year types. Therefore, a baseline flow of 20 cfs across all water year types was determined to be appropriate as a worst-case scenario. No changes to impact conclusions are warranted.

Comment SA01-22

Comment
This section states that pursuant to model results, Little Chico Creek flows would be reduced by more than 10 percent in multiple water year types from July to October. Although this reduction could be as much as 100 percent of

instream flows, the Project would not have a substantial impact on fisheries resources. The reason being that it's not uncommon for natural flows to be very low during these months (0.5 cfs and below), which causes an increase in temperature and reduced dissolved oxygen levels intolerable for over-summering adult spring-run Chinook salmon, so the fish would not be present anyway. Also, depletions from groundwater pumping would cause levels to be within the flow range normally experienced by any juvenile steelhead and hardhead species have experienced low-to-no flows in the past, project impacts that reduce flows to this level would not harm them.

CDFW recommends that the EIS/EIR analysis focus on the impacts that low flow periods in Little Chico Creek have on special-status fish species and fisheries resources in general, what an increase to the frequency of these low flow events caused by the Project means to these species, and how do the periods were the Project completely dewaters the creek (i.e., reductions of "up to 100 percent of instream flows") affect stream connectivity, species movement, and the overall health of the species.

Response
Text was added to further explain the finding that low-flow periods would not increase in frequency.

Comment SA01-23

Comment
Section 3.8.2, Page 3.8-35:

This section states that the distribution of water year types within the action period is unknown. Additionally, the exact locations of cropland idling/shifting actions would not be known until the spring of each year, when water acquisition decisions are made. The contribution to instream flows from agricultural return flows would be reduced in areas where cropland idling occurs. However it is unclear how this reduction was accounted for in the analysis of impacts on fish and wildlife resources and instream flows if the locations are unknown at this time.

CDFW recommends that the EIS/EIR explain how reduced agricultural return flows due to cropland idling/shifting were factored into the impact analysis.

Response
As described in Section 2.3.2.1, water for transfers is made available by a seller who "must take an action to reduce consumptive use or use water in storage." In addition, "water transfers must be consistent with State and Federal law, as discussed in Chapter 1."

If sellers transfer water through cropland idling or crop shifting, they would decrease their diversions only by the amount of applied water that would have been consumed absent the transfer. Without transfers, some of the water applied on each field is consumptively used by the crop (the evapotranspiration of applied water), but some is not used by the crop and becomes percolation to the groundwater or surface runoff. For cropland idling or crop shifting, water that would have been applied to the field but not consumptively used by the crop would continue to be diverted by the seller and would enter the distribution system. Water that would run off fields into drain facilities would continue to flow into these drains; therefore, agricultural return flows would not be affected.

Comment SA01-24

Comment
Section 3.8.2.1.4 Page 3.8-38 to 3.8-40:

This section states that the magnitude and frequency of streamflow depletion in small streams were derived from a groundwater model (SACFEM2013) and then used to evaluate potential impacts to natural communities and special status vegetation and wildlife, since Central Valley Project and State Water Project operations could not be altered to offset any changes in small streams. However, the impacts of groundwater substitution on larger rivers and Central Valley Project/State Water Project reservoirs are carried from the groundwater model to the transfer operations model, which incorporates other changes in hydrology associated with cropland idling/shifting, reservoir releases and water conservations. This implies that changes in small stream hydrology associated with cropland idling/shifting were not included in the SACFEM2013 model.

CDFW recommends that the EIS/EIR explain how reduced agricultural return flows in small streams were accounted for in the SACFEM2013 groundwater model.

Response
Cropland idling and crop shifting would not result in changes to flows in small streams. Changes from these transfer mechanisms would occur on the water systems that supply water to the selling entity. As described in Chapter 2, these waterways include the Sacramento and Feather rivers. These waterways are not "small streams" and are analyzed using CalSim II and the Transfer Operations Model.

Comment SA01-25

Comment
Section 3.8.2.4.1, Page 3.8-47:

This section describes impacts on natural communities in shallow groundwater areas in the North Delta; however it does not address impacts on wildlife. Some sensitive wildlife species require shallowly flooded areas (e.g., GGS and WPT) and impacts on these areas may substantially adversely affect such species.

CDFW recommends that the impact analysis not be solely based on whether vegetation will change. In shallowly flooded areas, a reduction of groundwater that lowers surface water elevation of wetlands should also be described, and impacts on wildlife that rely on shallow water analyzed. Mitigation should be provided if warranted.

Response
Although areas in the North Delta could experience maximum modeled reductions of between 0.3 and 0.8 feet in subsurface drawdowns, these reductions are expected to occur slowly and would not substantially alter the suitability of shallowly-flooded habitat for wildlife, specifically giant garter snake and pond turtle. See Common Response 11 for more information.

Comment SA01-26

Comment
In this section, the Assessment/Evaluation Methods for groundwater substitution transfers states that potential impacts of groundwater substitution on natural communities in upland areas was considered potentially significant if it resulted in a consistent, sustained depletion of water levels that were accessible to overlying communities (groundwater depth under existing conditions was 15 feet or less). A sustained depletion would be considered to have occurred if the basin did not recharge from one year to the next (Page 3.8-33). In a few locations in the North Delta associated with wetlands, groundwater elevations under existing conditions are less than 15 feet below ground surface and natural communities reliant on groundwater are more likely to be impacted. In these areas, the maximum reductions would be 0.3 to 0.8 feet, with full recharge. The Project would have a less than significant effect on natural communities and special-status plants because increases in drawdown would be too small to cause a substantial effect on vegetation that relies on groundwater. However, the EIS/EIR doesn't identify where these "few locations in the North Delta" are located or the natural communities that occur in these areas. Also, the less than significant determination is based upon the assertion that full recharge of the groundwater basin would always occur, thus only reducing groundwater levels by a maximum of 0.3-0.8 feet.

CDFW recommends that the EIS/EIR identify and discuss the areas in the North Delta and the natural communities associated with those areas in greater detail. Since the less than significant determination is based upon the assertion that full recharge of the groundwater basin will always occur, thus resulting in a max reduction of 0.3-0.8 feet (too small to cause substantial effects), supporting historic groundwater elevation data should be provided.

Response
Figure 3.3-28c shows the changes in groundwater levels in the North Delta. The North Delta areas referenced in Section 3.8 include RD 2068, Pope Ranch,

and Sacramento County Water Agency. See Common Response 11 for more information.

Comment SA01-27

Comment
Section 3.8.2.4.1, Page 3.8-60:

For Little Chico Creek, this section states, "[b]ecause flow reductions would be small and only during months when the creek is essentially dry, changes in stream flow would not substantially reduce natural communities or wildlife species habitat." However, taking water from a creek that is nearly dry could result in significant impacts on wildlife because some animals may not be able to tolerate prolonged episodes of dryness (e.g.,WPT).

CDFW recommends that the EIS/EIR include an analysis of how the reduction of water during already dry times does not substantially reduce the availability of habitat for, or movement ability of, sensitive species.

Response
Pond turtles are not expected to occur year-round in Little Chico Creek, an intermittent stream, and likely use adjacent human-made ponds and nearby canals and drainages when the creek dries down. Section 3.8.2.4.1 states that the maximum modeled change in flow within Little Chico Creek would be a decrease of 0.04 cfs. This amount of water loss would not substantially change existing conditions for pond turtles.

Comment SA01-28

Comment
Appendix I, Table 1-1:

The Project proposes to fallow alfalfa and other row crops which Swainson's hawks (*Buteo swainsoni*, "SWHA"), a State-listed species, utilize to forage. However, the EIS/EIR does not disclose which croplands within foraging distance of SWHA nest trees will be fallowed, or the composition of these areas. Long term fallowing of these fields may result in a change or loss of pray base, prompting SWHA to leave the nest tree for longer periods to forage in other areas, which could negatively affect the species' reproductive effort. Therefore, the long term loss of foraging habitat could result in significant impacts on nesting SWHA by substantially reducing the number of an endangered, rare, or threatened species, and/or substantially adversely affecting a special status species (CEQA Guidelines, §15065 & Appendix G).

CDFW recommends that the EIS/EIR disclose which croplands in foraging distance of SWHA nest trees would be fallowed and the composition of these areas, analyze whether resultant impacts on SWHA could be significant, and provide for mitigation if warranted.

Response
Page 3.8-35 of the Draft EIS/EIR states that the exact locations of cropland idling/shifting actions would not be known until the spring of each year, when water acquisition decisions are made. Table I-1 in Appendix I of the Draft EIS/EIR states that the project may alter the composition of foraging habitat for Swainson's hawk within the project area, but these areas would still provide suitable habitat as fallowed fields and therefore no net loss of foraging habitat would occur. Fallowing of croplands may reduce some sources of forage for small rodents, which provide prey for Swainson's hawks, but the project is not expected to substantially alter the prey population because fallowing would result in a small loss of residual feed (a maximum 2 percent reduction for Glenn, Colusa, and Yolo counties and a maximum 9 percent reduction within Solano and Sutter counties). See page 3.8-63 of Draft EIS/EIR.

Comment SA01-29

Comment
Bureau of Reclamation contracts for Central Valley Project Improvement Act (CVPIA) Refuge Water Supply (RWS) delivery to USFWS, CDFW, and Grassland Water District managed wetlands all contain language in Article 7 allowing Project Water to be transferred, reallocated or exchanged to other refuges. CVPIA section 3406 subdivision (b)(3) requires development and implementation of a program to identify how the Secretary intends to utilize improvements in or modifications of project operation, including transfers, to fulfill the Secretary's obligations to deliver RWS.

CDFW recommends that the EIS/EIR identify the total amount of RWS available from all sources north of Delta, and how these transfers are integrated into project operation. The program should address annual and long-term water transfer impacts that may adversely affect managed wetland water supply including endangered species recovery needs at managed wetlands; lack of sufficient dedicated water storage; timing of water delivery and use on shared conveyance systems; and potential increased groundwater use. CDFW is available to assist Bureau of Reclamation with any and all efforts to maximize use of water transfers in the furtherance of overall CVPIA RWS program objectives. These efforts should be coordinated with USFWS, Grassland Water District, and the Central Valley Joint Venture.

Response
See Common Response 9.

Comment SA01-30

Comment
Section 2.3.2.4, Pages 2-29 to 2-30:

Much of this section involves Environmental Commitments to protect GGS. These same commitments were largely used for 2014 transfers, and to a lesser degree, in previous years. Efforts to develop and refine the Environmental Commitments are ongoing, and studies to better understand GGS life history and distribution continue.

CDFW recommends incorporating any monitoring and analysis available from 2014 and previous transfer years where these and similar commitments were in place, and adaptively incorporating feedback as more information becomes available each year, including drought year impacts, as well as the following: incorporate results from ongoing studies on GGS population dynamics and distribution analysis; continue development of a long-term strategy and research framework; continue interagency coordinated efforts and investigate partnerships with water districts, non-governmental organizations, and academia; and include coordinated and collaborative development, including CDFW, to address GGS long-term conservation needs.

Response
See Common Response 10 (Environmental Commitments/Mitigation Measures).

Comment SA01-31

Comment
Section 3.1.4.1, Page 3.1-21:

This section states that a streamflow depletion factor (SDF) would be applied to mitigate potential water supply impacts from additional groundwater pumping due to groundwater substitution transfers. This is intended to offset the streamflow effects of the added groundwater pumping. The exact percentage of the SDF would be determined based on hydrologic conditions, groundwater and surface water modeling, monitoring information, and past transfer data. However, it is unclear what monitoring information and past transfer data has shown, and if previous percentages been adequate to mitigate for impacts.

CDFW recommends that the EIS/EIR include information on previous monitoring efforts; for example, what they entailed, past transfer data, the type of post-transfer analysis that was done, and what this analysis showed with respect to impacts on streamflow from increased groundwater pumping.

Response
See Common Response 8.

Comment SA01-32

Comment
Section 3.3.4, Pages 3.3-88 to 3.3-91:

It is unclear whether mitigation measure GW-1 "Monitoring Program and Mitigation Plans" would reduce impacts on wildlife to less than significant because it appears that only wells would be monitored (as opposed to streams, wetlands, or sensitive species), and that impacts to wildlife would be reported by an outside entity. Monitoring would be coordinated with well operators and "other decision makers." The section states that if the seller's monitoring efforts indicate that the operation of wells for groundwater substitution pumping are causing substantial adverse impacts, the seller will be responsible for mitigating any significant environmental impacts that occur. However, it is unclear how this determination would be made.

CDFW recommends that the EIS/EIR analyze the need for monitoring of other water features and resources and include discussion of the types of monitoring and mitigation efforts conducted for past transfers, what will be duplicated for the Proposed Project, and any new/revised activities to ensure impacts on fish and wildlife resources are reduced to less than significant. The EIS/EIR should clarify who the "other decision makers" are and include representatives from CDFW and USFWS. Mitigation should also state that CDFW and USFWS would have authority to deem a monitoring and mitigation plan adequate or not for the purposes of issuing a water transfer agreement. The EIS/EIR should identify an entity with appropriate expertise to determine if Project activities are resulting in substantially adverse impacts and an adequate level of mitigation.

Response

Groundwater monitoring and mitigation plans will be implemented to avoid any potentially significant adverse effects, as set forth in the EIS/EIR and clarified in response to comments. See Common Response 10 for additional information.

Comment SA01-33

Comment

There are several EIS/EIR sections that conclude impacts on wildlife would be reduced to less than significant levels based on implementation of mitigation measure GW-1, which is intended to take corrective actions once substantial adverse impacts have been identified. However, these impacts appear to be based almost exclusively on changes in vegetation, which are not necessarily appropriate proxies for wildlife populations. Animals may starve or be exposed to greater predation well before signs of substantial impacts on riparian and wetland vegetation become evident. In addition, because there is no requirement for monitoring of vegetation changes, those signs would apparently have to be identified by agencies and organizations outside of the water transfers; therefore, there are no assurances they would be identified. Further, increases in flows are not always beneficial. For example, if flows are over 200 percent of normal during summer months, WPT nests could be flooded out, significantly reducing recruitment.

CDFW recommends that the EIS/EIR include a more comprehensive approach to evaluating impacts on fish and wildlife based on the habitat components required by each affected species including, but not limited to, plant community requirements. Mitigation should be proposed if warranted.

Response

With respect to impacts on wildlife, vegetation composition and structure are important determinants of wildlife habitat suitability and provide an adequate assessment of impacts to terrestrial wildlife. Because changes in surface water flows in most streams and rivers that could be affected by groundwater transfers are anticipated to be insubstantial and limited in duration and location, impacts to wildlife would not be substantial and would not result in significant effects. Further discussion regarding groundwater monitoring and effects on vegetation is provided in Common Responses 10 and 11.

Comment SA01-34

Comment

This section states the objectives of the monitoring and mitigation plan. However, these objectives are not fully consistent with the Draft Technical Information for Preparing Water Transfer Proposals (Bureau of Reclamation and Department of Water Resources 2013) and Addendum (Bureau of Reclamation and Department of Water Resources 2014).

CDFW recommends that the above statement be consistent with the specific mitigation and monitoring requirements of the aforementioned Draft Technical Information for Preparing Water Transfer Proposals and Addendum.

Response

Transfers that may occur under the coverage of this document would need to conform to Mitigation Measure GW-1. The DWR documents referenced by the commenter were used as a reference in the development of Mitigation Measure GW-1, which has been clarified in response to comments. See Common Responses 6, 7, 8, 10, and 14 for additional information.

Comment SA01-35

Comment

This section states that water transfer proponents would provide a final summary report to Bureau of Reclamation evaluating the impacts of the water transfer. The final report would identify transfer-related impacts on groundwater and surface water during and after pumping. However, past water transfer activities could inform anticipated impacts on fish and wildlife resources.

CDFW recommends that the EIS/EIR include the impacts past reports have shown in order to inform analysis of future transfers regarding impacts on the environment, and to avoid or mitigate any significant effects of proposed transfers.

Response
Text has been added to the requirements of the summary report described in Section 3.3.4.1.2. Additionally, an end-of-transfer report regarding the implementation of conservation measures has been included in Section 2.3.2.4.

Comment SA01-36

Comment
Water Code section 1018 states that landowners "shall be encouraged" to cultivate or retain non irrigated cover crops or natural vegetation to benefit waterfowl, upland game bird, and other wildlife habitat. The Department of Water Resources is currently addressing guidance and implementation regarding this language. CDFW recommends incorporating this information into the EIS/EIR so those proposing transfers would be compliant with these provisions.

Response
Text has been added to Chapter 2 encouraging sellers to incorporate habitat features in cropland idling transfers.

Comment Letter SA02, Cindy Messer, Delta Stewardship Council

Comment SA02-1

Comment
The Delta Stewardship Council (Council) welcomes the opportunity to comment on the Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report (EIS/R) evaluating the potential impacts of alternatives to help address the Central Valley Project (CVP) water supply shortages (Project), being prepared jointly by the U.S. Bureau of Reclamation (Reclamation) and the San Luis & Delta-Mendota Water Authority (SLDMWA). The Council is an independent California state agency tasked with furthering California's coequal goals for the Delta through the implementation of the Delta Plan, a comprehensive, long-term Delta management plan. As defined in the California Water Code section 85054 [Footnote: “Coequal goals” means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.” – Water Code §85054], the State's coequal goals include providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The Delta Plan highlights that north-to-south water transfers across the Delta can be an important tool for improving water supply reliability and includes several

recommendations to identify and enhance opportunities for water transfers in furtherance of the coequal goals. The Plan also calls for improving water transfer procedures.

Even as the Council and Delta Plan support water transfers, they are only one important component for increasing water supply reliability and must be part of a larger suite of actions and projects. The Council has defined what the achievement of a more reliable water supply for California means:

(a) Better matching the state's demands for reasonable and beneficial uses of water to the available water supply. This will be done by promoting, improving, investing in, and implementing projects and programs that improve the resiliency of the state's water systems, increase water efficiency and conservation, increase water recycling and use of advanced water technologies, improve groundwater management, expand storage, and improve Delta conveyance and operations. The evaluation of progress toward improving reliability will take into account the inherent variability in water demands and supplies across California;

(b) Regions that use water from the Delta watershed will reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance, consistent with existing water rights and the State's area-of-origin statutes and Reasonable Use and Public Trust Doctrines. This will be done by improving, investing in, and implementing local and regional projects and programs that increase water conservation and efficiency, increase water recycling and use of advanced water technologies, expand storage, improve groundwater management, and enhance regional coordination of local and regional water supply development efforts;

(c) Water exported from the Delta will more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem. This will be done by improving conveyance in the Delta and expanding groundwater and surface storage both north and south of the Delta to optimize diversions in wet years when more water is available and conflicts with the ecosystem are less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. Delta water that is stored in wet years will be available for water users during dry years, when the limited amount of available water must remain in the Delta, making water deliveries more predictable and reliable. In addition, these improvements will decrease the vulnerability of Delta water supplies to disruption by natural disasters, such as, earthquakes, floods, and levee failures.

Response

The types of broad goals described in this comment are directed towards efforts that are materially different from the Proposed Action. See Common Response 14. Relative to the EIS/EIR for the proposed long-term water transfers, the

Lead Agencies establish the purpose and need to best describe their underlying reasons for taking an action. Reclamation has multiple planning efforts to help meet the many demands on the CVP, including projects to help address the many pressures on the Delta. Water transfers are one of the potential actions related to these purposes, but Reclamation is moving forward with multiple other efforts to help meet these objectives:

(a) Reclamation requires all agricultural contractors to implement agricultural water use efficiency best management practices and is continuing to work with these contractors to improve the efficient use of water.

(b) Reclamation is participating in multiple studies on groundwater and surface water storage.

(c) Reclamation is studying conveyance options through its participation in the Bay-Delta Conservation Plan efforts. Also, Reclamation is working on developing new biological assessments on long-term operations of the CVP and SWP, which help clarify potential exports based on biological needs in the Delta.

Comment SA02-2

Comment
The 2009 legislation that created the Council also provided the Council with regulatory authority over certain types of activities undertaken by local or state agencies, called covered actions, and requires that covered actions be consistent with the Delta Plan as cited in Water Code section 85225 “A state or local public agency that proposed to undertake a covered action, prior to initiating the implementation of that covered action, shall prepare a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan and shall submit that certification to the council.” The Council developed new regulations governing covered actions, which became effective on September 1, 2013, and included them in the Delta Plan. The water transfers that are identified in EIS/R may be considered covered actions. Typically the lead CEQA agency determines if a proposed activity is a covered action and would then file a certification of consistency with the Council. The Council strongly encourages all state and local agencies who propose to approve, fund, or carry out an action in the Delta, consult with the Council as early in the project's development as possible, to ensure the project is consistent with the Delta Plan.

Response
The lead agencies have prepared this EIS/EIR as a tool to evaluate potential CVP-related water transfer activities in a more comprehensive manner than has been conducted in the past. See Common Response 14. The Draft EIS/EIR provides a coordinated and detailed analysis of the environmental effects of a range of independent potential transfer activities that may or may not occur,

depending on a variety of factors that vary from year to year. In preparing this environmental analysis, the lead agencies have not made, and cannot make, any commitment to a definite course of action (i.e., no plan, program, or project is being considered or approved as that term is understood pursuant to Public Resources Code section 21065). Rather, the lead agencies would review individual proposed transfers if and when they are presented. All transactions are voluntary among willing buyers and willing sellers, who may seek to rely on the analysis in this EIS/EIR or proceed independently. Covered actions are not presented, and certifications of consistency as described in the comment could not be made until the details of the proposed individual transfers are known. See Section 1.5 of the Draft EIS/EIR and response to Comment NG01-24.

Comment SA02-3

Comment
The Council submits the following comments on the EIS/R: The Council suggests that SLDMWA, on behalf of its participating member agencies as well as the Contra Costa Water District (CCWD) and East Bay Municipal Utility District (EBMUD), file a certification of consistency with the Council on the program of water transfers covered by this EIS/R and indicate in the EIS/R that these transfers are covered actions. Water Code section 85057.5(a) defines a covered action as: ... a plan, program, or project as defined pursuant to Section 21065 of the Public Resources Code that meets all of the following conditions: 1. Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh; 2. Will be carried out, approved, or funded by the state or a local public agency; 3. Is covered by one or more provisions of the Delta Plan; 4. Will have a significant impact on the achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and state interests in the Delta.

It appears that water transfers identified in the EIS/R meet the definition of a covered action. The preparation of the EIS/R indicates the Project meets the definition of a plan, program, or project as defined pursuant to Section 21065 of the Public Resources Code, the water transfers will take place at least partially in the Delta, will be undertaken by the participating agencies, will have a significant beneficial impact on water supply reliability, and implicate the following two regulatory policies that cover proposed water transfers through the Delta:

WR P1 (23 CCR section 5003) - Reduce Reliance on the Delta through Improved Regional Water Self-Reliance. This policy covers a proposed action to export water from, transfer water through, or use water in the Delta.

WR P2 (23 CCR section 5004) - Transparency in Water Contracting. This policy covers:

1. With regard to water from the State Water Project, a proposed action to enter into or amend a water supply or water transfer contract subject to California Department of Water Resources Guidelines 03-09 and/or 03-10 (each dated July 3, 2003), which are attached as Appendix 2A; and

2. With regard to water from the Central Valley Project, a proposed action to enter into or amend a water supply or water transfer contract subject to section 226 of P.L. 97-293, as amended or section 3405(a)(2)(B) of the Central Valley Project Improvement Act, Title XXXIV of Public Law 102-575, as amended, which are attached as Appendix 2B, and Rules and Regulations promulgated by the Secretary of the Interior to implement these laws.

Response
See response to Comment SA02-2.

Comment SA02-4

Comment
The EIS/R should acknowledge the Delta Plan and its regulatory policies. As previously discussed, the Council's regulations apply to covered actions where water suppliers export water from, transfer water through, or use water in the Delta; and covered actions that include entering into or amending water supply or water transfer contracts. Therefore, the Council, and its role with respect to covered actions, should be included in the appropriate sections of the EIS/R.

Response
See response to Comment SA02-2.

Comment SA02-5

Comment
The EIS/R "Purpose and Need/Project Objectives" section of the EIS/R should include a quantitative assessment of the need for water transfers to help identify other possible reasonable alternatives. CEQA requires the project objectives describe the underlying need for and purpose of the project. The EIS/R states the Project's objectives as:

1. Develop supplemental water supply for member agencies during times of CVP shortages to meet existing demands.

2. Meet the need of member agencies for a water supply that is immediately implementable and flexible and can respond to changes in hydrologic conditions and CVP allocations.

However the EIS/R does not state what the water supply demand is for the participating agencies, nor does it state if that demand is changing over time, rather it merely identifies a list of potential buyers without any indication of the demands of those buyers. The EIS/R does describe how the member agencies' water supply from the CVP is variable, even with the use of water transfers. Table 1-1 indicates that the average CVP water supply allocation for the 2000 to 2014 period was 54% of contracted amounts for irrigation use and 83% of contracted amounts for municipal and industrial uses. Irrigation allocation was a full 100% only once during this period. Table 1-3 indicates that water transfers to SLDMWA member agencies occurred in 60% of the years between 2000 and 2014 though the amounts varied from several thousand acre-feet to over 169,000 acre-feet in 2009.

Are the participating agencies' demands variable and able to adjust to a decrease in supply? Then potential alternatives to reduce demand in lieu of increasing supply should also be considered. Or are the participating agencies' water supply demands constrained only by their contracts and the ability of the federal and state projects to deliver water? Understanding the demand on the Delta as a water supply is important. It is California's policy to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts (Water Code section 85021).

Response
See responses to Comment SA02-2 and Comment NG03-4.

Comment SA02-6

Comment
The EIS/R does not analyze the impacts of water transfers during periods when the state and federal water projects are unable to meet existing Delta water quality objectives. In January 2014, Reclamation and the Department of Water Resources jointly filed a Temporary Urgency Change Petition (TUCP) for their water right permits and licenses for the state and federal water projects in response to extreme drought conditions in California. They requested temporary modification of requirements included in the State Water Resources Control Board's Revised Decision 1641; specifically the TUCP requested modifications to the requirement to meet the Delta Outflow Objective. The EIS/R does not analyze the potential impacts of water transfers on Water Quality (Chapter 3.2), Aquatic Resources (Chapter 3.7), Terrestrial Resources (Chapter 3.8), or any other potential Delta impact under these extreme conditions. Given that the current drought may continue into the period of time

covered by the EIS/R and is likely to be a reoccurring event, the document should include an analysis of the impacts under extreme hydrologic conditions.

Response

The period of analysis used in modeling for this analysis includes critical and dry periods as well as multi-year drought periods. Tables within Section 3.2, Water Quality provide expected conditions as a result of each alternative for dry and critical water years. While exceedances of water quality standards have occurred, especially during recent drought years, the changes in operations from this project are not expected to significantly affect water quality such that exceedances are affected. Common Response 5 includes an explanation of why the modeled period hydrology is an appropriate representative period.

Comment Letter SA03, Diane Riddle, State Water Resources Control Board

Comment SA03-1

Comment

The State Water Resources Control Board (State Water Board) staff appreciates the opportunity to review and provide comments on the Long-Term Transfers Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). Comments on the Draft EIS/EIR are due on December 1, 2014. State Water Board staff conducted an initial review of the Draft EIS/EIR. Upon further review, the State Water Board may have additional comments.

State Water Board staff's comments are focused on groundwater issues associated with this project given the significant emphasis of the proposed project on groundwater substitution transfers and the recent California groundwater legislation that the State Water Board will have a role in implementing, specifically the Sustainable Groundwater Management Act of 2014 (SGMA). The SGMA requires development of local groundwater sustainability agencies and plans in certain basins, including most of the region covered by the proposed project, and requires sustainable groundwater management within 20 years of plan adoption. The legislation also provides the State Water Board direct authority to intervene when a groundwater basin is not sustainably managed.

Response

The State Water Resources Control Board (SWRCB)'s comments are addressed in the responses to specific comments included in the letter.

Comment SA03-2

Comment

Numerous water interests have long-relied on water transfers from the Sacramento Valley to meet their water supply demands. These transfers are in part made possible by groundwater substitution, and are important to the agricultural economy and municipal water supply needs of California. These transfers can be a critical component of long-term supply strategies for some water users. However, over-reliance on groundwater substitution can result in serious adverse impacts where the groundwater pumping occurs, and can result in depletion of groundwater resources, ecosystem impacts, subsidence, and water quality degradation, specifically during times of drought.

Response

Groundwater Mitigation Measure GW-1 was developed to avoid or reduce potentially significant impacts to groundwater resources to a less than significant level. See Common Responses 6 and 7.

Comment SA03-3

Comment

The Draft EIS/EIR finds that potentially significant impacts to groundwater resources could occur, but that with the proposed monitoring and mitigation program in place, these impacts would be less than significant. However, it is not clear whether these determinations are supportable. Specifically, the Draft EIR/EIS appears to underestimate the impact of the proposed project on local groundwater, does not appear to adequately account for the effect of current drought conditions on groundwater availability, and reaches conclusions that do not appear to be supported by the available data.

Response

The impacts analysis described in Section 3.3 of the EIS/EIR was developed using the best available modeling tools. These tools include modeling of the groundwater aquifer system and its interaction with surface water. The modeling also incorporates the surface processes that lead to deep percolation to the aquifer. Appendix D provides the technical background on the SACFEM2013 groundwater model. Potential groundwater substitution pumping was added to background pumping in the SACFEM2013 model to assess the potential changes to groundwater levels due to the transfers. The SACFEM2013 model was run through the previous wet and dry hydrology of the period from 1976 to 2003. Figure 3.3-27 shows the timing of the groundwater substitution transfer pumping for this hydrologic period, including pumping during drier periods when seller demand and Delta transfer capacity is available. Section 3.3.2, Environmental Consequences/Environmental Impacts, provides several figures that show the potential change in groundwater level both spatially across the Sacramento Valley (Figures 3.3-28 through 3.3-33) and with time (Figures 3.3-34 through 3.3-38; Appendix E).

Comment SA03-4

Comment

Comment #1: The Sustainable Groundwater Management Act

As mentioned above, California State Assembly Bill 1739 and Senate Bills 1168 and 1319 were passed by the Legislature in August 2014, and were signed into law by Governor Brown in September 2014. The package of bills constitutes the SGMA of 2014. The SGMA provides a framework for improved groundwater management by local authorities, and becomes effective January 1, 2015. The legislation requires that local agencies sustainably manage groundwater basins over a long-term planning horizon, and allows for state intervention by the State Water Board when additional efforts are needed to protect groundwater resources. The SGMA defines sustainable groundwater management, provides local agencies with tools and authorities to manage basins, and sets a timeline for implementation. Local groundwater sustainability agencies (GSAs) must be formed by June 2017, and groundwater sustainability plans (GSPs) must be completed for basins with the greatest need by 2022. Basins that must adopt a GSP must achieve sustainability within 20 years of plan adoption.

Sections 3.1.1.2.2, 3.2.1.2.2, 3.3.1.2, and 3.8.1.2 of the Draft EIS/EIR should be updated to include a discussion of the SGMA, which will be implemented during the 10-year timeframe (2015-2024) of the proposed project. The SGMA will affect the proposed buyer and seller regions in regard to their groundwater management, land use, water demands, and water availability. The SGMA also requires that GSAs, address groundwater quality issues and possible effects on groundwater dependent ecosystems (GDEs) caused by groundwater extraction. The Draft EIS/EIR should also be updated to address the management programs and regulatory requirements established under the SGMA, specifically new groundwater data that will be made available as part of a GSP that could be integrated into the proposed monitoring and mitigation program. The Draft EIS/EIR should also be updated to require that any transfers follow requirements (monitoring, reporting, and if necessary limits on pumping) required by a GSA or GSP.

Response
A summary of the SGMA has been added to the Water Supply, Water Quality and Groundwater Resources sections.

Comment SA03-5

Comment
Comment #2: Data and Modeling Issues

The Draft EIS/EIR indicates that the Sacramento Valley is “flexible and can respond to changes in hydrologic conditions and Central Valley Project (CVP) allocations (Executive Summary section 1.2)” as opposed to the southern Central Valley where there is a dire need for water. This conclusion appears to be based on an analysis of existing data primarily consisting of Department of Water Resources (DWR) hydrographs, supply availability data provided from potential sellers, and modeling results from the SACFEM2013 model. The State Water Board has the following comments regarding this assessment.

1. The analysis should include recent data showing significant groundwater depletions in the Sacramento Valley. There are several data sets and reports available from DWR that should be included in the analysis of groundwater availability, but are not. DWR has published a drought report (DWR, April 30th, 2014) showing groundwater declines for significant portions of the Sacramento Valley. The Draft EIR/EIS should include an analysis of how additional water extractions could affect local groundwater levels given the current groundwater elevations and drought status.

   Section 3.1.1.3, page 3.1-5, describing the existing conditions of water supplies available for transfer should be updated to include groundwater data (e.g., DWR's California Statewide Groundwater Elevation Monitoring (CASGEM), basin prioritization results, etc.) to support the stated assumptions of the quantity of groundwater available in seller areas for transfer through groundwater substitution.

Response
Section 3.3.1.3 has been revised to include recently published data regarding current drought conditions.

Comment SA03-6

Comment
2. The groundwater quality analysis should include additional assessments of groundwater quality, including the State Water Board's AB2222 report (Communities that Rely on Contaminated Groundwater Source for Drinking Water, available at: http://www.swrcb.ca.gov/water_issues/programs/gama/ab2222/index.shtml), GeoTracker data, and GeoTracker GAMA data to assure that potential impacts from mobilizing contaminant plumes and other groundwater quality impacts are adequately evaluated.

Response
Data from the Groundwater Ambient Monitoring and Assessment (GAMA) program was reviewed and included in Section 3.3.1.3, Affected Environment. As stated in Section 3.3.2, Environmental Consequences/Environmental Impacts, groundwater quality impacts are only expected if the project causes a change in groundwater flow levels and/or flow patterns that persists for a long period of time. The groundwater substitution pumping proposed in this EIS/EIR will occur only during the summer irrigation period.

Comment SA03-7

Comment

3. The statements in sections 3.2.2.4.1 page 3.2-28, and section 3.2.2.5.1, page 3.2-42, that “groundwater quality in the [seller service] area is generally good and sufficient for municipal, agricultural, domestic and industrial uses” is potentially overly broad. The conclusion does not account for current groundwater quality monitoring, including monitoring data from wells in the proposed seller areas that have been identified to be within close proximity of nitrate contamination.

   In order to accurately reflect the highly variable groundwater aquifer properties such as hydraulic conductivity and transmissivity, it is necessary to incorporate all well information within a data set. Most aquifers are neither homogeneous nor isotropic, and the hydraulic conductivity can be characterized differently in all directions. If the intent of the modeling analysis is to simulate the effects of the operation of high-productivity irrigation wells screened within the major producing zones, then it would be prudent to characterize these production zones with as much information as possible to avoid bias. In Section D.3.6, paragraph 3, the Draft EIS/EIR states that “all test data from wells that reported a well yield below 100 gallons per minute were eliminated from consideration, as were the test data from wells with a total depth less than 100 feet.” Are the criteria for filtering the well test data mutually exclusive or inclusive? If a well had low yield data and was located 600 feet below the surface, then it should be included in the data set. This filtered data set contains one of the most important parameters in the model and can influence flow direction and velocities and should be characterized as accurately as possible. As a result of filtering the data, the results do not reflect heterogeneous/anisotropic conditions seen in the subsurface. These subtle differences in the subsurface are what comprise the hydrodynamic character of each aquifer and without this data, the conclusions drawn by the model are potentially unreliable. The Draft EIS/EIR should have a better description of model parameters and inputs, and the potential effects that inclusion/exclusion of certain types of data could have on model results.

Response

Groundwater quality is described in greater detail in Section 3.3.1.3 because effects to groundwater quality are part of the analysis of impacts to groundwater resources. Section 3.3.1.3 includes identification of groundwater quality concerns in each sub-basin.

As with any numerical groundwater flow model, SACFEM2013 requires the user to construct a mathematical representation of an aquifer system, and to establish boundary conditions that govern how the modeled aquifer interacts with regions outside of the model domain. The assignment of subsurface parameter values during model development does not curtail the ability of the model to compute aquifer responses from imposed hydraulic stresses on the aquifer system. SACFEM2013 was calibrated to historical aquifer conditions over the period 1970 through 2010. The calibration data set contains wide fluctuations in climatic variability ranging from the 1976-1977 and 1987-1992 drought periods as well as extremely wet periods, such as 1983. The ability of the model to adequately replicate observed conditions during these periods demonstrates its ability to simulate aquifer responses for the range of conditions experienced during the calibration period. Reclamation and SLDMWA acknowledge that stochastic modeling would need to have been undertaken to address predictive uncertainty. SACFEM2013 is a deterministic model, as opposed to a stochastic model. As such, it is not possible to quantify a defensible margin of error associated with its forecasts. However, the forecasts are based on reasonable input assumptions and are considered adequate to help inform decision-making.

Comment SA03-8

Comment

4. The project model is based on an abbreviated calibration set from 1970 to 2003 that does not appear to represent current water use, precipitation, and drought conditions or future climate change scenarios, which are generally drier. Groundwater recharge in the northern part of the Central Valley is below normal due to drought conditions.

   Consequently, it could take several years to recharge the volume of water exported during a single year of transfers. This project proposes to export as much as 512,000 acre-feet of water annually. With the current drought, basin yield for these projects could be well below the amount used for the project model. As such, the interpretations based on the model may underestimate impacts to the area.

   Section 3.1.2, page 3.1-14, describing the assessment methods used to determine the environmental impacts associated with the project should be revisited. The water year time period (1970-2003) used for the model fails to account for current environmental conditions and water use trends. For example, the model assumes that water transfers occur in 12 out of the 33 year time period. However, the State Water Board's Division of Water Rights' Water Transfer Program records indicate that water transfers have occurred for the last six consecutive years of the current program's record (2009-2014). It is reasonable to expect that establishing a long-term transfer program would facilitate a higher frequency of water transfers, which would result in more frequent groundwater substitution transfers.

Response

See Common Response 5.

Comment SA03-9

Comment
In addition, known conditions do not appear to match what is shown in the Draft EIS/EIR. There are many wells in the northern Sacramento Valley that have cones of depression that cover large areas and are not accounted for. DWR maps show groundwater depletions in excess of 20 feet for shallow, intermediate, and deep groundwater aquifers from spring 2004 to spring 2013. The set of wells used to calibrate the model do not include wells that have undergone considerable groundwater elevation losses in excess of 20 feet within the last 10 years. The DWR potentiometric and groundwater elevation maps were created using over 200 wells around the northern Sacramento Valley. Choosing well locations and values that are not located within the cone of depression areas are not reflective of current conditions and will sway model results and how the system responds to future groundwater extraction.

Response
Modeled wells were calibrated to existing data from the simulation period (i.e., 1970-2003). Review Appendix D, Groundwater Model Documentation for details on calibration of the model. See Common Response 4.

Comment SA03-10

Comment
Comment #3: Monitoring and Mitigation

The Draft EIS/EIR references a Draft document titled Technical Information for Preparing Water Transfer Proposals and Addendum for providing guidance on the development of proposals for groundwater substitution water transfers; however, information on these documents were not described in detail. Based upon the information provided in the Draft EIS/EIR, there are several additions and clarifications that could strengthen the Mitigation and Monitoring Program (M&MP):

1. Groundwater elevation data captured by the sellers should be required to be submitted to DWR's CASGEM Program, and sellers should be required to submit their information to any GSA for development of the basin's GSP. Although the sellers may be able to address groundwater depletions within their own service areas, the groundwater extractions may influence areas far outside the boundaries of the seller agencies. The only way to assess basin-scale impacts of exporting hundreds of thousands of acre-feet of water is a comprehensive basin-scale monitoring program. Eventually, development of GSAs will produce basin-scale data repositories. However, those GSAs have not yet been developed. In the interim, CASGEM offers an existing method to compile and analyze the data. As an alternative, the sellers may submit the data to the State Water Board's GeoTracker GAMA system. Local water districts should also be involved in monitoring and mitigation

processes so they can provide oversight on the entire area, manage disputes, and activate any mitigation processes.

Response

All data collected as required by Mitigation Measure GW-1 will be submitted to Reclamation as the lead agency. The data provided to Reclamation is considered public.

Comment SA03-11

Comment

2. It is unclear why groundwater elevation monitoring reports should be submitted only to Reclamation. DWR, local agencies (e.g., GSAs, counties, local water districts, others), and the State Water Board all have regulatory mandates to protect and manage groundwater resources. At a minimum, the data provided through the monitoring reports should be made available to any public agency with local authority to manage groundwater. We suggest making the reports available on a publicly-accessible website or database.

Response

All data collected as required by Mitigation Measure GW-1 will be submitted to Reclamation as the lead agency. The data provided to Reclamation is considered public.

Comment SA03-12

Comment

3. To ensure that impacts to water quality and other users do not occur as a result of this project, the M&MP program should require: sellers to incorporate existing water quality data from CASGEM, the State Water Board's AB 2222 report, GeoTracker GAMA, and GeoTracker; should require an analysis of known potential contaminant sites; and should require setbacks from known contaminant sites or plumes. Where appropriate, the programs should include an analysis of well screen intervals, water source, and potential contaminants in the area. The State Water Boards' GeoTracker system shows the location of thousands of leaking underground storage tanks, including sites within the seller's service areas. Leaking tanks typically affect the shallowest portions of an aquifer. Table 3.3-3 shows that many of the proposed sellers' wells are located in relatively shallow portions of the aquifer. For example, The Natomas Central MWC estimates that wells pumping at 5,500 gallons per minute (gpm) are located at depths as shallow as 150 feet below the ground surface. A contaminant can quickly and easily migrate from the surface to a depth of 150, particularly where the local geology is hydrogeologically conducive for rapid infiltration.

Response
As stated in Section 3.3.4.1, Mitigation Measure GW-1 was based on the "Draft Technical Information for Preparing Water Transfer Proposals" as prepared by DWR and Reclamation. The monitoring and mitigation plan required as part of GW-1 addresses groundwater quality. The Technical Information document lists the specific details of the required water quality testing, including the identification of known contaminated areas. More comprehensive water quality testing may be required for wells in areas with known groundwater quality problems. See Common Responses 6 and 7 for additional information.

Comment SA03-13

Comment

4. The mitigation component is vague, and does not identify trigger points that activate a mitigation process. Nor does the mitigation plan identify who will require the mitigation, who will oversee the mitigation, and who will ensure that mitigation is completed. The document, in Section 3.3.4.1.3, describes a scenario where the seller would be responsible for self-initiating and managing the mitigation plan. Leaving the sellers to self-mitigate is a potential conflict of interest, and may result in scenarios where adverse impacts to groundwater and other resources go unaddressed.

Response
Mitigation Measure GW-1 requires development of an approved monitoring and mitigation plan to avoid potentially significant impacts from groundwater substitution pumping. Common Responses 6 and 7 provide additional information.

Comment SA03-14

Comment
The M&MP requirements proposed in the Draft EIS/EIR (section 3.3.4.1, page 3.3-88) do not consider all local regulations. Of the 28 proposed seller agencies, 7 agencies have existing Groundwater Management Plans (GWMPs), which include M&M requirements that may be duplicative. The SGMA will require that additional seller districts be part of a GSP (which will replace any existing GWMPs). As with GWMPs, the GSPs will contain local M&MP requirements. The Draft EIS/EIR M&MP should be rewritten to ensure that proposed seller agency activities meet the regulatory requirements in the existing GWMPs or future GSPs.

Response
The text in the last paragraph of Section 3.3.4.1 has been clarified to include Groundwater Sustainability Plans.

Comment SA03-15

Comment
Comment #4: Groundwater/Surface Water Interactions and Groundwater Dependent Ecosystems

Section 3.1.2.4 makes assumptions regarding groundwater availability for groundwater substitution transfers in seller areas that may misrepresent existing groundwater conditions. While the Draft EIS/EIR acknowledges that groundwater/surface water interactions exist, and that groundwater can contribute an important percentage of stream baseflow, the document does not account for potential impacts to surface waters in the sellers' areas that are caused by significant groundwater depletion. As written, the Draft EIS/EIR implies that natural in-stream groundwater recharge has a direct impact on streamflows, but does not consider how groundwater depletion in the sellers' area might reduce surface water baseflow. Additionally, the Draft EIS/EIR assumes that current groundwater levels are being sustainably managed and that there is adequate groundwater available to ensure reliable water sources for the proposed groundwater substitution transfers. The Draft EIS/EIR makes this assumption without demonstrating that current conditions and ongoing practices are not impacting groundwater dependent ecosystems.

Response
Information on existing regional groundwater conditions can be found in Section 3.3. The modeling effort, described in detail in Appendices B and D, included an extensive evaluation to estimate changes in groundwater levels and groundwater-surface water interaction. Section 3.1 includes an analysis of how the changes in groundwater-surface water interaction could affect water supply. Groundwater-surface water interaction could affect other resources, and these potential effects are assessed in Sections 3.7, Fisheries and 3.8, Vegetation and Wildlife.

Comment SA03-16

Comment
The Draft EIS/EIR includes a series of maps (figures 3.3-26 through 3.3-31) showing simulated change in groundwater head, for different depths, for the 1976 and 1990 transfer seasons. Those maps are illustrative, but do not represent current conditions. As noted above, transfers have taken place for the last six consecutive years. In combination with information that a single year's worth of drawdown could reduce shallow-aquifer levels by 15 to 20 feet (e.g., Figure 3.3-31, near the Cordua Irrigation District), there is significant concern that continued transfers will harm groundwater dependent ecosystems. Consecutive years of transfers could lower groundwater elevations to the point that ecosystems (including wetlands, springs, and streams) are disconnected from groundwater, causing harm to local species.

Response
The figures referenced by the commenter represent the change in groundwater level expected due to the transfer pumping. Mitigation Measure GW-1 was developed to avoid or reduce potential impacts to groundwater resources to a less than significant level. Impacts to ecosystems are discussed in Section 3.8, Vegetation and Wildlife.

Comment SA03-17

Comment
Section 3.8.2.1, page 3.8-31, describing the assessment methods used to determine transfer effects on groundwater dependent ecosystems leaves out critical information and appears to make incorrect assumptions in assessing harmful effects to groundwater-dependent ecosystems. (Section 3.8.2.1). The water year time period (pre-2003) used for the model, does not account for current environmental conditions and water use trends. Furthermore, the assumption that there will be no groundwater/surface water interaction where pre-transfer water levels are already more than 15 feet below ground surface is not supported. Baseflows may be disconnected to the stream course in one area of the catchment, but discharge to the land surface as streamflow or a spring in other areas of the basin. In addition, the logic appears to be circular, since pumping related to the proposed transfers can drive groundwater elevations to depths greater than 15 feet below ground surface.

Response
Please see Common Response 11 related to effects on groundwater-dependent vegetation and wildlife and Common Response 5 for a discussion of the model time period.

Comment SA03-18

Comment
Section 3.8.2.1 also discusses impacts to species that could occur where groundwater dependent ecosystems are cut off from their water source due to transfer-related pumping. The assumption that impacted species will be able to adjust to lowering groundwater levels in a single water year is not supported (Section 3.8.2.1.1, page 3.8-31). The 15-foot cutoff is based on a model run that uses decade-old data, and does not account for regional or basin specific geology that defines the extent of surface water-groundwater interactions.

Response
The commenter refers to text in Section 3.8.2.1.1 that is specific to a few locations in the North Delta where groundwater levels are high, and with a maximum reduction of 0.3 to 0.8 feet over the growing season, plants are expected adjust to this small reduction. Appendix E includes the depth of groundwater at other locations. See Common Response 11 for more

information on potential effects to vegetation and wildlife from surface water-groundwater interaction.

Comment SA03-19

Comment
The Draft EIS/EIR appears to disregard potential effects to groundwater dependent ecosystems that could occur in the sellers' area. A more thorough discussion of the effects of groundwater extraction on ecosystems in the sellers' area should be included in section 3.8.2.4, page 3.8-46. The associated impacts to the groundwater dependent ecosystems are determined to be not significant with the implementation of Mitigation Measure GW-1. However, the mitigation appears to be inadequate (where the primary mitigation action is to reduce groundwater pumping). To prevent negative impacts to groundwater dependent ecosystems, the mitigation plan should require preventative actions rather than reactive approaches to ensure impacts do not occur.

Response
See Common Responses 6, 10, and 11.

Comment SA03-20

Comment
Comment #5: Groundwater Levels in the Buyers' Area

In Section 3.3 (Table 3.3-7, page 3.3-86 and again on page 3.3-87), the Draft EIS/EIR states that transfers could increase groundwater levels, eliminate or minimize land subsidence, and improve groundwater quality in the Buyer Service Area by reducing groundwater pumping during shortages. This statement is potentially misleading. In order to show that the transfers would increase groundwater levels (presumably through percolation of excess irrigation water, and/or conjunctive recharge), the Draft EIS/EIR should include a water balance for the buyer's areas. In all likelihood, the volume of the transfer would need to be significantly greater than the amounts proposed for long-term transfer in order to replace the amount of groundwater that is currently extracted to meet agricultural demands in the buyer's region. For example, the Draft EIS/EIR states that the average annual groundwater production in the San Joaquin basin is 0.9 million acre feet (Section 3.3, page 3.3-41), which is more than the sum of the proposed transfers. It is not plausible to assume that transfer water will solve the San Joaquin groundwater depletion issues, especially considering precipitation and mountain-front recharge amounts have decreased in response to the drought. While the transfers may slow the rate of groundwater decline in the buyer's area, there is no basis to state that the application of the transfer water alone will raise groundwater levels. Similarly, while the transfers may temporarily slow subsidence, unless the transfer water raises groundwater elevations above historic lows the additional water is unlikely to halt subsidence (although it may slow locally significant rates). It would be more productive to show a simple water balance for the respective buyer's areas, with a discussion of how much groundwater pumping, in addition to transfer water, is needed to sustain current and projected agricultural practices.

Response

The text in Section 3.3.2.4.3 has been revised to state that the project may result in a reduction in the use of groundwater resources. This potential reduction in groundwater use would be a benefit, either by increasing groundwater levels or by reducing the rate at which groundwater levels decline.

Comment Letter LA01, Doug Teeter, Butte County Board of Supervisors

Comment LA01-1

Comment
Butte County and its surrounding region have a vested interest in assuring that the Long-Term Water Transfers Program has the least impact upon the community, agricultural economy and environment. Our region's water resources provide the life blood for our agricultural-based communities, economy and environment. Much of our local water supply comes from the various groundwater basins throughout the region that area recharged through these creeks and rivers.

We are troubled by the short amount of time afforded to provide comments on the EIS/EIR. It has been almost four years since the Bureau released a draft EIS/EIR, yet only provided the public 60 days to review, analyze and comment. The community has a strong interest in the Long-Term Water Transfers Program. So, in fairness, the Bureau of Reclamation (Bureau) should extend the comment period for at least ninety days.

Response
The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment LA01-2

Comment
Based on our preliminary review, we believe that the EIS/EIR is seriously flawed and will need to be revised and recirculated. The relied upon data is outdated, incomplete and selectively chosen. The result is that the EIS/EIR fails to meet the requirements of the National Environmental Policy Act and the California Environmental Quality Act. Again, due to the inadequate amount of time afforded to comment, the comments provided by the Butte County Board of Supervisors do not reflect a full review of the document.

Response
The Draft EIS/EIR included the most recent information available in the affected environment sections. The Final EIS/EIR has been updated to include information that has become available since the draft document was published. The amount of time provided for review of, and comment on, the Draft EIS/EIR is in accordance with the requirements of NEPA and CEQA.

Comment LA01-3

Comment
The Long-Term Water Transfers Program purports to assist water users south of the Delta with immediate implementable and flexible supplemental water supplies to alleviate shortages. The project objectives claim that shortages are

expected due to hydrologic conditions, climate variability, and regulatory requirements. Project justification intends to address unforeseen, short-term water supply challenges. The reality that the circumstances facing the water users south of the Delta are neither short-term nor unforeseen. These water supply reliability challenges are baseline conditions that must be addressed at the local and regional level. Ironically, water users north of the Delta face similar challenges in terms of hydrologic conditions and climate variability, but the EIS/EIR inadequately assesses these limitations. The project intends to establish a long-term water transfer program to meet the current and future demands south of the Delta, not based on any viable criteria.

Response
The Lead Agencies establish the purpose and need and project objectives to best describe their underlying reasons for considering an action. While the Lead Agencies recognize that drought causes water supply concerns in other areas of the state, the purpose and need for this EIS/EIR focuses on the area that relates to the parties that may participate in the range of potential transfers described in the document.

Comment LA01-4

Comment
Even though the EIS/EIR identified significant impacts in the Sacramento Valley, the methodology underestimated those impacts. The EIS/EIR identified significant impacts including lower groundwater elevations, changes to groundwater quality, reduction in groundwater recharge and decrease flows in surface water. However, it fails to take into account that the reduction in stream flows and the lowering of Lake Oroville that will harm the local economy. In additional to underestimating these impacts, the mitigation measures in the EIS/EIR are not viable and will not mitigate the significant impacts. The following specific examples highlight the flaws in the EIS/EIR and provides justification for a revised and recirculated EIS/EIR.

Response
The EIS/EIR evaluates the physical effects of decreases in Lake Oroville storage and reductions in stream flows. Mitigation measures to avoid any potentially significant reduction in stream flows were included for those resources affected. Section 3.10 presents an analysis of the potential economic impacts of water transfers, including effects to pumping costs of changes in groundwater levels. As discussed in Section 3.3, the groundwater modeling does account for stream flow depletion. The EIS/EIR evaluates physical impacts to recreation, water supply, flood control and other resources that could be affected by changes in storage or reservoir levels at Lake Oroville. There were not economic effects identified as a result of the small changes in storage in Lake Oroville.

Comment LA01-5

Comment

First, the description of the regulatory setting in Chapter 3 - Groundwater (section 3.3.1.2) is incomplete, misleading and inaccurate. The document makes no mention of the recently enacted Sustainable Groundwater Management Act. The implementation of the Sustainable Groundwater Management Act will occur during the ten year period of the water transfer program. The Sustainable Groundwater Management Act will affect the buyer and seller regions in regard to their groundwater management, land use, and water demands. The data and management programs developed through the Sustainable Groundwater Management Act will change the assumptions in the EIS/EIR.

Second, the EIS/EIR must reference and acknowledge Area of Origin provisions in the Water Code. Specifically, the EIS/EIR must reference Water Code 85031, which states "This division does not diminish, impair, or otherwise affect in any manner whatsoever any area of origin, watershed of origin, county of origin, or any other water rights protections, including, but not limited to, rights to water appropriated prior to December 19, 1914, provided under the law. This division does not limit or otherwise affect the application of Article 1.7 (commencing with Section 1215) of Chapter 1 of Part 2 of Division 2, Sections 10505.5, 11128, 11460, 11461, 11462, and 11463, and Sections 12200 to 12220, inclusive." Honoring are of origin water rights is consistent with state water policy and a foundational element to California's water future. In addition, the EIS/EIR should also discuss how the project complies with SB1X, which calls for a reduced reliance on the Delta and to promote regional water supply reliability.

The description of the local regulatory setting in the EIS/EIR failed to reference the Butte County Groundwater Conservation Ordinance (Chapter 33 of the Butte County Code), which Butte County voters overwhelmingly adopted in 1996. The Groundwater Conservation Ordinance requires a permit for water transfers that include a groundwater substitution component. The primary purpose of this Ordinance is to ensure that an adequate independent environmental review occur and to assure that groundwater resources would not be adversely affected (i.e., overdraft, subsidence, saltwater intrusion) or result in uncompensated injury to overlying groundwater users and others. Additionally, the process of the Groundwater Conservation Ordinance brings a measure of transparency and public involvement that should be part of any water governance process. It is imperative that the proposed program adhere to the spirit and intent of local groundwater ordinances that have been codified since the Drought Water Bank held in the early 1990s. In this regard, the program needs to recognize that groundwater basins can extend across multiple administrative jurisdictions. Groundwater substitution transfers that occur in Colusa or Glenn counties have the potential, over the long term, to draw down groundwater sources shared with Butte County.

Response
Section 3.3.1.2.2 has been revised to include additional text on Senate Bill 1168, Assembly Bill 1739, and Senate Bill 1319.

See Common Response 6 for additional information. The range of potential transfer actions analyzed in the EIS/EIR does not include any groundwater substitution transfers from Butte County, but Section 3.3 does assess potential impacts throughout the Sacramento Valley, including Butte County, from transfers originating in nearby areas.

Comment LA01-6

Comment
The EIS/EIR (Chapter 3, p. 21) includes a limited description of groundwater production, levels and storage in the Sacramento Valley. The section fails to report on the extensive data and analysis of groundwater conditions in this area. The section fails to report on the extensive data and analysis of groundwater conditions in this area. The EIS/EIR bases its analysis on a few selected wells, and provides a generalized description of regional groundwater conditions based on those wells. What is most troubling is the conclusion that the Sacramento Valley groundwater trends indicate that "wells in the basin have remained steady, declining moderately during extended droughts and recovering to pre-drought levels after subsequent wet periods." This conclusion misrepresents the reality of groundwater conditions in the Sacramento Valley. The EIS/EIR acknowledges that one of the selected wells, 21N03W22A004M, shows a steady decline but current groundwater conditions are being impacted beyond routine seasonal fluctuations and does not account for projected impacts from climate change. In some areas, BMO alert to trigger levels have been reached. There are a number of areas included a more comprehensive analyses of groundwater conditions and locally adopted Basin Management Objectives (BMO), clearly describing how BMOs will be utilized and how the program will address current conditions.

In addition to misrepresenting groundwater elevation data, the EIS/EIR also willfully ignored and misrepresented the current condition of streams and creeks in the Sacramento Valley. The Sacramento Valley subsidence monitoring data are readily available through the Department of Water Resources and the EIS/EIR should have included that data. For specific data and analysis of Butte County groundwater conditions we invite the Bureau to review the annual Groundwater Status Report at: http://www.buttecounty.net/waterresourceconservation/GroundwaterStatusReport.aspx.

Response
See Common Response 4. The statement "wells in the basin have remained steady, declining moderately during extended droughts and recovering to pre-drought levels after subsequent wet periods" is based on past hydrologic

conditions. At well 21N03W33A004M (DWR 2014a) groundwater levels recovered after declines noticed during drought conditions between 1975 and 1977. Current drought conditions have caused groundwater levels in some regions to decrease below historic lows noticed from 1900 through 1998. Additional data has been added to the Groundwater Resources section to present data for current dry conditions.

The Lead Agencies acknowledge that basin management objectives (BMO) alerts have been reached in some parts of Butte County. As a clarification, Butte Water District is the only seller in Butte County under the Proposed Action, and it has not proposed groundwater substitution-related pumping within Butte County. The Lead Agencies have reviewed the 2013 Groundwater Status Report (http://www.buttecounty.net/Portals/26/Reports/Butte_14_BMO.pdf) and noted groundwater elevation at well 17N03E16N001M during the fall 2013 monitoring falling below the Fall BMO Stage 1 alert by 0.3 feet, and the fall 2014 measurement falling below the Fall BMO Stage 2 alert by 0.7 feet (https://www.buttecounty.net/wrcdocs/Programs/Monitoring/GWLevels/2014/2014_Fall_BMO_Data.pdf). See Figure J-4 for spring 2014 measurements showing groundwater elevations approximately 2 feet above BMO alert 1 level. This is indicative of seasonal fluctuations in groundwater level with recovery in the post transfer period. The Lead Agencies acknowledge the long-term declining trend noticed between 1976-77 and 1987-92 and, more recently, from 2010 to the present. See Common Response 6.

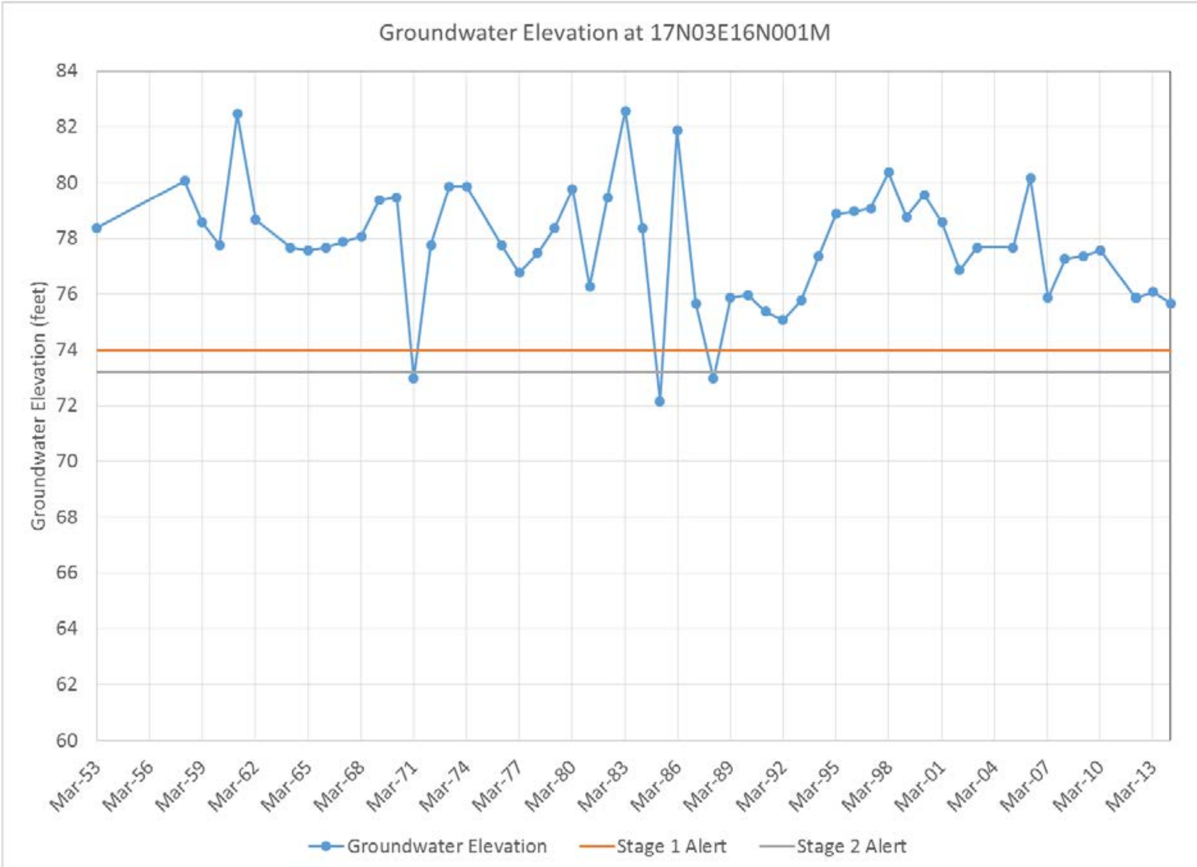


Figure J-4. Spring 2014 Groundwater Elevation Measurements at Well 17N03E16N001M

The draft CEQ guidance asserts that it is not useful for a NEPA evaluation to link a specific Proposed Action to climatological changes and the environmental impacts thereof. Additionally, while the CEQ acknowledges that the effects of climate on a Proposed Action should be considered, agencies must be cognizant of the scientific limitations on predicting climate change effects, especially for actions of a short-term nature. Based on these considerations, it is not feasible to consider the effects the Proposed Action would have on sensitive aquifer systems in light of the impacts of climate change.

Comment LA01-7

Comment

We have concerns over the modeling methodology and the resultant appraisal of that data. Unfortunately, the limited amount of time afforded to comment precludes Butte County from conducting an in-depth analysis. However, a preliminary review of the modeling data raised a number of questions. One is the implication of the limited dataset to conduct the CalSim II modeling analyses. These choice of data used to establish baseline conditions for the SACFEM2013 analysis is critical to identifying the impacts of the study. The reliance on data from 1970 to 2003 fails to take into account current conditions and trends. For example, the analysis of the data used lead to an assumption that 12 out of 33 years would result in groundwater substitution transfer events. However, recent experience (2000-2014) has shown that transfer programs have actually occurred in 9 of 15 years; more than one and a half times that of the analysis. A reasonable expectation is that having an established Long-Term Transfer Program would facilitate a higher frequency of water transfers and that, in turn, groundwater substitution transfers would occur in most years. The discrepancy between calculated expectations versus actual occurrences demonstrates an obvious fundamental flaw in the EIS/EIR that requires revision.

Response
See Common Response 5.

Comment LA01-8

Comment
One of the most egregious flaws with the EIS/EIR is how the impacts from groundwater substitution transfer programs are identified and mitigated. According to the EIS/EIR (p.3.3-61), "an impact would be potentially significant if implementation of groundwater substitution transfers or cropland idling would result in:

- A net reduction in groundwater levels that would result in adverse environmental effects or effects to non-transferring parties;
- Permanent land subsidence caused by significant groundwater level decline.
- Degradation in groundwater quality such that it would exceed regulatory standards or would substantially impair reasonably anticipated beneficial uses of groundwater;"

Based on our preliminary analysis, the EIS/EIR fails to adequately assess the impacts from groundwater substitution transfer programs. The EIS/EIR underestimates the effects and fails to adequately mitigate those effects in regards to determining whether there is a net reduction in groundwater levels that would result in adverse environmental effects or effects to non-transferring parties. As previously shown, the assumption that groundwater substitution would occur on a limited basis was false, so the simulated changes in water table elevations can only be assumed to be grossly underestimated. Additionally, the EIS/EIR conclusion that most wells in the Sacramento Valley are deeper than the resulting groundwater elevations is not true. In actuality, most of domestic wells are less than 100 feet. The combination of these two erroneous conclusions resulted in the EIS/EIR completely failing to assess the potential impact of the groundwater substitutions to shallow wells would only see a reduction in yield and not go "dry" is equally untrue. During the part two drought periods, Butte County and the Sacramento Valley have responded to numerous incidents of domestic well failing. The EIS/EIR must recognize and analyze how the Long-Term Transfer Program will contribute and exacerbate the impacts of a natural disaster to those who rely on domestic wells.

Response
The groundwater analysis used SACFEM2013 to evaluate potential impacts to groundwater resources, including groundwater levels. See Appendix D for documentation of SACFEM2013, which includes a discussion of why it was selected for this analysis. See Common Response 6 regarding groundwater mitigation. Transfer frequency for groundwater substitution alternatives is based on hydrologic conditions, buyers' priorities for transfer methods, transfer quantities, and ability to export through the Delta.

Table 3.3-4 lists the well depths in the Sacramento Valley Groundwater Basin. Well depths within the Sacramento Valley range from 11 to 1,750 feet and average well depths range from 100 to 250 feet.

Comment LA01-9

Comment
The EIS/EIR (Chapter 3.7) identified that the Long-Term Water Transfers Program will impact local streams and jeopardize critical ecosystems. Of particular concern is the calculated stream flow reduction in Little Chico Creek of more than 1 cubic foot per second and a reduction of more than 10%. The EIS/EIR categorized the impact to Little Chico Creek as a significant impact. Unfortunately, the EIS/EIR underestimated the impacts and relied on outdated information again. As mentioned previously, the EIS/EIR underestimates the frequency of groundwater substitution events, and the data relied upon for analyses are outdated. The stream gaging data along Little Chico Creek was based on data from 1976 to 1995, and the CalSim II modeling results did not include data after 2003. Because the stream data relied upon in the EIS/EIR do not reflect current baseline conditions in the Sacramento Valley, it raises significant doubts to the validity of the conclusion that the resultant reduction in flows, particularly in Little Chico Creek, would not impact spring-run Chinook salmon. Therefore, the Bureau must reevaluate the environmental impacts to streams and aquatic ecosystems based on current data.

Response
See Common Response 5 regarding the hydrology model timeframe.

The stream gage data used for Little Chico Creek were from USGS Stream Gage# A04280 - Little Chico Creek near Chico. Flow data publicly available, and therefore used in this analysis, for this location were for water years 1976-1996. A search of both USGS and DWR (CDEC) databases indicates that there are no other stream gage data publicly available either for A04280 or anywhere else in Little Chico Creek. Note that the text inadvertently indicated the dates for data used were 1976-1995, but this has been corrected to indicate data were for water years 1976-1996.

Comment LA01-10

Comment
The environmental analysis identified a number of significant impacts requiring mitigation. Unfortunately, the proposed mitigation measures, particularly Mitigation Measure GW-1: Monitoring Program and Mitigation Plans, will not mitigate adverse environmental effects or minimize potential effects to other legal water users. The EIS/EIR, as written, does not include criteria or standards that must be met to mitigate significant impacts and the Monitoring Program (3.3.4.1.2) has vague and subjective standards for what constitutes as an acceptable monitoring network. The EIS/EIR should assess the existing monitoring network and identify monitoring gaps based on the locations of potential willing sellers.

Another fundamental flaw is the expectation that potential sellers be required to develop a mitigation plan. The initial premise of the mitigation plan is that the seller's monitoring program would indicate whether the operation of wells for groundwater substitution pumping are causing substantial adverse impacts. Unfortunately, because the definition of substantial adverse impacts is not defined, the process to monitor and mitigate third party impacts lacks clarity. First, the Long-Term Water Transfers Program must define the specific parameters for what constitutes substantial adverse impacts. Then the Long Term Water Transfers Program must have an unambiguous, transparent, locally vetted dispute resolution program. It is imperative that the Long-Term Water Transfers Program recognize that potential impacts associated with the transfer of water from the Sacramento Valley need to be addressed through this type of approach.

Response
Mitigation Measure GW-1 requires a monitoring plan as part of any groundwater substitution transfer proposal to avoid potentially significant adverse impacts. The concept and process for these plans is based on the "Draft Technical Information for Preparing Waters Transfer Proposals." Each monitoring and mitigation plan will be customized for the local conditions surrounding the potential seller. Local conditions make it difficult to pre-define the required monitoring and mitigation efforts specific to each seller. Common Response 6 provides additional information.

Comment LA01-11

Comment
The description of potentially significant unavoidable impacts (Section 3.3.5) contains inaccurate statements and misleading information. First, it is unclear

why the Northern Sacramento Valley Integrated Regional Water Management Plan (NSVIRWMP) is included in this section. It appears that the Bureau does not understand the policy and governance of the NSVIRWMP. The NSVIRWMP does not have programs or project priorities that could be construed as potentially causing significant unavoidable impacts. Similarly, the reference to and characterization of the Tuscan Aquifer Investigation Project is inaccurate. The Tuscan Aquifer Investigation Project was a scientific project was a scientific project that intended to improve the understanding of the recharge characteristics of the lower Tuscan Formation and the interconnectedness of the basin. The characterization that the Tuscan Aquifer Investigation Project "would increase pumping within (or near) the Seller Service Area" is categorically false. If the Bureau had taken the time to review the data and reports from the Tuscan Aquifer Investigation, they might have improved their analysis by using current scientific investigation. We demand that the Bureau remove the reference to the Tuscan Aquifer Investigation Project.

Response

As described in Section 3.3.6.1.1, both NSVIRWMP and the Tuscan Aquifer Investigation have been described as studies. Section 3.3.6.1.1 describes the Tuscan Aquifer investigation as a study that will help improve the understanding of aquifer properties, and NSVIRWMP is a study that will help provide management objectives that would be protective of the groundwater resources in the northern Sacramento Valley.

Comment LA01-12

Comment

Finally, we have questions and concerns regarding the designated Lead Agencies in the EIS/EIR. The Department of Water Resources (DWR) should be designated as a lead agency rather than as a Responsible Agency. A number of the participating agencies are State Water Project (SWP) Contractors regulated by DWR and the conveyance for the project will use SWP facilities under the jurisdiction of DWR. One of the risks and uncertainties identified in Chapter 2 of the EIS/EIR was the ability to coordinate water transfers with DWR. Additionally, we fail to understand why the San Luis & Delta-Mendota Water Authority (SLDMWA) is the only lead water agency. Other water agencies have responsibilities equal to those of SLDMWA. The roles and responsibilities of participating agencies (Section 1.5) is inadequate and vague. The EIS/EIR fails to justify the choice of the SLDMWA as the sole lead agency when there is such as clear conflict of interest between the SLDMWA and the northern Sacramento Valley counties that overlie the groundwater sources that will contribute to groundwater substitution transfers. The document fails to provide a rationale for not including other water agencies named in the EIS/EIR as Lead Agencies.

Response
See Common Response 1.

Comment LA01-13

Comment
The magnitude of the proposed program is daunting and raises considerable concerns. In our comments on the scoping of the EIS/EIR in 2011, we surmised that an adequate EIS/EIR may not be possible based on the length and breadth of the proposed program. It appears that our concerns are true.

Response
The EIS/EIR has assessed the potential impacts of a range of potential transfer activities and alternatives on multiple resources, as described in Section 3 and summarized in Table 2-9. See Common Response 14.

Comment LA01-14

Comment
In conclusion, we cannot stress enough that actions through the Long-Term Transfer Program could have grave economic and environmental consequences in the Sacramento Valley that must be addressed. The EIS/EIR woefully fails to meet minimal environmental assessment standards, provides misleading statements and avoids including a complete, current, data set. We recommend that the Bureau of Reclamation extend the comment period for at least 90 days to allow a more complete review. Upon receipt of the comments, the Bureau must remedy the deficiencies in the EIS/EIR and recirculate it for comment.

Response
The EIS/EIR provides a comprehensive analysis of the potential impacts associated with a full range of alternatives, including potential environmental consequences in the Sacramento Valley. See Common Responses 3 and 14 for additional discussion. The EIS/EIR provides a complete and accurate analysis, which is supported by substantial evidence, and responses to all comments received on the Draft EIS/EIR have been included in this Final EIS/EIR. The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment Letter LA02, Brendan Vieg, City of Chico

Comment LA02-1

Comment
This letter is to provide the City of Chico's comments regarding the adequacy of the EIS/EIR analysis of the environmental effects, and mitigation for, water transfers from water agencies in northern California to water agencies south of the Sacramento-San Joaquin Delta and in the San Francisco Bay Area.

Through its General Plan, it is Chico's policy to oppose regional sales and transfers of local groundwater, including water export contracts, and the EIS/EIR should acknowledge and clearly highlight such inconsistency with a General Plan (CEQA Guidelines§ 15125(d)). The Tuscan aquifer is the primary groundwater basin underlying and providing municipal and agricultural water to Chico and its Planning Area. It's for this reason that the City opposes transfers of local groundwater in the long-term interest of a safe and reliable municipal water supply, and to support the regional economy and the environment.

Response
There will be no groundwater substitution pumping under the Proposed Action within Chico city limits. The closest groundwater substitution well is approximately 10 miles from the City of Chico. Impacts of potential transfer activities simulated in Section 3.3.2.4 (See Figures 3.3-28 through 3.3.-33) indicate no drawdown will be incurred near the City of Chico.

Comment LA02-2

Comment
While 60 days is the legal minimum for public review and comment on a Draft EIS/EIR, it is not an appropriate review time for such an important and voluminous document that attempts to analyze and mitigate the potential impacts of a six county, 10-year water transfer program. We request that the comment period be extended for at least an additional 90 days.

Response
The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment LA02-3

Comment
The Federal Register notice for the EIS/EIR states that "[t]ransfers of CVP supplies and transfers that require use of CVP or SWP facilities are subject to review by Reclamation and/or DWR in accordance with the Central Valley Project Improvement Act of 1992, Reclamation's water transfer guidelines, and California State law. Pursuant to Federal and State law and subject to separate written agreement, Reclamation and DWR would facilitate water transfers involving CVP contract water supplies and CVP and SWP facilities" (emphasis added). CEQA Guidelines Section 15367 and Section 15051 suggest that given the prominent role that DWR plays in the proposed water transfers, it is not proper that SLDMWA is the Lead Agency for the purposes of CEQA. A number of the participating water agencies are State Water Project contractors regulated by DWR and the conveyance for the project will use SWP facilities under the jurisdiction of DWR.

Response
See Common Responses 1 and 14.

Comment LA02-4

Comment
The project objectives for the EIS/EIR suggest that water shortages are expected due to hydrological conditions, climatic variability, and regulatory requirements. The project's justification therefore is to address unforeseen, short-term water supply challenges. The reality, however, is that the water supply challenges facing the water users south of the Delta are not unforeseen or short-term--- they are simply a created existing condition. The project objectives for the EIS/EIR need to be revised to accurately reflect the project's true purpose--- establishing a long-term water transfer program to address a created and growing water supply reliability challenge south of the Delta.

Response
The Lead Agencies establish the purpose and need to best describe their underlying reasons for taking an action. While the Lead Agencies recognize that drought causes water supply concerns in other areas of the state, the purpose and need for this EIS/EIR focuses on the area related to the parties participating in the document.

Comment LA02-5

Comment
The EIS/EIR (Chapter 3) provides an incomplete description of groundwater production, levels, and storage in the Sacramento Valley. In particular, the chapter fails to report on the extensive data and analysis of groundwater conditions in Butte County. The EIS/EIR bases its analysis on a few selected wells, and provides a generalized description of regional groundwater conditions based on those wells. The EIS/EIR fails to acknowledge data available from Butte County's Department of Water and Resource Conservation showing that current groundwater conditions are being impacted beyond routine seasonal fluctuations. In Butte County, Groundwater Basin Management Objective (BMO) alert levels have been reached for a number of wells, which requires specific management responses. The EIS/EIR should use recent and available well data to develop a comprehensive baseline condition for groundwater levels, and use locally adopted BMOs to determine appropriate thresholds of significance and mitigating responses for dropping groundwater levels.

Response
See Common Response 4. See response to Comment LA01-6 regarding triggering BMO alerts within Butte County.

Comment LA02-6

Comment

The EIS/EIR fails to consider the potential impacts of lowered groundwater levels on the City's urban forest. We request that the document be amended to include such discussion and analysis. The EIS/EIR acknowledges that groundwater levels would drop in response to groundwater pumping necessary to replace surface water transferred south of the Delta. The EIS/EIR does not provide any discussion or analysis of the relationship between the health of the City's urban forest and dropping groundwater levels. The environmental and economic benefits of a healthy urban forest are well known, and include habitat for migrating birds and other wildlife; protection from the extreme impacts of climate change; filtering for rainwater and groundwater; carbon storage, which reduces the amount of harmful greenhouse gases; energy savings from its shade canopy; aesthetic benefits; and enhancement of property values.

Response

See Section 3.3, Groundwater Resources for a complete description of impacts to groundwater levels. The effects on Little Chico Creek, and thereby the City of Chico's urban forest, are described in the EIS/EIR. As described in the analysis, in-stream reductions would occur when the stream is very low and therefore would not have a substantial adverse effect on this natural community. Urban vegetation is highly dependent on localized landscape irrigation, which would not be affected by the action alternatives.

Comment LA02-7

Comment

The environmental analysis does not adequately account for projected impacts associated with climate change. Reduced snow pack and sustained droughts are identified as key outcomes of climate change in California. Add to this the significant uncertainty regarding stream/aquifer interaction and the multiple dry years experienced by the State. What affect will this have on sensitive aquifer systems in light of the impacts of climate change?

Response

Section 3.6.1.3 of the EIS/EIR acknowledges that climate change could result in reduced snow pack and droughts. Additionally, this section indicates that climate change could potentially affect the aquifers from both over exploitation because of reduced surface water supplies and from saltwater intrusion that could occur from sea level rise (see Section 3.6-12). Impacts to the aquifers from groundwater substitution are discussed in detail in Section 3.3, Groundwater Resources. As described in Section 3.3, any effects on the aquifers from groundwater substitution would be less than significant with implementation of Mitigation Measure GW-1. See Common Response 6 for additional information regarding groundwater monitoring and mitigation. Because of the relatively short-term duration of the range of potential transfer activities under the action alternatives (10 years), they are not expected to have adverse effects on the aquifers, including cumulative effects from climate change.

Comment LA02-8

Comment

The EIS/EIR identifies a number of significant impacts requiring mitigation. Many of the significant impacts rely on Mitigation Measure GW-1: Monitoring Program and Mitigation Plans for mitigation. The EIS/EIR directs that monitoring programs and mitigation plans spelled out by this measure be developed consistent with the 2013 Draft Technical Information for Preparing Water Transfers Proposals and the 2014 Addendum documents prepared by the Bureau of Reclamation and Department of Water Resources. While the EIS/EIR purports that the monitoring and mitigation plans required by this measure will mitigate groundwater and biological impacts, the protocols, methodology, and emphasis outlined in the measure focus primarily on reducing effects to third party groundwater users. This critical mitigation measure needs to show a clear nexus for how it will reduce environmental impacts to groundwater and biological resources that will be caused by dropping groundwater levels.

Response

As stated in Section 3.3.4.1, the objectives of the monitoring and mitigation plan required under Mitigation Measure GW-1 are to mitigate adverse environmental effects that occur, to minimize potential effects to other legal users of water, to provide a process for review and response to reported effects to non-transferring parties, and to assure that a local mitigation strategy is in place prior to the groundwater transfer. The environmental effects listed are not limited to third-party groundwater users. Monitoring of groundwater levels is a simple way to determine impacts to the groundwater system. Impacts to other resources, such as biological resources, would come as a result of decreases in the groundwater levels. Therefore, monitoring the groundwater level serves as a surrogate for monitoring biological resources themselves. The monitoring program proposed as part of the transfer could include groundwater level monitoring targeted near areas that may have environmental concerns, such as biological resources. See Common Responses 6 and 10 for additional information.

Comment LA02-9

Comment

Our greatest concern is that water agencies south of the Delta continue to rely upon a transfer dependent water source that in turn depends on the use of north state groundwater. This proposed long-term water transfer program poses risks which we believe have not been addressed, and would be a precedent for future projects and decisions that could very seriously damage our city's- and our region's- environment, economy, and communities.

Response
See Common Response 3.

Comment Letter LA03, Jim Wallace, Colusa Drain Mutual Water Company

Comment LA03-1

Comment
The Colusa Drain Mutual Water Company (Company) objects to the EIS/EIR in its current form and requests that the Bureau extend the comment period for at least 120 days to allow the Bureau, the Company, and the Company's shareholders additional time to consider more carefully the potential negative impacts of the proposed water transfers.

Response
The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment LA03-2

Comment
Colusa Drain Mutual Water Company includes 50,000 acres of prime farmland and habitat. Shareholder lands lie both sides of the 2047 drain canal west of the Sacramento River and east of Interstate 5. Its northern border reaches into the southern part of Glenn County. It spans from the north to south borders of Colusa County, and its southern boundary lies well into Yolo County in the Yolo Bypass south of Interstate 80. Shareholder lands lie immediately adjacent to, or proximate to, 7 of the potential sellers identified in the EIS/EIR. Most of the Company's shareholders rely on water from 2047 drain canal as a primary source of irrigation water and many of the Company's shareholders rely on groundwater as a secondary source of irrigation water.

Our shareholders are particularly concerned that the EIS/EIR has not fully considered the negative impact of the proposed alternatives; Crop idling, Crop Shifting, and Conservation, on surface flows in the 2047 drain canal. Maintaining a minimum flow of food quality water throughout the length of the 2047 canal during the irrigation season is essential to our shareholder's farm operations and each of these proposed transfer methods once implemented will most certainly have an immediate negative affect on both water flow and water quality in 2047. The Company believes that the EIS/EIR does not fully account these negative affects nor does it provide sufficient mitigation alternatives. Since the 2047 drain was first constructed in the early 1900's, it has served dual purpose of providing needed drainage for those upstream while providing summer flows for irrigation for those downstream. While difficult at times, this balance between drainage and irrigation has been largely successful for all parties. The company believes the practice of crop idling, crop shifting, and conservation, will result in reduced surface flows in the 2047 and will increase salinity of the reduced remaining flow. If transfers are to be made, a plan to sufficiently mitigate this negative impact must be proposed. We see no such plan in the EIS/EIR.

Response
As described in Section 2.3.2.1, water for transfers is made available by a seller who "must take an action to reduce consumptive use or use water in storage." In addition, "water transfers must be consistent with state and federal law, as discussed in Chapter 1." Water transfers are one of several water management activities favored under state and federal law. See Common Response 14.

If sellers transfer water through cropland idling or crop shifting, they would decrease their diversions only by the amount of applied water that would have been consumed absent the transfer. Without transfers, some of the water applied on each field is consumptively used by the crop (the evapotranspiration of applied water), but some is not used by the crop and becomes percolation to the groundwater or surface runoff. For cropland idling or crop shifting, water that would have been applied to the field but not consumptively used by the crop would continue to be diverted by the seller and would enter the distribution system. Water that would run off fields into drain facilities would continue to flow into these drains, such as 2047; therefore, flows into the drain canals would not be affected.

The range of potential transfer actions includes only one conservation action from Browns Valley ID, which is not near the Colusa Basin Mutual Water Company. Conservation transfers must only transfer water that would have been an irrecoverable loss; therefore, water that would have flowed into an agricultural drain is not able to be transferred.

Comment LA03-3

Comment
The Company is also concerned that, while the EIS/EIR appropriately recognizes that the proposed alternative, groundwater substitution, will have "significant" negative impact on our shareholders groundwater supplies during such transfers, it incorrectly concludes that this impact will be "less than significant" after mitigation. It is the Company's position that the EIS/EIR provides insufficient mitigation measures in the case of groundwater substitution. And further, that the EIS/EIR does not sufficiently address the damage done to shareholders and our entire community due to long-term overdraft of underlying aquifers. In either case, whether in the context of mitigating negative impacts of current groundwater substitution transfers or mitigating negative impacts of long term overdraft of underlying aquifers, the EIS/EIR is inadequate. While groundwater transfers contemplated in the

EIS/EIR have not yet taken place, several of the potential sellers identified in the EIS/EIR have already moved ahead with groundwater substitution transfers within Northern California, particularly, to the west side of Colusa, Glenn, and Yolo Counties via the Tehama Canal system. Our Company's shareholders are currently suffering the negative impacts of these groundwater substitution transfers through increased costs of pumping as a result of a lowered aquifers, and in some cases the loss of irrigation water completely, where wells proximate to groundwater substitution wells go dry. Neither the groundwater substitution transfers taking place currently, within Northern California, not the transfers contemplated by the EIS/EIR, provide specific plan to limit the taking groundwater by potential sellers. At a minimum, some responsible limit on the taking of groundwater must be established before surface water can be transferred on the basis of groundwater substitution. To date, no such limits have been set. Our local communities, motivated by heightened awareness as a result of ongoing drought conditions, and as a result of recent state legislation, have begun the process of establishing a system for the responsible management of our community's groundwater. Some communities, like Glenn County, have already made significant progress in this process, while others, Colusa County, for example, have only just begun the process. In no case, however, have sufficient procedures or protections been put in place to adequately provide for responsible execution or reasonable mitigation of groundwater substitution transfers. The Company believes that the alternative "groundwater substitution" should be dropped entirely from the EIS/EIR as a viable alternative until such time as local communities impacted have completed their own studies and evaluations, developed reasonable plans that include reasonable limits for the taking of groundwater, and these studies, plans, and proposed limits then reconciled with conclusions already reached by the EIS/EIR.

Response

The maximum volume of water pumped for transfers (via groundwater substitution, cropland idling/switching, stored reservoir release, or conservation) as part of this EIS/EIR is listed in Table 2-5. To be covered by this EIS/EIR, transfer volumes must be equal to or less than the amounts listed. To mitigate for potential impacts of groundwater pumping, Section 3.3 includes Mitigation Measure GW-1. This measure includes the development of a monitoring plan to record the volume of water pumped as well as changes in groundwater level. This monitoring program will include data collection before, during, and after the transfer. Measure GW-1 also requires that the potential seller develop a mitigation plan detailing the actions to be taken should impacts be observed. The mitigations actions that could be included in the plan are listed in Section 3.3.4.1.3. These include options such as reducing groundwater pumping, lowering the pumping bowls in affected third party wells, and reimbursement for impacts. The mitigation plan will be tailored to the area in question and will include a procedure for the seller to receive reports of environmental or third-party effects, a procedure for investigation of purported effects, development of mitigation options in cooperation with the affected parties, and assurances that adequate financial resources are available to cover mitigation needs. Common

Response 6 provides additional information. In general, changes to groundwater levels will need to be in agreement with existing BMOs. In other areas, impacts to third parties will be addressed through coordination with third parties.

Comment LA03-4

Comment
The Long Term Transfers contemplated by the EIS/EIR if approved, will be of historic nature. Taken collectively, these transfers would be one of the largest single transfers of water from North to South. So the necessity to fully account the impacts on all stakeholders, consider all stakeholders concerns, and thoroughly respond to those concerns cannot be overstated. The Bureau, potential sellers, and potential buyers, have collaborated over several years to develop the EIS/EIR. Now they must carefully and patiently listen to those that their plan will affect. They must be prepared to explain how the proposed mitigation measures are sufficient to protect the Company's shareholders, and the community in general, from suffering the negative impacts of their plan. Today we are asking you to extend the comment period for at least 120 days to more reasonably slow for this process to take place. We would welcome an opportunity to listen and discuss in more detail the Bureaus plans. I can be reached directly at 530-218-1396 (cellular).

Response
The EIS/EIR analyzes a range of potential transfer actions, not a single transfer as described in the comment. The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment Letter LA04, Jennifer Buckman, Friant Water Authority

Comment LA04-1

Comment
The Friant Water Authority (FWA) has reviewed the subject Draft EIS/EIR and has the following comments regarding the sufficiency and conclusions of the document. FWA is a joint powers authority whose members have contracts with Reclamation that entitle them to receive water from the San Joaquin River. A portion of the San Joaquin River water is subject to senior water rights reserved by the Exchange Contractors [Footnote: The remainder of the San Joaquin River rights were purchased, condemned or otherwise acquired by Reclamation for the benefit of the Friant Division contractors. Water available under these rights must be provided to the Friant Division contractors, regardless of whether the terms of the exchange are being fulfilled or not.] and therefore is not available for delivery to the Friant Division until Reclamation has met its priority obligation [Footnote: Reclamation has a “vested priority obligation” to provide substitute water to the Exchange Contractors, consistent with the terms of the Second Amended Exchange Contract. Westlands Water

Dist. v. United States, 337 F.3d 1092, 1103-04 (9th Cir. 2003) ("Westlands VII").] to provide substitute water supply to the Exchange Contractors.

The hydrologic conditions in the 2014 Water Year have highlighted the difficulties inherent in moving both CVP and transfer water through the Delta and the export facilities. In the 2014 Water Year, several districts that are identified in the subject DEIS/R as buyers and sellers executed one-year transfer agreements similar to those described and evaluated in the subject DEIS/R. Reclamation has yet to demonstrate how much transfer water has been moved from the sellers and whether or not the conveyance of that transfer water in any way impacted its operations and exports of CVP water needed to meet its priority obligation to the Exchange Contractors.

With this background in mind, we were disappointed to note that the DEIS/R for Long-Term Water Transfers did not address the fact that there is a great potential for the movement of transfer water to adversely affect delivery of CVP supplies south of the Delta. As noted in Section 1.3.1.1, Reclamation acknowledges that it is inappropriate for a transfer to supplant or otherwise adversely affect the delivery of CVP supplies: "Transfer may not cause significant adverse effects on Reclamation's ability to deliver CVP water to its contractors." We assume that Reclamation is using the broad definition of the "CVP water" from the Central Valley Project Improvement Act; that definition includes the substitute supply for the Exchange Contractors as a type of "CVP water." Thus, Reclamation has acknowledged that the delivery of the transfer water may not cause "significant adverse effects" on Reclamation's ability to deliver the substitute supply of water to the Exchange Contractors, or any other CVP water.

Response

Section 3.1.2.4.1 includes an analysis of potential effects to CVP and SWP exports, which includes potential impacts to the Exchange Contractors. The analysis identifies the potential for significant impacts, but these impacts are avoided or reduced by Mitigation Measure WS-1 to less than significant levels. See Common Response 8 for additional information.

Comment LA04-2

Comment

The Project Description in Section 2.3.2.1 describes the criteria used to determine the amounts of water available for transfer under various transfer methods, but it does not describe how such determinations will be made available for public notice or review. Also, Section 2.3.2.3 describes the general operational approaches and actions associated with moving the water from the Seller through the Delta, but it does not describe how or when Reclamation will document that the transferred water did not displace the delivery of substitute water to the Exchange Contractors. Without an adequate description of the procedures and methods to be used to document the development and movement of the transfer water, there is no substantial evidence to support the conclusion that conveying the transfer water has no detrimental effect on the delivery of substitute water to the Exchange Contractors.

Response

Water approved for transfer and quantities transferred by Reclamation and DWR are currently posted at this website: http://www.water.ca.gov/watertransfers/. This method of making information available will continue in the future.

Comment LA04-3

Comment

Since the Project Description does not include features to ensure no adverse effects on Reclamation's ability to deliver substitute water to the Exchange Contractors, Chapter 3 should evaluate the potential for such impacts. Before the transfer program is approved, the DEIS/R should be revised to include, at a bare minimum, the following analyses and information: Whether the transferred quantity is real "wet" (as opposed to "paper") water; Whether the transfer displaces or otherwise diminishes the ability to deliver CVP water south of Delta; What methods will be used to measure the transfer water inputs to the river conveyance system (e.g., foregone diversions or releases from Yuba system), and where will those measurements occur; What criteria and methods will be used to determine that transfer water made available by the selling district either made it to the pumps in the south Delta or was backed into storage (including which reservoir(s) the transferred water is being stored at and in what volumes); What criteria and methods will be used to determine that releases of transfer water from a CVP reservoir do not constitute water that would have otherwise have been released for in-stream uses; and What criteria and methods will be used to determine that water pumped at Jones or Banks pumping plants is in fact transfer water and not water that could have otherwise been pumped due to minimum CVP upstream releases or unregulated flows. Unless this information and these analyses are included in the DEIS/R, it is not possible for the DEIS/R to baldly conclude that the transfer program does not have any potential adverse impacts on the delivery of CVP water supplies.

Response

Chapter 3 does evaluate the potential to reduce CVP Delta exports and deliveries in Section 3.1. It does not distinguish between Exchange Contractors and CVP contractors, but rather works to avoid impacts to both groups with Mitigation Measure WS-1. See Common Response 8 for additional information. Section 2.3.2.1 describes how Reclamation would confirm that water transferred is "real" water. Potential effects to CVP Delta diversions are discussed in Section 3.1.2.4.1. Transfers would be measured as foregone diversions, and monitoring in major waterways and reservoirs would be accomplished using the same monitoring efforts as are used for typical CVP and SWP operations.

Comment Letter LA05, Thaddeus Bettner, Glenn-Colusa Irrigation District

Comment LA05-1

Comment
The Glenn-Colusa Irrigation District (GCID) is providing this initial response letter to Reclamation on the Proposed Long-Term Water Transfer Program Draft EIS/EIR. The purpose of this letter is to inform Reclamation of GCID's intent to develop an independent Groundwater Supplemental Supply Program, as well as provide Reclamation with the District's position on the Long-Term Water Transfer Program. GCID wants to ensure that our local effort and Reclamation's project are not in conflict, and that the project selected to move forward for the Long-Term Program meets GCID's objective to ensure the long term sustainability of surface and groundwater resources in our region. GCID's Supplemental Supply Program over any proposed transfer program within the region, including Reclamation's Long-Term Water Transfer Program (LTWTP). In addition, GCID's potential participation in Reclamation's LTWTP is ultimately subject to the consideration and approval of the GCID Board of Directors, and that has not occurred.

Following is a summary of GCID's proposed Groundwater Supplemental Supply Program, and some preliminary comments on LTWTP Draft EIS/EIR.

GCID Groundwater Supplemental Supply Program: GCID is proposing to install and operate give new groundwater production wells and operate an additional five existing groundwater wells to augment surface water diversions for use within GCID during dry and critically dry water years. The wells would have a production well capacity of approximately 2,500 gallons per minute, and would operate as needed during dry and critically dry water years for a cumulative total annual pumping column not to exceed 28,500 acre-feet. Additional information is available at: http://gcid.net/GroundwaterProgram.php.

The primary objective is to develop a reliable supplemental water source for GCID during dry and critically dry years. The proposed project goals are as follows:

1. Increase system reliability and flexibility.
2. Offset reductions in Sacramento River diversions by GCID during drought years to replace supplies for crops and habitat.
3. Periodically reduce Sacramento River diversions to accommodate fishery and restorations flows.
4. Protect agricultural production.

GCID's surface water supply reliability is becoming less certain as a result of the following:

1. Litigation by environmental organizations challenging the renewal of the Sacramento River Settlement Contracts.

2. Increased delta flow requirements for delta smelt and delta outflows.

3. Increased flows and temperature requirements for fisheries.

Response
The Lead Agencies acknowledge GCID's interest in pursuing a supplemental supply program to augment surface water diversions for use within GCID. This program has been added to the cumulative analysis for groundwater resources. Even though GCID is a potential seller in the range of potential activities analyzed under the Proposed Action in this EIS/EIR, this document does not commit GCID to participating in long-term water transfers. GCID and other sellers and buyers listed in the EIS/EIR ultimately would determine whether specific transfers are proposed, and the Lead Agencies would determine whether and how specific transfers are implemented. See Section 2.3.2.2 of the Draft EIS/EIR for additional information. See Common Response 14.

Comment LA05-2

Comment
USBR Long-Term Water Transfer Program: GCID received the Draft EIS/EIR this week and had only initially begun its review. It is important for Reclamation to understand that GCID has not approved the operation of any District facilities to the LTWTP Action/Project that is presented in the draft EIS/EIR. GCID will be conducting groundwater modeling for the Groundwater Supplemental Supply Program and will include an analysis of any potential cumulative impacts associated with GCID's Project and the LTWTP.

Based on our initial review of Reclamation's LTWTP Draft EIS/EIR, GCID has the following comments:

Figure 3.3-25. Simulated Groundwater Substitution Transfers: This figure demonstrates those years that a groundwater substitution program would likely occur and the associated quantities of groundwater substitution pumping. To meet the needs of GCID's Supplemental Supply Program, it is likely that pumping would occur simultaneously in many of these years. For example, 1992, 1994, and 1997 were critical water years in which GCID received a 75% water supply allocation and in those years the district would have pumped these wells for supplemental supply only. It is important to underscore that GCID would prioritize pumping during dry and critically dry water years for use in the Groundwater Supplemental Supply Program, and thus wells used under that program would not otherwise be available for the USBR's LTWTP.

Response
As described in Appendix B, the modeling effort did not include transfers from Glenn-Colusa ID in critical years. See response to Comment LA05-1.

Comment LA05-3

Comment
Table 3.3-3 Water Transfer through Groundwater Substitution: Table 3.3-3 lists 11 GCID wells with associated flow rates between 2,389- 3,305 and well depths ranging from 500-1200 feet. GCID would need to thoroughly review this information in greater detail with Reclamation to make sure that well locations, proposed operational parameters, and well characteristics are accurate and which well, if any, could be included in USBR's LTWTP.

Response
Well data modeled and summarized in Table 3.3-3 was based on information received from sellers, including Glenn-Colusa ID. Seller correspondence has been documented in the administrative record.

Comment LA05-4

Comment
Figures 3.3-26 through 3.3-31: The figure does not accurately represent an assessment of cumulative groundwater effects on the groundwater system resulting from other groundwater wells in other districts. As previously mentioned, for the Groundwater Supplemental Supply Program GCID will perform groundwater modeling and will develop new water elevation maps in the vicinity of GCID's project.

Response
Figures 3.3-26 through 3.3-31 from the Draft EIS/EIR (Figures 3.3-28 through 3.3-33 in the Final EIS/EIR) represent simulated drawdown under the Proposed Action. Cumulative groundwater effects are discussed in Section 3.3.6.

Section 3.3.6 has been revised to include GCID's Groundwater Supplemental Supply Program.

Comment Letter LA06, Thaddeus Bettner, Glenn-Colusa Irrigation District

Comment LA06-1

Comment
As you know, Glenn-Colusa Irrigation District (GCID) sent you a letter on October 14, 2014, providing an initial response to Reclamation on the Proposed Long-Term Water Transfer Program Draft EIS/EIR. The purpose of the letter was to inform Reclamation of GCID's intent to develop an independent Groundwater Supplemental Supply Program, as well as provide to Reclamation

the District's position on the Proposed Long-Term Water Transfer Program (LTWTP).

On November 6, 2014, GCID's Board of Directors took the following actions on the LTWTP: Groundwater Substitution

The LTWTP identifies GCID as pumping 25,000 acre-feet in the years that transfers may occur. Importantly, while the LTWTP covers a ten-year period, transfers would occur only in the critical and/or dry years. Because GCID's surface water supply reliability is being challenged and GCID's surface supplies may be less reliable, GCID will need to implement its Groundwater Supplemental Supply Program in dry and critical years, primarily. Based on Figure 3.3-25 in the LTWTP Draft EIS/EIR, GCID would have pumped in 1992, 1994, and 1997, which were Shasta critical water years during which GCID received a 75% water supply allocation.

Based on the potential conflicts between the needs of GCID landowners and the LTWTP, the GCID Board decided that the District should proceed with its own Groundwater Supplemental Supply Program and should not participate in the Groundwater Substitution component in the LTWTP.

Response
Figure 3.3-27 in the Long-Term Water Transfers Final EIS/EIR (Figure 3.3-25 in the Public Draft EIS/EIR) shows combined groundwater substitution pumping from all sellers. Glenn-Colusa ID indicated that it would not sell any water through groundwater substitution transfers in Shasta Critical years because that water would be necessary to meet local needs. The modeling effort did not include any groundwater substitution transfers from Glenn-Colusa ID in Shasta Critical years (1977, 1991, 1992, and 1994), as shown in Appendix B.

See response to Comment LA05-01. If Glenn-Colusa ID does not want to participate in a groundwater substitution transfer, then no transfer would move forward.

Comment LA06-2

Comment
Land Idling: The LTWTP identifies GCID as idling up to 20,000 acres (providing up to 66,000 acre-feet of transferrable water), which is based on the 20% land idling maximum. The Board evaluated what was in the best interest of GCID, its landowners, and the regional economy and environment. Based on those factors, the Board decided to decrease and limit its participation in the Land Idling component to no more than 10,000 acres (up to 33,000 acre-feet of transferrable water).

Response
Similar to the response to Comment LA05-1, Glenn-Colusa ID could determine if it wants to transfer water each year, as long as it stays below the upper limits established in the EIS/EIR. The amount proposed in the comment is less than what was analyzed in the EIS/EIR; therefore, no changes to the EIS/EIR are necessary.

Comment LA06-3

Comment
GCID requests that the LTWTP Draft EIS/EIR be revised to show these changes, and include a corresponding re-evaluation of the potential impacts that will be significantly reduced in Glenn and Colusa Counties as well as neighboring counties.

Response
As discussed in responses to Comments LA05-1, LA06-1, and LA06-2, Glenn Colusa ID can choose whether or not to sell water, and analyzing those transfers in this document does not commit the district to selling water. Therefore, no changes to the EIS/EIR are necessary. See Common Response 14.

Comment Letter LA07, Ricardo Ortega, Grassland Water District

Comment LA07-1

Comment
Grassland Water District and Grassland Resource Conservation District (“GWD”) submit the following comments on the Long-Term Water Transfers Draft Environmental Impact Statement/Environmental Impact Report (“EIS”). The EIS will cover individual and multi-year water transfers of up to 500,000 acre-feet per year from north-of-delta water users to south-of-delta water users, from 2015 through 2024 (“Project”). GWD is generally supportive of north-to-south water transfers, as long as potential adverse environmental impacts are avoided or mitigated. The following comments pertain to how the Project will affect Reclamation’s operation of the Central Valley Project (“CVP”) to meet refuge water supply requirements. Section 3406 of the Central Valley Project Improvement Act (“CVPIA”) designates refuge water supplies as “mitigation” for “wildlife losses incurred” as a result of the construction, operation, and maintenance of the CVP. Accordingly, these comments have a direct relationship to the Project’s impacts on the environment, and each requires a written response under the National Environmental Policy Act.

1. Reclamation should be listed as a potential purchaser of water

First, Grassland Water District is a member agency of the San Luis & Delta Mendota Water Authority (“SLDMWA”), the CEQA lead agency for the Project. As described in the EIS, GWD and other south-of-delta refuges are within the service area of the SLDMWA. (EIS p. ES-4) GWD requests that the Bureau of Reclamation ("Reclamation"), on behalf of GWD and other south-of-delta refuges, be included in the list of potential purchasers of transferred water under the proposed Project.

GWD is informed that the failure to list refuges as potential Project water recipients may be an inadvertent omission. In the past, when refuges were inadvertently omitted from the list of potential recipients of transferred water, Reclamation has revised the applicable NEPA document. (E.g. Supplemental Environmental Assessment and Finding of No Significant Impact for the South of Delta Accelerated Water Transfer Program (2013), available at http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=6999.) The EIS should be revised to include the possibility that Reclamation may also purchase water from the listed sellers, on behalf of refuges. Making this change would not require any changes to the EIS analysis. Any impacts associated with the transfer of water from north of the delta to refuges south of the delta would be the same as those analyzed in the EIS, if not lessened by the environmental benefits that would accrue to the receiving refuges.

Reclamation has obligations under the CVPIA and section 3(a) of GWD's refuge contract to use its "best efforts" to acquire Incremental Level 4 water supplies. By including refuges in the EIS as potential beneficiaries of the Project's long-term north-to-south water transfer program, Reclamation could better facilitate water purchases for refuges, and would provide an incentive to north-of-delta landowners to offer water for sale to Reclamation's Refuge Water Supply Program. In fact, Reclamation has purchased refuge water supplies from at least one of the potential listed sellers in the EIS, the Anderson-Cottonwood Irrigation District. This year, Reclamation transferred a portion of that water to a south-of-delta refuge. It makes logical sense to include Reclamation as a potential purchaser of Project water, and to include refuges as potential recipients. To exclude this possibility from coverage under the EIS would be arbitrary and capricious, and would illustrate Reclamation's disregard for its duty to pursue the acquisition of Incremental Level 4 Water Supplies for refuges—an obligation that Reclamation persistently fails to meet.

Response
See Common Responses 9 and 14.

Comment LA07-2

Comment
2. Environmental commitments should benefit CVPIA refuges

Second, Reclamation must consider the implementation of environmental commitments that provide direct benefits to CVPIA refuges, to help offset the impacts of the proposed Project on species such as migratory birds, the giant garter snake, and others. CVPIA refuges will become increasingly important sources of habitat for these species if large volumes of Project water are redirected from habitat-beneficial crops such as rice and corn to non-habitat-beneficial crops and to urban water users. With the likely decrease in available habitat that will result from the proposed Project, and other potential impacts identified in the EIS, CVPIA refuges will bear the brunt of responsibility for meeting the habitat needs that result from operation of the CVP.

Reclamation has proposed no environmental commitments, however, that would benefit CVPIA refuges. Reclamation should offer water sellers a choice between making additional mitigation and restoration payments to the CVPIA Restoration Fund, or directly selling a percentage of the proposed water to be transferred to the Refuge Water Supply Program. If only 5 to 10 percent of the proposed water to be transferred were sold to the Refuge Water Supply Program, the persistent deficit in Level 4 refuge water deliveries would be significantly cured.

Response
See Common Response 9.

Comment LA07-3

Comment
3. No adverse impacts on refuge water deliveries may occur

Third, Reclamation must assure refuge contractors that the potential transfer of 500,000 acre-feet of water annually would have no adverse effect on the timing or volume of refuge water deliveries, or the future capability of the CVP to deliver full Level 4 refuge water supplies. CVPIA section 3405(a)(1)(H), and other provisions of Reclamation Law such as the Warren Act, prohibit Reclamation from approving water transfers if they would have any adverse effect on Reclamation's ability to deliver water to meet its contractual or fish and wildlife obligations "because of limitations in conveyance or pumping capacity." This prohibition must not be ignored.

The EIS does not describe the order of priority for use of CVP facilities, other than a statement that transferred water can only be conveyed "after Project needs are met." GWD is increasingly concerned that Reclamation has prioritized the conveyance of water transfers over the delivery of water that refuges are contractually and legally entitled to receive. GWD suffered a 10% reduction in its contractual entitlement to receive firm Level 2 water supplies this year. Despite GWD's repeated requests for an explanation of this deficiency, GWD was instead left with the impression that full Level 2 deliveries this fall and winter may have been denied so as to avoid interference with proposed water transfers. This is unacceptable. Reclamation must provide a written response to this comment to confirm that all refuge water deliveries, including the full potential capacity for Level 4 water deliveries, will take priority over the conveyance of transferred water supplies.

Response
See Common Response 9.

Comment LA07-4

Comment

4. Clarifications and assurances are needed for water transfers by Merced Irrigation District

The EIS contemplates that water may be transferred by Merced Irrigation District ("MID") through a variety of potential conveyance mechanisms. MID has a binding commitment, however, under its Federal Energy Regulatory Commission license, to provide 15,000 acre-feet of water directly to the Merced National Wildlife Refuge. Most of this water (13,500 acre-feet) is credited toward Reclamation's Level 2 water supply obligation to the Merced refuge, and the remainder is credited toward Reclamation's Incremental Level 4 obligation. Reclamation cannot authorize transfers by MID to others unless and until MID's water delivery obligation to Merced National Wildlife Refuge is first met. To act otherwise would violate Reclamation's duties under the CVPIA and under Reclamation's water supply contract with the U.S. Fish and Wildlife Service. Reclamation should revise its EIS or provide a written response to this comment to confirm that water will not be authorized for transfer by MID in any year that MID fails to meet its obligation to provide 15,000 acre-feet of water to the Merced National Wildlife Refuge.

Moreover, the EIS describes a mechanism whereby MID would exchange water to others by delivering water to "refuges in the San Luis unit" that would in turn reduce their water use "from the Delta-Mendota Canal." The EIS must note that under the terms of Reclamation's refuge water contracts, exchanges involving refuge water supplies must be agreed to by the refuge contractor. Furthermore, the proposed refuge exchange mechanism is not adequately described. There are only two refuges that can directly receive water from MID's conveyance system, Merced National Wildlife Refuge and the East Bear Creek Unit of the San Luis National Wildlife Refuge. These refuges are located east of the San Joaquin River, and they do not use water from the Delta-Mendota Canal. The EIS does not sufficiently explain how this proposed exchange mechanism would work.

Response
Merced ID's FERC relicensing process is ongoing, and the license terms are not yet finalized. The FERC license requirements, including current or future requirements to deliver water to the Merced National Wildlife Refuge, will have to be met before water could be transferred under the action alternatives.

All potential transfers analyzed in the EIS/EIR are voluntary, and exchanges with the refuges would require agreement by all parties before they are implemented. See Common Responses 9 and 14.

Comment Letter LA08, Osha Meserve, Local Agencies of the North Delta

Comment LA08-1

Comment

These comments on the Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report ("EIS/R") ("project") are submitted on behalf of the Local Agencies of the North Delta ("LAND"). LAND is a coalition comprised of reclamation and water districts in the northern geographic area of the Delta. As local agencies in the Delta, LAND is concerned about any actions that would result in water supply and/or quality impacts in the Delta that may occur as a result of the project. This letter addresses the following inadequacies of the EIS/R: (1) use of the wrong lead agency under the California Environmental Quality Act (Pub. Resources Code, §§ 21000 et seq. ("CEQA")); (2) failure to consider the cumulative effects of the project in combination with the Bay Delta Conservation Plan ("BDCP"); and (3) inadequacy of mitigation for significant effects caused by implementation of the project.

Response

See Common Response 1 for more information on the CEQA lead agency. The BDCP was not included in the cumulative analysis because the project is not sufficiently far along that implementation is reasonably foreseeable to be complete during the 10-year analysis period. Some commenters made specific suggestions of topics that could be strengthened within the mitigation measures. These comments led to clarifying edits to Mitigation Measures WS-1, GW-1, AQ-1, and AQ-2. Refer to Common Responses 6, 7, 8, and 10 for additional information.

Comment LA08-2

Comment

San Luis & Delta-Mendota Water Authority is the Wrong Lead Agency: Under CEQA, the "lead agency" is "the public agency which has the principal responsibility for carrying out or approving a project . . . ." (Pub. Resources Code, §21067.) Where several agencies have a role in approving, implementing or realizing a project, CEQA "plainly requires the public agency with principal responsibility to assume the role as lead agency." (Planning & Conservation League v. Department of Water Resources (2000) 83 Cal.App.4th 892, 906.) According to the Third District Court of Appeal, "the lead agency plays a pivotal role in defining the scope of environmental review, lending its expertise in areas within its particular domain, and in ultimately recommending the most environmentally sound alternative." (Id. at 904.) "So significant is the role of the lead agency that CEQA proscribes delegation." (Id. at 907.)

According to the EIS/R, the San Luis & Delta-Mendota Water Authority ("SLDMWA"), "consisting of federal and exchange water service contractors in western San Joaquin Valley, San Benito, and Santa Clara counties, helps negotiate transfers in years when the member agencies could experience shortages." (EIS/R, p. 1-1, italics added.) Furthermore: "This EIS/EIR addresses water transfers to [Central Valley Project ("CVP")] contractors from CVP and non CVP sources of supply that must be conveyed through the Delta using both CVP, SWP, and local facilities. These transfers require approval from Reclamation and/or the Department of Water Resources (DWR), which necessitates compliance with NEPA and CEQA." (EIS/R, p. ES-1, italics added.)

SLDMWA is not the proper CEQA lead agency for the project. Here, it appears that DWR has the principle responsibility with respect to carrying out and approving water transfers and would be the proper lead agency. Much like the lead agency role struck down in the Planning and Conservation League case, SLDMWA's assistance in negotiating transfers is insufficient to give rise to a lead agency role under CEQA. (See 83 Cal.App.4th at p. 906.) As a result of this error, the entire EIS/R process is tainted and must be restarted with the correct lead agency.

Response
See Common Response 1.

Comment LA08-3

Comment
BDCP as a Cumulative Project:

When conducting a cumulative impact analysis, a lead agency has the choice of using either the list-of-projects approach or the summary-of-projections approach, depending on which method is best suited to a particular situation. (CEQA Guidelines, §15130, subd. (b)(1).) According to the EIS/R, "both methods" are used. (EIS/R, p. 4-3.)

Yet the EIS/R fails to consider the effects of the project combined with the implementation of the BDCP. The BDCP is currently undergoing public review (Bureau of Reclamation is also the NEPA lead agency), and could be approved and implemented within the timeframe of the project. (See http://baydeltaconservationplan.com/PlanningProcess/EnvironmentalReview/TheProcess.aspx.)

The BDCP consists of new diversion facilities on the Sacramento River as well as other actions that constitute a proposed Habitat Conservation Plan within the Sacramento-San Joaquin Delta. While the diversion facilities would not be constructed within the 10 year timeframe of the project, other so-called conservation measures could be implemented. The cumulative effects of those aspects of the BDCP that could be implemented within the timeframe of the proposed project must be analyzed.

In particular, cumulative effects from reductions in Delta outflow should be analyzed. According to the EIS/R, the project would lead to changes in Delta hydrology. (EIS/R, p. 3.8-62.) These changes should be considered in conjunction with the BDCP, which may reduce Delta outflow by dramatically increasing the amount of open water habitat in the Delta (up to 65,000 acres tidal marsh). According to DWR data, open water and riparian vegetation consume about 67.5 acre-feet per year, which is much greater than most agricultural uses. (See Exhibit A.)2 The project's potential, in combination with BDCP, to reduce Delta outflow must be considered.

The cumulative effects of weed growth that results from BDCP/habitat projects in the Delta and within the Seller service areas on fallowed lands should also be considered. The EIS/R apparently assumes that invasive weeds will be managed on fallowed lands in the Seller area. Invasive weeds, however, consume significant quantities of water and may result in less water being available for transfer than assumed in the EIS/R. According to a 2004 study, for instance, about "one million acre-feet of water is consumed by star thistle each year in the Central Valley above and beyond what would be consumed by annual grasses."3 In addition to analyzing water demand of weeds in the Delta under BDCP as well as in the Seller service areas, effective weed management should be included as a mitigation measure.

Response
See responses to Comments LA13-9 and LA14-15.

Comment LA08-4

Comment
Inadequacy of Mitigation Measures:

The EIS/R contains inadequate mitigation for the significant effects of the project. In particular, Mitigation Measure GW-1 ("GW-1") does not meet basic CEQA requirements for mitigation. (Cf. CEQA Guidelines, § 15126.4; Communities for a Better Environment v. City of Richmond (2010) 184 Cal.App.4th 70, 94-95 (describing requirements for use of specific performance criteria to ensure the efficacy of the mitigation).) While the EIS/R states that this mitigation measure would reduce impacts related to natural communities in rivers and creeks in the Sacramento River Watershed, for instance (EIS/R, p. 3.8-51), this mitigation measure monitors wells, not river and creek levels. The analysis also assumes without any support that natural recharge will correct any environmental impacts that do occur. GW-1 also leaves entirely open the amount of time an adverse impact could occur and before it will be corrected. This approach fails to meet the requirement to mitigate the project's impacts to the extent feasible, as required by CEQA. (See Pub. Resources Code, § 21002.) While CEQA permits deferral of formulation of mitigation in certain instances, minimum requirements for deferred mitigation are not met by GW-1.

Response
Changes in groundwater-surface water interaction and their results (e.g., streamflow reduction, impacts to ecosystems) are difficult to measure in the field. For a potential reduction in streamflow to occur due to a groundwater substitution pumping transfer, the groundwater level must be lowered. Changes in groundwater levels are quicker and simpler to measure. Therefore, Mitigation Measure GW-1 is specified to avoid potentially significant impacts. Measure GW-1 requires the development of a monitoring and mitigation plan, customized to the seller's conditions, to ensure compliance with performance criteria and to avoid significant impacts. More information related to the natural communities that may be affected by a reduction in streamflow can be found in Sections 3.7, Fisheries and 3.8, Vegetation and Wildlife. See Common Responses 6, 7, and 10.

Comment LA08-5

Comment
Overall, we remain concerned that the project, in combination with other cumulative projects, will significantly affect Delta water supply and quality for in-Delta users. While increased transfers have the potential to increase flows into the Delta, it is not clear that this project will result in such flow increases. Without actual increases in flows, this transfer program could facilitate increased diversions out of the Delta for CVP contractors, leaving in Delta water supplies further depleted and degraded. We respectfully request that the EIS/R be corrected and recirculated to correct the deficiencies identified in these and other comment letters prior to any action being taken on the project. Thank you for considering these comments.

Response
The EIS/EIR included an extensive modeling effort, including both surface water and groundwater modeling, to simulate how the transfers would affect these systems (see Appendices B and D for more information). The modeling effort indicated that additional flows would enter the Delta. Additionally, the analysis included the application of the DSM2 model to estimate changes in Delta water quality, circulation, and water levels (see Appendix C for more information). This analysis did not indicate significant adverse changes to these resources. Section 3.1.6 summarizes the cumulative impacts on water supply of the action alternatives in combination with other existing or reasonably foreseeable future projects.

Comment Letter LA09, Lewis Bair, Reclamation District 108

Comment LA09-1

Comment
Reclamation District 108 ("RD 108") has no concerns with a reasonable groundwater substitution program. Indeed, RD 108 is identified as a potential

transferor of groundwater substitution water in the EIS/EIR and may be willing to transfer up to 15,000 acre-feet per year of surface water made available through groundwater substitution. (Draft EIS/EIR, at Table 2-5).

RD 108 is concerned; however, about the intensity and magnitude of the proposed Conaway Preservation Group ("Conaway") groundwater substitution program. RD 108 covers nearly 48,000 acres and will potentially substitute up to 15,000 acre-feet/year of groundwater to replace transferred surface water. RD 108 will thus pump less than 1/3 of an acre-foot/acre of land/year. On the other hand, Conaway owns 16,088 acres of land, but will pump up to 35,000 acre-feet/year under the proposed project. Thus, Conaway's proposed groundwater substitution program, as described in the EIS/EIR, will result in pumping more than 2 acre-feet of groundwater per acre of land owned by Conaway.

Response

Section 2.3.2.2 of the DEIS/EIR indicates that the quantities listed in Table 2-5 are "the potential upper limit of available water for transfer by each agency for each transfer type; however, actual purchases could be less, depending on hydrology, the amount of water the seller is interesting in selling in any particular year, the interest of buyers, and compliance with Central Valley Project Improvement Act transfer requirements, among other possible factors. Additionally, these transfers would not occur every year, but only years when there is demand from buyers and pumping capacity available to convey the transfers (generally dry and critical years)." In other words, significant uncertainty exists with regard to the timing of a potential water transfer, which directly impacts the potential water transfer quantities. The intent of the quantities listed in the DEIR/EIS was to provide flexibility considering the uncertainty in the timing for a potential water transfer. The volume of groundwater pumped per acre is not directly relevant to inelastic land subsidence because other factors influence land subsidence such as groundwater levels and hydrogeologic characteristics.

Any proposed transfer involving groundwater substitution by Conaway Preservation Group would be subject to Mitigation Measure GW-1. Further, any proposal would need to account for proposed transfer pumping in the cumulative context, including total pumping on the Conaway Ranch. The performance criteria and mitigation requirements contained in Mitigation Measure GW-1 would ensure that any contribution to a potentially significant cumulative impact is not considerable. Common Responses 6 and 7 provide additional information.

As explained in Section 2.3.2.2 of the Draft EIS/EIR, Common Response 14, and as set forth in Measure GW-1, existing local conditions will be taken into account before Reclamation approves a specific transfer proposal. Local conditions such as those in the Conaway Preservation Group area may be such that Reclamation cannot approve a transfer.

Comment LA09-2

Comment
Conaway, however, has an even more ambitious groundwater substitution program than the EIS/EIR indicates. Through an agreement with the Woodland-Davis Clean Water Agency (WDCWA), Conaway may pump up to an additional 10,000 acre-feet/year to substitute for a transfer of surface water rights to WDCWA. Accordingly, if Conaway pumps the maximum amount of groundwater for which authorization is being sought under the long-term transfer program and the WDCWA Water Agreement, Conaway could pump a maximum annual quantity of 45,000 acre-feet of groundwater. This would result in Conaway pumping nearly 3 acre-feet per acre of land.

While RD 108 has no objection to the provision of water to WDCWA through groundwater substitution, the cumulative impacts of Conaway's groundwater pumping for WDCWA and its groundwater pumping for the long-term transfer program must be fully analyzed as required by the National Environmental Policy Act and the California Environmental Quality Act.

Response
The Woodland-Davis Clean Water Agency (WDCWA) regional surface water supply project has been added to the cumulative analysis. See response to Comment LA09-1 for additional information.

Comment LA09-3

Comment
1. Impacts Analysis: The EIS/EIR's analysis of the environmental impacts of the proposed groundwater substitution program is deficient in at least three respects: A. The EIS/EIR only includes an analysis of impacts related to groundwater pumping for Conaway's proposed 35,000 acre-feet/year groundwater substitution program. Because Conaway intends to pump an additional 10,000 acre-feet/year pursuant to its agreement with WDCWA, the impacts analysis on groundwater levels and land subsidence are artificially deflated. B. Measuring groundwater level drawdown at only one location on Conaway Ranch is inadequate given the magnitude of Conaway's proposed groundwater substitutions. (Draft EIS/EIR, at Figure 3.3-26) As the EIS/EIR indicates, land subsidence has occurred at Conaway Ranch in the past. (Draft EIS/EIR, at 3.3-82) Accordingly, the EIS/EIR should have analyzed more fully the land subsidence and groundwater level drawdown impacts in Conaway's area. Instead, the EIS/EIR analyzes impacts on groundwater levels and subsidence in three locations far from Conaway, while relegating a hydrograph of the Conaway location (Location 30) to the Appendix with little analysis. (Draft EIS/EIR, at E-204-E210) Moreover, as Exhibit 1 to this letter demonstrates, the effects of Conaway's groundwater pumping are already causing land subsidence. But instead of measuring conditions that have already occurred, the draft EIS/EIR relies on

a simulation of Conaway's proposed pumping that does not take its current actions into account. Therefore, the final EIS/EIR should evaluate potential environmental impacts based on current conditions, rather than on a simulation in which the data set ends in Water Year 2003. C. Impacts from subsidence related to the Project and Project Alternatives are not presented in the EIS/EIR. This is a particularly important issue in relation to Conaway because Conaway has flood control levees adjacent to its property. One would expect that the increase in the magnitude of subsidence currently experienced at Conaway Ranch from existing pumping (which is not quantified or described in the draft EIS/EIR) would increase in relation to the expected groundwater level declines from the Project. Subsidence is often a delayed response to groundwater level declines and the proposed monitoring for subsidence is inadequate to assess longer term or delayed effects from subsidence that could occur after pumping for groundwater substitution has ceased.

Response

The volume of water proposed for each potential seller (Table 2-5) is listed as an upper limit. The seller will need to develop a proposed transfer that will meet the criteria set forth in the EIS/EIR (See Common Response 14). These criteria include developing a monitoring and mitigation plan as described in Mitigation Measure GW-1 (Section 3.3.4.1) to ensure compliance with performance standards. Measure GW-1 includes monitoring and mitigation aspects related to groundwater level declines as well as subsidence issues. Common Response 7 also explains changes to Measure GW-1 related to subsidence. These changes apply to all sellers, including Conaway Preservation Group. The requirements of Measure GW-1 may result in certain sellers, including Conaway, reducing or eliminating groundwater substitution pumping transfers, depending on conditions. Common Response 6 provides additional information on groundwater level impacts. See response to Comment LA09-01 for additional information.

Comment LA09-4

Comment

2. Mitigation Measures: The draft EIS/EIR fails to adequately develop and explain how the potentially significant impacts of the project will be mitigated. Mitigation Measure GW-1 is insufficiently robust to reduce impacts from the proposed project to less than significant. In particular, the mitigation measures for land subsidence are inadequate. The mitigation measures proposed in GW-1 for land subsidence are not sufficiently set forth in the EIS/EIR. (See Draft EIS/EIR, at Section 3.3.4.1) Instead, GW-1 defers to a monitoring program to be developed in the future by the U.S. Bureau of Reclamation. Furthermore, the EIS/EIR states that areas with "higher susceptibility to land subsidence will also require more extensive monitoring" without specifying what that more extensive monitoring will involve. Mitigation Measure GW-1 also does not include any provisions for

well replacement should well interference or longer term groundwater level declines result in wells going dry and an inability for bowls or pumps to be lowered in response to Project impacts. Most importantly, the bulk of the mitigation responsibility falls on sellers, but the individual sellers' plans are nowhere to be found in the EIS/EIR. In short, the EIS/EIR claims that mitigation measure GW-1 mitigates the potentially significant land subsidence effects without describing what the mitigation program actually entails. The final EIS/EIR should develop and analyze each of these aspects of the mitigation measure in greater detail.

Response
Mitigation Measure GW-1 has been clarified in the EIS/EIR. Common Responses 6 and 7 provide additional information.

Comment LA09-5

Comment
3. Cumulative Impacts Analysis: The cumulative impacts analysis is inadequate in that it does not include an analysis of the WDCWA project. Moreover, the cumulative impacts of other reasonably foreseeable groundwater development projects must be analyzed in the EIS/EIR.

Response
The Woodland-Davis Clean Water Agency (WDCWA) regional surface water supply project has been added to the cumulative analysis in Section 3.3.6.

Comment Letter LA10, Karen Huss, Sacramento Metropolitan Air Quality Management District

Comment LA10-1

Comment
The Sacramento Metropolitan Air Quality Management District (SMAQMD) staff reviewed the Long-Term Water Transfers Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). SMAQMD staff provides the following comment regarding the air quality section.

The EIS/EIR provides two measures to reduce air emissions from the project:

- AQ-1: Reduce pumping at diesel or natural gas wells to reduce pumping below significance levels, and
- AQ-2: Operate dual-fired wells as electric engines.

State CEQA Guidelines require mitigation measures to be fully enforceable through permit conditions, agreements, or other legally binding instruments (Sec. 15126.4(a)(2)). Additional details on how AQ-1 and AQ-2 will be implemented and enforced are necessary to ensure the emissions from the project will not have a significant impact to air quality.

Response
Proposed transfers that involve activities such as groundwater pumping with the potential to exceed an air district's significance thresholds for emissions will be required to maintain recordkeeping logs showing the engines' size (horsepower), hours of operation, and applicable emission factor to calculate emissions on a daily basis. The selling agency will compare emissions to significance criteria. Furthermore, records will be maintained for any selling agencies that operate dual-fuel engines (e.g., natural gas and electric) to document that the engines are not operated with natural gas.

Copies of the recordkeeping logs will be sent to Reclamation on a monthly basis as an enforcement provision.

Comment Letter LA11, Garth Hall, Santa Clara Valley Water District

Comment LA11-1

Comment
Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement/Report (EIS/EIR) prepared by the Bureau of Reclamation (Reclamation) and the San Luis & Delta-Mendota Water Authority (SLDMWA) for the proposed Long-Term Water Transfers Project (Project). The Santa Clara Water District (SCVWD) understands that Reclamation is serving as the lead agency under the National Environmental Policy Act (NEPA) and the SLDMWA is serving as the lead agency under the California Environmental Quality Act (CEQA). These comments are provided by SCVWD for both NEPA and CEQA.

SCVWD respectfully requests that Reclamation and SLDMWA provide further discussion regarding the items identified below in order to more fully comply with NEPA, CEQA, and those laws' respective public disclosure and analysis requirements. SCVWD's comments relate primarily to the analysis of the Project's potential impacts to the San Felipe Division related to San Luis Reservoir (SLR).

Information provided in Section 3.2.2.4.2 (pp.3.2-41 and 3.2-42) indicates that the projected SLR storage levels are lower under the Proposed Action. The Draft EIS/EIR recognizes that SLR storage "could decrease by as much as six percent (of water in storage in the No Action/No Project Alternative) during August of critical water years." Based on Table 3.2-27 on p.3.2-42, monthly storage in SLR during a critical year could decrease by as much as 27,300 acre feet (AF) between June and October, when SLR typically has the highest likelihood of reaching its lowest storage levels. The Draft EIS/EIR concludes that "potential storage-related effects on water quality would be less than significant for San Luis Reservoir." SCVWD would like more information to substantiate the statement that "these small changes in storage are not sufficient to…substantially degrade water quality." SCVWD would also like more information on whether deliveries to Santa Clara County could be impaired with the Project.

SCVWD relies on delivery of its Central Valley Project (CVP) water and other imported water supplies from SLR through the San Felipe Division. When SLR storage levels drop below an elevation of 369 feet, about 300,000 AF in storage or the "low point," algal blooms occurring during the summer can enter the lower intake of the Pacheco Pumping Plant and deliveries of SCVWD's CVP supplies can be adversely affected; water quality within the algal blooms is not suitable for municipal and industrial users relying on existing water treatment facilities in Santa Clara County. Deliveries to the San Felipe Division may be severely or completely interrupted when storage levels are drawn down such that there is insufficient hydraulic head to effectively operate Pacheco Pumping Plant. The EIS/EIR should provide more detail on the existing low point issue, and existing Reclamation operational protocols designed to minimize low point conditions. It should also provide greater analysis and detail on the impacts of the Project on SLR storage levels, and on SCVWD's water supplies due to low point conditions.

SCVWD thanks Reclamation and the SLDMWA for the opportunity to review and comment on the Draft EIS/EIR. SCVWD appreciated the Project's overall goal of increasing flexibility and reliability with regard to management of CVP water supplies. However, SCVWD requests that Reclamation and SLDMWA expand on the issues identified above in order to comply with CEQA and NEPA. SCVWD believes it is necessary to provide a more complete environmental analysis under NEPA and CEQA to help ensure that the Project does not provide a benefit to certain water providers to the potential detriment of others.

Response
A discussion of the San Luis low point algal bloom issue has been added to Section 3.2.2.4.2.

Comment Letter LA12, John Herrick, South Delta Water Agency, Central Delta Water Agency

Comment LA12-1

Comment
The following comments and the attached comments are submitted on behalf of the South Delta Water Agency and the Central Delta Water Agency. Each of these agencies are charged with, and the surrounding lands dependent on good quality water in Delta channels for the protection of agricultural and other beneficial uses. Operations of the Central Valley Project and the State Water

Project adversely affect flows, circulation, levels, and quality of water in the channels to the detriment of agricultural and other beneficial water users. By statute, regulation and permit, the United States Bureau of Reclamation ("USBR") and the Department of Water Resources ("DWR") are supposed to fully mitigate their impacts on such other uses as well as maintain various water quality standards intended to project the Delta estuary and in-Delta users. The projects fail to meet these obligations on a regular basis and the proposed Long Term Transfer Project ("Project") may exacerbate DWR and USBR's continued failure to meet their obligations. SDWA and CDWA represent various water right holders who may be affected by the Project.

Response
Section 3.2, Water Quality assesses potential effects from the action alternatives on Delta water quality. In response to comments, additional information on the water supply effects from changes to Delta water levels and circulation have been included in Section 3.1, Water Supply.

Comment LA12-2

Comment
1. The Project in significant part appears to violate the language and spirit of CVPIA, the controlling federal statute for CVP-related water transfers. In 1992, Congress passed and the President signed into law the Central Valley Project Improvement Act, commonly known as "CVPIA" or Public Law 102-575. The provisions of CVPIA fundamentally altered the operation of the CVP, requiring a dedication of water for fish and wildlife purposes, significant habitat and fish population goals and mandates and set forth new criteria for water transfers. CVPIA defined "Central Valley Project water" as "all water that is developed, diverted stored, or delivered by the Secretary in accordance with the statutes authorizing the Central Valley Project and in accordance with the terms and conditions of water rights acquired pursuant to California law." This broad description of CVP water importantly uses the word "or" to include virtually any water that gets from one place to another via the CVP, notwithstanding any water right under which the water might originally derive.

CVPIA also specifies the terms and conditions under which transfers of CVP water can be made. Section 3405 of the Act allows transfers of any CVP water "under water service or repayment contracts, water rights settlement contracts or exchange contracts…" Thus, any individual or district which receives CVP water can transfer its CVP water if they or it comply with Section 3405.

Section 3405 (a)(1)(I) limits the transfers "to water that would have been consumptively used or irretrievably lost to beneficial use during the year of years of the transfer." The purpose of this provision is to ensure that a transfer of the water does not increase the total amount of water consumed, rather it allows for the shifting of water use from one party to another. This is an important distinction. The transfers are meant to facilitate the movement of water to the highest use, or that use which can afford it especially in dry times. If the transfer criteria allowed the seller to continue to consume the same amount of water, then the system as a whole would be consuming more water during dry times; an obviously counter-productive policy.

The Project being contemplated by USBR and others specifically allows the sellers to replace the transferred water through ground water substitution (see for example ES.3 - ES.4). Hence, the Project is by definition, at least in part contrary to the controlling statute under which the transfers are being contemplated. In the abstract, one could evaluate any transfer wherein the seller replaced the transferred water with another source and estimate the impacts and potentially mitigate the impacts. However, CVPIA as an expression of Congressional intent, has already made the determination that transfers dealing with CVP water shall not result in any total increase in use. Thus the draft EIS/R's analysis of what the impacts of such substitution might be and how they might be mitigated is irrelevant. No transfers which allow the seller to continue to consume any portion of the amount of water being transferred are legal.

It does not matter that the Project intends to allocate a portion of the transfer water to instream or ground water replacement. Any of the Project's transfers which are based on substituting ground water (or any other source) are prohibited under Public Law 102-575.

Response
Section 1.3.1.1 of the EIS/EIR describes the purpose of the CVPIA and its applicability to potential water transfers. Also, see Common Response 14. As indicated therein, the range of potential transfers evaluated under the Proposed Action would only occur in compliance with the provisions of the CVPIA. Also see the response to Comment LA12-49. The Lead Agencies do not agree with the comment that the potential transfer activities evaluated under the action alternatives would conflict with the CVPIA, and such conjecture is not consistent with the analysis in the EIS/EIR.

Comment LA12-3

Comment
2. Transfers under the Project which allow ground water substitution appear to violate CVPIA's mandate that any transfer have no significant impact on the seller's ground water. CVPIA section 3405 (a)(1)(J) states that no transfer shall be approved unless it is determined that "such transfer will have no significant long-term adverse impacts on groundwater conditions in the transferor's service area." Although the draft EIS/R includes an analysis of impacts to ground water in proposed sellers' areas (see attachment hereto criticizing the DEIS/R analysis), it clearly concludes that specific impacts are not susceptible to determination. Therefore the Project proposes significant monitoring to evaluate the actual effects on ground water levels, and subsequent measures to insure protection of the underlying basins. However, planning to evaluate the

impacts of ground water substitution (or other methods of "funding" transfers) is clearly not a determination that any such transfer will have no significant long-term effects on the underlying basins. To comply with the provision of CVPIA, the Bureau would have to arrive at some level of certainty that actions like ground water substitution will indeed not adversely affect the transferor's basin. Future efforts at determining whether or not the basin will be affected are inadequate under the statute. Future mitigation does not insure no harm.

Response
This provision of the CVPIA sunsets on September 30, 1999 (according to CVPIA Section 3405(a)(3)). However, potential impacts on groundwater conditions are assessed in Section 3.3, and the potentially significant impacts to groundwater levels and subsidence are mitigated by Mitigation Measure GW-1. The comment focuses on the monitoring requirements in this measure, but it also requires mitigation plans that identify the actions that would be taken to ensure compliance with performance standards and avoid potential impacts. Refer to Common Responses 6 and 7 for additional information.

Comment LA12-4

Comment
3. The Project is contrary to and does not examine CVPIA's mandate to restore anadromous fish populations. Another provision of CVPIA requires the establishment of an anadromous fish restoration program, or AFRP. This program was developed and adopted by the Fish and Wildlife Service in consultation with the Bureau and other state and federal agencies. The program must double the populations of certain specified fish species. (see webpage http://www.fws.gov/sacramento/fisheries/CAMP-Program/Home/Documents/Final_Restoration_Plan_for_the_AFRP.pdf) This program includes recommended higher flows on many rivers including various small and all the main tributaries to the Sacramento and San Joaquin Rivers (see webpage http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/sjrf_spprtinfo/afrp_1995.pdf)

The amounts of flows recommended by the AFRP are significantly higher than currently mandated flows and would necessitate significant "new" sources of water. Since the precipitation in any particular year is finite, to get the increased flows for the AFRP program the Bureau (or FWS or NMFS) would need to purchase water from upstream interests, including not only those who operate other dams on various tributaries, but also current CVP contractors who claim rights to some of that additional supply.

The Project anticipates the transfer of water from the same supply from which AFRP water must come. Hence, the Bureau is moving forward with a program that will prevent it from meeting its federally mandated obligation to double anadromous fish. Although the Bureau may be allowed to move forward on numerous projects and activities at the same time, undertaking a "voluntary" project that will preclude it from meeting a federally mandated obligation is not proper or legal. At a bare minimum, the DEIS/R must examine how the proposed Project will, and to what extent, affect the success of the AFRP. Absent a detailed analysis of this renders the DEIS/R insufficient.

Response
While Reclamation operates to meet multiple purposes and is trying to meet multiple planning objectives, the purpose of the potential water transfer activities evaluated in this EIS/EIR is not to fulfill the requirements of the CVPIA related to anadromous fish. Nor do the water transfer activities analyzed preclude compliance with CVPIA as the EIS/EIR found no effects of the project on anadromous fish. As described in Section 3.7.2.4, there would be no changes in instream flows that would affect spawning, rearing, or migration habitat for anadromous fish in any of the waterways that could potentially be affected.

Comment LA12-5

Comment
4. The Project is contrary to and does not examine its effects on compliance with other federal law. In 2004, Congress passed and the President signed into law the "Water Supply, Reliability, and Environmental Improvement Act" (hereinafter "2004 Act") commonly referred to as HR 2828 or Public Law 108-361 (see webpage https://www.govtrack.us/congress/bills/108/hr2828/text). This statute mandates various duties to the Bureau and other federal agencies with regard to water issues and uses in California.

The 2004 Act required the Bureau to develop a plan to meet all existing water quality standards and objectives for which the (CVP) has responsibility (2004 Act Section 103 (d)(2)(D)(I)). The Bureau (which holds the State issued permits to operate the CVP in California) is assigned the responsibility for meeting numerous water quality standards/objectives. The objectives include not only Delta outflow or X2, but also water flow and quality standards on the San Joaquin River and in the southern Delta. The Bureau must meet fishery flow standards measured at Vernalis during various times of the year, and must meet salinity (measured in electrical conductivity, or EC) standards at Vernalis and at three locations in the southern Delta all year round. [The three interior compliance stations are Brandt Bridge on the San Joaquin, Old River at Middle River, and Old River at the Tracy Blvd. Bridge.] These various standards are set forth in the State Water control Board Decision D-1641 (see webpage http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649/wrd1641_1999dec29.pdf).

Compliance with the fishery flow standards requires more water than the Bureau allocates from its reservoirs on the San Joaquin and its tributaries and thus compliance is dependent on there being water purchases. Compliance with the salinity standards also, to varying degrees, is dependent on flows in the river in excess of the amounts the Bureau allocates from its reservoirs. The 2004 Act states that as part of the Program to Meet Standards

"The Secretary shall incorporate into the program the acquisition from willing sellers of water from streams tributary to the San Joaquin River or other sources to provide flow, dilute discharges of salt or other constituents, and to improve the water quality in the San Joaquin River below the confluence of the Merced River… and to reduce the reliance on New Melones Reservoir for meeting water quality and fishery flow objectives." (Section 103 (d)(2)(D)(v))

The Bureau has undertaken no effort to investigate, discuss or identify any willing sellers of water to comply with the above mandates of the 2004 Act nor done any environmental review of such mandatory transfers. Just as it has ignored the AFRP mandate, the Bureau has ignored these mandates and is now identifying potential sellers on the San Joaquin System to transfer water for export to CVP contractors. Again, the finite amount of water produced each year means that the Bureau is acting in a manner which precludes it from meeting federally mandated obligations contained in the 2004 Act. The DEIS/R make no analysis of how the Bureau intends to meet those obligations. As will be seen below, since the Bureau regularly violates its obligations to meet water quality standards its efforts associated with the Project are clearly frustrating not only the law, but in violation of the Bureau's permit and statutory obligations.

Response

Fisheries flow standards are discussed in Section 3.7, Fisheries. A discussion and results regarding changes in salinity (EC) attributable to this project have been added to Section 3.2, Water Quality. Reclamation and DWR have provided information to the SWRCB regarding exceedances at Old River near Tracy Boulevard. Reclamation and DWR have worked to improve water quality in the Delta using measures such as reducing exports at Banks and Jones Pumping Plants, increasing releases from New Melones Reservoir into the Stanislaus River, and modifying operations of agricultural barriers in the Delta. These measures have greatly reduced electroconductivity in the Delta but have not improved quality at this monitoring station. Reclamation and DWR have found that water quality exceedances are not attributable to CVP or SWP operations (Reclamation and DWR 2012).

Comment LA12-6

Comment

5. By undertaking the Project, the Bureau is choosing to not meet is permit obligations to meet water quality standards, contrary to the assumptions in the DEIS/R. Since 2007, California has experienced two significant dry periods. 2007 and 2008 were a dry and a critical year. 2009 started off as being another critical dry year until some rains, especially in February eased the situation.

2012 was a below normal year with 2013 being one of the driest years on record. Those extremely dry conditions continued through 2014. In each of these dry periods, the Bureau (and DWR) were unable to meet their permit conditions for fishery and other water quality standards. The full extent of the hydrological conditions, reservoir operations and the lack of compliance with specific project obligations is too voluminous to repeat here. Reviewing the relevant SWRCB documents (see attached TUCP, http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/orders/wro2009.shtml) and the attached correspondence between CDWA and SWRCB provides a much more detailed summary. With that said, the following summarizes recent failures of the Bureau to meet its obligations. After a two year drought from 2007-2008, the Bureau, according to its own petition before the SWRCB, had insufficient water in storage to fully supply its highest priority contractor (the Exchange Contractors) and was unable to meet Delta outflow (X2) requirements beginning in early 2009. After a below normal year in 2012 and six months of virtually no precipitation in 2013, the Bureau was unable to meet and sought relief from its obligations to meet the Western Delta agricultural standard and the cold water requirements for Sacramento River fisheries. In 2014, as the drought continued, the Bureau was unable to meet outflow (X2), unable to meet cold water requirements, unable to meet the spring Vernalis fishery pulse flow standard, unable to meet the Vernalis salinity standard, unable to meet the three inferior southern Delta salinity standards and unable to meet the fall Vernalis fishery pulse flow standard. [See for example attached Notices of Violation and EC data from DWR webpage.]

Response
The modeling completed for this project takes into account a period of record from 1970 through 2003. This period included several dry and critical years, in addition to multi-year drought periods. Especially during recent drought years, the changes in operations from this project are not expected to significantly affect water quality such that exceedances are affected. Fisheries flows are explained in Section 3.7, Fisheries.

Comment LA12-7

Comment
This “drought-related” problem is unfortunately not just a function of droughts. The Bureau has also failed to meet the spring fishery pulse flow at Vernalis on a number of occasions and most every year violates the salinity standard at Old River at Tracy Blvd. Bridge. [See attached DWR 2013 and 2014 Water Quality Data] The underlying reason for the Project is to find additional supplies for CVP contractors during years when they do not get enough water under their CVP contracts. It is precisely those years that the Bureau is incapable of meeting its permit obligations to maintain water quality standards. However, instead of taking actions to meet its obligations, the Bureau instead embarks upon a program to find water to provide additional exports. Thus the Bureau has unlawfully elevated export contractor desire for additional water above the

Bureau's existing obligations to protect fisheries and other beneficial uses. Although the Bureau's permits condition the delivery of water to its contractors on compliance with all other permit conditions, the Bureau consistently fails to do so. By undertaking the Project, the Bureau is insuring that not only will it not be able to meet its obligations in following years, but it is also making compliance even less likely and violations more severe. There is only so much water in the system. When the Bureau seeks to facilitate transfers of portions of the limited supply to satisfy contractor desires, it necessarily decrease the amount of water available to meet standards. It is important to note that in precisely the years when there is insufficient water to meet permit and other obligations for the protection of water quality, the Project will increase the consumptive use as a whole by allowing sellers to substitute their water supply to fund a transfer.

The DEIS/R purports to examine the Project's effects on stream flow and other waters, but it makes no analysis of how the Project will affect Bureau (and DWR) mandated obligations to meet water quality standards. The DEIS/R, like so many other environmental documents simply assumes that standards will bet met and ignores the reality of the water supply. As we have seen so clearly in the past 8 years, DWR and the Bureau operate to not meet the standards.

Response
Salinity exceedances at Old River at the Tracy Boulevard Bridge are beyond the control of water project operations (see response to Comment LA12-5). Other than the installation of temporary barriers, DWR and Reclamation cannot reasonably impact the salinity level at this location because it is largely the result of local degredation. Based on water quality modeling, changes proposed under this project are not expected to significantly affect salinity within the Delta.

Comment LA12-8

Comment
6. The DEIS/R does not adequately examine the effects of the additional pumping on southern Delta water levels, quality or circulation. Export pumping at the SWP and CVP facilities in the southern Delta and central Delta. [See attached 1980 Report of Effects of CVP]. The DEIS/R reasons that as long as the Bureau and DWR comply with their existing permit conditions and applicable SWRCB orders, no party is harmed. Thus, additional projects, like the contemplated Project will also not cause third party harm. That is to say, if the current regulations on exports protects third parties, those same regulations will prevent any harm from any exports done under altered, but allowed exports. DWR and the Bureau intend to continue compliance with the regulatory scheme. Such assertions are incorrect.

Operations under current CVP permit conditions do cause harm. The SWRCB has partially addressed some of these third party impacts caused by the CVP and SWP in a Cease and Desist order issued against the projects (and subsequently amended). The Cease and Desist Order is WR Order 2006-0006 and its modification is WR Order 2010-0002, both can be found at http://www.swrcb.ca.gov/waterrights/board_decisions/adopted_orders/orders/wro2006.shtml. This Order places limits on export operations, including those wherein the Bureau would use SWP facilities as is contemplated in the Project. The 2006/2010 Order requires the Bureau and DWR to develop water level and quality response plans, the latter of which requires the agencies to give notice of anticipated water quality violations and of actions undertaken to avoid such violations. The Order specifically lists the purchase of additional water for flow on the San Joaquin River as one potential mechanism to meet the standards. The Order also requires those agencies to give notice of actual violations and specify what actions were indeed taken to correct or minimize the violation. To date, DWR and USBR have generally failed to give the appropriate required notice and have taken no additional actions to prevent or minimize violations of water quality standards. The standards are regularly violated.

Response

Appendix C presents an assessment of Delta conditions necessary to assist in evaluation of potential environmental impacts associated with long-term water transfers within the Delta. Water transfers have the potential to affect both the natural system and operation of the CVP and SWP. The analysis applies the DSM2 model to simulate the hydrodynamics and water quality within the Delta when transfer water is made available by various sellers to determine how and where within the Delta the effects are likely to occur under the alternatives. The model outputs Delta conditions for parameters such as water level (stage), water quality, and environmental flows under D-1641 and the biological opinions (BOs) provide a basis for the environmental assessment of the impacts of the alternative compared to the baseline (Base) alternative, the No Action/No Project Alternative without proposed water transfers. The model is used to compare the extent and significance of any differences resulting from the transfers. In order to conduct a comparative analysis the model is run twice, once with conditions representing a baseline and another run with an alternative representing specific changes to Delta operations and/or bathymetry in order to assess the change in modeled outcome due to the given change in model configuration. The assumption is that while the model might not produce results reflecting these changes with absolute certainty, it does produce a reasonably reliable estimate of the relative change in outcome.

The EIS/EIR is comparing the action alternatives to the existing conditions (under CEQA) and No Action Alternative (under NEPA) to assess whether potential changes could affect the environment. Changes in Delta water quality (in Section 3.2), circulation, and water levels (in Section 3.1) were found to be very small compared to the baseline. Therefore, the impacts of the action alternatives were found to be insubstantial.

Comment LA12-9

Comment

Levels. The hydraulics of southern Delta channels are very complicated and difficult to understand. In general, the operation of the SWP and CVP export pumps draw down local water levels to the point where it affects the ability of local diverters to operated their diversion pumps or siphons. The extent of the effects at any particular time are dependent on how much export pumping is occurring, inflow from the San Joaquin River, tidal flows, when (during the tidal cycle) the pumping is occurring, the existence of the temporary tidal barriers [Footnote: Three rock barriers are installed in the South Delta each year from approximately April through November. These barriers are meant to mitigate export effects on water levels by allowing incoming tides to fill the channels but then preventing the ebb tide from lowering water levels.] and the depth and capacity of any particular channel. Although there is a "water level response plan" as required by the CDO as referenced above, that response plan only applies to times when the CVP is using the SWP pumps or vice versa (this use of the other's facilities is known as joint point of diversion, or JPOD). There is no response plan during other times, yet exports continuously adversely affect local diverters as the barriers are not a complete mitigation and are not installed and operated at all times. Even during times when the response plan is in effect, the practice of the Bureau and DWR is to operate in a manner that harms local diverters.

As can be seen in email and modeling charts provide by DWR/USBR in just this last month (see attached JPOD information), rather than comply with the mandatory seven-day notice requirement in the response plan, the projects "asked" to implement JPOD sooner than the mandated seven days. The modeling provided indicated that they intended to go forward with the JPOD since the water levels would be too low (adversely affect local diverters) anyway, and thus the JPOD was only a minor additional harm, and not significant. It is SDWA's position that when water levels are at the point where they adversely affect local diversions, no additional export pumping should be allowed as it only adds to the harm. None of this is mentioned must less analyzed in the DEIS/R.

This adverse impacts on levels from export pumping is graphically evidenced this past summer. When exports were at historic lows this summer, diverters along Tom Paine Slough had adequate water levels in the Slough. In all prior years, when exports were significantly higher, the Slough did not fully fill on the incoming tide and the diverters were often times incapable of diverting when needed. [See attached Tom Paine Slough data.] Under the Project, additional export pumping will occur, but the impacts to southern Delta diversions is completely unexamined. The DEIS/R is therefore insufficient for two reason. The first is that it makes no inquiry into how increased exports might affect southern Delta diverters ability to divert, and second, it wrongfully assumes that existing compliance with regulatory limitations on export pumping means there is no harm caused by current export pumping levels.

Response
Changes in south Delta water levels were addressed in Appendix C of the Draft EIS/EIR, and an impact discussion has been added to Section 3.1 to summarize potential supply impacts. The action alternatives would have very small effects (either no change or as much as a 0.1 foot decline) to water levels in the south Delta. Data supporting this discussion has also been added to Section 3.1. Because the changes in water levels would be so small, these changes would not significantly affect local water diverters' ability to pump from the Delta.

Comment LA12-10

Comment
Quality. It is a similar situation with regards to water quality. First, the DEIS/R makes no mention of the impacts to EC at any of the three interior southern Delta compliance stations where the SWRCB Water Quality Control Plan objectives are measured. The DEIS/R does give information about changes at Vernalis, but again, ignores the three objectives downstream of Vernalis. As stated before, the hydraulics of the area are complicated. Southern Delta salinity (measured in EC) is a function of the salt which flows into the area from the San Joaquin River, local use, riverine evapo-transpiration, incoming tidal flows (and the salt contained therein), and flow changes due to export pumping. As referenced above and in the attached materials, the salinity standard measured at Old River at Tracy Blvd. Bridge is commonly violated. [Footnote: The attached Salinity Measurements material shows DWR information indicating the measured EC at the four compliance stations as well as the 30-day running average. The standard is a 30-day running average of 1.0 EC (September- March) and 0.7 EC (April - August).Thus, any time the 30-day running average in the attached materials exceeds 1.0 EC from September - March or 0.7 EC from April - August there is a water quality violation.] The DEIS/R seems to accept these violations as a base case or accepted practice. By assuming this, the DEIS/R does not fully explain how the current conditions are causing harm to third parties or what or how the incremental effects of the project may also cause harm. The DEIS/R simply assumes current exports and additional exports under the Project do not affect third parties.

Importantly, the DEIS/R notes in Table 3.2.26 that water quality is sometimes worse under the Project at Clifton Court Forebay, the intake for the SWP export facility. If water quality is worse at this location, that means the dilution benefits of the incoming tide are less and the water quality upstream (where the three interior south Delta salinity standards are measured) is necessarily worse, and the resulting impacts unknown.

Response
The Final EIS/EIR has incorporated additional information about Delta water quality in Section 3.2. (This information was in Appendix C of the Draft EIS/EIR.) Salinity exceedances at Old River at the Tracy Boulevard Bridge are beyond the control of water project operations (see response to Comment LA12-5). Other than the installation of temporary barriers, DWR and Reclamation cannot reasonably impact the salinity level at this location because it is largely the result of local degredation. Based on water quality modeling, changes proposed under this project are not expected to significantly affect salinity within the Delta.

Comment LA12-11

Comment
Circulation. The DEIS/R has no analysis of how any changes in San Joaquin River flows or export levels will affect flow pattern in the southern Delta. As stated above, flows in the area are a function of many things including exports and inflow from the San Joaquin River. Even small changes in either one of these can have significant effects on flow patterns. This is true even during times when the tidal barriers are installed an operating. The barriers are designed and operated in a manner that provides the maximum protection from decreased water levels while also trying to minimize salt from concentrating in the area. The barriers are most efficient at certain levels of inflow as that inflow helps determine how much diluting tidal inflow will enter the area. A complete explanation of these issues is contained in the DWR documents at http://bavdeltaoffice.water.ca.gov/sdb/tbp/index_tbp.cfm (The temporary barrier project site) and http://baydeltaoffice.water.ca.gov/sdb/sdip/index_sdip.cfm (The South Delta Improvement Program site which includes the final EIS/EIR for that project). The documents at these sites are incorporated herein as the underlying technical background of how the southern Delta flow is understood and barrier operations occur.

Response
Appendix C presents a DSM2 modeling analysis of Delta conditions for the alternatives (including changes in San Joaquin River flows because of Merced ID transfers). The modeling addresses regulated parameters to determine the magnitude of changes to these parameters that could occur if the system operations defined by any of the alternatives were implemented instead of Base operations. The flow analysis included changes in south Delta stage heights, as decreases in stage might affect agricultural diversion operations and changes in the magnitude in the combined Old River plus Middle River flow (OMR) from December through June as regulated by the National Marine Fisheries Service (NMFS) and USFWS biological opinions.

Changes in the south Delta stage were calculated for each alternative in comparison with Base at all D-1641 locations, and discussed in the Draft EIS/EIR only for representative locations; the entire set of results are compiled in the Attachment to Appendix C. Stage changes were assessed via a conservative calculation that compared the monthly average of differences in daily minimum stage. The analyses consider a stage difference of -0.2 ft. to indicate a potentially significant result. Stage decreases were greatest for the Proposed Action/All Transfers alternative at the Old River downstream of agricultural barrier location, but changes of this magnitude only occurred in 7 of the 408 months simulated. These decreases occurred in July and August of dry or critical water years, when south Delta exports increased in comparison with Base. Monthly average decreases in stage were sparse in all other locations and alternatives, with few instances when stage changes reached -0.2 ft. (e.g., in June 1993 in several locations for each of the alternatives). A summary of this assessment has been added to Section 3.1, Water Supply.

Comment LA12-12

Comment

7. The DEIS/R does not adequately examine the impacts of transfers from the San Joaquin River system or how diversions of such transfers upstream of the Delta affect third parties. Table 3.2.25 on page 3.2.38 of the DEIS/R shows decreases in San Joaquin River flow under certain modeling conditions for various months in differing year types. Initially it must be noted that these numbers are averages for the year types. Though potentially helpful in analyzing impacts (assuming the modeling is correct and reliable) any average result is misleading because it mixes the lowest flow with the highest. Thus we cannot see what the lowest flow in any month is only the average of all flows from a set of years for that month. Impacts at these lower flows are therefore not examined and no conclusions should therefore be made about how the project may or may not injure third parties.

The information provided indicates that in some years San Joaquin River flows can decrease (for example) under the Project by up to 84 cfs in June and up to 81.3 cfs in March. These decreases can be significant in that flows on the River are sometimes very low. In the past year alone, Vernalis flow has dropped to 219 cfs in July (see attached DWR Flow Export data). Any change in such low flow would be very significant. Although the decreases in Table 3.2.25 are shown in above normal years, not knowing the flows in all years prevents us from determining if there are decreases in River flow during drier times under the Project.

Response

Section 3.2 includes an assessment of the water quality of Merced ID transfer water diverted upstream from the Delta. Additional information has been added regarding the potential water quality impacts to Delta inflow associated with these diversion locations.

The decrease in river flows represent times when reservoir storage in Lake McClure is refilling after a transfer, which decreases downstream releases.

Refill agreements dictate that refill could only occur during wetter periods when it would not affect downstream water quality or flow requirements. The decreases in flow are during wet and above normal years. Flow does not decrease in other year types because it would not be consistent with the terms of the refill agreements.

Comment LA12-13

Comment
The project also anticipates potential diversions of transfer water upstream of Vernalis and between Vernalis and the Delta proper (the later at the diversion of the Banta-Carbona District intake). The DEIS/R makes no real analysis of how such diversions would affect flow or water quality when the water enters the Delta (downstream of the Banta-Carbona intake). The San Joaquin River suffers from decreased flows (see 1980 Report attached hereto) and severe salinity problems due to drainage (surface and subsurface) from the CVP service area (see 1980 Report and Salinity in the Central Valley at www.waterboards.ca.govcentralvalley/water_issues/salinity/central.

Much of the salt entering the San Joaquin River occurs upstream of the River's confluence with the Merced River. Generally, the Merced and other tributary flows downstream provide some dilution to the saline San Joaquin. Depending on where and when the Project might allow diversions along the River (of transferred water) determines the effects on the water quality of the water which eventually enters the Delta. As we have seen, the water quality standards in the Delta are often violated, which means that any change in salinity and flow could affect water quality especially at the locations where the violations occur. Both the amount of inflow and the load of salt are important given the manner in which the CVP and SWP cause salt to collect and concentrate in the southern Delta. In addition, New Melones dam/reservoir on the Stanislaus is used to control salinity on the San Joaquin River at Vernalis through releases. However, New Melones is not operated to meet the standards in the southern Delta. The DEIS/R must examine how any changes in flows due to diversions of transferred water upstream of the Delta (at Banta Carbona's intake and above) affect releases from New Melones and how it may affect interior southern Delta water quality. The DEIS/R does neither.

It is important to note that although the salinity standards are measured at four compliance locations, the standards apply throughout the channels at all locations (see SWRCB 2006 Water Quality Control Plan at page 10; http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/index.shtml. The DEIS/R does not even cover New Melones storage impacts which might occur due to changes in San Joaquin River flows or quality. Since the 2004 Act requires the Bureau to decrease New Melones use for meeting water quality standards, the DEIS/R is clearly incomplete and inadequate.

Response
Section 3.2 includes an assessment of the water quality of Merced ID transfer water diverted upstream from the Delta. Additional information has been added regarding the potential water quality impacts to Delta inflow associated with these diversion locations

Comment LA12-14

Comment
8. The DEIS/R is an improper "piecemealing" of a project under CEQA and NEPA. According to the November 2013 Draft EIR/EIS for the Bay Delta Conservation Plan (BDCP), "Conveyance of transfer water by Authorized Entities is a covered activity provided that the transfers are consistent with the operational criteria described in CM1 and the effects analysis described in BDCP Chapter 5, Effects Analysis." (BDCP DEIR/EIS, p. 3-120; see excerpts enclosed herewith.) Because the BDCP will not only facilitate CVP water transfers, but will expressly include them as "covered activit[ies]," under CEQA and NEPA those transfers must be evaluated within the EIR/EIS for the BDCP and not in a separate, independent EIR/EIS.

With regard to CEQA, as the court explains in Orinda Assn v. Board of Supervisors (1986) 182 Cal.App.3d 1145, at page 1171: A public agency is not permitted to subdivide a single project into smaller individual sub-projects in order to avoid the responsibility of considering the environmental impact of the project as a whole. "The requirements of CEQA, 'cannot be avoided by chopping up proposed projects into bite-size pieces which, individually considered, might be found to have no significant effect on the environment or to be only ministerial.' [Citation.]"

As the court in Berkeley Keep Jets Over the Bay Committee v. Board of Port Com'rs (2001) 91 Cal.App.4th 1344, similarly explains: There is no dispute that CEQA forbids "piecemeal" review of the significant environmental impacts of a project. This rule derives, in part, from section 21002.1, subdivision (d), which requires the lead agency ... to "consider[] the effects, both individual and collective, of all activities involved in [the] project."

Moreover, in a similar vein, as the California Supreme Court explains in Laurel Heights Improvement Assn. v. Regents of University of California (1988) 47 Cal.3d 376, at page 396: We hold that an EIR must include an analysis of the environmental effects of future expansion or other action if: (1) it is a reasonably foreseeable consequence of the initial project; and (2) the future expansion or action will be significant in that it will likely change the scope or nature of the initial project or its environmental effects.

CVP water transfers are indeed a "reasonably foreseeable consequence" of the BDCP (for among other reasons, they are in fact a "covered activity" under the BDCP), and those transfers will indeed "likely change the scope or nature of the initial project or its environmental effects." With regard to the latter, the November 2013 Draft EIR/EIS for the BDCP itself acknowledges that the scope of the BDCP would indeed change if CVP water transfers were added to the scope of that EIR/EIS. As that Draft EIR/EIS explains: "[T]he withdrawal of transfer waters from source areas is outside the scope of the covered activity." (BDCP Draft EIR/EIS, p. 3-120; see excerpts enclosed herewith.) Hence, if such withdrawal of transfer waters were included within that scope, it would undisputedly constitute a (significant) change of the scope of the BDCP Draft EIR/EIS (and, hence, its environmental effects).

For these reasons, the instant EIS/EIR is contrary to both CEQA and NEPA. The environmental analysis of the CVP transfers must be undertaken within the pending EIR/EIS for the BDCP and not separately from that EIR/EIS.

Response
The range of potential transfer activities evaluated under the Proposed Action involves voluntary transactions that may or may not occur and which are independent, separate, and distinct from the proposed BDCP. The term of the potential transfer activities evaluated under the Proposed Action ends in 2024 and would be over by the time BDCP may be implemented. Therefore, BDCP is also not included in the cumulative analysis (see responses to Comments LA13-9 and LA14-15).

Comment LA12-15

Comment
9. The DEIS/R incorrectly assumes there will be no transfers from 2015-2024 absent the Project. On page 2-6 (section 2.3.1) and other places in the DEIS/R is it noted that the Base Case/No Action Alternative assumes no transfers during 2015 - 2024. There is no support for this assumption. Even in this second year of significant drought, the Bureau and DWR conducted JPOD operations of transfer water (see attached JPOD). If such transfers occur under current conditions they will certainly occur sometime in the next 10 years under the Base Case. I note that per the language of CVPIA, any water that moves via CVP facilities is considered "CVP water" and thus comes under both the Project and CVPIA limitations.

Response
See responses to Comments LA12-2 and LA12-73.

Comment LA12-16

Comment
10. The DEIS/R is inadequate in that it is impossible to determine water savings under the crop shifting method of supplying transfer water. One of the methods of supplying transfer water is to account for the amount of water saved by a seller due to a shift of one crop to another that consumes less water. Since

transfers are to provide supply in drier times, there is no way to know if the seller would have shifted to that crop anyway because of such drier times. In this past year the SWRCB curtailed all post-1914 water rights and publically considered curtailing pre-1914 water rights, riparian rights and even CVP and SWP contract rights (deliveries). Hence, the pressures of drought can and do affect farming decisions in all areas, including those identified as potential sellers under the Project. There is no method to accurately determine if a seller would have shifted to a different crop absent a transfer, which makes the Project incapable of analysis and precludes any calculation of “how much water was saved.” This issue also is affected by the DEIS/R's failure to review water rights issues associated with any seller. If a seller is getting water from the CVP under a settlement or exchange contract, is the water he uses from his right or from the contract? Is he getting contract water in excess of what his underlying water right would provide under "natural conditions?" Is he making decisions on acreage and crops based on the contract or underlying water right? Does the decision on water use depend on what right is used? Until this morass of issues is resolved, there is no method by which one can determine if a crop shift actually results in more water being available.

Response

When evaluating a proposed crop shifting transfer, Reclamation would not simply take the seller's word for what would have happened absent the transfer. Reclamation would consider planting data from the past five years to better understand the historic cropping pattern and how planting decisions are made on each field. This information would be used to determine water saved. See Common Response 14.

Transfers from CVP contractors could be either Base Supply or Project water. A sentence has been added to Section 2.3.2.1 to clarify this issue. Sellers must take an action to reduce consumptive use of water or release additional water from non-Project reservoir storage (as described in Section 1); therefore, they cannot transfer more water through crop shifting than they have consumptively used in past years.

Comment LA12-17

Comment

11. The DEIS/R incorrectly assumes the CV-SALTS process will decrease salt entering the southern Delta. One of the assumptions used to minimize, ignore or not examine the Project's impact on southern Delta salinity is that the CV-SALTS process will decrease the amount and concentration of salts entering the San Joaquin River. This indicates a misunderstanding of the CV-SALTS process. CV-SALTS is a joint SWRCB, CVRQWCB and stakeholder effort to address the valley/River salt problems. Although the process is developing Basin Plan amendments which can/could limit discharges of salt, the main thrust of the effort is to find a way to get the valley salts out to the Bay and Ocean. Hence, rather than decrease salt loads, the implementation of the Basin

Plan will be through a real time monitoring/discharge program already being developed by the Bureau and stakeholders. Under such a program, Highly concentrated salts will be discharged to the River during times when the River is of better quality than the discharge, and such mixing will not exceed the standard. Hence, the plan is to spread the salts out over time so that times of better water quality will be degraded, not improved. The times when the concentration is already too high will not be affected as New Melones currently dilutes the River regardless of the salt concentration. In sum, the San Joaquin River will not improve under the CV-SALTS program, the salts will simply be spread out, degrading the River at all times. The same amount of salts will enter the south Delta as do now. Whether or not those salts will leave the area or be adequately diluted for local use remains unknown, unexamined and unplanned. (See webpage www.cvsalts.com.)

Response
The CV-SALTS process is evaluating alternatives to be adopted in the Salt and Nitrate Management Plan and addressed in a Basin Plan Amendment in order to manage salt and nitrates on a sustainable basis. Real time management is only one of the alternatives being considered. Other alternatives include "in valley" approaches such as regional reuse and desalinization and "out of valley" approaches such as a brine line interceptor.

Comment LA12-18

Comment
Pg ES-1, par3- There is no evidence to support or assure that Buyer's use will be beneficial. Application of water to lands with particularly high latent levels of selenium or boron which further directly degrade the San Joaquin River or cause degrading accretions to the San Joaquin River would not be beneficial.

Response
Buyer's use is considered beneficial based on the additional use of water for agricultural and municipal and industrial (M&I) purposes. Although additional agricultural use will lead to additional irrigation, the runoff associated with this additional irrigation is not expected to cause any significant degradation of water quality. Section 3.2.2.4.2 includes an assessment of whether increased agricultural irrigation in the buyers' area could affect water quality. The assessment indicates that the irrigation would not be focused on drainage-impaired lands because growers would focus limited supplies during shortages on permanent crops or crops planted on prime or important farmland. The impact finding is that agricultural runoff would not significantly degrade water quality in San Joaquin Valley waterways, which would indicate that the effort would not result in water quality-related impacts

Comment LA12-19

Comment
Pg ES-1, par3- There is no evidence to support or assure that the transfer water is not going to "service any new demands". Water used to irrigate new plantings of permanent crops or even an annual crop not yet planted is serving a new demand. As permanent crops mature water demand generally increases and constitutes a new demand. For M&l type uses new connections and increases in use of existing connections adds new demand.

Response
Water transfers are not a reliable source of water to service new demands. As discussed in Chapter 2, transfer water is a supplemental supply to help meet existing demands during a water shortage. In addition, water transfers would not occur each year, as would be necessary if they were servicing new demands. Water transfers would not meet new M&I demands or be used to plant new permanent crops.

Comment LA12-20

Comment
Pg ES-1, par4- SLDMWA is the state lead agency. The SWP operations and facilities are an integral part of the proposed project implementation. DWR must operate the SWP to accommodate these transfers and will be responsible for identifying when excess capacities exist to create the transfer opportunity in the first place. DWR is also the permit holder for the right to operate the SWP that mitigate for the SWP operations. SLDWMA assistance in negotiating transfer agreements between parties is hardly a superior qualification for them as lead agency over DWR who has to operate the system to make the transfers happen. DWR should be the state lead agency.

Response
See Common Response 1.

Comment LA12-21

Comment
Pg ES-2, par2- Other concurrent transfers must be considered for the projects affects on those operations, both directly and indirectly as well as in combination and cumulatively with them, e.g. Lower Yuba River Accord water transfers from YCWA.

Response
Resource evaluations in Chapter 3 evaluate cumulative effects, including potential SWP transfers and the Lower Yuba River Accord. Chapter 4 describes the projects included in the cumulative analysis.

Comment LA12-22

Comment
Pg ES-2, par4- The Purpose and Need limits the consideration to transfers from upstream of the Delta to water users south of the Delta and in the San Francisco Bay. This improperly limits the objective consideration of all reasonable alternatives. Measures other than transfers and measures including transfers within the Buyer area or other parts of the State present reasonable alternatives.

Response
The Lead Agencies establish the purpose and need to best describe their underlying reasons for considering an action. The EIS/EIR considered these alternatives (and others) during the alternatives development process described in Section 2.2 and detailed in Appendix A.

Comment LA12-23

Comment
Pg ES-2, par6- Water transfers are only one potential method to meet supplemental water supply objectives. Water recycling, water conservation, and within water buyer district local conjunctive use, transfers, and land retirement are all other reasonable and effective alternative methods to satisfy this objective.

Response
The EIS/EIR considered these alternatives (and others) during the alternatives development process described in Section 2.2 and detailed in Appendix A. The Lead Agencies screened the alternatives based on their ability to meet key elements of the purpose and need and basic project objectives. Alternatives should be immediately implementable and flexible, and should provide additional water supplies. The alternatives that moved forward for more detailed analysis in the EIS/EIR are those that best meet the NEPA purpose and need and CEQA objectives, minimize negative effects, are potentially feasible, and represent a range of reasonable alternatives.

Comment LA12-24

Comment
Pg ES-2, par8- The premise that the water transfers will occur to make up for regulatory constraint impacts on water supplies is fundamentally flawed. The failure of the projects to develop sufficient supplies to meet regulatory requirements, senior obligations and project contractor desires is the driver. Buyer's desire to acquire through water transfers water which is not truly surplus to the needs within the watersheds of origin.

Response
The buyers’ purpose and need for water transfers is identified in Chapter 1, which is the driver for the Proposed Action. Only willing sellers participate in water transfers and they would only transfer water they do not plan to use during the transfer year. See Common Response 14.

Comment LA12-25

Comment
Pg ES-3, figure ES-1- New Melones storage facilities and the Stanislaus River are identified as a potential conveyance for the proposed project, but no potential sellers have been identified in this watershed and no "Area of Analysis" (Table ES-2) was included for this geographic area. Without a willing seller identified with New Melones water rights or water rights in the Stanislaus River basin, the New Melones facilities and the Stanislaus River should not be involved in the proposed project. This was not disclosed in the EIS/R. Since this geographic area and facility was not analyzed or impacts disclosed, the New Melones facilities and the use of the Stanislaus River cannot be covered under this environmental document or for agency decisions or permits issued based on this document.

Response
Water transfers would not occur from agencies on the Stanislaus River or from New Melones Reservoir. These are not conveyance facilities for proposed transfers. Figure ES-1 shows potential sellers and buyers. The water bodies shown are for reference purposes. Each resource evaluation in Chapter 3 shows the area of analysis for that resource.

Comment LA12-26

Comment
Pg ES-3, figure ES-1- The figure and project description fail to identify the water conveyance routes that could be utilized (and which could precipitate different environmental impacts. Without identifying the route in which surface water flows would be affected by the project, there cannot be a proper project level impact analysis. Such impacts have not been adequately identified, characterized, evaluated, quantified, mitigated or disclosed.

Response
Chapter 2, Section 2.3.2.3 describes the range of potential transfers and the waterbodies or conveyance facilities needed for moving transfer water. The Executive Summary is a summary and does not include all of these details.

Comment LA12-27

Comment
Pg ES-5, parES 2.2- The willing sellers are not described in any detail (like the buyers were), they were only included on a list. The map of willing sellers is not sufficiently detailed to determine who is where. As an example, the area south of the town of Davis cannot be determined as to who the land owner(s) may be. Regardless, no conveyance route to deliver the water for a transfer is identified or analyzed for this water transfer so the impacts for the transfers from this property are not disclosed in or covered by this environmental document.

Response
Section 3.1 provides additional information on the sellers related to water supply. Additional detail has been added to the map for the seller services area; however, individual land owners are not shown due to privacy considerations. Chapter 2 describes conveyance routes of transfers by river basin.

Comment LA12-28

Comment
Pg ES-8, par ES 3.2- Alternatives should have included all reasonable measures, including land retirement, within the Buyer area as well as areas of the State other than upstream of the Delta.

Response
Land retirement was considered in the EIS/EIR as part of the Land Retirement in San Joaquin Valley Alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives as it would not be immediate or flexible, and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment LA12-29

Comment
Pg ES-9, Table ES-3- Crop shifting- crop shifting and idling appear to be used interchangeable in the document in terms of creating water supply, but the environmental impacts of them are significantly different in kind and magnitude. The analysis must clearly separate the location, timing, and magnitude of each of these water conservation strategies and address their separate types and magnitudes of impacts.

Response
Chapter 2, Section 2.3.2.1 distinctly describes cropland idling and crop shifting as separate water transfer methods. The resource evaluations in Chapter 3 also describe effects of both transfer methods. If the effects are the same, then the

resource chapters may combine the discussion of effects of cropland idling and crop shifting. Where the effects are different, such as Regional Economics (Section 3.10), the effects are described separately.

Comment LA12-30

Comment

Pg ES-9, Table ES-3- Even with the improperly limited alternatives there should have been an alternative 5 which included all other water supply source concepts except seller service area crop idling and shifting so seller service area agricultural impacts from the water transfers could have been identified, characterized, quantified and disclosed. As the alternatives stand, all of the alternatives, except the no action, included seller service area agricultural conservation. This alternative must be included in the revised EIS/R so these impacts can be isolated and quantified and compared to the other alternatives.

Response

In accordance with NEPA and CEQA requirements, the EIS/EIR provides and addresses a reasonable range of alternatives. Alternative 3, No Cropland Modifications, includes all transfer methods except for seller service area cropland idling and crop shifting. All action alternatives do include conservation, but these impacts were isolated and quantified in the separate CEQA document on this transfer (available at http://www.bvid.org/CEQA07102009.html).

Comment LA12-31

Comment

Pg ES-9, Table ES-3- Even with the improperly limited alternatives there should have been an alternative 6 which included all other water supply sources except reservoir releases so reservoir release impacts from the water transfers could have been identified, characterized, quantified and disclosed. Isolating the impacts of storing and conveying water is essential to complying with the requirements of the Warren Act Contract assessment. As the current analysis stands, all of the alternatives except the No Action/No Project included reservoir releases so these CVP reservoir-related water wheeling related impacts cannot be separated from the other project impacts in order to satisfy Warren Act analysis requirements.

Response

A separate analysis of Warren Act actions is not necessary for compliance with Warren Act requirements. The impacts of conveying non-CVP water in CVP facilities are analyzed in this document to satisfy Warren Act requirements.

Comment LA12-32

Comment

Pg ES-9, Table ES-3- Since most willing sellers identified are part of the CVP and SWP, these contractors will also be short on water allocations in years in which the buyers would want to do water transfers. Since the sellers would be short on water supply in these years, they would already be doing the feasible water conservation actions, shifting to less water consumptive crops, idling farmland and utilizing groundwater as an alternative water supply to their surface water rights. Therefore, the proposed project and other alternative which rely upon seller service area water conservation, crop fallowing, crop shifting and use of alternative groundwater water supply assumptions are fundamentally flawed and unrealistic. Much of the water saving that the project is going to take credit for transfer would already be happening (switching to lower consumptive crops, idling land and switching to groundwater), so the project is claiming false credit for water conservation. The EIS/R must show, defensibly, how the water claimed as saved is actually saved, above and beyond what was going to happen absent the project.

Response

As willing sellers, sellers will only sell water they do not need to meet their water needs for the season. As defined in the project description, water conservation transfers must reduce irrecoverable water losses. Reclamation has measures in place during approval of water transfers to ensure that water being transferred via conservation transfers could not be used by downstream users. There is only one water conservation transfer proposed in the EIS/EIR, from Browns Valley Irrigation District. The Browns Valley Irrigation District water conservation transfer has been evaluated and it complies with the requirements for water conservation transfers.

Comment LA12-33

Comment

Pg ES-9,ES 4 par 2- 'The biological opinions on the Coordinated Operations of the CVP and SWP (U.S. Fish and Wildlife Service [USFWS] 2008; National Oceanic and Atmospheric Administration Fisheries Service [NOAA Fisheries] 2009) analyze transfers through the Delta from July to September (commonly referred to as the "transfer window") that are up to 600,000 AF in dry and critically dry years. For all other year types, the maximum transfer amount is up to 360,000 AF." This statement is correct as to the USFWS OCAP BO, but the NMFS OCAP BO has no similar provision or language. This erroneous assumption/representation distorts the EIS/EIR analysis of impacts to species covered in the NMFS OCAP BO.

Response

Text has been revised relative to transfer amounts allowable under the NOAA Fisheries biological opinion (BO). In dry years following critical years and in dry years following dry years, the maximum transfer amount is also up to 600,000 acre-feet (AF), according to NOAA Fisheries BO Appendix A p. 126-127.

Comment LA12-34

Comment

FWS OCAP BO pg 229, pl, "Water transfers would increase Delta exports by 0 to 360,000 acre-feet (AF) in most years (the wettest 80 percent of years) and by up to 600,000 AF in Critical and some Dry years (approximately the driest 20 percent years). Most transfers will occur at Banks (SWP) because reliable capacity is not likely to be available at Jones except in the driest 20 percent of years. Although transfers can occur at any time of year, the exports for transfers described in this assessment would occur only in the months July-September." The proposed project transfers from April through June are not covered in the FWS OCAP BO impact assessment of water transfers so the proposed project water transfers that would occur in April through June must seek ESA consultation from FWS.

Response

The range of potential water transfers through the Delta evaluated under the Proposed Action and alternatives would occur from July through September. See response to Comment LA12-83 for additional information.

Comment LA12-35

Comment

FWS OCAP BO pg 229, pl, "Delta smelt are rarely present in the Delta in these months, so no increase in salvage due to water transfers during these months is anticipated, but as described above, these transfers might affect delta smelt prey availability." This is why the FWS OCAP BO analysis of impacts of CVP and SWP water transfers in July through September are covered by the current take permits and any other months are not.

Response

See response to Comment LA12-34.

Comment LA12-36

Comment

FWS OCAP BO pg 229, p4, "The pumping capacity calculated is up to the allowable E:I ratio and is limited by either the total physical or permitted capacity, and does not include restrictions due to ANN salinity requirements with consideration of carriage water costs." So the transferred water is allowed to degrade water quality because the flows to maintain salinity standards would cost too much?

Response
Water transfers include carriage water. See response to Comment LA12-82 for additional information. Water quality is evaluated in Section 3.2, which concludes there would be no significant impacts to water quality under the proposed alternatives.

Comment LA12-37

Comment
FWS OCAP BO pg 230, pl, "For all other study years (generally the wettest 80 percent) the available capacity at Banks for transfer ranges from about 0 to 500 TAF (not including the additional 60 TAF accruing from the proposed permitted increase of 500 cfs at Banks. But, over the course of the three months July-September other operations constraints on pumping and occasional contingencies would tend to reduce capacity for transfers. In consideration of those factors, proposed transfers would be up to 360 TAF in most years when capacity is limiting." The project description of the proposed project is not specific as to how much of the potential 511,000+AF are proposed to be transferred by water year type. Therefore, the project description is inconsistent with the limitations for water transfers set in the FWS OCAP BO.

Response
The Lead Agencies have defined the range of potential water transfer activities evaluated under the Proposed Action to comply with the requirements in the biological opinions on the Long-Term Operations of the CVP and SWP, as stated in Section 2.3.2.1. Figure 2-10 shows an exceedance plot of the available export pumping capacity for transfers. The figure shows that in 65 percent of years, there would be no capacity at the pumps to convey transfer water. Capacity is estimated to be mostly available in dry and critically dry years. This is consistent with the NOAA Fisheries and USFWS biological opinions.

Comment LA12-38

Comment
FWS OCAP BO pg 230, p3, "for this assessment proposed exports for transfers (months July-September only) are as follows:

Water Year Type	**Maximum Amount of Transfer**
Critical	up to 600 kaf
Consecutive Dry	up to 600 kaf
Dry after Critical	up to 600 kaf
All other Years	up to 360 kaf"

Note that the FWS OCAP BO addresses these transfer amounts only during the period of July through September.

Response
The range of potential water transfers through the Delta evaluated under the Proposed Action and alternatives would occur from July through September. See response to Comment LA12-83 for additional information.

Comment LA12-39

Comment
NMFS OCAP BO pg 729 p3, " ... this consultation does not address ESA section 7(a)(2) compliance for individual water supply contracts. Reclamation and DWR should consult with NMFS separately on their issuance of individual water supply contracts, including analysis of the effects of reduced water quality from agricultural and municipal return flows, contaminants, pesticides, altered aquatic ecosystems leading to the proliferation of non-native introduced species (i.e., warm-water species), or the facilities or activities of parties to agreements with the U.S. that recognize a previous vested water right." The NMFS OCAP BO appears to provide that the water transfer seller and recipient agencies will require ESA consultation.

Response
The preceding sentence in the NOAA Fisheries biological opinion states that "take from the administration of water transfers is included in the CVP/SWP operations for this consultation." Therefore, the biological opinion does consider the effects of water transfers. The cited text refers to individual water supply contracts, not water transfers. The range of potential transfer activities under the Proposed Action and alternatives are within the operating requirements of the NOAA Fisheries biological opinion on the Long-Term Operations of the CVP and SWP.

Comment LA12-40

Comment
Pg ES-10, ES 4.1- Specific measures are not set forth to assure that the Seller substitutes groundwater for surface water.

Response
Reclamation has monitoring measures in place as part of the water transfers approval process to make sure transfers are being implemented responsibly, including that real water is being transferred. See Common Response 14.

Comment LA12-41

Comment
Pg ES-10, ES 4.2- "Reclamation would limit transferred water to what would not have otherwise been released downstream absent the transfer." Specific measures to assure that this is the case are not spelled out.

Response
The comment includes part of the definition of reservoir release transfers. Reclamation has monitoring measures in place as part of the approval process to make sure transfers are being implemented responsibly, including that real water is being transferred.

Comment LA12-42

Comment
Pg ES-10, ES 4.2- "Each reservoir release transfer would include a refill agreement between the seller and Reclamation (developed in coordination with DWR) to prevent impacts to downstream users following a transfer." "Refill of the storage vacated for a transfer may take more than one season to refill if the above conditions are not met in the wet season following the transfer." The reduction in storage from the transfer, that according to the document could take years to replace, could cause significant impacts to downstream users, reservoir resources (recreational boat launch access and marinas, warm water fisheries reproduction success, exposure of sensitive archaeological sites in the reservoir fluctuation zone and other significant impacts). The project must only be allowed to release water it has already stored, not release water that it does not yet have as appears to be proposed by the project. If the project is only allowed to release water it has already stored then the impacts to other resources are dramatically reduced. If the release only of water that is already stored is not a part of the project description, it must be a requirement for mitigation of the impacts caused by releasing water before it is stored.

Response
Reservoir release transfers include water that has already been stored in non-Project reservoirs. Water available for transfer is water that would not have been otherwise released downstream absent the transfer.

Comment LA12-43

Comment
Pg ES-11, ES 4.3- If weed cover is not removed then the consumptive use conservation the project claims to be using for the water transfer is not supportable.

Response
Reclamation requires cropland idling participants to control weeds during the transfer period. Participants typically disc their fields once or twice depending on the condition of the field. In past transfers, weed cover has been low.

Comment LA12-44

Comment
Pg ES-11, ES 4.3- Consideration must be given to protecting adjacent properties from herbicide spray drift and weed pressure from fallowed adjacent fields. Mitigation should include monitoring and funding to address these significant project impacts.

Response
Water transfer participants typically disc their fields to control weeds. DWR and Reclamation do not require use of herbicides to control weeds. Some farmers apply herbicides to wet fields where tractors may get stuck, but this is generally not applicable to idled fields. Farmers generally manage weeds to protect neighboring rice fields as a best management practice. This would not be an impact with or without transfers.

Comment LA12-45

Comment
Pg ES-11, ES 4.4- "Transfer water generated by crop shifting is difficult to account for. Farmers generally rotate between several crops to maintain soil quality, so water agencies may not know what type of crop would have been planted in a given year absent a transfer. To calculate water available from crop shifting, agencies would estimate what would have happened absent a transfer using an average water use over a consecutive 5-year baseline period. The change in consumptive use between this baseline water use and the lower water use crop determines the amount of water available for transfer." Due to the speculative aspects of the determination of true water savings this alternative should be deleted.

Response
Calculating water savings from crop shifting is based on data from past cropping patterns and is not speculative.

Comment LA12-46

Comment
Pg ES-12, ES 5- "The No Action/No Project Alternative considers the potential for changed conditions during the 2015-2024 period when transfers could occur, but because this period is relatively short, the analysis did not identify changes from existing conditions." Based on this quote from the document, the No Action/No Project baseline is incorrectly defined. The current OCAP

Biological Opinions of NMFS and FWS include many Reasonable and Prudent Alternatives and Actions that the CVP and SWP must legally implement during this period. Some of these actions, e.g. bypass flows to inundate floodplain habitat and fish passage, have flow and operational implications that must be included ·in the No Action/No Project that do not exist (other than current legal obligation) in the Existing Conditions. The EIS/R analysis must be revised to correct for this error in the definitions of the baselines for comparison.

Response
The baseline modeling considers the reasonable and prudent alternatives (RPAs) listed in the biological opinions. Some are included in the modeling, such as Delta Cross Channel, Export/Inflow Ratio, and Lower American River Flow Management. Other actions in the RPAs are not expected to affect flows substantially from existing conditions, and other actions in the RPAs would not be implemented within the 10-year timeframe of potential transfer activities evaluated under the Proposed Action. Therefore, the No Action Alternative modeling does reflect the RPAs to the extent possible with available data at this time and remodeling is not required.

Comment LA12-47

Comment
Pg 1-2, 1.1.2- A project objective identified is, "Develop supplemental water supply for member agencies during times of CVP shortages to meet existing demands." New plantings, the maturing of already planted crops, new service connections in M&l areas and increased use of existing service connections are examples of new demand. The analysis is inconsistent with this objective and there are no significant measures to preclude increased reliance on diversions from the Delta.

Response
See response to Comment LA12-214.

Comment LA12-48

Comment
Pg 1-2, 1.1.2- "Because shortages are expected due to hydrologic conditions, climatic variability, and regulatory requirements, transfers are needed to meet water demands." As pointed out in other comments, the regulatory requirements constrain CVP/SWP operations and when CVP/SWP operations are constrained by regulations there is no excess capacity to support water transfers. This component of the project objectives is not satisfied by any of the project alternatives.

Response
Capacity to convey transfer water through the Delta is a factor that limits the overall amount of transfers that could occur each year. This is described in

more detail in Section 2.3.2.5. Reclamation has multiple planning efforts to help meet the many demands on the CVP, and increasing operational capacity is part of separate planning efforts. See Common Response 14.

Comment LA12-49

Comment
Pgs 1-10 & 11, 1.3.1- "According to the CVPIA Section 3405(a), the following principles must be satisfied for any transfer." ... "Transfer will not adversely affect water supplies for fish and wildlife purposes." The impact analysis in the EIR/S identifies several adverse, significant and less than significant proposed project and project alternative impacts to water supplies for fish and wildlife purposes both before and after mitigation. The statute does not limit affects based on significance. The proposed project and its alternatives are in violation of the CVPIA Section 3405(a).

Response
Section 1.3.1 summarizes CVPIA requirements, and has been revised to clarify that the CVPIA does specify that significant effects should be avoided. CVPIA Section 3405(a)(L) includes the following: "The Secretary shall not approve a transfer if the Secretary determines, consistent with paragraph 3405(a)(2) of this title, that such transfer would result in a significant reduction in the quantity or decrease in the quality of water supplies currently used for fish and wildlife purposes, unless the Secretary determines pursuant to finding setting forth the basis for such determination that such adverse effects would be more than offset by the benefits of the proposed transfer."

Comment LA12-50

Comment
Pg 1-11, 1.3.1.2, -"The biological opinion concluded that continued long term operations of the CVP and SWP, as proposed, were "likely to jeopardize" the continued existence of delta smelt without further flow conditions in the Delta for their protection and the protection of designated delta smelt critical habitat." As identified in other comments, reverse Old and Middle River flow limitations, X2 and net delta outflow requirements of the FWS OCAP BO RPAs have (theoretically) been implemented, but other required RPAs such as restoration of delta smelt habitat have not been implemented and are obviously not on schedule for compliance. FWS OCAP BO Action 6, "A program to create or restore a minimum of 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh shall be implemented." "The restoration efforts shall begin within 12 months of signature of this biological opinion and be completed within a 10 year period." Reclamation and DWR do not appear to have met this requirement in that they have not completed project specific designs for these actions, started project specific EIS/R environmental documents or initiated the permitting or contracting processes to implement this action that is required to be implemented by 2018. Since Reclamation and

DWR have failed to implement this RPA, then the species are still in jeopardy and the proposed water transfers would only further exacerbate the conditions that led to the original FWS jeopardy opinion.

Response

Reclamation and DWR are working cooperatively with the USFWS and NOAA Fisheries to implement the RPAs. Reclamation and DWR submit annual reports to show progress and status. The existing biological opinions currently govern operations of the CVP and SWP. Water transfers comply with the existing regulatory framework. See Common Response 14.

Comment LA12-51

Comment

Pg 1-11, 1.3.1.2,- "The USFWS developed a Reasonable and Prudent Alternative (RPA) aimed at protecting delta smelt, improving and restoring habitat, and monitoring and reporting results." Reclamation and DWR have not implemented and complied with many of these RPAs and have missed the deadlines for submitting plans, reports, implementations and accomplishing the specific goals of most of the RPAs. Since DWR and Reclamation have not implemented most of the protections that were designed to protect the ESA listed species for jeopardy, the proposed water transfers will only add to and exacerbate the impact of the CVP and SWP operations on those species, which could only result in further jeopardy to these species.

Response

See response to Comment LA12-50.

Comment LA12-52

Comment

Pg 1-11, 1.3.1.2, - "(NOAA Fisheries 2009). This biological opinion concluded that continued long term operations of the CVP and SWP, as proposed, were "likely to jeopardize" the continued existence of Sacramento River winter run Chinook salmon, Central Valley spring run Chinook salmon, Central Valley steelhead, and the southern Distinct Population Segment of North American green sturgeon and were "likely to destroy or adversely modify" designated or proposed critical habitat of these species. NOAA Fisheries also concluded that CVP and SWP operation both "directly altered the hydrodynamics of the Sacramento-San Joaquin River basins and have interacted with other activities affecting the Delta to create an altered environment that adversely influences salmonid and green sturgeon population dynamics." The biological opinion identified an RPA to address these issues and protect anadromous fish species." Reclamation and DWR have not implemented and complied with many of these RPAs and have missed the deadlines for submitting plans, reports, implementations and accomplishing the specific goals of most of the RPAs. Since DWR and Reclamation have not implemented most of the protections that were designed to protect the ESA listed species for jeopardy, the proposed water transfers will only add to and exacerbate the impact of the CVP and SWP operations on those species, which could only result in further jeopardy to these species.

Response
See response to Comment LA12-50.

Comment LA12-53

Comment
Pg 1-12, 1.3.1.2,- "The Opinions included the following operational parameters applicable to water transfers: A maximum amount of water transfers is 600,000 AF per year in dry and critical dry years. For all other year types, the maximum transfer amount is up to 360,000 AF." This EIS/R statement is incorrect with regard to the NMFS BO.

Response
Text has been revised relative to transfer amounts allowable under the NOAA Fisheries biological opinion. In dry years following critical years and in dry years following dry years, the maximum transfer amount is also up to 600,000 AF (NOAA Fisheries Biological Opinion on the Long-Term Operations of the CVP and SWP, Appendix A p. 126-127).

Comment LA12-54

Comment
Pg 1-12, 1.3.1.2,- "Transfer water will be conveyed through DWR's Harvey O. Banks (Banks) Pumping Plant or Jones Pumping Plant during July through September unless Reclamation and/or DWR consult with the fisheries agencies." The operations of the proposed project may not be altered from what is proposed, analyzed and disclosed in this environmental document or the modification of the BOs must be subjected to subsequent piecemealed environmental analysis of altered impacts.

Response
The range of potential water transfers through the Delta evaluated under the Proposed Action and alternatives would occur from July through September. See response to Comment LA12-83. The cited text has been revised for clarity.

Comment LA12-55

Comment
Pg 1-12, 1.3.2,- "Several sections of the California Water Code provide the SWRCB with the authority to approve transfers of water involving post-1914 water rights." Since almost exclusively post-1914 water rights would be transferred under the proposed project, all of the applicable SWRCB and

CVRWQCB codes must be disclosed. Reference to and compliance with the applicable Basin Plans must be evaluated in the EIS/EIR.

Response
The subsequent sections (Sections 1.3.2.1 through 1.3.2.5) describe the sections of the Water Code. Compliance with Basin Plans is assessed in Section 3.2.

Comment LA12-56

Comment
Pg 1-12, 1.3.2,- "Section 1725 defines consumptively used water as "the amount of water which has been consumed through use by evapotranspiration, has percolated underground, or has been otherwise removed from use in the downstream water supply as a result of direct diversion." Evapotranspiration is defined as "the sum of evaporation and plant transpiration from the Earth's land and ocean surface to the atmosphere. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and waterbodies." (Wikipedia) When crops are reported by the universities on their total consumptive use to complete a crop cycle, these water use calculations include the water that is resident in the soil profile at planting from natural precipitation and precipitation that occurs during the crop growth cycle. The EIS/R analysis appears to take credit for saving the entire consumptive use of a crop as estimated by the universities. The project fails to take into account in their water savings calculations that a significant fraction of the water consumption for a crop is not saved by simply not planting the crop. Soil and water surface evaporation from precipitation still occurs even if the crop is not there. A certain amount of precipitation that falls is leached below the soil root zone and is lost to groundwater and that occurs if the crop is planted or not. The proposed project and the EIS/R analysis has made an error in taking credit for water saved for the entire evapotranspiration attributed to a crop when the fallowing of a field (provided it is kept free of vegetation) only saves the crop "transpiration" component of the water consumption attributed to a crop, not the "evaporation" component of water consumption that happens whether the crop is planted or not. The water savings credited for water transfer used by the project for "crop idling" and "crop shifting" are wrong and must be corrected to reflect the continued loss of water through evaporation and natural percolation to groundwater. Even the amount of groundwater substitution actually occurring from foregone surface water diversions is wrong in the EIS/R because of the mistaken project use of the entire evapotranspiration associated with a crop. Only the irrigation component of the crop's total evapotranspiration reported by the university would be saved by the groundwater conjunctive use. The natural precipitation component of the universities reported crop consumptive use would not be saved by the groundwater substitution and cannot be credited to water savings for water transfers as the EIS/R water accounting has proposed. This significant error in the water savings from crop idling, crop shifting and groundwater conjunctive use distorts the analysis and minimizes the impacts to ground and surface water.

Response

The transfers do not take credit for the entire evapotranspiration of the crop. Water available for transfer by cropland idling transfers is only the evapotranspiration of applied water (ETAW), which is the portion of applied surface water that is used by the crop and evaporated from the soil and plant surfaces. The portion of the crop evapotranspiration met by precipitation during the growing season or stored as soil moisture within the root zone before the growing season does not qualify as transferable water. ETAW does not include either applied water lost as deep percolation to groundwater or conveyance losses. Unless the acreage overlies an unusable groundwater basin or discharges to a saline sink, these depletions contribute to the overall water supply and are excluded from the calculation of transferable water.

Comment LA12-57

Comment

Pg 1-18, 1.5,- "Alternatives considered in this EIS/EIR only analyze transfers of to CVP contractors that require use of CVP or SWP facilities. SWP contractors may also transfer water originating north of the Delta to areas south of the Delta. The cumulative analysis evaluates potential SWP transfers, but they are not part of the action alternatives for this EIS/EIR." As a result of this statement and how the alternatives have been formulated and analyzed, no SWP contractor can sell water to the project proponents regardless of whether they use CVP or SWP conveyance to deliver it; Only sales of or from CVP contractors that are delivered through the CVP or SWP to the project proponents are covered by this EIS/R or any agency decisions or permits that are issued based on this EIS/R.

Response

This EIS/EIR analyzes a range of potential transfers to CVP contractors. These transfers could originate from the sellers included in Table 2-4. Some of the sellers are CVP contractors, some are SWP contractors, and some are independent entities. The language on page 1-18 was clarified to indicate transfers to SWP contractors are not analyzed in this EIS/EIR, but transfers from SWP contractors listed in Table 2-4 to CVP contractors are included.

Comment LA12-58

Comment

Pg 1-18, 1.5,- "Buyers and sellers must prepare transfer proposals for submission to Reclamation. Proposals must also be submitted to DWR if the transfers require use of DWR facilities or the transfers involve a seller with a settlement agreement with DWR." The EIS/R fails to define what information must be included with the transfer proposal.

Response
This section was clarified to include additional information regarding specific transfer proposals. See Common Response 14.

Comment LA12-59

Comment
Pg 1-18, 1.5,- "Reclamation reviews transfer proposals to ensure they are in accordance with NEPA, CVPIA, and California State law." This statement fails to include that Reclamation must also consider Warren Act Contract requirements when federal facilities are wheeling nonfederal water (seller or buyer) through federal facilities. A Warren Act Contract Water Wheeling Assessment is required for any non-federal water from either transfer source or recipient that uses any CVP facility. This would appear to include use of San Luis Reservoir even if only SWP conveyance was used.

Response
Clarifying text has been added to this section.

Comment LA12-60

Comment
Pg 1-18, 1.5, - "DWR may also be involved in conveying water for transfers and is interested in verifying that water made available for transfers does not compromise SWP water supplies. For water conveyed through the SWP system, DWR must also determine if the transfer can be made without injuring any legal user of water and without unreasonably affecting fish, wildlife, or other instream beneficial uses and without unreasonably affecting the overall economy or environment of the county from which the water is being transferred." It should be made clear that DWR will be required to develop and approve a separate environmental document for any water transfers that use SWP facilities. San Luis Reservoir is a joint SWP facility so use of these facilities, even if other SWP facilities or water are not involved, should result in the requirement of a separate environmental document from DWR.

Response
As discussed in Section 1.5, DWR is a Responsible Agency under CEQA for the range of potential activities analyzed in the Draft EIS/EIR, and may choose to use this EIS/EIR if environmental analysis is necessary for transfer-related decisions the agency considers. See Common Response 14.

Comment LA12-61

Comment
Pg 1-18, 1.6, -The EIS/R omitted that if the project proposes to use SWP facilities DWR has decisions it must make. DWR must decide if there is available capacity, if they will conduct the transfer, and they do decide to do the

transfer, they must do an EIS/EIR as the SWP transfers are not covered under the proposed project or any of the project alternatives (see EIS/R section 1.5 and the related comment).

Response
See responses to Comments LA12-57 and LA12-60.

Comment LA12-62

Comment
Pg 2-4, Table 2-1- Ag conservation in the Buyer Service Area was inaccurately screened. Some types of ag conservation can be immediate, as an example, crop switching and improvements in irrigation scheduling or irrigation system distribution uniformity. Some ag conservation can be nearly immediate, such as improvements to irrigation systems to more water efficient types, e.g. sub-surface drip instead of flood furrow. Each of these ag conservation examples "provides water" for transfer within the buyer area.

Response
As described in Appendix A, Section 4.1.1, the buyers are CVP contractors and are required to implement water use efficiency best management practices, as required by the Central Valley Project Improvement Act Section 3405(e). The Agricultural Conservation (Buyer Service Area) Alternative would implement water use efficiency measures above and beyond those already being implemented; additional measures would generally require substantial infrastructure and investment and would not be immediately implementable. This alternative was also not analyzed in more detail in the EIS/EIR because it would not provide additional water to the water users affected by CVP shortages.

Comment LA12-63

Comment
Pg 2-4, Table 2-1- The alternatives considered failed to include: Increase water conservation for municipal and industrial uses in Seller Service Area to reduce water demands. It would have provided immediate and flexible water supplies as the buyer service area alternative concept to this option determined, but also would have provided water.

Response
Measures in the seller service area are driven by potential sellers; if no sellers want to participate, the measure is not feasible. No sellers proposed municipal and industrial water conservation in the seller service area to make water available for transfer.

Comment LA12-64

Comment
Pg 2-4, Table 2-1- The determination that reuse of water for ag was not possible for immediate implementation does not appear supportable. This option requires more full investigation for feasibility and consideration in a fair and evenly applied alternatives screening process.

Response
This alternative was analyzed in more detail in Appendix A. As described in Section 4.1.7 of Appendix A, agricultural reuse of water requires the development of infrastructure that would not be immediately implementable.

Comment LA12-65

Comment
Pg 2-4, Table 2-1- Permanent land retirement could be immediate and provides water. It seems a logical compliment to the other concepts of fallowing and crop switching. Permanently retiring marginal farmland has less of an impact than fallowing productive ground. Permanent retirement of land would allow that land to be restored to wildlife habitat. There is no significant habitat value to the fallowed field kept free of vegetation as compared to one that is farmed or one that is permanently retired. Retiring land in the buyer service area is part of the No Action/No Project, including additional permanent land retirement in the buyer area should be part of one of the project alternatives.

Response
As described in Appendix A, Section 4.1.10, land retirement under other efforts has taken many years and has not been found to be an immediately implementable option. Additionally, it would not reduce the environmental effects of cropland idling or crop shifting transfers because it would be a permanent change. A permanent change to these farmlands would have long-term effects to the local economies, farmworkers, land use, and agricultural resources.

Comment LA12-66

Comment
Pg 2-4, Table 2-1- Purchasing water entitlements in the Buyer area is as immediate and creates just as much water as the proposed project long term water transfers. This alternative concept must be fully evaluated in the revised EIS/R.

Response
The concept of purchasing surface water entitlements was considered in the EIS/EIR as part of the Water Rights Purchase Alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it

did not meet the key elements of the purpose and need or basic project objectives, as it would not be immediate and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment LA12-67

Comment
Pg 2-4, Table 2-1- Groundwater substitution should equally apply to the buyer area in the project alternatives.

Response
The concept of groundwater substitution transfers within the buyer area was considered in the EIS/EIR as part of the Transfers within Buyer Service Area Alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need/basic project objectives because it would not provide additional water to water users that face CVP shortages. See Appendix A for more details on the screening of this alternative.

Comment LA12-68

Comment
Pg 2-4, Table 2-1-The characterization that not applying rice decomposition water does not result in saving (providing) water is unsupportable. Approximately 350,000 acres of rice is flooded for rice straw decomposition (http://www.arb.ca.gov/cc/capandtrade/protocols/rice/pbcs-12-20-13.pdf) and this flooding consumes approximately 175,00AF of water. There are several viable alternatives to applying rice decomposition water including rice straw baling and application of inputs to speed rice stubble decomposition. There are commercially available agricultural inputs that are designed to speed crop residue decomposition (https://www.soiltechcorp.com/product/stubble-digest/, http://www.midwestbioman.com/biocat.htm). Rice straw decomposition loads can be significantly reduced by baling and removing the rice straw (http://calrice.org/pdf/Sustainability+Report.pdf) and is used for erosion control (water quality benefits), cattle feed and power cogeneration (greenhouse gas emission benefit). The best part about this water conservation option (other than the fact it is immediate, flexible and provides water) is that the impacts are beneficial on the local communities by actually increasing the number of jobs rather than destroying them as crop idling does. This project alternative is too good of an opportunity not to be included as an alternative and must be included in the revised EIS/R.

Response
The Rice Decomposition Water Alternative was considered in the EIS/EIR (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives, as it would not provide additional water to water users

that face CVP shortages. The rice decomposition water would not be available during the period when users need the water because it would not be available until after the rice harvest. Additionally, this alternative would not reduce environmental effects because the flooded rice fields are a valuable resource for migratory waterfowl in the Central Valley. See Appendix A for more details on the screening of this alternative.

Comment LA12-69

Comment
Pg 2-4, Table 2-1-Transfer of water stored in CVP or SWP reservoirs should be considered?

Response
Water stored in CVP or SWP reservoirs is part of the CVP or SWP allocation in each year. That water is earmarked to meet allocations under CVP and SWP processes, and transferring that water would reduce supplies to a CVP or SWP contractor. This would not meet the purpose and need or basic project objectives in the EIS/EIR.

Comment LA12-70

Comment
Pg 2-4, Table 2-1-Transfer of water within a buyer area provides water. This alternative and transfers from areas of the State other than upstream of the Delta should be analyzed.

Response
Appendix A further describes the alternatives development process and explains the reasons for the determinations regarding whether alternatives should be carried forward for more detailed analysis. The Transfers within Buyer Service Area Alternative was not carried forward for additional analysis because it would not provide additional water to the buyer service area. As described in Chapter 2 of the EIS/EIR, transfers would occur only in dry and critical years when CVP contractors have demand for water and conveyance capacity is available to move the water through the Delta. While CVP contractors currently engage in in-basin transfers to try to flexibly manage shortages, in-basin transfers do not bring additional water into the area and the CVP contractors would continue to face shortages.

Comment LA12-71

Comment
Pg 2-4, Table 2-1-Developing groundwater wells within a buyer service area provides water and implementing them is fairly immediate. This alternative should be analyzed.

Response
Appendix A further describes the alternatives development process and explains the reasons for the determinations regarding whether alternatives should be carried forward for more detailed analysis. The Groundwater Development Alternative was not carried forward for additional analysis because planning, designing, and installing new wells and conveyance systems would not be an immediate action. Additionally, new groundwater development would not provide a substantial supply because groundwater levels in the buyer service area have declined in response to previous dry years and they typically do not recover without additional recharge.

Comment LA12-72

Comment
Pg 2-4, Table 2-1- The EIS/R must include an alternative that includes continuation of one year transfers.

Response
The EIS/EIR analyzes impacts from a range of potential water transfers, and these transfers could be single-year or multi-year agreements (see Section 2.3.2.7). The environmental impacts do not differ if the transfers are a series of single-year transfers or multi-year transfer agreements; therefore, this alternative is not different from the range of potential activities evaluated under the Proposed Action and alternatives.

Comment LA12-73

Comment
Pg 2-7, 2.3.1, - The No Action/Project should have included the assumption that single year water transfers would still have occurred absent the proposed project. The lack of the implementation of the proposed project or alternatives does not preclude these single year transfers so the project analysis must be revised to correct the current flawed baseline assumption.

Response
The purpose of the No Action/No Project Alternative is to investigate conditions that would occur if the Proposed Action/Proposed Project does not move forward. Including the same action as part of the No Action/No Project Alternative, but assuming it would go through a separate environmental compliance effort, is not consistent with direction under CEQA and NEPA (as described in Section 2.3.1). See Common Response 14.

Comment LA12-74

Comment
Pg 2-9, 2.3.2.1, -"A similar case regarding the NOAA Fisheries biological opinion is before the court. If new biological opinions are completed, the new

biological opinions or the findings of the NEPA analysis could change the quantity or timing of transfers. If the biological opinions alter the timing and quantity of transfers, the Lead Agencies will determine if supplemental environmental documentation is necessary to address any changes in potential impacts." An alternative for continuing with short term transfers should be included.

Response
This text has been updated because the findings have been issued related to this court case. The USFWS and NOAA Fisheries Biological Opinions on the Long-Term Operations of the CVP and SWP will remain in place and will guide operations of potential water transfer activities.

Comment LA12-75

Comment
Pg 2-11, Figure 2-3- The figure shows water transfers starting approximately May- June (when the lines are diverging), but the FWS OCAP BO only allows transfers from July- September.

Response
Figure 2-3 is schematic and does not specify a date when reservoir release transfers would begin. Table 2-5 specifies the reservoir release transfers would occur from July through September.

Comment LA12-76

Comment
Pg 2-11, 2.3.2.1,- "The seller could request that Reclamation store the non-CVP water in the CVP reservoir until Delta capacity is available, which would require contractual approval in accordance with the Warren Act of 1911." This statement indicates, as an example, that PCWA could sell water from its' reservoir, PCWA would release the water when they needed to into their tributary, Reclamation would release less water from Shasta into the Sacramento River during the PCWA release and make the saved Shasta reservoir water available for transfer for the project later in the season. There are multiple fisheries impacts in both tributaries and downstream of them from these interbasin proposed changes in water operations. These inter-basin operational changes to proposed project impacts include changes to water temperature suitability for coldwater fisheries resulting in adverse modification of critical habitat for ESA species, increased fish mortality and reduced fecundity; altered attraction flows and water temperatures for migrating fish causing straying which in turn increases redd superimposition, prespawn mortality, reduced fecundity, egg mortality and genetic introgression. These are all serious significant impacts to endangered species that the EIS/R failed to identify, evaluate, characterize, quantify, mitigate or disclose. The EIS/R must

be revised to include these impact analyses and to rectify these material deficiencies in this document.

Response
The paragraph cited in the comment begins, "Some entities that could transfer water through reservoir release are upstream of CVP reservoirs and could request to store water temporarily in the CVP reservoirs." This sentence clarifies the subsequent sentence by explaining that this storage would only occur in downstream reservoirs. Therefore, the example cited with Placer County WA storing water in Shasta Reservoir could not occur; releases from Placer County WA would only have the potential to be stored in Folsom Reservoir. Water released in a reservoir release transfer would be water that would have remained in the reservoir absent the transfer. Moving this water from storage in upstream Placer County WA reservoirs into Folsom Reservoir would not alter river flows downstream of Folsom Reservoir during the transfer period. Flows could be affected during reservoir refill, and these potential effects are analyzed throughout the EIS/EIR.

Comment LA12-77

Comment
Pg 2-12, Table 2-3- The table assumes that the amount of water saved for each crop is the same regardless if the crop is idled or it is shifted to another crop. If the field is shifted to another crop it will consume moisture from the soil profile and any precipitation that occurs even if it is not actively irrigated. The water savings for shifting a crop is not the same as for idling a crop.

Response
The table shows Estimated ETAW Values for Various Crops Suitable for Idling or Shifting. The crop shifting description below the table further states, "the difference in the accepted ETAW values between the two crops would be the amount of water that can be transferred." This does not state that cropland idling and shifting result in the same amount of water that can be transferred.

Comment LA12-78

Comment
Pg 2-12, Table 2-3- The proposed project plan of crop shifting is fatally flawed for its vulnerability to gaming by the sellers. There is nothing in the proposed project to assure that real water savings will be realized by crop shifting.

Response
Reclamation and DWR have measures in place in their water transfers approval process to ensure that the correct amount of water is transferred and it is "real" water. See Common Response 14.

Comment LA12-79

Comment
Pg 2-12, 2.3.2.1,- "To calculate water available from crop shifting, agencies would estimate what would have happened absent a transfer using an average water use over a consecutive five-year baseline period." The proposed project and the EIS/R analysis fail to provide any reasonable assurances that real water savings will occur to offset these proposed transfers.

Response
See response to Comment LA12-78.

Comment LA12-80

Comment
Pg 2-13, 2.3.2.2, -"Modeling analysis indicates that using hydrology from 1970-2003, transfers could occur in 12 of the 33 years." The project description, analysis and range of permit conditions should be limited to the same type of water years used for the analysis.

Response
See Common Response 5.

Comment LA12-81

Comment
Pg 2-13, 2.3.2.2,- "Sellers that are not specifically listed in this document may be able to sell water to the buyers as long as: the water that is made available occurs in the same water shed or ground water basin analyzed in this EIS/EIR,... " Unless included within the scope of this EIS/R this would lead to piece-mealing project impacts. Also, New Melones Reservoir and the Stanislaus River were not included in the Areas of Analysis so according to this declaration in the EIS/R, no water from this basin can be included in future water transfers under this project.

Response
Transfers would need to be of a smaller total size than what is analyzed here in order to be within the scope of the EIS/EIR, and the impacts of the transfers would have to be encompassed within the analysis in this EIS/EIR. If transfers that are materially different from those described in this EIS/EIR are later proposed and could result in impacts outside of those analyzed in the EIS/EIR, those transfers would require additional environmental documentation. Transfers from the Stanislaus River or New Melones Reservoir are not analyzed in this EIS/EIR and would require additional environmental documentation if any such transfers were proposed.

Comment LA12-82

Comment

Pg 2-14, Figure 2-4- Water transferred from Merced Irrigation District would have to flow down the San Joaquin River and other channels prior to being diverted by the CVP or SWP pumps in the south Delta or their diversions. The EIS/R analysis did not take into account the amount of that water lost in transit. Evaporative losses and losses to groundwater are likely significant. This type of water loss in the transfer process is also true of all of the other water transfers to varying degrees depending on locations, transit path and times of year. As a result of the flawed assumptions of the EIS/R analysis, the project proposes to divert much more water than would actually be saved and understates the reduction in available water supply for other needs and the related impacts. As a result of the project taking too much credit for the amount of water transferred, the project would actually result in a net deficit of water in the delta and tributaries rather than the neutral flow impact the project analysis claims in the EIS/R. The impacts were not adequately identified, characterized, evaluated, quantified, mitigated or disclosed in the EIS/R. The EIS/R is flawed in its water conveyance loss assumptions and therefore deficient in its analysis and disclosure and must be revised. Attached is a copy of the May 24, 2013 letter from the USBR and DWR to Tom Howard attempting to justify the April 28,2013 violation of the D-1641 salinity objective at Emmaton. The letter highlights a dramatic increase in overall rates of depletion to reservoir releases which was simply not anticipated by project operators and is extreme from a historical perspective". The analysis for the EIS/R is based on the same project operator modeling as was used in the flawed 2013 project operations. Although diversions for rice cultivation were cited the impact of water transfers, depletions of streamflow due to groundwater pumping and interception of accretions to streamflow in the dry year are likely. The models used for the analysis should be subjected to peer review corrections made and the analysis revised accordingly.

Response

Water losses during conveyance would be captured in the "carriage water" calculation. Section 2.3.2.4 includes a description of carriage water that focuses on water used to maintain water quality through Delta outflow. This explanation has been clarified to indicate it also includes instream losses. Carriage water is estimated to be 10 percent for San Joaquin River transfers, but this percentage is updated based on monitoring and modeling efforts during the transfer that estimate real-time conditions.

Comment LA12-83

Comment

Pg 2-16, Table 2-5- FWS OCAP BO pg 229, p1, "Although transfers can occur at any time of year, the exports for transfers described in this assessment would occur only in the months July-September." The analysis conducted in the FWS

OCAP BO only addresses water transfers from July through September. Water transfers at any other time of year are not covered in the FWS OCAP BO, so the proposed project transfers in April- June are not covered under the current FWS OCAP Biological Opinion and are therefore not covered under the current CVP/SWP incidental take permits. Water transfers for any months outside of July-September must require additional ESA consultation with FWS.

Response
Transfer water would only be made available in April, May, and June if it can be stored until transfer capacity is available in the Delta during July, August, and September (as explained on page 2-13). Water would only be transferred through the Delta at times that are consistent with the biological opinions on the coordinated operations of the CVP and SWP.

Comment LA12-84

Comment
Pg 2-16, Table 2-5- The reason that the water transfers covered under the FWS OCAP BO only covered July- September is that "Delta smelt are rarely present in the Delta in these months, so no increase in salvage due to water transfers during these months is anticipated, but as described above, these transfers might affect delta smelt prey availability." (FWS OCAP BO pg 229, p1). So water transfers that occur outside of those months, such as the April- June transfers in the proposed project, would result in take as smelt would be present at the pumps. The transfer impacts analyzed and approved in the FWS OACP BO specifically do not include the impacts that would occur from transfers during these other months. The Proposed Project and alternative must be revised to omit the April- June transfers or the project must seek ESA consultation with FWS for a Biological Opinion and incidental take permits that covers the impacts to delta smelt that would occur with water transfers in those months.

Response
See response to Comment LA12-83.

Comment LA12-85

Comment
Pg 2-18, 2.3.2.3,- "Delta conveyance capacity would be available when conditions for sensitive species are acceptable to NOAA Fisheries and USFWS, typically from July through September, but groundwater substitution and cropland idling/crop shifting transfers would be available from April through September." If the south delta pumps of the CVP or SWP are used in the April through June water transfers, regardless of the source or type of water credit being taken as the justification for the transfer, they will result in additional levels of ESA species take that was not covered under the FWS OCAP BO and therefore would require a new ESA consultation with FWS in order to occur.

Appropriate environmental analysis for any changes would be required and should be a part of the EIS/R.

Response
See response to Comment LA12-83.

Comment LA12-86

Comment
Pg 2-18, 2.3.2.3,- "Reclamation would only consider storing water for transfers if it would not affect releases for temperature, or if it could be "backed up" into another reservoir (by reducing releases from that reservoir). Backing up water may be possible if the Delta is in balanced conditions and instream standards are met. The decision to back up transfer water would be made on a case-by-case basis, but storage is analyzed in this EIS/EIR so that the analysis is complete in the event Reclamation determines that storage is possible in a specific year." Backing up transfers "into another reservoir by reducing releases from that reservoir" results in complex and significant fisheries impacts from water being released in one tributary at one time vs. a different tributary at a later time. In order for the permits based on this EIS/R to cover this proposed mode of operation of the proposed project, the analysis conducted in this EIS/R must cover the full range of operations proposed to be covered by this document and implemented by the project. The EIS/R claims an analysis of storing water in Shasta was conducted. Analyses for other affected reservoirs must also be conducted.

Response
The text cited in this document is from the section describing transfers on the Sacramento River, where water could potentially be stored in Shasta Reservoir. The subsequent sections identify the potential for American River transfers to be stored in Folsom Reservoir and Feather River transfers to be stored in Lake Oroville. These actions are analyzed in the EIS/EIR.

Comment LA12-87

Comment
Pg 2-18, 2.3.2.3,- "Sacramento River sellers and buyers would generally prefer water transfer options that are more flexible, such as starting groundwater substitution pumping when Delta pumping capacity for transfers is available." The analysis is inadequate to include the broad range of impacts associated with such flexibility.

Response
The flexibility described would reduce the potential impacts of transfers analyzed in this EIS/EIR. The EIS/EIR analyzes cropland idling transfers and groundwater substitution transfers as if they make water available during the full irrigation season of April through September. In many transfer years,

storage would not be available for water made available in April, May, and June. In these years, cropland idling transfers cannot be operated to make water available only from July through September because cropland must be idled for the full irrigation season. Water made available from April through June could not be exported in the Delta and the buyers would receive only a small portion of the transfer water made available. Groundwater substitution transfers could be operated for a shorter period, however, which would reduce potential impacts from those described in the EIS/EIR. This flexibility would reduce environmental impacts rather than increase them.

Comment LA12-88

Comment
Pg 2-18, 2.3.2.3,- "Proposed sellers divert water from various locations along the Sacramento River or the Sutter Bypass." The interrelationship of ground and surface water in the seller areas is obvious and difficult to analyze and monitor. After the fact monitoring does not avoid the impact. The groundwater substitution alternative should be rejected.

Response
The impacts to groundwater levels, quality, and subsidence are analyzed in Section 3.3. Interrelated impacts to other resources (surface water supply, vegetation and wildlife, fisheries, recreation, flood control, etc.) are also analyzed in Section 3. The identified impacts to these resources will provide information to decision-makers when choosing an alternative to implement.

Comment LA12-89

Comment
Pg 2-22, 2.3.2.3,- "The Canal experienced substantial losses during conveyance to vegetation along the Canal system. The conservation project replaced the Canal with a pipeline and reduced associated losses to vegetation, thereby creating water for transfers." Reducing vegetation is a critical factor in meaningful water savings. The EIS/R failed to identify, characterize, evaluate, quantify, mitigate or disclose any special status plants, fish or animal species that will be affected by the removal of this water source at the current leaks. Leaks could result in habitat supporting wetland plant communities and associated species. The project failed to mitigate for the wetland habitat that will be destroyed from fixing these leaks. Water from these leaks also would have contributed to adjacent stream flows which provide habitat for yellow and red legged frog, tiger salamander, and steelhead. In addition to the ESA species consultation with the fisheries and wildlife agencies for this action, the project also will need streambed alteration agreements, wetlands alteration, etc. from DFG, USACE and others.

Response
As described on page 2-22, the action to replace the canal with a pipeline to make water available for transfers has already taken place; therefore, the existing conditions, No Action/No Project Alternative, and action alternatives have the same conditions in these areas. This EIS/EIR is analyzing the potential impacts of conveying the water to potential transfer buyers.

Comment LA12-90

Comment
Pg 2-22, 2.3.2.3,- "Cordua ID would transfer water made available through groundwater substitution actions. This transfer would increase flows on the Yuba River downstream of Cordua ID's point of diversion (absent the transfer) during the transfer period." Groundwater and surface water interact. Groundwater wells, especially those physically located in proximity to a tributary, are hydraulically connected to the surface water. When a groundwater cone of depression intersects groundwater maintained by tributary surface flows, the cone of depression increases the rate of loss of surface flows to groundwater and bank recharge. In order to determine the actual increase in surface flows from the foregone diversion of surface water in favor of groundwater use, the location of each groundwater well and its situational relationship to surface water hydraulics must be analyzed. Irrigation district well fields tend to be in locations that are near their surface water diversion locations because the infrastructure to convey the surface water was there first and is required in order to deliver the pumped groundwater. This proximity of irrigation well fields being in proximity to irrigation surface water diversions was well documented in the Sacramento Valley Regional Water Plan "Phase 8" environmental document. This comment and criticism of the incompleteness of the EIS/R analysis of groundwater substitution impacts on surface water flows applies to all of the proposed groundwater substitutions included in the proposed project and alternatives. This deficiency and undisclosed impacts must be corrected in the revised EIS/R. Similarly the overall lowering of the groundwater even from pumping long distances from the rivers and streams will increase losses from the surface flow.

Response
The potential streamflow depletion associated with groundwater substitution transfers was analyzed using CalSim, the SACFEM2013 groundwater model, and the Transfers Operations Model. The models used the well location, depth, and pumping rate to assess potential impacts to groundwater and surface water and the resources that depend on them. The linked models are described in more detail in Appendices B and D.

Comment LA12-91

Comment
Pg 2-26, Figure 2-8- "Water could flow down the Merced River into the San Joaquin River and be diverted through existing facilities within Banta Carbona ID, West Stanislaus ID, or Patterson ID (see Figure 2-8)." The NMFS and FWS OCAP BO analysis does not address this type of operation or these diversion locations for these purposes so the incidental take permits based on those BOs do not cover these operations.

Response
The Long-Term Water Transfers EIS/EIR provides analysis of potential environmental impacts to satisfy requirements of CEQA and NEPA associated with diverting water at these facilities. If necessary, incidental take at these diversion locations would be covered under the existing biological opinions for these facilities. If the existing biological opinions do not provide coverage, new biological opinions would be required.

Comment LA12-92

Comment
Pg 2-29, 2.3.2.4- A number of assurances are missing from this list.

- There must be assurances that the project changes in relative flows and water temperatures for all tributaries affected by earlier or later releases and increased or decreased tributary flows do not adversely affect migratory fish. Changes in flow proportions or relative water temperatures at a tributary confluence can increase salmonid straying. Straying causes increased competition for holding and spawning habitat and associated prespawn mortality and reduction of fecundity; redd superimposition and associated egg mortality and genetic introgression result in a loss of productivity and reductions in the genetic integrity and diversity of the species.

- There must be an environmental commitment to use the stored water to protect water quality to be compliant with all water quality standards prior to any water transfer water being delivered. DWR and Reclamation routinely deliver SWP and CVP water while concurrently violating water quality requirements, including adverse modification of critical habitat for ESA listed species, e.g. dissolved oxygen deficiency in delta smelt critical habitat. This water transfer operation must not be allowed to deliver any water unless all water quality requirements are met and in the event that current water quality requirements are not being met by the CVP/SWP regular operations, this transfer water must be used for these water quality protection purposes first, before transfer water can be delivered.

- Since Reclamation's requirement to comply with the CVPIA is a requisite for their approval of water transfers for the project, the project should include the CVPIA 3405 (a) limitation which provides water transfers cannot "adversely affect water supplies for fish and wildlife purposes" as an environmental commitment.

Response
Section 2.3.2.4 describes key limitations on the size, location, or operations of transfers that are a part of the way transfers work. The concepts identified in this comment are mitigation for potential impacts, and would be included if the analysis in Section 3 identified significant impacts related to these measures. The analysis of impacts to fisheries (Section 3.7) did not identify significant adverse impacts to fisheries; therefore, mitigation measures were not required. The analysis of potential impacts to water quality (Section 3.2) did not identify potentially significant changes in ability to meet water quality standards compared to existing conditions or the No Action/No Project Alternative; therefore, additional mitigation was not required related to this topic.

Comment LA12-93

Comment
Pg 2-29, 2.3.2.4,- "In groundwater basins where sellers are in the same groundwater subbasin as protected aquatic habitats, such as giant garter snake preserves and conservation banks, groundwater substitution will be allowed as part of the long term water transfers if the seller can demonstrate that any impacts to water resources needed for special-status species protection have been addressed. In these areas, sellers will be required to address these impacts as part of their mitigation plan." There are no sub-basins in the proposed seller areas that do not contain protected aquatic habitats. This commitment must be expanded to include all protected habitats that may be affected by the water transfers. Not all special status species are in aquatic habitat. As a very real example of a proposed project impact, the repair of the pipeline as a conservation action will impair habitat for red and or yellow legged frog. A protected aquatic habitat not only includes preserves or conservation banks, but also critical habitat as designated by the ESA. There are no seller area sub-basins that do not have any ESA designated critical habitat so all of the sellers must address these impacts as part of their mitigation plan. These mitigation plans must be part of and disclosed in this EIS/R unless these will be addressed in a separate EIS/R prepared by the sellers as part of their ESA consultation process. To avoid piecemealing the analyses should be included in this document.

Response
Potential impacts to special-status terrestrial species are analyzed in Section 3.8. As discussed in response to Comment LA12-89, the conservation action would not include any construction and would not affect terrestrial species.

Comment LA12-94

Comment
Pg 2-29, 2.3.2.4- "Carriage water (a portion of the transfer that is not diverted in the Delta and becomes Delta outflow) will be used to maintain water quality in the Delta." The analyses must include a defensible calculation of the quantity of the transferred water that actually reaches the delta to contribute to transfers and delta water quality. There are surface water evaporation losses, and loss to groundwater percolation and interception of accretions that must be accounted for that the EIS/R analysis has overlooked. Each potential water conveyance route, with its associated loss rates for the time period of the water transfer must be accounted for in the EIS/R analysis. The EIS/R must be revised to address this material deficiency.

Response
This environmental commitment has been clarified to indicate that it also includes conveyance losses between the water source and the Delta.

Comment LA12-95

Comment
Pg 2-29, 2.3.2.4, -"As part of the approval process for long-term water transfers, Reclamation will have access to the land to verify how the water transfer is being made available and to verify that actions to protect the giant garter snake are being implemented." Access to land does not assure compliance. Monitoring must be by a party without conflict, there must be a real enforcement mechanism and there must be funding for the enforcement effort.. Such assurances are not provided.

Response
This measure indicates that Reclamation would verify that actions to protect the giant garter snake are being implemented.

Comment LA12-96

Comment
P 2-31, 2.3.2.5, - East Bay MUD and Contra Costa WD should have been Lead Agencies as this EIS/R document will inform them for their decision on if to approve this document and to participate in the water transfer program.

Response
See Common Responses 1 and 9. East Bay Municipal Utility District (MUD) and Contra Costa WD have indicated that they would complete separate CEQA documentation (as described in Section 2.3.2.8); therefore, they are not suitable as the CEQA lead agency. SLDMWA has prime responsibility for most of the potential transfer activities described in this EIS/EIR.

Comment LA12-97

Comment
Pg 2-31, 2.3.2.5, -"Transfers to East Bay MUD and Contra Costa WD are limited by available pumping capacity at the Freeport intake and Contra Costa WD's Delta intakes ... " Water diverted at Freeport does not traverse the delta and does not contribute to south delta water quality or net delta outflows.

Response
This section discusses transfer quantities and does not indicate that water diverted at Freeport would enter the Delta.

Comment LA12-98

Comment
Pg 2-34, 2.3.2.7, - "Buyers and sellers may negotiate transfers that last one year or multiple years." The project could result in some land being idled for 10 years straight. This could lead to land use designation changes fostering development or protected habitat. The possible long term impacts should be further analyzed.

Response
Under all proposed alternatives, water transfers would not occur every year. Buyers would only seek water transfers in dry and critical years and in many years, capacity would not be available at the pumps to export water through the Delta. Figure 2-10 shows that in 65 percent of the years, there would be no capacity at the pumps to convey transfer water. Further, cropland idling is the lowest priority transfer method under the Proposed Action and Alternative 3 and buyers would not purchase water from cropland idling in all years that transfers occur. Alternative 4, which includes more frequent cropland idling transfers, includes a mitigation measure to avoid the same land from being consecutively idled.

Comment LA12-99

Comment
Pg 2-39, 2.5, - "While the alternatives would affect different resources in different ways, none of the alternatives are considered to be the environmentally superior alternative. There are no unavoidable significant impacts associated with the Proposed Action that would otherwise be avoided or substantially reduced by an alternative, and each of the alternatives has its own unique set of environmental impacts which, on balance, would be a "trade-off" of environmental impacts in selecting any one alternative over another." A number of significant impacts have been ignored and missed by the EIS/R analysis. The Proposed Action (Alternative 2) is not the environmentally superior alternative. 2.5, provides "Alternative 4 would reduce effects to groundwater levels, quality, and land subsidence." Any land subsidence from

groundwater substitution is a significant impact. Alternative 2 includes groundwater substitution and land subsidence impacts, so alternative 4 is clearly environmentally superior.

Response
The commenter's assertion that the environmental analysis ignored or missed any potentially significant impact of the range of potential transfer activities evaluated under the Proposed Action is unsubstantiated. The commenter's opinion that Alternative 4 is environmentally superior is noted and will be conveyed to the decision makers for their consideration. Response to Comment NG03-139 further discusses the environmentally superior alternative.

Comment LA12-100

Comment
Pg 2-39, 2.5 - The project should have separated crop idling from crop switching in an alternative as they have very different impacts and operational requirements. Crop switch was proposed and screened as a separate conservation measure from crop idling. If crop switching were made a standalone alternative along with other conservation measures such as irrigation canal lining and leak repair, irrigation system water distribution uniformity and water efficiency improvements and irrigation scheduling water use efficiency improvements, there would have been an alternative which yielded real water for transfer, was flexible and immediate to implement. This combination of measures in an alternative would have yielded substantial water supplies with fewer environmental impacts of the other alternatives.

Response
Crop shifting and conservation are transfer methods included in the Proposed Action. These elements do not provide enough water to meet buyers' needs to be a stand-alone alternative. The transfer quantities were determined with sellers, which did not indicate a substantial amount of water available to transfer from crop shifting or conservation.

Comment LA12-101

Comment
Pg 2-40, Table 2-9, 3.2 - "Cropland idling transfers could result in increased deposition of sediment on water bodies." Some soils carry contaminants with them. This sediment deposition degrades water quality and beneficial uses. Any degradation of beneficial uses is significant for compliance with the Central Valley Regional Water Quality Control Board Basin Plan.

Response
The referenced section is a summary of the impact further described in Section 3.2.2.4. The more detailed analysis indicates that clay soil textures in counties in the seller service area reduce the likelihood of significant erosion.

Comment LA12-102

Comment
Pg 2-40, Table 2-9, 3.2 - "Cropland idling/shifting transfers could change the water quality constituents associated with leaching and runoff." The EIS/R consistently lumps the description of effects of these two very different actions together. These are separate, mutually exclusive actions to implement a piece of ground and they have very different impacts in type and magnitude. The EIS/R must separate the analysis of these two actions and disclose and mitigate their impacts separately. As an example, crop shifting would have very little erosional deposition in tributaries while crop idling may precipitate large and significant soil deposition and contamination to waterways.

Response
Additional discussion of the impacts regarding cropland idling and cropland shifting are provided in Section 3.2, where they are analyzed in separate discussions.

Comment LA12-103

Comment
Pg 2-40, Table 2-9, 3.2 - "Cropland idling/shifting transfers could change the quantity of organic carbon in waterways." Again, the impacts of these two separate and different project actions have been lumped together to obscure the impacts of each-they are not the same.

Response
See response to Comment LA12-102.

Comment LA12-104

Comment
Pg 2-40, Table 2-9, 3.3 - "Groundwater substitution transfers could cause a reduction in groundwater levels in the Seller Service Area." and "Groundwater substitution transfers could cause subsidence in the Seller Service Area." Both were determined by the EIS/R to be a significant impact. The mitigation proposed by the EIS/R is to monitor the groundwater levels and subsidence. Monitoring something does not mitigate the impact of a project, only positive action like having a specific decision threshold for ceasing groundwater pumping activities would be a mitigation. There also needs to be a mitigation plan if groundwater levels do not recover or subsidence occurs even after cessation of groundwater pumping.

Response
Table 2-9 summarizes the potential impacts and mitigation measures for the action alternatives. Mitigation Measure GW-1 is described in more detail in Section 3.3.4.1. See Common Responses 6 and 7 for additional information.

Comment LA12-105

Comment

Pg 2-45, Table 2-9, 3.9 - "Cropland idling water transfers could permanently or substantially decrease the amount of lands categorized as Prime Farmland, Farmland of Statewide Importance, or Unique Farmland under the FMMP ." The EIS/R identifies the alternative 4 impact as significant and alternative 2 as LTS. Although alternative 2 includes groundwater substitution, there is no description in the alternatives which prohibits just as much crop idling in alternative 2 as in alternative 4 so both impacts are significant. If alternative 4 results in 177,000 acres of land being fallowed and alternative 2, because it includes groundwater substitution idles only 100,000 acres, the impact of alternative 2 is still significant even though it is less than alternative 4.

Response

Section 3.9 describes these impacts in more detail. While the upper limit for both alternatives is the same (about 177,000 acre-feet of water, not 177,000 acres of land idled), the frequency at which the transfers would be made would differ. Alternative 2 includes groundwater substitution transfers, which would likely be purchased more frequently because of the flexibility to start transfers in July instead of April (when the water cannot be conveyed through the Delta). Therefore, cropland idling transfers would be less frequent compared to Alternative 4, which includes fewer other options for transfers.

Comment LA12-106

Comment

Pg 2-45, Table 2-9, 3.9 - "Cropland idling water transfers could convert agricultural lands under the Williamson Act and other land resource programs to an incompatible use." There is no support for the LTS impact call when 177,000 acres of crops could be idled and nothing in the project precludes the same land being idled for all 10 years of the program? 10 years of crop idling and using the property for nonagricultural purposes is in direct conflict with the requirements of the Williamson Act. As the Proposed Project and alternatives are defined, the maximum impact to Williamson Act lands is 177,000 acres of crop idling on the same land for 10 years. This is a significant impact that must be mitigated and disclosed.

Response

The maximum annual acreage proposed for idling under the Proposed Action and Alternative 4, the two alternatives that include cropland idling transfers, is 59,973 acres. 177,000 acres would not be idled annually under any proposed alternative. Under all proposed alternatives, water transfers would not occur every year. Buyers would only seek water transfers in dry and critical years, and in many years capacity would not be available at the pumps to export water through the Delta. Figure 2-10 shows that in 65 percent of the years, there would be no capacity at the pumps to convey transfer water. Further, cropland idling is the lowest priority transfer method under the Proposed Action and buyers would not purchase water from cropland idling in all years that transfers occur. Alternative 4, which includes more frequent cropland idling transfers, includes a mitigation measure to avoid the same land from being consecutively idled. Impacts to land enrolled in the Williamson Act are evaluated in Section 3.9.

Comment LA12-107

Comment
Pg B-8, B.4.3.1.2 - "Transfer Operations and Priorities TOM uses an assumed priority for transfer mechanisms used to make water available under Project alternatives." This assumption is a fundamental flaw in the analysis of the impacts of the project. The alternatives clearly say that the sellers can transfer up to a limit amount. The project does not define in what priority or sequence those different sources for water for transfer would be implemented under the project. Operational problems with reservoirs or differences in snowpack in different basins could alter the sequence of implementation of the water transfer sources. As an example, if alfalfa prices were to go to levels that were unprofitable, many growers would first offer to switch to another crop and sell that water to the program. Although there is some rationale provided for the assumption used, the project may very well not operate that way at all in reality. The project must not be approved for operations that deviate from the assumptions used in the project analysis of impacts, otherwise the project has been permitted for impacts that were never analyzed mitigated or disclosed.

Response
The environmental analysis covered a range of transfer mechanisms and options for implementation. The analysis included conservative assumptions that attempted to analyze the maximum volume and frequency of transfers. Priorities regarding which transfer mechanisms would be used were assumed for the hydraulic modeling, but most resource analyses considered the full quantity of water that could be made available. The impacts of different priorities, or of greater or lesser use of certain mechanisms, were addressed under the different alternatives. Alternative 2 analyzed an upper boundary for total transfers by considering all potential mechanisms. Alternative 4 considered potential increases in crop idling that may occur if there were no groundwater substitution. The potential water made available and the environmental impacts of crop shifting are expected to be less than for crop idling, and are therefore covered under the analysis of crop idling transfers.

Comment LA12-108

Comment
Pg B-8, B.4.3.1.2, pl - "TOM simulates the four transfer mechanisms in the following order:

- Groundwater substitution - for alternatives that include this mechanism
- Reservoir release
- Conserved water
- Crop idling - for alternatives that include this mechanism"

The TOM assumptions do not include crop shifting so the model assumptions were incomplete and incorrect to reflect the actions that were included in the alternatives.

Response
Crop shifting makes water available on a monthly pattern based on the difference in evapotranspiration of applied water (ETAW) between the original crop and the shifted crop. The water would be made available and stored in upstream reservoirs for transfer in future months, when possible, or transferred directly from the point of non-diversion to the point of re-diversion under the transfer in the month it is made available. Each of these potential options was analyzed for crop idling transfers. Therefore, the effects of crop shifting on water operations are similar, but of lesser magnitude, than those associated with crop idling.

Comment LA12-109

Comment
Pg B-9, Figure B-4 - The project is only using a 33 year period of record for hydrologic conditions. This truncated hydrologic period skews the impact analysis and fails to use the best available science of the readily available and industry standard utilized 83+ year period of record. The EIS/R must be revised using the best available science as NEPA and CEQA requires.

Response
See Common Response 5.

Comment LA12-110

Comment
Pg B-9, B.4.3.1.2, - "Groundwater substitution transfers from the Sacramento Valley have the potential to create changes in stream-aquifer interaction that affect other parts of the water delivery system." Each tributary reach has unique surface and groundwater interactions. The EIS/R fails to disclose what the modeling assumptions were for the geographic distribution of the estimated

groundwater transfers. If the groundwater is drawn from primarily adjacent to a single or limited set of tributaries then the groundwater surface water interactions and impacts would be more severe and focused. It appears the analysis assumed an even distribution of the estimated (with unsound rationale) amount of groundwater substitution across the whole north of Delta seller area. This error in modeling assumption causes the analysis to conclude much lower impacts that would occur within the range of operations the proposed project and alternatives.

Response

The analysis did not assume "an even distribution of the estimated amount of groundwater substitution;" rather, the analysis evaluated transfer volumes and pumping from individual sellers based on information provided by those sellers, demands for transfer water, and capacity to convey transfer water from seller to buyer. Table 2-5 in the Draft EIS/EIR is a summary of the maximum volume of transfers analyzed, including groundwater substitution transfers, and it provides some information on the geographical distribution of pumping analyzed. Based on this distribution of transfer pumping, the analysis was conducted using the best available tools to estimate the resulting effects on streams.

Comment LA12-111

Comment

Pg B-11, B.4.3.1.2 - "Changes in Delta inflow affect the CVP and SWP differently based on system conditions at the time and COA accounting." This is why we said in an earlier comment that the COA being out of date was a problem for this project that had to be addressed by updating the COA.

Response

The analysis assumed and modeled the current Coordinated Operating Agreement (COA) and operations of the CVP and SWP. Renegotiation of the COA is beyond the scope of this project.

Comment LA12-112

Comment

Pg B-15, B.4.3.1.5, - "Annual volumes were assumed to be made available on a monthly pattern based on the ETAW of rice, the assumed crop to be idled." This is a flawed assumption which leads to underestimating the impacts of the proposed project and alternatives. Rice has the highest ETAW at 3.3AF per acre of any of the crops proposed for idling. This assumption is in conflict with the reality of the program which would have a mix of idled crops with different and lower ET AW water consumption rates. This flawed analysis assumption will either lead to the project estimating that less number of acres will be fallowed to accomplish a given target amount of water for transfer or less water being made available for transfer with a given number of acres idled. Either way, the analysis assumption under-estimates the impacts of the project and the analysis must be revised and recirculated once this material analytical error is corrected.

Response
The monthly pattern was used for modeling purposes and reflects the most water that could be transferred because rice has the highest ETAW of the crops eligible for idling. Any other crop idled would provide less water for transfer for rice, and the changes to flows and storage would be less than what was modeled. There are limits to the amount of non-rice crops that can be idled, so more non-rice crops cannot be idled to reach a target amount of water. The modeling shows a maximum transfer scenario that results in the greatest effects, as is common when models are used to evaluate impacts.

Comment LA12-113

Comment
Pg B-16, B.4.3.1.5, p4 - "Crop idling transfers offer the least flexibility of all transfer mechanisms. The decision to enter into crop idling transfers is typically made in spring months when there is still considerable uncertainty in the water supply forecast and the ability to convey water through the Delta." This is not true. In most years when water transfers are most desired are in years after the first year of a Dry or Critically Dry water year. In those cases when reservoir storage is down, although the exact amount of water allocation may not be announced until the spring, all of the buyers already know that they want to buy water. Each of the water transfer water sources suffer the same limitations on knowing the delta conditions ahead of time and their ability to convey water through the delta. This misperception on the part of the project in terms of the relative desirability of the water sources in the sequence in which water sources would be implemented in the project is flawed. In order to be conservative in identifying the types and magnitude of impacts from the proposed project, the EIS/R should have analyzed the range of actions that it desired to be permitted, not an undefined, unjustified and flawed rationale for generally how the program may or may not be implemented. In order to correct these flawed assumptions and allow a full range of operations as proposed by the project, the analysis needs to do a sensitivity analysis of doing the maximum amount of each water transfer type and in combination with other types. Only then will the potential impacts of the project be disclosed and properly mitigated.

Response
The reduced flexibility in the citation refers to the fact that growers must decide before the planting season whether or not to participate in a cropland idling water transfer, and buyers must commit to purchasing the water months before the July through September transfer period when hydrologic conditions and Delta pumping capacity are better understood. This is less flexible relative to groundwater substitution transfers, where growers are still planting a crop and can switch to groundwater supplies for the transfer during the July through

September period. This is also less flexible than reservoir release transfers, where reservoir releases can be controlled for the transfer period.

Comment LA12-114

Comment
Pg B-16, B.4.3.1.5, - "Crop idling transfers make water available on the fixed schedule illustrated in Figure B-10. Therefore, transfer water made available in May and June, a total of 37 percent of the annual volume, can be lost or not diverted ... " Some rice is not planted until the first of June, so the potential transfer loss in those cases is only 22% rather than the 37% as claimed in the EIS/R.

Response
Planting times can vary based on farming conditions and some planting may occur in June; however, most rice is planted in May in the seller service area. The ETAW pattern was confirmed with the sellers.

Comment LA12-115

Comment
Pg B-17, B.4.3.1.6, - "Analysis of the baseline CalSim II simulation of CVP and SWP operations was performed to identify potential opportunities to store both groundwater substitution and crop idling transfer water made available from April through June in upstream CVP and SWP reservoirs." Again, the analysis did not include the assumption of water transfer volumes from crop switching.

Response
Crop shifting makes water available on a monthly pattern based on the difference in evapotranspiration of applied water (ETAW) between the original crop and the shifted crop. The water would be made available and stored in upstream reservoirs for transfer in future months when possible, or transferred directly from the point of non-diversion to the point of re-diversion under the transfer in the month it is made available. Each of these potential options was analyzed for crop idling transfers. Therefore, the effects of crop shifting on water operations are similar, but of lesser magnitude, than those associated with crop idling.

Comment LA12-116

Comment
Pg B-17, B.4.3.1.7, - "TOM simulates shifts in timing of Project water movement at SWP facilities by adjusting baseline Oroville releases and Banks pumping from July through September of some years. Logic in TOM adjusts Oroville releases and Banks pumping to create a more regular monthly pattern of available export capacity." The EIS/R stated that only Reclamation facilities and water transfers would be covered under this document and that any SWP

operations in conjunction with this project would be subject to prior DWR approval and a separate environmental document. This analytical assumption seems to belie that EIS/R statement as the modeling assumptions clearly are counting on SWP operations to facilitate the water transfers covered under this environmental document. The EIS/R modeling assumptions must remove the assumption that SWP operations will be altered to facilitate these CVP water transfer operations.

Response
The EIS/EIR identifies in multiple places (pages 1-1, 1-2, 1-18, and 2-9, among others) that the transfers analyzed in this EIS/EIR could be conveyed using CVP or SWP facilities; conveyance of this water through SWP facilities is analyzed in this EIS/EIR. This EIS/EIR does not analyze transfers to SWP contractors; in other words, the buyers listed in Table 2-6 are only CVP contractors. See response to Comment LA12-57 regarding SWP contractors as sellers.

Comment LA12-117

Comment
Pg B-17, B.4.3.1.8.1, - "East Bay MUD diverts both CVP Project water and transfer water at the Freeport Regional Water Project on the Sacramento River near Freeport." The ‘water transferred by East Bay MUD through the CVP facilities is covered by the OCAP BOs water transfer provisions. The Freeport Regional Water Project facility is not part of the SWP or CVP that is covered under the OCAP BOs and therefore the ESA species impacts of transferring water through these facilities is not covered by an incidental take permit and must seek ESA consultation prior to implementation.

Response
The comment states that “[t]he Freeport Water Project facility is not part of the SWP or CVP that is covered under the OCAP BOs,” and suggests that the associated incidental take permits do not apply to the facility. That statement is not accurate. The Freeport Regional Water Project (FRWP) was included in the actions within the scope of the biological opinions on the Long-Term Coordinated Operations of the CVP and SWP, and the terms therein apply to water diversions that utilize the FRWP, as appropriate. Further, USFWS and NOAA Fisheries issued biological opinions specific to the FRWP, and those opinions incorporate and apply the biological opinions on the Long-Term Coordinated Operations of the CVP and SWP to the FRWP. Among other things, the incidental take statements in both of those FRWP-specific biological opinions address take of listed species that could occur as a result of FRWP operation. See USFWS and NOAA Fisheries biological opinions for the Freeport Regional Water Project, issued December 2004.

Comment LA12-118

Comment
Pg B-18, B.4.3.1.8.2, pl - "Contra Costa WD diverts water under existing water rights, a CVP water service contract, and transfer water from multiple points of diversion in the Delta." The CCWD facilities are not part of the SWP or CVP that is covered under the OCAP BOs and therefore the ESA species impacts of transferring water through these facilities is not covered by an incidental take permit and must seek ESA consultation prior to implementation.

Response
ESA consultation was performed for Contra Costa WD's diversion facilities in association with the Los Vaqueros Reservoir Expansion, Alternate Intake Project, and other projects constructed and operated by Contra Costa WD. Contra Costa WD has consulted with USFWS, NOAA Fisheries, and CDFW and has received the necessary biological opinions and incidental take permits for the operation of its facilities.

Comment LA12-119

Comment
Pg B-18, B.4.3.1.8.2 (this was a document numbering error, it should have been B.4.3.1.8.3),

p 1 - "Transfer water purchased by SLDMWA is conveyed through available export capacity at Jones and Banks pumping plants. Transfers from the Sacramento River assume a 20 percent carriage water adjustment to maintain Delta salinity. Transfers from Merced ID that enter the Delta from the San Joaquin River assume a ten percent carriage water adjustment." The EIS/R must disclose the basis and justification for these carriage water assumptions. Under some conditions, the carriage water requirements to maintain delta water quality would have to be much higher, e.g. 30 or 40%.

Response
This assumption is based on discussions with Central Valley Project Operations. An assumption for carriage water is necessary for analysis and initial planning for transfers. However, the actual method for determining carriage water costs is significantly more complex and involves real-time monitoring, actual conditions, post-transfer modeling, and analyses. The process for calculating carriage water for actual transfers through the CVP/SWP export facilities would be similar to what has occurred in the past and may require a higher or potentially lower percentage than the 20 percent used in the analysis.

Comment LA12-120

Comment
Pg B-18, B.4.3.1.8.2 (this was a document numbering error, it should have been B.4.3.1.8.3), p2 - "Additionally, water made available by Merced ID can be conveyed directly to SLDMWA member agencies through facilities that connect to Merced ID's internal conveyance system and facilities that join the lower San Joaquin River and the DMC without going through CVP/SWP export facilities." These facilities and operations are not covered under the OCAP BO operations or water transfer assumptions so these operations must seek separate ESA consultation with the fisheries agencies prior to implementation.

Response
See response to Comment LA12-91.

Comment LA12-121

Comment
Pg B-18, B.4.4 - The EIS/R must disclose its assumptions as to what projects they included as reasonably foreseeable. If they are elsewhere in the document, the mention of these assumptions should have included a reference as to what section that content could be found. In general this EIS/R is very poor at making the document reader friendly.

Response
The assumptions included in the water operations analysis, including those that are reasonably foreseeable and affect CVP/SWP operations, are included in Appendix B, Water Operations Assessment, starting on page B-66.

Comment LA12-122

Comment
Pg B-20, B.6.1, - " ... they would need to complete individual NEPA and Endangered Species Act compliance for each transfer ... " Buyers and sellers will need to complete ESA consultations anyway as the OCAP BOs only cover SWP and CVP water transfer activity and specifically exclude coverage of buyer and seller area impacts.

Response
Reclamation is consulting with USFWS on the Proposed Action and has submitted a Biological Assessment to USFWS on Long-Term Water Transfers for Section 7 consultation. In the buyer service area, the use of transfer water would be within the range of existing activities of each CVP contract and associated BO.

Comment LA12-123

Comment
Pg B-20, B.6.2, - "Alternative 2 includes transfers under all potential transfer measures: groundwater substitution, reservoir release, conserved water, and crop idling." . Again, the assumptions leave out crop switching which has very different modeling implications to water use, savings and conveyance than crop idling. The current EIS/R modeling assumptions do not reflect all of the actions included in alternative 2 and the analysis must either be redone with the corrected assumptions or the description of and actions included in alternative 2 must drop crop switching as a component.

Response
Crop shifting was added to the text. Cropland idling was modeled because it represents the largest potential impact to the resources that could occur under Alternative 2. Chapter 3 discusses impacts of crop shifting on the environmental resources in addition to cropland idling.

Comment LA12-124

Comment
Pg B-23, Figure B-14 and Pg B-28, B-24 - The EIS/R stated that only Reclamation facilities and water transfers would be covered under this document and that any SWP operations in conjunction with this project would be subject to prior DWR approval and a separate environmental document. This analytical assumption seems to belie that EIS/R statement as the modeling assumptions clearly are counting on SWP operations to facilitate the water transfers covered under this environmental document. The EIS/R modeling assumptions must remove the assumption that SWP operations will be altered to facilitate these CVP water transfer operations.

Response
See response to Comment LA12-116.

Comment LA12-125

Comment
Pg B-29, Figure B-27 -This figure demonstrates the point regarding project impacts on proportional flows at tributary confluences on salmonid homing and straying. The information to conduct the analysis of project impacts on straying is clearly available and yet the EIS/R did not conduct that analysis, disclose the impacts or mitigate the impacts.

Response
See response to Comment LA12-185.

Comment LA12-126

Comment
Pg B-66, Appendix B, attachment 1-The2005 level of development should not have been used in that the rest of the modeling updates were current up to January 2014. This out of date level of development assumption biased the analysis results as the 2014 level of demand is higher than it was in 2005.

Response
See Common Response 5. Additionally, the model described in Appendix B as being received from Reclamation in January 2014 included demands at a future level of development, approximating forecasted demands in the Sacramento Valley at a 2030 level of development. No CalSim II model includes demands at a 2014 level of development.

Comment LA12-127

Comment
Pg B-66, Appendix B, attachment 1 -The Baseline Assumptions did not include implementation of the existing OCAP BO RPA requirements for restoration of subtidal and intertidal habitat and floodplain habitat. The subtidal and intertidal habitats have tidal exchange impacts to delta water quality and CVP/SWP operations that must be included in the modeling assumptions. These are reasonably foreseeable as they are current legal obligations of the CVP and SWP that are required to be implemented prior to 2015. Since the implementation deadline is so close, the location, design and operational characteristics must be thoroughly defined by now or DWR and Reclamation will not be compliant with the BO requirements. The floodplain habitat restoration results in altered water quality and water consumption from evapotranspiration and changes in the tidal prism that must be accounted for in the modeling and impact analysis. The modeling assumptions must be revised and the analysis rerun to reflect these current legal obligations of the CVP and SWP under the OCAP BOs.

Response
See response to Comment LA12-46.

Comment LA12-128

Comment
Table C-17, pl - "Although D-1641 specifies 14-day durations for mean daily chloride concentration, since most DSM2 boundary conditions are specified as monthly values, it is not sensible to account for this constraint herein." DSM2 reports data on 15 minute time increments, so the data from DSM2 is readily available to do the analysis to determine the frequency, duration and magnitude of exceedances of this water quality parameter as defined and required by D-1641. The EIS/R must use the best available science and this readily available

DSM2 data to complete this study. The failure to use the best available is unsupportable. The quantity of data available from DSM2 is why this data is always presented as exceedance graphs to show the frequency, duration and magnitude of water quality exceedances. Monthly averages of this data mean nothing and are obviously designed by the project to obscure the impacts of the project. The EIS/R must be revised to include exceedance plots of the full time series of data that is available from DSM2. This comment applies to all water quality evaluations done from DSM2 data.

Response
While it is possible to output information from DSM2 on a finer time step, the quality of the output would be questionable at that scale. The input information coming from CalSim was at a monthly time step.

The water quality analysis in the EIS/EIR is comparing the action alternatives to the existing conditions (under CEQA) and the No Action Alternative (under NEPA) to determine if changes could affect environmental resources. The modeling output indicates that changes would be very minor and would not significantly affect Delta water quality.

Comment LA12-129

Comment
C.9 - p2 - "1. the daily minimum stage was calculated for all the Base and three Alternative from the 15-minute model output ; 2. daily change from Base stage was calculated (Daily Alternative Min Stage - Daily Base Min Stage) 3. monthly average stage was calculated from the results at step 2." So the analysis took two daily time step data sources and decided to water it down to a nice monthly average that is designed to hide all but extraordinary catastrophic impacts. Dewatering an ag intake does not have impacts on a monthly basis, it is an impact that occurs on a day by day basis. With the current analysis, the intakes could be dewatered by 6" for 20 of the 30 days of a month and then covered by l' of water for the last 10 days and still show no impact. This analysis and any other used in the EIS/R that used daily source data and analyzed it at a monthly average for the impact assessment must be revised to reflect a best available science use of the full potential of the data sets for a daily impact analysis.

Response
This comment is based on an overly simplified understanding of how the CALSIM boundary conditions are applied. While it is true that DSM2 reads in daily time series for the Sacramento and San Joaquin River inflows, it is not correct to say that the fluctuations in these DSM2 time series are can be considered as daily flows in any practical sense. DSM2 reads in a daily time series that is based on CALSIM monthly modeling results; therefore, the DSM2 flows do not have an adequate level of detail to analyze the results at a daily level. DSM2 in this context is most appropriately viewed as a monthly model

in terms of how the comparisons between Alternatives and the existing conditions are made.

The DSM2 model results were intended to compare the action alternatives to the baseline, so determining changes on an average basis provides information about whether the alternatives could affect environmental resources. The changes driven by the action alternatives would apply to the water levels throughout the day (as the water levels increase and decrease based on tides). Appendix C water level information has been clarified to show water level increases as well as water level decreases for a more complete set of data.

Comment LA12-130

Comment
C-48, p4-The Proposed Project" ... alternative sees the largest increases in EC when exports are the greatest, with Critical water years in July seeing the largest percent difference of 4.2% at the SWP location and 3.3 % at the CVP location." This is a very significant impact as the SWP and CVP are constantly in violation of these water quality parameters in Critical water years already. For the proposed project to make that violation worse by over 4% is a very significant impact that must be mitigated.

Response
The following sentences in Appendix C indicated that D-1641 criteria were met at the times of these differences. The alternatives under this project are not expected to directly increase the occurrence of D-1641 salinity violations.

Comment LA12-131

Comment
D.3.6, pl - "The distribution of aquifer properties across the Sacramento Valley is poorly understood. In certain areas with significant levels of groundwater production, the collection of aquifer test data and the measurement of historical groundwater-level trends in response to known groundwater production rates have provided valuable information on aquifer properties. However, in the majority of the valley, these data are not available." Yes, this may be true, but it also invalidates the use of modeling for predicting groundwater and surface water interactions. This model is not generally accepted for these types of analyses and its use for this kind of document and analysis in this geographic area is unprecedented. Peer review and supporting acceptable calibration is not apparent.

Response
SACFEM has undergone an extensive independent peer review performed by an independent consultant with extensive experience in the application of groundwater models to evaluate groundwater systems and surface water-groundwater interaction (WRIME 2011). The objective of the peer review was

to evaluate the adequacy of the model to estimate the impacts of groundwater substitution water transfer pumping on third party groundwater users as well as impacts to surface water flows. The results of the peer review identified seven primary enhancements to the model that would improve its accuracy in forecasting pumping impacts on water resources in the Sacramento Valley. All seven of these enhancements have been incorporated into SACFEM2013, the most recent version of SACFEM. Appendix D also includes information on sensitivity studies on the aquifer properties in SACFEM 2013. See also Common Responses 4 and 5 for additional discussion related to existing hydrologic conditions of the Sacramento Valley and to hydrologic modeling completed for the EIS/EIR, respectively.

Comment LA12-132

Comment
Appendix D - The documentation fails to disclose the assumptions used in the model of how the groundwater substitution was geographically distributed or that the model used actual well locations that would be used under the Proposed Project and alternatives. Based on the very generalized description of the data, we conclude that the model used an assumption of an average groundwater source usage distributed evenly across the seller areas. This assumption of course would have no relationship to reality or the impacts that would occur with implementing the project within the boundaries of how it was described. The generalized assumption of distributed groundwater well locations and demand would vastly underestimate the localized groundwater and surface water interaction impacts from the project that would be implemented such that those impacts were not uniformly distributed. The groundwater analysis in the EIS/R must be redone using an accepted model, with specific well locations and water demands.

Response
The modeling effort did not assume an even distribution of groundwater pumping. Appendix B includes a description of which agencies were assumed to sell water during each year of the modeling effort, and it has been updated to show the quantities included in each year. The groundwater modeling effort used well information provided by the sellers (including well location, depth, size, and screened interval) to determine where the pumping would occur in each selling agency area.

A more detailed user's manual for the SACFEM2013 model has been added as Appendix M in the Final EIS/EIR.

The most recent documentation for the MicroFEM code can be found on the developer's web site: http://www.microfem.com/

Comment LA12-133

Comment
Figure D-4 -There are almost no well data points to characterize the hydraulic conductivity of the aquifer in the Feather River basin in which many seller areas were identified. These areas have almost no data to support the model analysis which render the results unreliable.

Response
Fewer hydraulic conductivity estimates being available in a given subarea does not mean that model forecasts associated with that subarea are unreliable. The technical experts on the model development team used available data regarding aquifer properties across the valley. Although the number of locations in the Feather River Basin at which hydraulic conductivity has been estimated with field data is limited, the modeled aquifer hydraulic properties and associated forecasts in that area are reasonable, in the professional judgment of the experts who prepared the analysis.

Comment LA12-134

Comment
The EIS/R No Action/Project assumptions were not consistent with the BDCP EIR/S and Reclamation Remand EIS. Since Reclamation is a lead agency for all of these projects and they are all on the CVP operations and they all occur over the same time period, it is an inexcusable inconsistency and bias in the outcomes of the analysis to have different baseline assumptions. Since the other documents have undergone public review already, this project's No Action/No Project assumptions must be revised to be consistent with these other documents, reanalyzed and revised, and then recirculated for public comment.

Response
The BDCP and Remand environmental documents describe efforts that would be in effect for a much longer period than the range of potential water transfers analyzed in this EIS/EIR, which would only take place for 10 years. Because the No Action/No Project Alternatives reflect different planning horizons, it makes sense that they include different assumptions about the conditions that exist at those times.

Comment LA12-135

Comment
The geographic area included in the EIS/R impact assessment fails to include areas and tributaries downstream of drainage from water transfer recipient service areas. Transferred water will be applied to buyer areas and some of that water will result in runoff that will be carried downstream of those service areas. Those water transfer runoffs will alter flows and water quality in those downstream tributaries. Some of those downstream tributaries that should have

been included in the EIS/R analysis, but were not, include (but are not limited to): San Joaquin River, Coyote Creek, Liaghs Creek, Pescadero Creek, Uva Creek, Stevens Creek, Berryessa Creek, Alameda Creek, Tassajara Creek, Walnut Creek, Marsh Creek, Kellog Creek, Lone Tree Creek, Hospital Creek, Corral Hallow Creek, Ingram Creek, Salido Creek, Crow Creek, Orestimba Creek, Garzas Creek, Quinto Creek, Romero Creek, Los Banos Creek and others. The San Joaquin River and several of these creeks are documented habitat for ESA species salmonids and therefore the lack of analysis of these ESA species impacts in the EIS/R is a particularly egregious omission.

Response
Analysis of potential runoff to the San Joaquin River is included in Section 3.2. Creeks in the San Francisco Bay region are in areas where transfer water would meet municipal and industrial uses; therefore, it would be treated before distribution and would not likely result in increased runoff to local creeks. The creeks in the San Joaquin Valley (other than the San Joaquin River) are very small and primarily ephemeral. During the irrigation period, these creeks are generally dry or contain agricultural runoff. The contribution from water transfers to these creeks through runoff would be negligible and the concept for this type of impact is captured in the analysis for the Buyer Service Area.

Comment LA12-136

Comment
The geographic area included in the EIS/R impact assessment fails to include areas from the reservoirs involved in the project to the upstream first impassable fish barrier. Fluctuations of the reservoirs from project releases affect the ability for reservoir fish to forage and spawn in the upstream tributaries. The project operations reduce reservoir cold and warm water fisheries access and use of these upstream habitats from exposing sediment wedges in the tributaries at the interface with the reservoir and increasing the frequency and duration of impassable conditions for fish. Cold and warm water fisheries are designated beneficial uses of water in the CV Basin Plan and therefore must be evaluated in a revised EIS/R.

Response
Changes in reservoir levels could have effects within the reservoir, but would not affect flows upstream of the reservoir. These potential effects to fisheries within these reservoirs are assessed in the Fisheries Resources analysis (Section 3.7).

Comment LA12-137

Comment
Both seller and buyer service areas are in unconfined groundwater basins. The impact area of groundwater resources, surface water interactions with groundwater, and fisheries and wildlife resources in the adjacent groundwater

basins connected to these seller and buyer service areas must also be fully analyzed in the EIS/R. As the EIS/R stands, these extended impact areas in the interconnected groundwater basins are not identified, characterized, evaluated, quantified, mitigated or disclosed. This serious omission in the extent of the geographic area of impact from the project must be corrected in the revised EIS/R.

Response

The Sacramento Valley Groundwater Basin includes portions of Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Solano, Tehama, Yuba, and Yolo counties. The Sacramento Valley Groundwater Basin is bordered by the Red Bluff Arch to the north, the Coast Range to the west, the Sierra Nevada to the east, and the San Joaquin Valley to the south. Bulletin 118 further divides the Sacramento Valley Groundwater Basin into subbasins (DWR 2003). Figure 3.3-5 shows the Sacramento Valley Groundwater Basin and subbasins. The modeling conducted for the analysis documented in Section 3.3, Appendix B, and Appendix D uses the SACFEM2013 groundwater model. The SACFEM2013 model simulates groundwater conditions throughout the entire Sacramento Valley groundwater basin, including all the subbasins in the valley.

Comment LA12-138

Comment

The EIR must use a full range of significance criteria which are consistent with Reclamation's use in other similar environmental documents. These similar environmental documents from which Reclamation should use the significance criteria include: Remand EIS, Shasta Enlargement, Sacramento Valley Water Management Plan (AKA Phase 8), CALFED, and BDCP. For this project to use anything less than the synthesis of the significance criteria from these recent and similar projects with Reclamation as the lead agency would be an inconsistent application of policy, procedure and science. The EIS/R impact analysis must be revised to address them missing impact criteria and thresholds. The revised EIS/R must be recirculated after addition of this material new information.

Response

The significance criteria in the EIS/EIR are generally based on the examples in CEQA Appendix G. Appendix G recognizes that significance criteria may vary from project to project based on the applicable circumstances and begins with this note: "The following is a sample form and may be tailored to satisfy individual agencies' needs and project circumstances."

Comment LA12-139

Comment

ESA Incidental Take Permit - Impacts from the selling and receiving water service areas are not covered by the OCAP BOs. They will require separate section 7 consultation (BA and BO). NMFS OCAP BO, pg729, p3 - " ... this consultation does not address ESA section 7(a)(2) compliance for individual water supply contracts. Reclamation and DWR should consult with NMFS separately on their issuance of individual water supply contracts, including analysis of the effects of reduced water quality from agricultural and municipal return flows, contaminants, pesticides, altered aquatic ecosystems leading to the proliferation of nonnative introduced species (i.e., warm-water species), or the facilities or activities of parties to agreements with the U.S. that recognize a previous vested water right." The water transfers ESA species impacts in the seller and buyer service areas are not covered under the FWS or NMFS OCAP BOs and therefore a separate section 7 or 10 consultation for the water transfers for the seller and buyer service areas must be conducted and approved prior to the water transfers.

Response
Reclamation is consulting with USFWS on the Proposed Action and has submitted a Biological Assessment to USFWS on Long-Term Water Transfers for Section 7 consultation. In the buyer service area, the use of transfer water would be within the range of existing activities of each CVP contract and associated biological opinion. The text cited in this comment from the NOAA Fisheries biological opinion on the Long-Term Coordinated Operations of the CVP and SWP refers to individual water service contracts; water transfers are included in the consultation.

Comment LA12-140

Comment
Reclamation and DWR have not implemented the OCAP BO RPAs, so the CVP and SWP are not compliant with the terms of their current Incidental Take Permits (ITP). NMFS specifically provides in the OCAP BO that if the agencies are not compliant with the terms of the OCAP BO RPAs that they will rescind their ITP. Since DWR and Reclamation are not compliant with the OCAP BO RPAs (see related comments), NMFS must rescind Reclamation and DWRs ITP and reinitiate ESA re-consultation. FWS and NMFS cannot approve the permits for the proposed water transfers until OCAP BO compliance is achieved.

Response
See response to Comment LA12-50.

Comment LA12-141

Comment
The project will require a 401 Clean Water Act certification to address all types of discharges that occur under the proposed project and alternatives. These discharges by the project which must be permitted include (but are not limited to): releases from each reservoir to each tributary involved in the transfers, leaks

from conveyance used in the water transfers (e.g. California Aqueduct), discharge at the water transfer recipient service area, discharges of water used in the buyer service areas, discharge groundwater pumped for groundwater substitution, discharge of groundwater substituted water after use on the fields. These last categories of discharges from groundwater wells and drainage discharge of groundwater substituted fields represent new locations of discharges for the project that would not be covered under any 401 permits the SWP or CVP currently have (if they have any).

Response
The action alternatives would not include any new discharges that would require a Section 401 Clean Water Act certification.

Comment LA12-142

Comment
The project will also need Air Quality permits for project impacts from (but not limited to): electrical load demand from groundwater pumping (this increased electrical load is not offset by not surface water pumping), changes in the timing and location of electrical generation from backing up water in reservoirs for transfer (the foregone generation must be replaced and the timing of the impacts are different), idling crops causes wind erosion and airborne particulate loads, operating equipment on fields receiving water from transfers in the buyer service areas are emissions that would not happen under the No Action/Project. All of these impacts are different from the conditions of the CVP and SWP without the project so these impacts are not covered by any current CVP or SWP air quality permits (if they have any).

Response
Air quality permits must be obtained from the local air districts whenever a stationary source, such as an engine, could increase or decrease criteria pollutant emissions. Although greenhouse gas (GHG) emission increases could also trigger the need for permits, this would only occur for individual stationary sources or facilities with substantial GHG emissions. The action alternatives would not cause an increase in GHG emissions that would trigger the need for additional permitting. Furthermore, any diesel- or natural gas-fueled engines that would be used for groundwater substitution are already permitted (unless exempt) at the local level and the action alternatives would not require any modifications. Emissions from wind erosion are included in the air quality management plans for any regions designated nonattainment or maintenance for PM10 or PM2.5. As such, no additional air quality permitting is required.

Comment LA12-143

Comment
Water Supply: The EIS/R must be revised to evaluate the year to year potential geographic distribution of the sellers and to evaluate the worst case scenario of

the distribution (or lack thereof) of the sellers. Since the EIS/R did not evaluate a worst case scenario for how the sales would be distributed, the project must not be approved or permitted for operations that would result in more geographically concentrated impacts than what was represented in the analytical assumptions in the EIS/R. The EIS/R assumed an average water transfer contribution from all seller areas for the available transfer capacity for each water year type. With these assumptions, the impacts are equally spread and are reduced in severity in any geographic location the most of any of the potential operational scenarios. The EIS/R should have conducted and disclosed some sensitivity analysis in which the extremes of operational scenarios were tested and evaluated for their environmental impacts. Several of these scenarios that represented the worst potential impacts from the project should have been fully evaluated. Only under that approach could the project be awarded permits that allow the full amount of water transfer proposed under a set of mitigations that would have addressed the impacts. The analysis took the most optimistic (and completely unrealistic) assumption of even geographic distribution water transfer operations and impacts, each of the identified seller areas should be only allowed to transfer the averaged amount of water that was actually analyzed in the EIS/R. Here is a description and analysis of the critically flawed assumptions the impact analysis used in its impact analysis. The maximum proposed water transfer by the identified water sellers is 511,094AF. In all water years except Critical, Consecutive Dry, and Dry after Critical; the FWS OCAP BO says that the maximum transfer that can be conducted under the permitted conditions is 360,000AF. The EIS/R makes the erroneous assumption that the 360,000AF would be evenly distributed across the seller's area. In reality, the impacts would never be so perfectly distributed and reduced in their severity. The EIS/R should have tested a number of scenarios in which the transfer water was concentrated with various combinations of sellers. The EIS/R should have evaluated the impacts of all of the transfers coming from a single drainage basin under these limited subscription conditions, e.g. all from the Feather River or American River basin and none from the Sacramento River/Shasta drainage basin or visa versa. The scenario of all water transfers from one basin and none from another basin is very plausible as snowpack could favor one basin over another and make more or less water available for transfer or operational considerations of reservoirs in one basin vs. the other could make water storage much more feasible. The EIS/R should have evaluated at least two scenarios of different distribution of willing sellers. These are: all available sellers from the Sacramento and Feather River Service area with none from any of the other seller service areas and another scenario of all transfers being from Merced River, Delta, American River, Yuba River, and Feather River with none from the Sacramento River.

Response

The EIS/EIR did not apply an "optimistic" geographic distribution. As described in Appendix B, the analysis considered the maximum transfers in each year considering conveyance limitations and transfer availability. The buyer demand is limited by available capacity to convey the water to the buyers;

therefore, the modeled available capacity was the upper limit for potential demand. The analysis assumed that the largest sellers would be the first to provide water. In most years with capacity for transfers, adequate capacity exists such that most willing sellers could sell water. Multiple sellers indicated that they would sell less during Shasta Critical years or multiple critical years, and these limitations were also included in the modeling.

Additionally, groundwater substitution transfers were the first type of transfers to be purchased in order to assess what would happen with frequent groundwater substitution transfers. The locations of the wells for groundwater substitution transfers were identified by each seller as the wells that could be used in a transfer. Wells were not evenly distributed over the entire seller area, but rather in the locations provided by sellers as the most likely pumping scenario for transfers.

Comment LA12-144

Comment

Water Supply: The EIS/R does not analyze the impacts of the proposed project and alternatives on other existing long-term (e.g. YCWA Lower Yuba River Accord) or year-to-year water transfer opportunities. The proposed project and alternatives preclude or significantly reduce the amount of potentially available excess CVP and SWP capacity for other long- and short-term water transfers which compete to use these same CVP and SWP facilities. Some of the Lower Yuba River Accord water transfers are for environmental objectives. Some or all of these transfers may not occur under the proposed project or alternatives. This is unknown because the EIS/R failed to identify, characterize, evaluate, quantify, mitigate or disclose the impacts to these other water transfers. This omission is a material deficiency of this EIS/R document which must be revised and recirculated.

Response

Section 3.1 analyzes potential cumulative effects to water supply. The action alternatives in this EIS/EIR would not affect the Yuba Accord transfers. Yuba Accord environmental transfers have access to additional pumping capacity at Banks Pumping Plant that is not available for the CVP transfers analyzed in this document; therefore, they would not compete for conveyance capacity through the Delta. Yuba Accord transfers to SWP contractors would have pumping priority at Banks Pumping Plant and would not be affected by CVP transfers. Yuba Accord transfers to CVP contractors would not necessarily have priority over the transfers under the action alternatives, but the CVP contractors receive both sources and would limit additional purchases to avoid exceeding available capacity.

Comment LA12-145

Comment
Water Supply: The EIS/R proposed "paper water accounting" as the basis for some of its analysis. As an example, the project description says that "These agencies ... would use the water diverted from the San Joaquin River in exchange for their CVP water from the Delta-Mendota Canal." (EIS/R page 2-25, p3). The impacts of the other 4 proposed conveyance routes and operations are very different from the foregone diversions of these other water districts in favor of the proposed San Joaquin River diversion impacts. The different impacts of these different proposed modes of accomplishing this Merced ID water transfer were not analyzed, mitigated or disclosed in the EIS/R. These material omissions and deficiencies in the EIS/R must be corrected in the revised and recirculated EIS/R.

Response
The use of water diverted from the San Joaquin River in exchange for CVP water from the Delta-Mendota Canal is not “paper water.” Under this condition, Merced ID would make water available for transfer by releasing water from Lake McClure that would have remained in storage absent a transfer. The exchanges with Banta Carbona ID, West Stanislaus ID, or Patterson ID would simply provide a way to deliver the water from the San Joaquin River to CVP contractors that receive water from the Delta-Mendota Canal. This delivery mechanism is not discussed in the water supply section because it does not change water supply to these three districts. Diversions at these pumping facilities are discussed in other resource areas where there is the potential for an environmental effect, including Sections 3.2, Water Quality and 3.7, Fisheries.

Comment LA12-146

Comment
Water Supply: If the transferred water is allegedly conserved and does not result from and is limited to an actual reduction in consumptive use (which will vary with the climate) it could reduce runoff to surface flow and percolation to recharge the groundwater.

Response
As described in Section 2.3.2.1, “Conservation transfers must include actions to reduce the diversion of surface water by the transferring entity by reducing irrecoverable water losses. The amount of reduction in irrecoverable losses determines the amount of transferrable water.” The action alternatives include only one conservation transfer from Browns Valley ID. For this transfer, the water available for transfer reflects a decrease in irrecoverable losses to weeds in conveyance canals. Water available for transfer does not include water that would have been runoff to surface flow or groundwater percolation.

Comment LA12-147

Comment
Water Supply: Is water transferred from outside of basin? E.g. Feather River basin surface water rights transferred, but delivered from Shasta?

Response
No. If water is transferred out of the Feather River, then it must be released from Oroville Reservoir.

Comment LA12-148

Comment
Water Supply: Operational assumptions for reservoir storage for water transfer failed to take into account operational changes required by the OCAP BO RPAs for fish passage at Shasta, Folsom and New Melones.

Response
The baseline modeling considers the RPAs listed in the biological opinions. Some RPA actions are included in the modeling, such as Delta Cross Channel, Export/Inflow Ratio, and Lower American River Flow Management. Other RPA actions are not expected to affect flows substantially from existing conditions, and other RPA actions would not be implemented within the 10-year timeframe of the transfer activities evaluated under the Proposed Action. Therefore, the modeling does reflect the RPAs to the extent possible with available data at this time.

Comment LA12-149

Comment
Water Supply: The EIS/R analysis should be specific on the operations and impacts for each water transfer in order to justify project-level permits required for implementation of the project. The level of specificity of the current EIS/R is only at a programmatic level of detail so the project should be subject to additional project level impact analysis prior to implementation each year.

Response
The EIS/EIR included a detailed modeling effort for the action alternatives that identified operational changes for the transfers included in each alternative. The operations are described in more detail in Appendix B. See also response to Comment NG03-8 for additional discussion regarding program-level versus project-level of analysis.

Comment LA12-150

Comment
Water Supply: The EIS/R analysis should be specific on the operations and impacts for each water transfer and cumulatively for year to year for the project

and in combination with all current and other reasonably foreseeable projects, e.g. Lower Yuba River Accord water transfers.

Response
Section 3.1.3 analyzes the cumulative impacts of the alternatives and reasonably foreseeable projects, including the Yuba Accord.

Comment LA12-151

Comment
Water Supply: Each river, stream and location has different geology and hydrology. The EIS/R analysis did not incorporate analysis of all potential operational scenarios that could occur under the range of operations and conditions included in the project description. The project should only be permitted for the operations and conditions analyzed, mitigated and disclosed in the EIS/R, not on the range proposed that were not addressed in the analysis.

Response
The transfer operations model (TOM) analysis used to determine the water supply impacts associated with the alternatives used a 34-year analysis period. This model captured various water year types, including multiple dry years (i.e., 1987-1992) to anticipate future conditions under the alternatives. It used results from SACFEM 2013 to assess potential changes within waterways in the Sacramento Valley. More information on the model timeframe is provided in Common Response 5.

Comment LA12-152

Comment
Water Supply: Water transfers from this project result in discouragement of investment in water conservation or adaptation of water users to more sustainable water uses in the Buyer Service areas. If you can buy water cheaper than the cost of implementing water conservation to achieve an equal amount of water supply then you will always choose the cheaper option of buying the water. This is also why desalination projects or other new water or major conservation efforts (e.g. fixing all the water conveyance leaks) will never occur until all the cheaper water that exists is purchased and transferred. This project and others like it, result in a California that will continue to take water from each other until there is no more water to take before it makes any meaningful investment in water conservation, alternative water supplies, and changes in lifestyle related to water use (hundreds of golf courses in the desert) and water allocation. The BDCP does not count as a project to create new water as this project claims that it "won't divert any more water than current operations" and the real purpose of that project is to just facilitate the transfer of water from a poorer Northern California to a richer Southern California.

Response

The concepts of increasing agricultural water use efficiency and desalination were considered in the EIS/EIR as part of the Agricultural Conservation (Buyer Service Area), Desalination-brackish, and Desalination-seawater alternatives. These alternatives were not carried forward for more detailed analysis, and not because they were more expensive than the remaining action alternatives. These alternatives were not carried forward because they would not reduce environmental effects of the other alternatives or meet key elements of the purpose and need or basic project objectives. These alternatives would not be immediate and would not provide additional water. See Appendix A for more details on the screening of these alternatives.

Comment LA12-153

Comment

Water Supply: CVP and SWP operations are often constrained by net delta outflow requirements. The Net Delta Outflow Index (NDOI) that the SWP and CVP are currently using is grossly over-reporting net delta outflow. "While the NDOI is, at best, an estimate of Delta outflow, there are stations that accurately measure actual Delta outflow. The United States Geological Survey (USGS) has established a series of stations in the Delta to measure flow and water quality parameters. "Four of the USGS gauging stations ... accurately measure Net Delta Outflow (NDO)." ("The Case of the Missing Delta Outflow" California Sportfishing Protection Alliance) DWR's own analysis of NDOI ("Dayflow") estimates vs. the new more accurate USGS gage measurements indicates that the "Dayflow under estimates flow during wet periods and over estimates flow during dry periods." (http://www.water.ca.gov/dayflow/docs/2013 Comments.pdf) This DWR report means that during the majority of the CVP and SWP diversion season (spring through fall), the operations systematically over estimate NDOI and systematically divert more water from the south delta than regulatory operational constraints would allow if NDO was correctly accounted for. As a result of this over-estimation of net delta outflows and the resulting lack of operational constraint, Reclamation and DWR's evaluation of available excess capacity for water transfers for this project will result in more capacity being identified as available as actually would exist if the delta net outflows were being accurately measured. The EIS/R must include an evaluation of the accuracy of the Delta Net Outflow Index accuracy and an adjustment for the water transfer delivery quantities that would result from correctly adhering to the operational constraints of the CVP and SWP from Delta Net Outflow Index requirements. This regular exceedance of regulatory constraints on the CVP and SWP operations must be evaluated in this EIS/R and water transfer amounts included in the project must be limited to amounts that would not result in the CVP and SWP violation of net delta outflow requirements. This over estimation of net delta outflow also results in insufficient carriage water being pulled out of the water transfers to maintain delta water quality and CVP/SWP operational compliance with the OCAP Biological Opinions and the Reclamation Remand court order.

Response
The EIS/EIR is comparing the action alternatives to existing conditions (under CEQA) and the No Action Alternative (under NEPA). The concern that standards are not being accurately measured is something that would apply in both the baseline and the action alternatives. The action alternatives would not affect how the measurement tool works, or cause different environmental effects because of the measurement tool. Considering different measurement techniques is not part of this effort.

Comment LA12-154

Comment
Water Supply: Coordinated CVP/SWP operations, funding and water deliveries are based on the COA. The COA is grossly out of date and has not been updated since 1986. COA determines the proportional distribution of available water supplies and operations. If the COA were updated, the amount and locations of excess capacity in the SWP and CVP system would change. This project must include an update to the COA as part of the scope or the actual amount of conveyance capacity available for transfers cannot be determined.

Response
The EIS/EIR is comparing the action alternatives to existing conditions (under CEQA) and the No Action Alternative (under NEPA). The COA would govern operations for both the baseline and the action alternatives. The action alternatives would not affect how COA works, or cause different environmental effects because of the agreement. Renegotiating the COA is not part of this effort.

Comment LA12-155

Comment
Water Rights: Water rights were not addressed at all in the ES impact summary table.

Response
Existing water rights are described in Section 3.1.1.3.1.

Comment LA12-156

Comment
Water Rights: In 2014, some federal water contractor's had stored some water from the previous year for later release at Reclamation's Friant facility. Due to the drought conditions and lack of available water supply in 2014, Reclamation decided to deliver that water contractor stored water to the Exchange Contractors to fulfill their other standing obligations to the Exchange

Contractors rather than to the water agencies that stored their water in Friant. The EIS/R does not address this potential scenario in released water from reservoirs or the "backed up" water operations of the Proposed Project or alternatives. As a very similar scenario example for the Proposed Project or alternatives, water stored in Friant for Merced Irrigation District that was held back specifically for a water transfer could be hijacked by Reclamation to service the Exchange Contractors instead. This scenario could easily occur on the other dams with backed up water released to fulfill minimum flow or senior water rights holders on the downstream tributaries rather than for the project water transfers. Again, there is a difference in the timing and location of impacts for when the water is released and where it is used for the project or for other obligations. Without the project, the backed up water would not have existed so there would not be the impacts of releasing that water to fulfill these other obligations. The difference in release timing and location of use create impacts that the EIS/R did not identify, characterize, evaluate, quantify, mitigate or disclose.

Response

The EIS/EIR considers "backing up" water into storage during the first part of the irrigation season (April through June) when water could be made available for transfer but could not be moved through the Delta. This water would be held in storage until it could be moved through the Delta later in the same season (July through September). If buyers want to store transfer water in between years, they would have to meet requirements of CVP and SWP storage. This water would be lost if the storage facilities fill.

Comment LA12-157

Comment

Water Rights: When downstream senior water right holder settlement agreement (settlement contractors, e.g. Shasta - Tehama and GCID; Oroville - WCWD, BWGWD, Richvale, etc.) water supply is released from storage for transfer to the water buyers under the Proposed Project and alternatives, it may include natural flow water or stored water which is in violation of permit terms and conditions from their Settlement Agreements. The water rights that the settlement contractors have under the settlement agreement are not the same as their original pre-1914 or riparian water right so they should not have the senior water right status for the water transfer. Since they do not have this senior water right status, these actions must not be allowed to affect parties with more senior water rights. All water transfers must be subject to water rights priorities. The EIS/R is deficient as it did not correctly differentiate the water rights level of the settlement contractors and allowed these water transfers to impact the water rights (water quality) of more senior water rights holders.

Response

As described in Section 1.3, water transfers may not violate any federal or state law, including water rights. Water rights of potential sellers, as described in

Section 3.1.1.3, were developed in coordination with sellers. The EIS/EIR analyzes potential effects to water quality in Section 3.2, and does not find that the action alternatives would result in significant adverse effects.

Comment LA12-158

Comment
Water Rights: The analysis should cover the requirement or recognition that no water can be exported from the Delta by the projects unless the Delta is first provided an adequate supply (WC 12200 etseq.) and to the extent the transfer is dependent on the water rights of the SWP or CVP the water can be recaptured to serve needs in the watersheds of origin (WC 11460 etseq.).

Response
Section 1.3 summarizes the federal and state laws that pertain to water transfers. All transfers must follow these regulations. See Common Response 14.

Comment LA12-159

Comment
Water Rights: Reclamation and DWR water rights are subordinate to senior rights and conditioned on compliance with statutory requirements as well as permit conditions. The CVP and SWPs post-1914 water rights are junior to most in-Delta water rights and, as a result, the project has no right to divert the natural flows within the Delta if there is not enough natural flows through the Delta to satisfy in-Delta pre-1914 appropriative ·rights. The CVP and SWP, as junior water rights holders, are also not allowed to impair the water quality of the senior water rights holders from the operational impacts of their diversions. Reclamation and DWR, through their CVP and SWP operations, consistently violate these water quality standards and impact the beneficial uses of water for agricultural use of the senior water rights holders in the delta.

Response
See response to Comment LA12-158.

Comment LA12-160

Comment
Water Rights: The SWRCB cannot certify or issue permits on a project which knowingly and consistently violates state surface water rights and the addition of these water transfers under the Proposed Project and alternatives would only exacerbate the frequency, magnitude and duration of these violations. Area of Origin Statutes were enacted during the years when California's two largest water projects, the Central Valley Project and State Water Project, were being developed to protect local Northern California supplies from being depleted as a result of the projects. County of origin statutes provide for the reservation of water supplies for counties in which the water originates when, in the judgment

of the State Water Resources Control Board, an application for the assignment or release from priority of State water right filings will deprive the county of water necessary for its present and future development. Watershed protection statutes are provisions which require that the construction and operation of elements of the Federal Central Valley Project and the State Water Project not deprive the watershed, or area where water originates, or immediately adjacent areas which can be conveniently supplied with water, of the prior right to water reasonably required to supply the present or future beneficial needs of the watershed area or any of its inhabitants or property owners. The addition of these water transfers under the Proposed Project and alternatives would only exacerbate the area of origin conflicts.

Response
See response to Comment LA12-158.

The EIS/EIR is comparing the action alternatives to existing conditions (under CEQA) and the No Action Alternative (under NEPA). The analysis does not indicate that the action alternatives would violate surface water rights or have significant adverse effects on water quality.

Comment LA12-161

Comment
Water Rights: The Delta Protection Act, enacted in 1959 (not to be confused with the Delta Protection Act of 1992, which relates to land use), declares that the maintenance of an adequate water supply in the Delta--to maintain and expand agriculture, industry, urban, and recreational development in the Delta area and provide a common source of fresh water for export to areas of water deficiency--is necessary for the peace, health, safety, and welfare of the people of the State, subject to the County of Origin and Watershed Protection laws. The act requires the State Water Project and the federal CVP to provide an adequate water supply for water users in the Delta through salinity control or through substitute supplies in lieu of salinity control. The addition of these water transfers under the Proposed Project and alternatives would only exacerbate the water supply conflicts addressed under the Act.

Response
The EIS/EIR is comparing the action alternatives to existing conditions (under CEQA) and the No Action Alternative (under NEPA). The analysis does not indicate that the action alternatives would adversely affect water supplies in the Delta.

Comment LA12-162

Comment
Water Rights: In 1984, additional area of origin protections were enacted covering the Sacramento, Mokelumne, Calaveras, and San Joaquin rivers; the

combined Truckee, Carson, and Walker rivers; and Mono Lake. The protections prohibit the export of ground water from the combined Sacramento River and Sacramento-San Joaquin Delta basins, unless the export is in compliance with local ground water plans. Also, Water Code Section 1245 holds municipalities liable for economic damages resulting from their diversion of water from a watershed." (http://www.waterplan.water.ca.gov/previous/b160-93/b160-93v1/ifrmwk.cfm) The addition of these water transfers under the Proposed Project and alternatives would only exacerbate the water supply and groundwater conflicts addressed under the water code.

Response
The Water Code prohibits direct export of groundwater unless it is in compliance with local groundwater plans, but the action alternatives do not include direct export of groundwater. The EIS/EIR analyzes potential effects of the action alternatives on water supply (Section 3.1) and groundwater (Section 3.3). The results indicate the significant adverse effects on both resources would be mitigated with the mitigation measures included in these sections.

Comment LA12-163

Comment
Water Rights: Reclamation is not compliant with their junior water rights requirements as the CVP operations frequently exceed Delta water quality requirements in violation of the Delta Protection Act of 1959. Transfers of water supplies through the CVP or SWP from conjunctive use of groundwater substitution for surface water supplies are not consistent with local groundwater plans. Water contractors supplied through the SWP are liable for any direct or indirect damages from diverting water from a watershed. These damages may include injury, damage, destruction or decrease in value of any such property, business, trade, profession or occupation resulting from or caused by the taking of any such lands or waters, or by the taking, diverting or transporting of water from such watershed. (Water Code 1245) The addition of these water transfers under the Proposed Project and alternatives would only exacerbate the water quality impacts addressed under the Act.

Response
Section 3.2 of the EIS/EIR analyzes potential effects to water quality in the Delta from the range of transfer activities, and finds that the action alternatives would not have significant adverse effects.

Comment LA12-164

Comment
Water Rights: The Proposed Project and alternatives must consider the water supply, water rights, water quality impairments and other water beneficial use impacts associated with the water transfers of south delta water. The conditions of waters in the delta including direction of flows, water quality and impacts to

agriculture, drinking water supplies and fisheries resources are a direct consequence of the CVP and SWP south delta facilities water diversions.

Response

The EIS/EIR analyzes effects to water supply and water quality in Sections 3.1 and 3.2, respectively. The analysis of potential Delta effects included application of the DSM2 model, as described in detail in Appendix C. This model estimated potential effects to water quality, circulation, and water levels in the south Delta. The analysis found that the impacts would not result in a significant, adverse change from the baseline conditions.

Comment LA12-165

Comment

Water Quality: The sellers identified are mostly water districts. When water districts transfer water they typically rotate the fallowed lands from year to year so not the same land or owners are participating from year to year. The EIS/R just assumes there will be some even distribution of the fallowed fields across a water district. They do put some constraints on adjacency to wildlife refuges, but other than that, the fallowing could occur in any location or in any combination of locations or concentrations. By not having specific locations or a very specific rule set about how fallowed fields can be distributed within a water district, the analysis of the impacts from field fallowing is at a programmatic level of detail, not a project site specific level of detail. The rules for how fallowed fields are distributed in a water district are not specific enough to allow detailed analysis of impacts such as reduced ag drainage return flows and resulting drainage flows and water quality impacts. The EIS/R must be revised such that project specific levels of detail on the impacts of field fallowing are conducted. Although the agencies can approve a programmatic EIS/R, this project, because of its lack of project-level analysis of impacts, must have a subsequent environmental analysis prior to implementation.

Response

See response to Comment NG03-8.

Comment LA12-166

Comment

Water Quality: Each groundwater basin and sub-basin area has different water quality, e.g. south of Sutter Buttes has higher saline groundwater than farther to the north. Different depth groundwater aquifers can have different water quality. The differences in groundwater quality that would be substituted for surface water supplies and the specific differences in the water quality of discharge water from the conjunctive use properties in the project are not characterized, evaluated, quantified, mitigated or disclosed in the EIS/R. This material omission of groundwater substitution water quality impacts on surface and groundwater quality must be addressed in a revised and recirculated EIS/R.

Response
Groundwater quality is discussed in Section 3.3, Groundwater Resources. Additional discussion regarding the impacts to surface water is included in Section 3.2, Water Quality. The amount of groundwater substituted for surface water would be relatively small compared to the amount of surface water used to irrigate fields in the seller service area. Return flows from these fields would eventually discharge into receiving water. Pollutants, if any, associated with these discharges may be covered under the SWRCB Agricultural Waivers program, and would likely be related to agricultural applications of fertilizers and pesticides which would occur in the absence of water transfers.

Comment LA12-167

Comment
Water Quality: Ag drainage water quality is lower in the areas of groundwater substitution than if their surface water supplies were utilized. As an example of the impact of the project, groundwater is higher in dissolved minerals (TDS) than surface water. High dissolved minerals in water can have significant adverse impacts on development of juvenile salmonids that occur in the tributary reaches where the proposed project surface water quality degradations would occur from groundwater substitutions. The Sacramento Valley Regional Water Plan (AKA Phase 8) identified and addressed those impacts in their project's conjunctive use analysis, but this project EIS/R did not even though Reclamation was a lead agency on both projects and both involve conjunctive use.

Response
See response to Comment LA12-166.

Comment LA12-168

Comment
Water Quality: The EIS/R also failed to evaluate the impact of fallowed fields on reduced ag return flow volumes and increased contaminant loads which could exceed the discharge permits tolerances, e.g. water temperature difference, TDS, DO, nutrient loading, DOC, ECw, contaminant metals (Hg, Se, Pb, Fe) other (diaznon, DDT, chlorpyrifos, etc.) of the water and reclamation districts. This is a material omission and deficiency of the EIS/R which must be corrected in the revised EIS/R prior to recirculation.

Response
This Draft EIS/EIR discusses potential impacts of cropland idling in Section 3.2, Water Quality. As discussed in this section, the rice crop cycle and prevalent soil textures in the seller service area would reduce potential impacts from soil erosion and runoff in this region. Additionally, return flows from these fields would not be considered point source discharges, would not be covered by National Pollutant Discharge Elimination System (NPDES)

discharge permits, and would not require a mixing zone analyses. Pollutants, if any, associated with these discharges may be covered under the SWRCB Agricultural Waivers program, and would likely be related to agricultural applications of fertilizers and pesticides which would not occur during field fallowing.

Comment LA12-169

Comment
Water Quality: The Proposed Project and alternatives will result in water quality impacts to delta and other beneficial uses which were not fully addressed in the EIS/R.

Response
Section 3.2, Water Quality, includes an assessment of potential effects to Delta water quality. Further data has been added for more locations in the Delta based on comments received.

Comment LA12-170

Comment
Water Quality: The Proposed Project and alternatives idling of fields will result wind erosion of soils which will be deposited into tributaries which will degrade water quality of those tributaries with the associated contaminant loads. The contaminant loads from fallowed field wind and water erosion into surface water tributaries was not fully addressed in the EIS/R because the location and number of fields was not defined by the Proposed Project and alternatives. This significant impact must be more specifically analyzed for the field locations, number and distribution and the significant impacts to surface water quality mitigated and disclosed.

Response
Soil properties are discussed in Section 3.4, Geology and Soils. Based on the low erodibility of soils within the seller service area, impacts resulting from wind erosion on idled fields will not significantly degrade water quality in the region.

Comment LA12-171

Comment
Water Quality: Water quality impacts vary greatly depending on the tributary and groundwater substituted, e.g. Berryessa and Putah Creek flow transfers would mobilize a disproportionate amount of Hg. Transfers from Friant to Westlands would mobilize a disproportionate amount of Se. Both of these project impacts are not fully addressed in the EIS/R. This significant impact must be more specifically analyzed for the tributary locations, timing of

substitution and transfer, and volume of those transfers and the significant impacts to surface water quality for the project mitigated and disclosed.

Response
Project impacts are addressed for water bodies that could potentially be affected by the project. Berryessa and Putah Creek are not part of the action alternatives and are not included in this analysis. Westlands Water District would not be a potential seller under this document, and the Friant Water Authority area is not included as either a buyer or a seller.

Comment LA12-172

Comment
Groundwater: If the transferred water is based on an actual reduction in consumptive use (which will vary with the climate) it will reduce runoff to surface flow and percolation to recharge the groundwater. As an example, ag irrigation quantities include a component for leaching salts below the plant root system. The leaching component of irrigation water contributes to groundwater recharge. In the case of proposed project idling of fields or crop switching to lower water use crops, that irrigation leaching component contribution to groundwater recharge is significantly reduced or eliminated all together. The EIS/R failed to identify, characterize, evaluate, quantify, mitigate or disclose this significant impact from the Proposed Project and alternatives. This material omission in the analysis of the EIS/R must be rectified and submitted for public review in a recirculated document.

Response
Section 3.3.3.4 states, "the reduction in percolation would be less than significant because rice is the primary crop and grown on soils with low permeability." In areas where soils have a low permeability, the amount of percolation through these soils is relatively low. The low permeability is the reason water can be ponded on these surfaces for rice production.

Comment LA12-173

Comment
Groundwater: Groundwater drawdown affects of the proposed project and alternatives on adjacent groundwater wells and changes in direction or magnitude of groundwater hydraulic gradient on contribution to surface water flows was not addressed in the EIS/R. The EIS/R Regional Economics section identified "Groundwater substitution transfers could increase groundwater pumping costs for water users in areas where groundwater levels decline as a result of the transfer." as an adverse project impact. Obviously the groundwater section missed this impact, which is a significant impact and must be mitigated.

Response
As discussed in Section 3.3.2.4, Alternative 2: Full Range of Transfers (Proposed Action), groundwater substitution pumping in Alternatives 2 and 3 is expected to decrease groundwater levels (as shown in Figures 3.3-28 through 3.3-38 and Appendix E). The inclusion of Mitigation Measure GW-1 would avoid potentially significant impacts from groundwater level decreases. See Common Responses 6 and 7 for additional information.

Comment LA12-174

Comment
Groundwater: Subsidence impacts from groundwater drawdown in the seller service area as a result of the project were not addressed in the EIS/R. The EIS/R only addressed the reduction of groundwater subsidence in the buyer's service area as a benefit. Since groundwater substitution in the sellers area is a significant component to the source of water for transfer, the one sided and biased EIS/R analysis where the beneficial impact is disclosed, but the significant adverse impact is ignored and goes unmitigated and disclosed, There is an egregious violation of the requirements and intent of NEPA and CEQA.

Response
Section 3.3.2.4 evaluates land subsidence impacts in the seller service areas. Potentially significant land subsidence impacts in the seller service area will be avoided through mitigation. See Common Response 7 for additional information.

Comment LA12-175

Comment
Groundwater: The amount of groundwater substitution/transfer cannot be greater than the maximum sustainable yield or groundwater aquifer collapse occurs. The Proposed Project does not provide operational limits and the EIS/R analysis does not determine how much water can be sustainably withdrawn from groundwater aquifers without risk of collapsing them. The Proposed Project does not define how much groundwater substitution would occur in each seller area from year to year. With both of these critical information components missing in order to ensure protection of the groundwater aquifers, the EIS/R document is deficient and must be revised to correct these omissions. In order to avoid and mitigate the significant impact of the project on groundwater subsidence, the project must include an alternative for a sustainable rate of groundwater withdrawal and/or propose the sustainable rate of groundwater withdrawal as a mitigation of the impacts of the current Proposed Project and alternatives. This "sustainable groundwater alternative" extraction and transfer amount can be calculated for each seller service area groundwater basin using the following generalized methodology. First, determine the current size (TAF) and annual groundwater recharge for each groundwater basin for the 82 year period of hydrologic record. Second,

determine the safe and sustainable annual quantity of groundwater yield (including maximum rate of groundwater withdrawal without collapsing water bearing strata) in each basin. Now add the groundwater basin (with size, recharge rates and maximum sustainable rates of withdrawals) as a "reservoir" for each groundwater basin and seller service area to CALSIM (or in a post processing module for analyzing CALSIM results). Next, using the 82 year period of record and the CALSIM model, optimize the amount of seller area water deliveries for each groundwater basin area. Determine the amount of groundwater extraction for transfer that does not accrue into an over-draft of the groundwater basin at any time during the 82 year period of record. The maximum groundwater substitution amount that does not result in over-drafting the groundwater in any year in the 82 year hydrologic period of record will be the maximum contract delivery amount for that groundwater basin and seller service area for use in the "sustainable groundwater" EIS/R alternative or as a mitigation for the significant groundwater aquifer collapse impacts of the Proposed Project. The EIS/R also fails to identify impacts to infrastructure (roads and bridge structural integrity and safety, canal capacity and structural integrity and safety), and other resources (such as surface water drainage) that occur from groundwater withdrawal caused ground level subsidence.

Response

Estimates of safe yield have not been previously calculated for the Sacramento Valley. In lieu of estimates of safe yield, multiple technical studies have been conducted to evaluate the potential impacts to groundwater levels. The models used in these studies were deemed to be the best available tools. The models simulate changes in groundwater levels that may result from the alternatives discussed in the EIS/EIR (see Appendices B and D for more information on the modeling effort). The models were used to estimate the changes in groundwater level that may result from the groundwater substitution pumping in Alternative 2. The results of the model simulations are shown in Section 3.3.2.4. Several figures in Section 3.3 show the historical groundwater levels in several wells throughout the Sacramento Valley. In general, groundwater levels tend to decline in dry or drought periods. In wetter years groundwater levels recharge. The current dry period appears to show trends in decreasing water levels similar to previous years. Figures 3.3-28 through 3.3-33 show the potential change in groundwater level due to groundwater substitution pumping. These figures are for simulated conditions in a historically dry year (1976) and following four years of substitution pumping in a dry period (1990). Figures 3.3-34 through 3.3-38 provide a graphical representation of the change in groundwater level with and without groundwater substitution pumping at several locations in the Sacramento Valley. Appendix E contains figures for additional locations. The rate of aquifer recovery (or recharge) can be seen in the rate at which the blue line (Alternative 2) approaches the dashed-red line (Baseline). Mitigation Measure GW-1 includes actions to avoid potentially significant impacts from groundwater level declines and subsidence. See Common Responses 6 and 7 for additional information.

Comment LA12-176

Comment
Geology & Soils: The EIS/R evaluated the potential loss of top soil from fallowing, but did not address the different soil erosion potentials that occur in different seller areas. The EIS/R analysis must be revised to reflect the site specific soil erosion characteristics at the seller areas; otherwise the analysis is programmatic rather than project specific and would require subsequent environmental analysis prior to implementation of the project.

Response
Figures were added to show, more specifically, the seller water district locations in relation to different surface soil textures. The impact analysis was revised to add detail based on these figures. There were no material changes to the conclusions of the impacts analysis based on the additional information.

Comment LA12-177

Comment
Geology & Soils: The EIS/R did not address salt accumulation and resulting reductions on soil productivity from the water transfers on the buyer areas. The EIS/R analysis must be revised to reflect the continued and increased salt accumulation of soils and reduced soil productivity from the proposed water transfers.

Response
Transfer water would go to existing agricultural lands; it would not be used to expand agricultural production. Hence, there would be no increase in the amount of land that would be irrigated. Transferred water used in the buyer service areas would be surface water, which has lower salinity levels than groundwater. Finally, there are ongoing regional efforts to address the issue of salt accumulation and decreased soil productivity. One such program is Central Valley Salinity Alternatives for Long-Term Sustainability (CV SALTS), which is looking at sustainable salinity and nitrate planning for the Central Valley. These efforts will occur in parallel with the water transfers and continued irrigation in the Central Valley and will develop and implement solutions to salinity issues.

Comment LA12-178

Comment
Geology & Soils: Water released from CVP or SWP facilities for water transfers is on top of the water that would have been released in the No Action/No Project. Most of the water transfer releases of the Proposed Project will be on top of higher natural flows so that less carriage water is required and water diversion yields of the transferred water will be highest at the south delta pumps. This extra flow increment of the transferred water on top of the flows

that would be there under the No Action/No Project will result in increased erosion of banks in the tributary reaches below the dams. As an example of this impact, see DWRs settlement agreement and compensation to Emerald Farms on the lower Feather River from increased erosion from the SWP operations. These flow related impacts to bank erosion are a real impact of the Proposed Project and alternatives. The EIS/R failed to analyze these identify, characterize, evaluate, quantify, mitigate or disclose these impacts.

Response
Discussion in the EIS/EIR has been clarified to address these potential impacts. The flow increases would only occur during the dry season of dry and critical years and would result in less than significant impacts to bank erosion. The Flood Control and Recreation sections of the EIS/EIR also address changes in river flows under the Proposed Action, and conclude that impacts would be less than significant.

Comment LA12-179

Comment
Air Quality: The EIS/R identifies a benefit from the reduction of emissions from farm equipment that would not be operated on fallowed water seller fields, but does not address the increase in emissions from farm equipment being operated on buyers fields that would have otherwise been fallowed. This shifting of air quality impacts from farm equipment operations from northern California to the southern central valley is a significant impact as the northern counties generally do not have a problem meeting their air quality attainment requirements and the bay area and southern central valley counties are constantly in violation of their air quality attainment requirements. The EIS/R identification of a beneficial impact while ignoring the more than offsetting corollary significant impact demonstrates the one sided biased nature of the impact assessment. The EIS/R must be revised to disclose and mitigate the air quality impacts of the farm equipment operated in the buyers area under the proposed project which would not occur under the No Action/No Project.

Response
As described in Chapter 1, "[w]ater transfers would be used only to help meet existing demands and would not serve any new demands in the buyers' service areas" (see page 1-1). It is not known at the time of this writing how the buyers would participate in any potential water transfers, so it is not feasible to estimate potential emission increases to the same level of detail as was completed for the sellers. However, because water would only be used to meet existing demand and not to increase growth, any use of farming equipment by the buyers would not be greater than under existing conditions. As such, it is not possible to conclude that impacts would be significant.

Comment LA12-180

Comment
Air Quality: The EIS/R claims that dust from fallowing fields is an overall benefit because there is no tilling and harvest associated dust. This analysis and conclusion is completely biased and is not supportable. Much more soil is eroded from a field that is fallowed and bare of all vegetation all year as compared to a field that is tilled and harvested. This impact is not a benefit, it is a significant impact that must be mitigated.

Response
Fugitive dust emissions from wind erosion, land preparation, and harvesting were estimated using methodologies published by the California Air Resources Board (see CARB 1997, CARB 2003a, and CARB 2003b, as referenced in Section 3.5, Air Quality). The emission calculation methodologies published by CARB support the conclusion in the EIS/EIR that more fugitive dust is generated by land preparation (e.g., tilling) and harvesting than by wind erosion. As a result, no revisions to the EIS/EIR to change the significance determination are required.

Comment LA12-181

Comment
Air Quality: Increased air pollution from increased groundwater and other pumping (e.g. CVP/SWP lift pumps and groundwater pumps) under the proposed project is a significant impact, not a less than significant impact as the EIS/R determined. This significant impact must be mitigated.

Response
As described in Section 3.5, Air Quality, Mitigation Measures AQ-1 and AQ-2 would reduce any potentially significant impacts to less than significant levels. The air quality analysis was conservative in that it assumed every pump for a given water agency would operate continually during project implementation and would be a "noncertified" diesel engine if additional information regarding engine specifications was not known. As a result, any predicted emissions from groundwater substitution are maximized when possible; therefore, the EIS/EIR correctly concludes that air quality impacts would be less than significant with implementation of mitigation measures AQ-1 and AQ-2.

Comment LA12-182

Comment
Climate Change: The EIS/R is analysis is fundamentally flawed because the future project condition to 2024 did not include sea level rise, precipitation or other climate change impact assumptions. NEPA requires the end condition of the project period to be analyzed, in this case 2024. The BDCP has incorporated climate change in its analysis of conditions in 2025, so this EIS/Rs

omission of climate change for 2024 is a serious inconsistency in how climate change is addressed between these two similar projects. Reclamation is a lead agency on both projects, both projects cover the same water systems and geographic areas and resources; and yet the BDCP addresses climate change in 2025 and this EIS/R does not for 2024. NEPA guidance and specifically USACE and EPA in their analytical requirements for a 401 permit, require consideration of climate change. Department of Interior, USACE and EPA all have specific methods and assumptions which are required to be utilized in an EIS. The project failed to incorporate these methods and assumptions. This EIS/R must be revised to incorporate climate change assumptions in its Proposed Project, Alternatives and No Action/No Project assumptions. A 401 permit for this project must not be issued without analysis that includes climate change that is consistent with Department of Interior, USACE and EPA analytical method requirements and assumptions.

Response

As described in Appendix B, Water Operations Assessment, "[t]he Project's ten-year period allows simulation of a single level of development under the assumptions that conditions are not likely to change significantly over such a short time horizon" (see page B-19). By its very nature, CalSim II incorporates any influence from climate change into the modeling because it considers long-term hydrologic influences from 1922 through 2003 (page B-19). The CalSim II baseline study was further revised in collaboration with Reclamation to account for an existing level of development, requirements, and projects (see page B-5). As a result, the analysis is consistent with the requirements of NEPA and additional modeling is not required.

The action alternatives would not involve any activities that would trigger the need for permitting under Section 401 of the Clean Water Act. As a result, it is not necessary to change the EIS/EIR to incorporate any additional information required for Section 401 permitting.

Comment LA12-183

Comment

Climate Change: Fallowed fields do not transpire so the cooling effect of the growing crops would not occur in acres fallowed from the implementation of the proposed project or alternatives which include crop idling. Some publications have speculated that the central valley is 10+°F cooler in the summer due to crop irrigation as compared to non-irrigation of the current irrigated acres. The fallowing of crop acres from the project would have similar impacts as those widely recognized for urban heat island effects. The EIS/R is deficient as it did not identify, characterize, evaluate, quantify, mitigate or disclose these impacts and it must be revised to address these omissions.

Response
Any cropland idling that could occur because of a water transfer would only occur during a given water year, and would not be a long-term impact that could cause a permanent temperature increase from the fallowed fields. Additionally, fallowing fields is a normal agricultural practice used by the individual farmers.

Comment LA12-184

Comment
Climate Change: Greenhouse gas emissions from increased groundwater and other pumping (e.g. CVP/SWP lift pumps and groundwater pumps) is a significant impact, not a less than significant impact as the EIS/R determined. This significant impact must be mitigated.

Response
As described in Section 3.6, Climate Change, GHG emissions could increase by 20,078 tons of carbon dioxide equivalent per year under the Proposed Action. As described in the chapter, the significance threshold for GHG emissions was identified as100,000 tons per year; therefore, the EIS/EIR correctly concluded that emissions would be less than significant and no changes to the EIS/EIR are required.

Comment LA12-185

Comment
Aquatic Resources: Increased deliveries of CVP/SWP south of delta service areas of Sacramento Valley basin water supply increases the proportion of "foreign basin" introduction of water and drainage water to the tributaries downstream of the water transfer receiving service areas. The water transfers under the proposed project increases the proportion of foreign basin water into the tributaries downstream of the service areas receiving these transfer waters. The out of basin water has a different signature as a homing cue for anadromous fish, especially salmonids. False attraction of migrating fish from out of basin water is well documented in published literature and is a major problem with central valley salmonid reproductive survival rates and genetic introgression which is a direct threat to the species diversity and viability. The proposed project is particularly problematic for increasing salmonid straying from out of basin water transfers in that the years where the proposed project water transfers are anticipated to be most active are the years where otherwise the CVP/SWP would have the lowest operational impacts on out of basin caused salmonid straying and genetic introgression. As an example, in 2014, CVP and SWP deliveries to the agricultural users that are the proposed project recipients of the water transfers, their 2014 water deliveries from the CVP and SWP were 0%. This means that in 2014 there would have been no straying and genetic introgression from out of basin transfers from these areas for the San Joaquin River and the South San Francisco Bay and their tributaries. With the proposed project, the out of basin transfers would occur on years of low and no CVP and

SWP deliveries which will result in an increase in the proportion of out of basin water in the downstream drainage tributaries and in the rate of salmonid straying, associated mortalities and loss of fecundity and genetic introgression impacts on the species genetic integrity and diversity as compared to the No Action/No Project condition. In the case of years with 0% CVP/SWP water deliveries, to go from zero straying impact from the CVP/SWP operations under the No Action/No Project condition to some increased amount of straying impact is an increase of infinity percent as compared to the baseline condition that occurs without the project water transfers. The EIS/R failed to identify, evaluate, quantify, mitigate or disclose this impact.

Response
The water entering the Delta has historically come from both the Sacramento and San Joaquin rivers and their tributary sources. There is high variability in the spatial and temporal dynamics of water moving through the Central Valley, and native fishes have evolved to manage this variability. The potential transfer of water under the Proposed Action does not add "foreign" or "out of basin" water. Foreign or out of basin water would be new water from outside the Central Valley, which does not occur under the Proposed Action. Potential transfers only slightly change the quantities of water from various sources that have historically flowed through the Delta system and to which native fishes have evolved. The majority of water flowing through the Delta already comes from the Sacramento River.

Comment LA12-186

Comment
Aquatic Resources: The EIS/R must be revised to evaluate the year to year potential geographic distribution of the sellers and to evaluate the worst case scenario of the distribution (or lack thereof) of the sellers. Since the EIS/R did not evaluate a worst case scenario for how the sales would be distributed, the project must not be approved or permitted for operations that would result in more geographically concentrated impacts than what was represented in the analytical assumptions in the EIS/R. The EIS/R assumed an average water transfer contribution from all seller areas for the available transfer capacity for each water year type. The EIS/R average geographic distribution of water seller assumption for the impact analysis is actually the best case scenario for the least impacts as the impacts are equally spread and are reduced in severity in any geographic location the most of any of the potential operational scenario. Any other scenario of seller distribution would result more significant impacts than the average seller distribution assumption used in the EIS/R analysis. The EIS/R should have conducted and disclosed some sensitivity analysis in which the extremes of operational scenarios were tested and evaluated for their environmental impacts. Several of these scenarios that represented the worst potential impacts from the project should have then been fully evaluated to disclose the range of impacts that could or would be precipitated by implementing the proposed project. Only under that "bookend" of worst case

scenarios analytical approach should the project be awarded permits that allow the full amount of water transfer proposed with a full set of mitigations to cover the worst case scenarios that would address these impacts. The current EIS/R analysis took the most optimistic (and completely unrealistic) assumption of an evenly distributed geographic spread of water transfer operations and impacts. Under the current set of analysis assumption that assumes only average seller water allocation in the transfers, each of the identified seller areas should be only allowed to transfer the averaged amount of water that was actually analyzed in the EIS/R. Any more water than that allowed under the operations would precipitate impacts that were not analyzed, mitigated or disclosed. Here is a description and analysis of the current critically flawed analytical assumptions the EIS/R used in its impact analysis. The maximum proposed water transfer by the identified water sellers is 511,094AF. In all water years except Critical, Consecutive Dry, and Dry after Critical; the FWS OCAP BO says that the maximum transfer that can be conducted under the permitted conditions is 360,000AF (see related comments). The EIS/R makes the erroneous assumption that the 360,000AF would be evenly distributed across the seller's area. In reality, the impacts would never be so perfectly distributed and reduced in their severity. The EIS/R should have, as described earlier in this comment, tested a number of scenarios in which the transfer water was concentrated with various combinations of sellers. The EIS/R should have evaluated the impacts of all of the transfers coming from a single drainage basin under these limited subscription conditions, e.g. all from the Feather River or American River basin and none from the Sacramento River/Shasta drainage basin and visa versa. The scenario of all water transfers from one basin and none from another basin is very plausible as snowpack could favor one basin over another and make more or less water available for transfer or operational considerations of reservoirs in one basin vs. the other could make water storage much more or much less feasible. The EIS/R should have evaluated at least two scenarios of different distribution of willing sellers. These are: all available sellers from the Sacramento and Feather River Service area with none from any of the other seller service areas and another scenario of all transfers being from Merced River, Delta, American River, Yuba River, and Feather River with none from the Sacramento River. To analyze the salmonid straying effects of the project (see related comments), these scenarios should have also included maximum differences in flow contributions from different operational scenarios for each tributary confluence. At the minimum, these should have included max operations on the Sacramento and no operations on the Feather River and Yuba (and visa versa), max operations on the Feather River and none on the Yuba (and visa versa), max operations on the Sacramento, Feather and Yuba rivers and none on the American (and visa versa). The concept proposed by the project of "backed up water" (see related comments) where water is released earlier in one tributary (e.g. Feather River), water is stored in another tributary basin (e.g. Shasta) and then released later in the other tributary (e.g. Sacramento River) has many more complex flow and water temperature impacts than just the raw number of acre feet in the transfer would indicate by just considering the "upper limits" of transfers as presented in the EIS/R Table 2-5. In the case of "backed up water", the flow impacts on proportional flows at a tributary confluence are doubled. Under the backed up water operational scenario of the proposed project operations, all of the water identified by willing sellers in the Feather and Yuba River and could be released earlier than they otherwise would have in lieu of releases that would have occurred from Shasta. This results in an increase of Feather River flows and a relative decrease in Sacramento River flows at the confluence of the rivers. This is a 2x change in proportional flows at the tributary confluence (e.g. Feather and Sacramento River confluence} (+90,000AF in the Feather River and -90,000AF in the Sacramento River} as compared to the No Action/No Project during the release period. The proposed project does not define when or how short a time period a backed up water transfer could occur (presumably limited by available excess capacity for transfer), but in the absence of supported assumptions provided by the EIS/R we must assume the worst case period ohime and volumes so as to be protective of the endangered fisheries species resources. If the analysis does not specify when, where and how these reservoir backup water transfers would occur, the agencies must assume the worst case scenario and limit the project permitted operations accordingly to assure ESA fish protections. Without these potential flow and temperature change analyses at the confluences of the salmonid migratory tributary confluences, the potential impacts of the range of operations that the project has proposed have not been evaluated, quantified, mitigated or disclosed. The EIS/R is deficient for the lack of this analysis which must be rectified when the document is revised and recirculated.

Response
The EIS/EIR evaluated a maximum transfer scenario in which all transfers would occur based on the available capacity in the Delta. This is a worst case scenario for potential impacts. The range of potential transfers analyzed is based on actual potential sellers that have identified some level of willingness to participate. This EIS/EIR does not include transfers from sellers not included in Chapter 2. Therefore, the transfers were geographically distributed based on actual potential seller locations, including groundwater pumps they identified to include in groundwater substitution transfers, and it would not be realistic to model scenarios where all transfers are "geographically concentrated." See response to Comment LA12-143. Appendix B describes the transfer operations modeling assumptions.

Comment LA12-187

Comment
Aquatic Resources: The Terrestrial species impact analysis determined that "Groundwater substitution could reduce stream flows supporting natural communities in small streams" was a significant impact for alternatives 2 and 3. If groundwater impacts on streams can be significant for terrestrial species, how can it not be significant for aquatic species? The EIS/R must be revised to correct this impact call omission in the aquatic species section.

Response
The nature and relevance of reduced stream flows for terrestrial species differ from those for aquatic species. For the riparian natural community, the root zones of the vegetation would be dewatered, resulting in a significant impact. For fish, the spatial and temporal overlap of flow reductions with fish species would be minimal, resulting in a less than significant impact.

Comment LA12-188

Comment
Aquatic Resources: Vegetation removal from Bouldin Island was required for a water transfer to Semitropic Water District in 2014. The herbicide application resulted in the damage to 10s of thousands of acres of agricultural crops and wildlife habitat. Since Bouldin Island is in the very middle of the delta, the herbicide spray drift that impacted terrestrial habitat would have also have to have contaminated hundreds of acres of aquatic habitat. In this case the aquatic habitat damaged included designated critical habitat for San Joaquin steelhead and Chinook salmon, green sturgeon, delta smelt and other special status species. Previous water transfers have proven that this is a real risk of this type of project and these risks must be evaluated. The EIS/R failed to identify, characterize, evaluate, quantify, mitigate or disclose these very real potential impacts of the proposed project. The EIS/R must be revised and recirculated to address these material omissions and deficiencies in the document.

Response
The Bouldin Island incident was an isolated incident that is still under investigation. For cropland idling transfers, the lead agencies monitor idled lands to look for excessive vegetation that may be resulting in consumptive use of water on the property. If they determine excessive vegetation is present, they request the landowner to disc the field, not to apply herbicide.

Comment LA12-189

Comment
Wildlife: The sellers identified are mostly water districts. When water districts transfer water they typically rotate the fallowed lands from year to year so not the same fields or owners are participating from year to year. The EIS/R just assumes there will be some even distribution of the fallowed fields across a water district. They do put some constraints on adjacency to wildlife refuges, but other than that, the fallowing could occur in any location or in any combination of locations or concentrations. By not having specific locations or a very specific rule set about how fallowed fields can be distributed within a water district, the analysis of the impacts from field fallowing is at a programmatic level of detail, not a project site specific level of detail. The rules for how fallowed field are distributed in a water district are not specific enough to allow detailed analysis of impacts. The lack of specificity of the location and distribution of fields also does not allow for impact analysis to wildlife. There

are some vague assurances from the project about not disrupting habitat corridors, but they do not say how this would be determined, what threshold of disruption is acceptable or unacceptable. A single fallowed field is disruptive to habitat connectivity by itself, is that too much? How about two adjacent fields fallowed, too much or OK? How about 3 contiguous fields or 30 contiguous fields? The EIS/R assurances to not disrupt habitat are so vague that these questions cannot be answered and therefore these assurances by the project are meaningless. The EIS/R must be revised such that project specific levels of detail on the impacts of field fallowing are conducted. Although the agencies can approve a programmatic EIS/R, this project, because of its lack of project-level analysis of impacts, must have a subsequent environmental analysis prior to implementation.

Response

The commenter incorrectly states that the Draft EIS/EIR assumes an even distribution of fallowed fields across a water district. The Draft EIS/EIR lists the upper limits in acre-feet of water by transfer type for each district/water agency (Table 2-5), but does not assume or require that transfers be distributed across the district in a particular manner. Page 3.8-35 (Section 3.8.2.1.2) of the Draft EIS/EIR explains that the exact locations of cropland idling/shifting actions would not be known until the spring of each year, when water acquisition decisions are made. The initial decision about whether to idle a parcel is made by the individual landowner.

As further described on page 3.8-35, the effects of cropland idling/shifting are evaluated based on the total acreage idled/shifted, the frequency with which cropland idling/shifting is expected to occur, the value of that cropland to special-status species, and the degree of habitat fragmentation that would likely occur. Reclamation and SLDMWA consider this information sufficient to determine if potentially significant impacts could occur as a result of the identified range of potential water transfer activities. Regarding habitat corridors, water sellers must maintain adequate water in major irrigation and drainage canals used as movement corridors within idled croplands. The analysis acknowledges that cropland idling/shifting has the potential to contribute to habitat fragmentation (page 3.8-35), but this impact was determined to be less than significant based on existing variability of the landscape.

Comment LA12-190

Comment

Wildlife: Farmed fields contribute wildlife habitat values for foraging, refuge, and mating. Fallowed bare ground impacts wildlife by altering habitat values and uses and overall provides lower habitat value than a cultivated field, e.g. no flooded rice when fallowed. Loss of habitat on the international flyway, which the seller areas are in a core area of, impact the United States compliance with the International Migratory Bird Treaty which was not addressed in the EIS/R.

Response
As acknowledged throughout Section 3.8 of the EIS/EIR, fallowed agricultural lands provide suitable habitat for a variety of wildlife species. The value of fallowed versus flooded rice is dependent on the species, with some species benefiting from rice field idling (i.e., Swainson's hawk). Because the range of potential transfer activities analyzed in this EIS/EIR is not expected to adversely affect migratory birds, implementation of those activities would not be in violation of the Migratory Bird Treaty Act.

Comment LA12-191

Comment
Wildlife: Southern Central Valley land that has been fallowed and is put back into production due to a water transfer will destroy the habitat values that have been created while the field was fallowed. Some of the species that move into fallowed fields that would have their habitat destroyed by putting the field back into production by the water made available by the water transfers include giant garter snake, tiger salamander, Alameda whip snake, San Joaquin kit fox, San Joaquin kangaroo rat, and others. The project failed to quantify and mitigate these impacts.

Response
As described in Section 1.1, the purpose of the potential water transfer activities analyzed in this EIS/EIR is to alleviate water shortages and help meet existing demand in water districts identified in the buyer's service area. Water transfers are not expected to result in the conversion of non-agricultural habitat to active cultivation.

Comment LA12-192

Comment
Wildlife: If a field is fallowed for up to 10 years under the Proposed Project, habitat values will be created. The project fails mitigate for the destruction of these created habitat values that will occur at the end of the project period when these lands are put back into production.

Response
Although it is possible for one specific parcel to be fallowed every year as a result of potential water transfer activities, that scenario is highly unlikely and speculative at best. As described in Section 2.3.2.2 of the Draft EIS/EIR, water transfers would not occur every year, but only in years when there is demand from buyers and pumping capacity is available to convey the transfers (generally dry and critical years). Because crop rotation and idling are a common practice in managed agricultural landscapes, variation within this habitat type from year to year is common and implementation of the potential transfer activities analyzed in this EIS/EIR will not result in permanent destruction of wildlife habitats.

Comment LA12-193

Comment

Wildlife: Vegetation removal from Bouldin Island was required for a water transfer to Semitropic Water District in 2014. The application of herbicide for vegetation removal resulted in the damage to 10s of thousands of acres of agricultural crops and wildlife habitat. In this case the habitat damage included critical habitat for giant garter snake, riparian brush rabbit and rat, tiger salamander, greater sandhill crane, San Joaquin steelhead and Chinook salmon, green sturgeon, delta smelt and other special status species. This spray drift damage has been well documented and publicized (http://wineindustryinsight.com/?p=54211, http://www.winebusiness.com/blog/?go=getBlogEntry&datald=l35322, http://www.lodinews.com/news/article 3c58d352-f196-11e3-8efa-0019bb2963f4.html, http://rivernewsherald.org/articles2014/bouldin 8-6-2014.html). Bouldin Island is only 5,900 acres. The proposed project could idle as much as 177,000 acres in a year if it utilized its maximum transfer capacity covered under the EIS/R using mostly the crop idling strategy component of its proposed project water conservation. If the transfers were maximized for the 10 year project period and utilized mostly crop idling as its water conservation strategy then over the 10 year project period, there would be as many as 1,770,000 acres that required herbicide treatment. If only 1% of the herbicide treatments for the proposed project water transfers go as badly as the Bouldin Island water transfer, the impact of these water transfers could damage 100s of thousands of acres of wildlife habitat. Previous water transfers have proven that this is a real risk of this type of project and these risks must be evaluated. The EIS/R failed to identify, characterize, evaluate, quantify, mitigate or disclose these very real potential impacts of the proposed project. The EIS/R must be revised and recirculated to address these material omissions and deficiencies in the document.

Response

See response to Comment LA12-187 for impacts associated with herbicide application at Bouldin Island. Regarding acres of habitat affected, Tables 3.8-8 and 3.8-9 list the maximum cropland idling/shifting that would occur from long-term water transfers in a given year is as much as 51,473 acres of rice and as much as 8,500 acres of upland crops. The 177,000 acres referenced by the commenter refers to acre-feet of water and not acreages of land.

Comment LA12-194

Comment

Land Use & Agriculture: Improved irrigation management and scheduling as a water conservation measure should have been included as a component to some of the alternatives.

Response
Improved irrigation management and scheduling in the buyers' area are measures that are part of the Agricultural Conservation (Buyer Service Area) Alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives as it would not be immediately implementable and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment LA12-195

Comment
Land Use & Agriculture: The timing and method of vegetation removal was not adequately defined in the EIS/R to ensure water conservation. As an example a previous comment alluded to, Bouldin Island vegetation management was very late, so much of what was supposed to be conserved was not. The EIS/R has failed to provide descriptions, process, monitoring and contingency plans to guarantee idled crop land does not continue to transpire and use water that was supposed to be conserved.

Response
The only conservation transfer analyzed in the Draft EIS/EIR is from Browns Valley Irrigation District. This project replaced a distribution canal with a pipeline to reduce water use by vegetative growth along the canal. This conservation transfer does not include herbicides or other forms of vegetation management.

Comment LA12-196

Comment
Land Use & Agriculture: Long term transfers conflict with Williamson Act conservation as long term fallowed ground with no vegetation is no longer agriculture.

Response
Water transfers would not result in the permanent conversion of agricultural land uses that are incompatible with Williamson Act contracts. As described in the Land Use and Agriculture section, cropland idling would be temporary in nature and would not result in a permanent conversion of agricultural lands. Landowners would annually choose whether to idle their fields to transfer water and could place fields back into production the following season. Further, buyers have indicated cropland idling transfers are the lowest priority transfer method under the Proposed Action; therefore, it is unlikely that the maximum cropland idling transfer would occur over consecutive years.

Comment LA12-197

Comment
Land Use & Agriculture: Transfers include water conserved from "crop shifting". If a grower was to plant alfalfa (very water consumptive use intensive) and then they say they will take that crop out and plant winter wheat instead and sell the water that was "saved" by not continuing to grow the water use intensive crop, it opens the whole project to gaming and false water savings.

Response
Alfalfa is eligible for cropland idling or shifting on a case-by-case basis. Table 2-3 states, "Only alfalfa grown in the Sacramento Valley floor north of the American River will be allowed for transfers. Fields must be disced on, or prior to, the start of the transfer period. Alfalfa acreage in the foothills or mountain areas is not eligible for transfer." Reclamation will not allow crop shifting if it does not result in a reduction of consumptive use for the crops. As described in Chapter 2, Reclamation has a process in place to account for water savings for crop shifting transfers. See Common Response 14.

Comment LA12-198

Comment
Land Use & Agriculture: "Cropland idling water transfers could permanently or substantially decrease the amount of lands categorized as Prime Farmland, Farmland of Statewide Importance, or Unique Farmland under the FMMP." was determined in the EIS/R to be a Less Than Significant impact for alternative 2. This is an error as irrigation of the land is a core requirement of the definition of "prime farmland. The proposed project and alternatives take irrigation water away from as much as 177,000 acres in any alternative that includes land fallowing. Alternative 2 includes land fallowing, so it is a significant impact. Alternative 2 may have less of this impact than alternative 4, but it is still significant and must be mitigated.

Response
In order for agricultural lands to be categorized as Important Farmland on the Farmland Mapping and Monitoring Program (FMMP) maps, they must have been used for irrigated agricultural production at some point during the four years prior to the Important Farmland Map date (mapping is completed every two years), and the soils must meet the physical and chemical criteria determined by the U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS). Therefore, for lands to be reclassified out of Important Farmland categories, the same parcel would need to be idled for four consecutive years. Transfers would not change the soil characteristics of land. The maximum annual cropland idling under both the Proposed Action and Alternative 4 would be 59,973 acres, as shown in Tables 3.9-14 and 3.9-15 in the Land Use and Agriculture section.

Comment LA12-199

Comment
Land Use & Agriculture: The EIS/R fails to identify increased weed pressure on properties adjacent to fallowed fields. This results in additional herbicide applications being required, which has environmental impacts and costs for the adjacent land owner. The EIS/R must be revised to identify, characterize, evaluate, quantify, mitigate and disclose this impact.

Response
This issue has not been observed by Reclamation or DWR staff responsible for monitoring water transfer operations.

Comment LA12-200

Comment
Land Use & Agriculture: Native grasses and herbaceous plants are slow to colonize highly disturbed soils such as idled agricultural fields so the idled fields are primarily initially colonized by exotic and invasive weed species. The EIS/R failed to identify that the proposed project and alternatives operations would increase weed pressure of exotic and invasive plant species. These exotic and invasive plants also alter habitat value for foraging and refuge for wildlife.

Response
The majority of fallowed agricultural lands would be rice crops. Consistent with the provisions contained in Water Code Section 1018, Reclamation and DWR recognize that rice fields and irrigation/drainage ditches can provide habitat for terrestrial wildlife and waterfowl species. Potential sellers are encouraged to incorporate measures in their crop idling proposal to protect habitat value in the areas to be idled. CDFW can advise landowners in the use of nonirrigated cover crops or natural vegetation as it applies to the provision of waterfowl, upland game bird, and other wildlife habitat (DWR and Reclamation 2014). While idling cropland can result in degradation of soils from invasive species, DWR monitors fields and advises landowners to avoid these impacts.

Comment LA12-201

Comment
Land Use & Agriculture: The EIS/R failed to analyze proposed project impacts on the suitability of water temperatures for agricultural irrigation beneficial uses. The proposed project increased reservoir releases and tributary flows which result in reduced water temperatures farther downstream which in turn results in increased coldwater impacts on crops. DWR's Oroville Facilities reached a settlement agreement with the water districts which are affected by water temperatures being too cold for crop production. The settlement agreement has resulted in more than a million dollars per year in compensation

to the affected growers. The proposed project operations at Oroville would add to these impacts. Similarly, cold water affects from releases from Shasta reservoir for the project, could precipitate impacts for growers that divert water at TCID and GCID. The EIS/R failed to identify, evaluate, quantify, mitigate or disclose coldwater affect impacts to agricultural irrigation beneficial uses resulting from the Proposed Project or alternatives.

Response
Potential impacts from changes in water temperature are related to lack of adequate cold water supply for fisheries. Transfers are evaluated to determine if there will be a negative impact on the cold water pool in the reservoir needed for later fishery releases. The release of stored water may be beneficially timed to provide instream fisheries benefits.

Thermalito afterbay at the Oroville Facilities serves as a warming basin for agricultural water delivered to farms east of the afterbay, thus addressing potential cold water impacts to agriculture. Increasing storage in the reservoirs could cause increases in the cold water pool, but would not affect water temperatures downstream as water is released. The Feather River water users may experience effects related to cold water; however, Thermalito afterbay and other facilities on the Feather River would not be affected by the action alternatives.

Comment LA12-202

Comment
Land Use & Agriculture: The water transfers must be restricted to avoid inducement of more permanent demand such as conversion of annual crops to permanent crops in the buyer service areas. The EIS/R failed to addressed the impacts of the water transfers in conversion of crop land to permanent crops and development of permanent demand as a result of the project.

Response
The irrigation water in the water transfers will be used for supplemental water supply in dry years. Water transfers will not be used to meet permanent water demand. As stated in Section 1.1 of the EIS/EIR, water transfers would be used to fulfill the need of water users for flexible supplemental water supplies to alleviate shortages.

Comment LA12-203

Comment
Land Use & Agriculture: Fields adjacent and downwind of fallowed fields have yield losses from hot dry and dusty air being blown from the bare fields. This impact was not addressed in the EIS/R.

Response

This impact is addressed in Section 3.4, Geology and Soils. The majority of cropland idling would take place on rice fields. Rice is typically grown on clay soils that are less susceptible to erosion than sandy soils. The rice crop cycle also reduces the potential for erosion. The process of rice cultivation includes incorporating the leftover rice straw into the soils after harvest. The fields are then flooded during the winter to aid in decomposition of the straw. If no irrigation water is applied to the fields after this point, the soils would remain moist until approximately mid-May. Once dried, the combination of the decomposed straw and clay soils produces a hard, crust-like surface. This surface texture would remain until the following winter rains if not disturbed. In contrast to sandy topsoil, this surface type would not be conducive to soil loss from wind erosion. Therefore, idled rice fields would not be conducive to soil loss from wind erosion. In general, soils that contain some percentage of clay content, such as the predominant soils in counties in the sellers service area, are less susceptible to erosion. It is possible that some idling could occur on the more erodible soil textures. While these soils are more susceptible to wind erosion, the amount of potential acres idled is small – a maximum of 1,800 acres of alfalfa, corn, and tomatoes in Glenn, Colusa, and Yolo counties. See Section 3.4.2.4 for a complete analysis of this impact.

Comment LA12-204

Comment

Land Use & Agriculture: Vegetation removal from Bouldin Island was required for a water transfer to Semitropic Water District in 2014. The herbicide application resulted in the damage to 10s of thousands of acres of agricultural crops. In this case the crop damage included large portions of the Lodi wine grape district. This spray drift damage has been well documented and publicized (http://wineindustryinsight.com/?p=54211, http://www.winebusiness.com/blog/?go=getBlogEntry&datald=135322, http://www.lodinews.com/news/article 3c58d352-f196-lle3-8efa-0019bb2963f4.html, http://rivernewsherald.org/articles2014/bouldin 8-6-2014.html) and is estimated to have caused as much as $1Billion in damages. Bouldin Island is only 5,900 acres. The proposed project could idle as much as 177,000 acres in a year if it utilized its maximum transfer capacity covered under the EIS/R using mostly the crop idling strategy component of its proposed project water conservation. If the transfers were maximized for the 10 year project period and utilized mostly crop idling as its water conservation strategy then over the 10 year project period, there would be as many as 1,770,000 acres that required herbicide treatment. If only 1% of the herbicide treatments for the proposed project water transfers go as badly as the Bouldin Island water transfer, the impact of these water transfers could be $3 Billion in damages. If you look at the amount of herbicide damage claims associated with water transfer vegetation removal to date, you will find the damage rate is well above 1%. Just talk to some Forensic Agronomists in California that deal with these types herbicide drift cases (e.g. Rush Markroft, Whaley and Stienberg, Bahme and Associates) to get a realistic rate of damages which occur. DWR has a particularly bad track record (probably among the worst in the state when compared to the amount of damages vs. the number of herbicide applied acres) when it comes to damages to third parties from herbicide applications. If the project claims that some or most of the water conservation will not come from crop idling that require herbicide spray weed control, then they must define these limits and analyze and disclose them in the EIS/R. Previous water transfers have proven that herbicide spray drift is a real risk of this type of project and these risks must be evaluated. The EIS/R failed to identify, characterize, evaluate, quantify, mitigate or disclose these very real potential impacts of the proposed project. The EIS/R must be revised and recirculated to address these material omissions and deficiencies in the document.

Response
See response to Comment LA12-187 for impacts associated with herbicide application at Bouldin Island. As shown in Section 3.9.2.4, Table 3.9-14, the maximum acreage that could be idled under the Proposed Action is 59,973. Buyers have indicated cropland idling transfers are the lowest priority transfer method under the Proposed Action (see Chapter 2); therefore, it is unlikely that the maximum cropland idling transfer would occur in a given year where transfers take place. Remnant vegetation (weeds, cover crop, or over-winter crop) may remain on idled fields. There is no proposal to remove it with herbicide application (DWR and Reclamation 2014). Excess vegetation on idled fields would only require abatement measures following inspection by Reclamation or DWR. Active management would take the form of discing. There would be no large-scale herbicide application as occurred on Bouldin Island.

Comment LA12-205

Comment
Cultural: The impact criteria for cultural resources are incorrect. It is not an impact only if the reservoir levels are drawn down below historical levels, it is an impact if the reservoir drawdown from proposed project and alternatives operations that result in an increase of the frequency and magnitude of archaeological site exposure within the fluctuation zone of the reservoirs. Any increase in the frequency or magnitude of exposure of cultural or archaeological resources is a significant impact of the project. As an example of a correct impact criteria for this resource in a similar environmental document, see the Cultural Resources reports from the California Department of Water Resources Oroville Facilities Relicensing.

Response
Section 3.13, Cultural Resources, states that "[s]ignificant impacts would be determined when operations expose previously submerged resources, increasing their vulnerability to vandalism and other factors; and expose resources to increased cycles of inundation (erosion) and drawdown" (see page 3.13-14).

The significance criteria is consistent with the commenter's statement that impacts would be significant if the frequency or magnitude of exposure to cultural resources is increased. No changes to the significance criteria are warranted.

Comment LA12-206

Comment
Recreation: The impact calls related to reservoir recreation are incorrect. If the proposed project or alternatives result in an increase in the frequency or earlier calendar date of boat ramp dewatering, then the impact is significant and must be mitigated. As an example of a correct impact criteria for this resource in a similar environmental document, see the Recreation Resources reports from the California Department of Water Resources Oroville Facilities Relicensing.

Response
The impacts to reservoir recreation in the Draft EIS/EIR consider how changes to water surface elevations and river flows could affect recreation at reservoirs potentially affected by transfers. Boat ramp use is a popular recreation activity at the various reservoirs and is reflective of reservoir recreation use. Thus, it is a reasonable parameter to use in analyzing the alternatives' effects to reservoir recreation in the context of the stated significance criteria within the EIS/EIR.

The effects in the Recreation Resources reports from the California DWR Oroville Facilities Relicensing are different from those that would occur in connection with the range of potential transfer activities evaluated under the Proposed Action, thus the use of different significance criteria is appropriate.

Comment LA12-207

Comment
Power: The EIS/R misses the main impact of the proposed project and alternatives 2 and 4 in the impact of increased energy demand from groundwater pumping and from groundwater level drawdown. The amount of groundwater pumping the project can create definitely could be a significant impact to power resources in northern California, especially with power transmission line capacity constraints in the areas where the groundwater power demand can be anticipated. Additionally, "backed up reservoir" water transfers which are include in the proposed project and all alternatives alter the timing and location (see related comments) of hydroelectric power generation associated with these releases as compared to the No Action/No Project. The EIS/R failed to consider these power generation timing and location, changes in location and timing of power consumption and constraints and impacts on power transmission from the proposed project and alternatives. The EIS/R must be revised to correct these omissions and propose mitigations for these undisclosed significant impacts.

Response
The EIS/EIR analyzes the impact of increased groundwater pumping (and the associated increase on energy demand) on climate change (see Section 3.6). The EIS/EIR discloses the anticipated timing of changes in power generation from the alternatives in Section 3.16.2.

Comment LA12-208

Comment
Flood Control: The impact calls relative to project impacts on reservoir storage are flawed. Reservoirs are multipurpose, including flood control and water supply. Flood control comes first in terms of overriding operations as adequate flood control reserve must be managed in the flood control season. If the reservoirs are lower due to proposed project operations, there is no impact to flood control operations as flood control reserve releases are less likely to be triggered and therefore the project has no impact. If flood control reserve releases are activated when the reservoir is fuller due to proposed project operations, the water stored by the project will be spilled first.

Response
Although the commenter is correct that flood operations supersede reserve releases, there will still be an incremental change in storage from existing operational conditions under the action alternatives. As stated in Section 3.17.2, decreases in reservoir storage levels in project-related facilities could potentially benefit flood control; these changes would be very small and would not provide a substantial benefit. No change has been made to the document.

Comment LA12-209

Comment
Regional Economics: "Water transfers from idling alfalfa could increase costs for dairy and other livestock feed." This impact category misses the fact that alfalfa would be one of the primary crops not grown in the component of the proposed project for "crop shifting". When rotation away from water use intensive forage crops in crop shifting is added to the loss of these crop acres in the fallowing part of the proposed project and alternatives, the impact to forage supplies and feed prices to local dairies the impacts could be significant.

Response
See response to Comment LA14-14. Crop shifting was added to this discussion. Use of alfalfa in transfers will be on a case-by-case basis and is limited in some areas. Table 2-3 states, "Only alfalfa grown in the Sacramento Valley floor north of the American River will be allowed for transfers. Fields must be disced on, or prior to, the start of the transfer period. Alfalfa acreage in the foothills or mountain areas is not eligible for transfer."

Comment LA12-210

Comment

Regional Economics: The EIS/R does not disclose if the water transfers are paying proportionate fees for conveyance as the water districts that are paying for the SWP and CVP facilities construction and operations.

Response

Buyers are responsible for fees for use of state and federal facilities to deliver water to their service areas. Water transfers will not affect fees for other state or federal water contractors. Reclamation does not have input regarding the prices of water transfers, as price is negotiated between buyers and sellers. NEPA does not require a discussion of costs in an EIS.

Comment LA12-211

Comment

Regional Economics: Vegetation removal from Bouldin Island was required for a water transfer in 2014. The use of an unregistered combination of herbicides and misapplication of them has resulted in the damage to 10s of thousands of acres of agricultural crops. In this case the habitat damage included critical habitat for giant garter snake, riparian brush rabbit and rat, tiger salamander, greater sandhill crane, San Joaquin steelhead and Chinook salmon, green sturgeon, delta smelt and other special status species. This spray drift damage has been well documented and publicized (http://wineindustryinsight.com/?p=54211, http://www.winebusiness.com/blog/?go=getBlogEntry&datald=l35322, http://www.lodinews.com/news/article 3c58d352-f196-11e3-8efa-0019 bb2963f4.html, http://rivernewsherald.org/articles2014/bouldin 8-6-2014.html) and is estimated to have caused as much as $1Billion in damages. Bouldin Island is only 5,900 acres. The proposed project could idle as much as 177,000 acres in a year if it utilized its maximum transfer capacity covered under the EIS/R using mostly the crop idling strategy component of its proposed project water conservation. If the transfers were maximized for the 10 year project period and utilized mostly crop idling as its water conservation strategy then over the 10 year project period, there would be as many as 1, 770,000 acres that required herbicide treatment. If only 1% of the herbicide treatments for the proposed project water transfers go as badly as the Bouldin Island water transfer, the impact of these water transfers could be $3 Billion in damages. Previous water transfers have proven that this is a real risk of this type of project and these risks must be evaluated and $3 billion in damages to the crops in the seller service areas from the project is a substantial impact to the agricultural industry and local economies that the EIS/R failed to evaluate. The EIS/R failed to identify, characterize, evaluate, quantify, mitigate or disclose these very real potential impacts of the proposed project. The EIS/R must be revised and recirculated to address these material omissions and deficiencies in the document.

Response
See responses to Comments LA12-106 and LA12-204. There would be no large-scale herbicide application as there was on Bouldin Island. All transfers in the Delta will be evaluated on a case-by-case basis. Past cropland idling transfers in other areas of the seller service area have not reported crop damages. Section 3.10 evaluates the potential economic effects of the maximum cropland idling transfers in the seller service area. NEPA and CEQA do not require mitigation for economic effects.

Comment LA12-212

Comment
Environmental Justice: Fallowed ground and shifting to lower water use intensive crops which are typically less labor intensive than more water intensive crops has significant impacts on disadvantaged local communities, employment opportunities, the working poor, and minority farm workers. Regional economics identifies that 500 people would lose their jobs in the water sellers area from fallowing and crop shifting. The vast majority of these people would be minorities. The EIS/R impact call of "No disproportionately high or adverse effect" is not only incorrect, it is not even a proper NEPA or CEQA impact call.

Response
Effects on minority and low-income communities, including farmworkers, are addressed in Section 3.11. As stated in Section 3.11.2, environmental justice effects are analyzed as a part of NEPA and are not considered significant environment effects under CEQA; therefore, no significance determinations are made or mitigation measures required in the impact analyses. Terms such as "adverse and disproportionate" are adequate terms used to describe environmental justice effects as stated in the Council on Environmental Quality's "Environmental justice: guidance under the National Environmental Policy Act." (1997). As described in Section 3.11.2.1.3, to determine if an effect would be adverse and disproportionately high on minority populations, this analysis compares losses in farmworker employment as a result of transfers to total farmworker employment in the region. The change is compared to historical fluctuations in farm worker employment in the region. As shown in Table 3.11-13, cropland idling transfers under the Proposed Action could decrease farm labor demands in environmental justice affected areas by 0.01 percent; however, these effects would be temporary in nature and minimal compared to total farm labor. Effects to the buyer service area would be beneficial, as proposed transfers would increase water supplies in environmental justice affected areas and support farm worker and other employment opportunities.

Comment LA12-213

Comment
Growth inducement was not a section included in the ES summary. Growth inducement consideration is a NEPA requirement.

Response
Growth inducing impacts were evaluated in Chapter 5, Section 5.3. A summary of impacts has been added to the Executive Summary.

Comment LA12-214

Comment
These water transfers result in an increase of the economic disparity between the value of water used for agriculture vs. M&I uses. M&I water uses can justify costs in excess of a thousand $ per acre foot. Almost no crops can be economically grown at a comparable cost to the values that can be justified for M&I uses. The proposed project water transfers inducement creation of permanent demand such as for industrial, urban, commercial or permanent crop use because those water uses can always afford to pay more than the value of the water if it were used for normal row crop production. Therefore, creation of this long term water transfer opportunity from the project has significant growth inducement impact from permanent shifting of water use location and beneficial use that must be evaluated, quantified, mitigated and disclosed by the project. The EIS/R must not be approved until these material deficiencies in how it addresses growth inducing impacts are rectified.

Response
There is no evidence that “These water transfers result in an increase of the economic disparity between the value of water used for agriculture vs. M&I uses.” In general, an increased availability of transfer supply should reduce costs for all users. Water transfer prices are set between willing sellers and willing buyers. SLDMWA has purchased water transfers in past years despite urban water transfers also occurring at sometimes higher prices. Therefore, SLDWMA and its member agencies have not been priced out of the water transfer market and will continue to negotiate water transfers in the future with willing sellers. Water transfers are not a reliable source of water each year. Transfers depend on willing sellers, hydrologic conditions, regulatory restrictions, and capacity to pump through the Delta. These factors can vary each year and can prevent transfers from occurring. Therefore, water transfers would not result in a permanent water source. Growth inducing impacts are discussed in Chapter 5.

Comment LA12-215

Comment
Long-term transfers resulting from this project encourage reliance on this water supply. Annual transfers as an alternative for comparison do not. This difference in growth inducement must be evaluated.

Response
See response to Comment LA12-213.

Comment LA12-216

Comment
The EIS/R analysis must be specific as to each transfer and cumulatively. This cumulative analysis must be in conjunction with single year water transfers and other long-term transfers such as the Lower Yuba River Accord.

Response
Each resource section in Chapter 3 includes a cumulative analysis that evaluates long-term water transfers with other individual transfers, including SWP water transfers and the Lower Yuba River Accord.

Comment Letter LA13, Terry Erlewine, State Water Contractors

Comment LA13-1

Comment
The State Water Contractors ("SWC") appreciate the opportunity to review and comment on the Draft Environmental Impact Statement/Environmental Impact Report ("EIS/EIR") prepared by the Bureau of Reclamation ("Reclamation") and the San Luis & Delta-Mendota Water Authority ("SLDMWA") for the proposed Long-Term Water Transfers Project (the "Project"). The SWC understand that Reclamation is serving as the lead agency under the National Environmental Policy Act ("NEPA") and that SLDMWA is serving as the lead agency under the California Environmental Quality Act ("CEQA"). These comments are provided by the SWC for both NEPA and CEQA.

As Reclamation and SLDMWA know, the SWC is a nonprofit mutual benefit corporation that represents and protects the common interests of its 27 members [Footnote: The SWC members agencies are: Alameda County Flood Control and Water Conservation District Zone 7; Alameda County Water District; Antelope Valley-East Kern Water Agency; Casitas Municipal Water District; Castaic Lake Water Agency; Central Coastal Water Authority; City of Yuba City; Coachella Valley Water District; County of Kings; Crestline-Lake Arrowhead Water Agency; Desert Water Agency; Dudley Ridge Water District; Empire-West Side Irrigation District; Kern County Water Agency; Littlerock Creek Irrigation District; Metropolitan Water District of Southern California; Mojave Water Agency; Napa County Flood Control and Water Conservation

District; Oak Flat Water District; Palmdale Water District; San Bernardino Valley Municipal Water District; San Gabriel Valley Municipal Water District; San Gorgonio Pass Water Agency; San Luis Obispo County Flood Control & Water Conservation District; Santa Clara Valley Water District; Solano County Water Agency; and Tulare Lake Basin Water Storage District.] in California's State Water Project ("SWP"). Collectively, the SWC member agencies utilize the SWP and other facilities to deliver water to more than 26 million residents throughout the state and to more than 750,000 acres of agricultural lands. Hence, the SWC have an interest in any project that may impact SWP water supplies.

As described in the EIS/EIR, the Project covers a 10-year period (2015 through 2024) during which water could be transferred between willing sellers and buyers through groundwater substitution, reservoir release, conservation, and other mechanisms. More specifically, the Project would allow Central Valley Project ("CVP") contractors in areas south of the Delta or in the San Francisco Bay area to purchase transferred water. The transferred water would be conveyed to the purchasers by the sellers through the Delta using existing CVP or SWP facilities and pumps.

After reviewing the EIS/EIR, the SWC have several questions regarding the Project and its environmental analysis. Accordingly, the SWC respectfully request that Reclamation and SLDMWA provide further discussion regarding the items identified below in order to more fully comply with NEPA, CEQA, and those laws' respective public disclosure and analysis requirements. Specifically, the SWC's questions relate primarily to the analysis of, and mitigation for, potential impacts associated with the Project's groundwater substitution and reservoir re-operation elements.

Response

Analysis of groundwater substitution and reservoir release transfers is included in Section 3 of the Draft EIS/EIR and summarized in Table 2-9. Information in response to the commenter's specific comments and questions is provided below.

Comment LA13-2

Comment

1. The SWC request that Reclamation and SLDMWA clarify the criteria for assessing the magnitude of impacts. Based on the SWC's review of the EIS/EIR, it is unclear how thresholds of significance or magnitudes of impacts were utilized to determine whether the Project would result in significant impacts to water supplies. The SWC request that the EIS/EIR be clarified to identify with greater specificity how thresholds were applied in both the groundwater substitution and reservoir re-operation contexts, and what specific magnitude of impacts were used when arriving at a significance conclusion.

Response
The following clarifies the groundwater substitution significance criteria and how effects related to them were evaluated:

(1) A net reduction in groundwater levels that would result in substantial adverse environmental effects or effects to non-transferring parties. Simulated groundwater levels were compared to average domestic and municipal/irrigation well depths shown in Table 3.3.-4. See Common Response 6.

(2) Permanent land subsidence caused by significant groundwater level declines. Simulated groundwater levels were compared to historic lows (see Table 3.3.-5) to determine the potential for subsidence. See Common Response 7.

(3) Degradation in groundwater quality such that it would exceed regulatory standards or would substantially impair reasonably anticipated beneficial uses of groundwater. Migration of reduced quality groundwater is not likely to be a concern unless groundwater levels and/or flow patterns are substantially altered for a long period of time.

The first significance criterion was clarified to indicate that effects to the environment or non-transferring parties must be substantial to be characterized as significant. This change was made to be consistent with CEQA guidelines, which indicates that a substantial change to a resource leads to a significant impact. This change does not affect the findings of significance in the groundwater analysis, but rather clarifies that those findings of significance are based on a substantial change.

Comment LA13-3

Comment
Similarly, when determining whether the Project would result in significant impacts to groundwater resources as a result of groundwater substitution, the EIS/EIR asks whether the Project would cause "[a] net reduction in groundwater levels that would result in adverse environmental effects or effects to non-transferring parties." (EIS/EIR, p. 3.3-61). Thus, the threshold suggests that any net reduction in groundwater levels or any effect to non-transferring parties (regardless how small) may be significant. The SWC request that the EIS/EIR more clearly identify what standard/magnitude of impact was used for assessing significance. Similarly, the threshold asks whether the Project would result in "adverse environmental effects." The SWC's request clarification regarding how "adverse environmental effects" were assessed and what magnitude of impact was used when reaching the significance conclusions in the EIS/EIR.

Response

Groundwater Mitigation Measure GW-1 requires the development of an approved monitoring and mitigation plan to ensure compliance with performance standards and avoid potentially significant impacts from groundwater substitution pumping. Common Response 6 provides additional information. In counties where BMOs currently exist, the BMOs will be used as monitoring criteria. In counties where BMOs do not exist, critical changes to groundwater levels will be avoided through close coordination with third parties.

Comment LA13-4

Comment

Finally, the EIS/EIR could avoid ambiguities by answering the following questions. Is any amount of “permanent land subsidence” considered significant, and how did Reclamation and SLDMWA determine whether “significant groundwater level declines” would occur in the first instance? (See second threshold at EIS/EIR, p. 3.3-61; see also third threshold which appears to be incomplete at EIS/EIR, p. 3.3-61). The SWC request that the EIS/EIR be clarified to more specifically identify how Reclamation and SLDMWA determined the significance/magnitude of Project impacts.

Response

See Common Response 7 regarding subsidence and Common Response 6 regarding groundwater levels. The third threshold is complete; the typographical error at the end of the bulleted phrase has been corrected.

Comment LA13-5

Comment

2. The SWC request that Reclamation and SLDMWA expand the analysis of impacts and also clarify the “Environmental Commitments” and Project features that are relied upon to prevent impacts from arising. a. The SWC request a further elaboration on the Project’s impacts on water supply and surface/groundwater interactions. The discussion of water supply impacts and surface/groundwater interaction confirms the Project’s groundwater substitutions will cause reduced Delta Pumping Station exports on an annual basis. (EIS/EIR, p. 3.1-17). However, it is unclear how those reductions were calculated or during which specific months of the year they are likely to arise. As the EIS/EIR notes, the Biological Opinions (“BiOps”) applicable to the Coordinated Operations of the CVP and SWP typically limit the bulk of Delta exports to the months of July through September. (EIS/EIR, pp. ES-9, 1-11). Accordingly, if Project-induced reductions in exports are all concentrated within a narrow-window (particularly during summertime peak exports), the overall impact on water supply may be disproportionately large. The SWC request clarification regarding what month(s) reductions in exports are likely to occur and what impacts to water supply exports may result.

Response
Section 3.1 has been revised to clarify when the impacts are likely to arise.

Comment LA13-6

Comment
Similarly, the SWC request further discussion regarding the groundwater substitutions. Specifically, the SWC request explanation of which specific surface flows are likely to see the largest flow reductions; when those flow reductions are most likely to manifest; and what the magnitude of those reduced volumes may be. As the EIR acknowledges throughout Section 3.3, the geographic area covered by the Project is large and it hosts a wide variety of hydrological and geologic conditions (annual rainfall, volume of groundwater basin, depth to groundwater, etc.). These varying conditions presumably make certain surface flows more vulnerable to the effects of groundwater substitution impacts than others. (See EIS/EIR, p. 3.1-16 [Figure 3.1-2]). Thus, the EIS/EIR should provide a stream-by-stream discussion of whether flow reductions are likely; when those reductions are likely to arise; and what the magnitude of those reductions may be. As described below, mitigation could then be tailored to more specifically address those impacts.

Response
The impacts of the streamflow depletion, as related to groundwater substitution transfers, on fisheries and on vegetation and wildlife are described in Sections 3.7 and 3.8, respectively. These sections identify estimates of streamflow depletion for smaller streams throughout the Sacramento Valley and provide details on streams that have changes with the potential to affect environmental resources.

Comment LA13-7

Comment
The EIS/EIR also confirms that reservoir re-operations will cause a drawdown in reservoir levels. (EIS/EIR, p. 3.1-19). It is anticipated that this drawdown volume would, over time, be replaced by water that would otherwise flow downstream. (EIS/EIR, p. 3.1-18). However, and again as the EIS/EIR alludes to, there are certain flow and salinity requirements arising from the BiOps that regulate Delta exports. If water that would normally flow downstream and assist in meeting BiOp requirements is now withheld in upstream reservoirs (for example, flows that would normally enter the Delta from the San Joaquin River), that could reduce the SWC's ability to export water from the Delta, an impact that should be described in greater specificity in the EIS/EIR.

Response
The analysis conducted in preparation of the EIS/EIR analyzed both the releases from the reservoir that create additional drawdown, and reductions in releases and downstream flows that refill reservoirs. This analysis included simulation

of current regulatory obligations of the CVP/SWP including the biological opinions. Reservoirs cannot, and do not, refill by reducing downstream flows at times when those reductions would result in violation of requirements such as the biological opinions or SWRCB decisions. Rather, reservoirs refill when storage levels approach and reach flood control limits, and at times when water available in the system is in excess of all regulatory requirements. This is true in both the analysis conducted for the EIS/EIR and in actual operations.

Comment LA13-8

Comment
The EIS/EIR also states that reservoir re-operations may result in reservoir drawdowns that require more than one season to refill. (EIS/EIR, p. ES-11). It is unclear how refill would occur, if at all, in periods of multiple drought years akin to the drought conditions that exist today. Ultimately, the SWC request that the EIS/EIR discuss in greater detail how compliance with the BiOps' flow requirements, water quality requirements (such as salinity targets), and release timing requirements would be affected by reservoir re-operations.

Response
Chapter 2.3.2.1 describes how reservoir releases would occur and how refill would occur. In consecutive multiple dry years, the reservoir may not refill completely until subsequent wet conditions occur. Each refill agreement will specify periods when refill should not occur because of downstream conditions; these periods include Delta balanced conditions, times when water is used to meet downstream water quality or flow standards, and times when the water could have been stored in a downstream CVP or SWP reservoir. If refill does occur during these periods, it would affect the CVP and SWP (which would continue to meet standards in the absence of the additional flow). The refill agreement specifies how refill would be monitored to prevent these effects, and compensate the CVP and SWP for the effects if they are not fully avoided. Further detail would be identified in a refill agreement between the seller and Reclamation in coordination with DWR.

Comment LA13-9

Comment
With regard to cumulative impacts, the SWC request clarification of the discussion regarding groundwater substitution and reservoir re-operation. The EIS/EIR confirms that the cumulative effects analysis spans a ten year period (2014-2024). (EIS/EIR, p. 3.3-91). However, elsewhere the EIS/EIR states that residual reservoir drawdowns and stream flow effects may linger for more than one season, potentially even after any transfers have been completed. The SWC request further discussion to confirm that the Project's impacts have been captured, including those impacts that may remain even after the 10-year transfer period has concluded. Additionally, it is unclear how the cumulative impacts analysis accounts for the combined pressures of existing CVP and SWP

operations, the ongoing drought, the potential effects of BiOps, and other projects. The SWC request that an expanded discussion of those issues be provided.

Response

The TOM analysis used to determine the water supply impacts associated with the alternatives used a 34-year analysis period, from water year 1970 through 2003. This model captured various water year types, including multiple dry years (i.e., 1987-1992) to anticipate future conditions under the alternatives. The cumulative analysis in each resource area considers cumulative effects in combination with this entire operational period, so impacts that extend after the last transfer are captured. The modeling analysis results in a description of potential changes associated with the action alternatives under a variety of hydrologic conditions (including extended drought) under the current biological opinions and operational pressures.

The cumulative projects analyzed in the Draft EIS/EIR are based on those that could be implemented during the Proposed Action's 10-year transfer period. The fact that effects could extend for a year or two after the transfer period ends was considered in determining the list of cumulative projects under consideration. For this effort, however, there are no additional projects that could result in cumulative impacts. Commenters have suggested that the BDCP should be included in the cumulative section, but the earliest features would not be complete until 11 years after construction begins (which is still several years away). Commenters also suggest the Yolo Bypass Salmonid Habitat and Fish Passage could be a cumulative project. This effort, which is part of the Reasonable and Prudent Alternative under the NOAA Fisheries Service Biological Opinion on Long-Term Operations of the CVP and SWP, is not likely to be completely constructed and operational before 2024. But even if it were operational during period when transfer effects are still present, these two projects would not have similar effects. The Yolo effort could increase flow into the Yolo Bypass by 6,000 cfs during wet periods, but the range of potential transfers analyzed in this EIS/EIR would not be in effect during these wet periods.

Comment LA13-10

Comment

b. The SWR request that “Environmental Commitments” and Project features be further specified. The EIS/EIR puts forward a number of measures intended to prevent water supply impacts from occurring. The SWC appreciate those efforts, and agree that proactive management is appropriate to prevent impacts from arising. However, the SWC believe that the proposal could be improved with more specific details of those measures specified as part of the current EIS/EIR process. As one example, all transfers (including both groundwater substitution and reservoir re-operation) are subject to a “carriage water” requirement that is aimed at

> maintaining water quality in the Delta. (EIS/EIR, p. 2-29). It is unclear if this carriage water factors is intended to be duplicative of the stream flow depletion requirement imposed by Mitigation Measure WS-1, or if the carriage water concept is an entirely separate and distinct requirement.

Response
Section 2.3.2.4 has been revised to clarify the meaning of carriage water. As the revised description indicates, carriage water and the streamflow depletion factor, as described in Mitigation Measure WS-1, are distinct terms.

Streamflow depletion accounts for the loss of surface water as a result of groundwater and surface water-groundwater interaction. Carriage water is the amount of water used to increase the outflow from the Delta to maintain Delta water quality and account for conveyance losses.

Comment LA13-11

Comment
As another example, the EIS/EIR states that all reservoir re-operation transfers would be subject to a "refill agreement" between the seller and Reclamation to prevent impacts to downstream users. (EIS/EIR, p. 2-11). However, it is unclear how quickly refill would be required or how such an agreement would be enforced. Likewise, the EIS/EIR states that the refill agreements would require refill of reservoirs only when it would not adversely affect downstream water users." (EIS/EIR, p. 3.1-19). It is unclear to the SWC what standards apply for making that determination and which party (the seller, the buyer, the downstream water user, or DWR/Reclamation) would have the burden to prove or disprove any adverse impact. The SWC request clarification of the specific performance standards and enforcement mechanisms for the refill agreements, such as withholding water to refill reservoirs only occurs during times when Delta water exports are not occurring.

Response
See response to Comment LA13-8.

Comment LA13-12

Comment
The EIS/EIR also confirms that Delta water quality may be adversely impacted by reduced flows or changed timing of flows. Thus, "Reclamation and DWR would need to either decrease Delta exports or release additional flow from upstream reservoirs to meet flow or water quality standards." (EIS/EIR, p. 3.1-16). The SWC request further details on how this Reclamation/DWR process would be implemented; which entity would bear responsibility for documenting the decision; and what factors Reclamation and DWR anticipate applying in deciding whether to cut water supply exports or release upstream reservoir volumes. Similarly, the SWC request elaboration on whether upstream

reservoir volumes are likely to be available, particularly as the EIS/EIR elsewhere confirms that total reservoir volume is likely to decrease for more than one season at a time. (See EIS/EIR, p. ES-11).

Response
The EIS/EIR indicates that water quality could be affected if the CVP and SWP would not reoperate to address these changes, but the document concludes that they would alter operations to continue to meet water quality and flow standards. Decisions would continue to be made through the same process as currently exists. Operators of the CVP and SWP water systems would continue to operate the systems, as they currently do, to meet all flow and water quality standards.

Comment LA13-13

Comment
Finally, the EIS/EIR states that transferred water would only be used to meet existing needs and not future or expanded needs. (EIS/EIR, pp. ES-1, 101). The SWC request elaboration on how this Project feature will be monitored to ensure no unanticipated impacts will arise.

Response
During the 10-year implementation period of the range of potential transfer activities evaluated under the Proposed Action, parties wishing to transfer water would submit information to Reclamation to show that the proposed transfer incorporates the provisions included in this EIS/EIR and would not result in any new or substantially more severe environmental impact than those identified in this environmental document. Reclamation would not approve transfers that do not fit within the selected action alternative without additional environmental documentation. See Common Response 14.

Comment LA13-14

Comment
3. The SWC request that Reclamation and SLDMWA clarify the mitigation to ensure performance with specific criteria. Here – separate and apart from the “Environmental Commitments” and Project feature concerns addressed above – the SWC believe Mitigation Measure WS-1 requires the implementation of a stream flow depletion factor, which will be developed at a future date and subject to change, and which will be designed to offset any water supply impacts and prevent conflict with the “no injury” rule that may otherwise arise from groundwater substitution transfers. (EIS/EIR, p. 3.1-21). However, measure WS-1 does not identify what specific minimum depletion factor would be required. Instead, it appears that this decision is left largely to DWR and Reclamation’s future discretion. The SWC request further elaboration on how this factor would be developed and enforced, and

the SWC recommend that a minimum stream flow depletion factor percentage be established now as part of the current EIS/EIR process.

Response
See Common Response 8 regarding clarifications to Mitigation Measure WS-1 in response to comments.

Comment LA13-15

Comment
Likewise, measure WS-1 provides that the stream flow depletion factor will be established “in consultation with buyers and sellers.” (EIS/EIR, p. 3.1-21). However, many of the entities that may suffer injury as a result of any approved transfer are actually downstream water recipients that are neither the buyer nor the seller in the transfer. Thus, the SWC request that measure WS-1 be modified to state that any depletion factor will only be established in consultation with buyers, seller, and other potentially affected parties.

Response
See Common Response 8 regarding clarifications to Mitigation Measure WS-1 in response to comments. In addition to these clarifications, the lead agencies note that Reclamation and DWR are responsible for protecting CVP and SWP water supplies. As such, including these agencies in the process to determine any potential changes to the minimum depletion factor would represent other potentially affected parties.

Comment LA13-16

Comment
Further, measure WS-1 states that no water transfer will be approved if it violates the "no injury rule." (EIS/EIR, p. 3.1-21). The SWC request that the Mitigation Measure be revised to elaborate on who bears the burden of providing/disproving injury, and what information would be relevant to that determination.

Response
See Common Response 8 regarding clarifications to Mitigation Measure WS-1 in response to comments.

Comment LA13-17

Comment
Similarly, the SWC request that Mitigation Measure GW-1 be revised to further explain how long-term decreases in surface flows will be prevented or mitigated. As set forth above, the EIS/EIR confirms that surface flows may decrease as a result of increased groundwater pumping. The EIS/EIR confirms that surface flows may experience some decrease over baseline conditions as groundwater basins subsequently recharge. Without further details, it appears

that surface water flows may be decreased for a period of 10+ continuous years as transfers result in an ongoing tradeoff between groundwater pumping and groundwater recharge (both of which would reduce flows in surface stream). Thus, the SWC would appreciate further explanation of how Mitigation Measure GW-1 will prevent that long-term reduction in surface flows from occurring. One recommendation is to provide a body-by-body performance standard that states how much reduction in surface water flows would be allowed and over what time period in order to assure that no significant impacts result.

In conclusion, the SWC thank Reclamation and the SLDMWA for the opportunity to review and comment upon the EIS/EIR. The SWC appreciate the Project's overall goal of increasing flexibility and reliability with regard to management of CVP water supplies. However, the SWC do request that Reclamation and SLDMWA expand on the issues identified above in order to comply with CEQA and NEPA. SWC believe it is necessary to provide a fuller and more complete environmental analysis under NEPA and CEQA to help ensure that the Project does not provide a benefit to certain water providers to the potential detriment of others.

Response
See response to Comment LA08-4.

Comment Letter LA14, Patrick Blacklock, Yolo County

Comment LA14-1

Comment
The County of Yolo ("County") submits this letter to provide its initial comments on the Long Term Water Transfers Draft Environmental Impact Statement/Environmental Impact Report ("Draft EIS/EIR"). The County is continuing to review the Draft EIS and may submit further comments in early 2015.

Altogether, the Executive Summary of the Draft EIS/EIR indicates that up to 86,000 acre-feet of surface water could be transferred each year from 2015 through 2024 from properties within Yolo County to buyers in the San Luis & Delta-Mendota Water Agency ("SLDMA") service area, as well as the Contra Costa Water District and East Bay Municipal Utility District. The County's comments focus on proposed transfers within Yolo County and, in particular, on the potential transfer of up to 35,000 acre-feet annually ("af/yr") from Conaway Ranch. Notwithstanding this letter's focus on transfers from Yolo County, however, the following comments apply equally to other proposed transfers and the Draft EIS/EIR generally.

Response
The lead agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment LA14-2

Comment
As an overall matter, the County disagrees with the conclusion that Alternative 2 (the "Proposed Action" analyzed in the Draft EIS/EIR) will not have any significant, unavoidable adverse effects. Even considering the "environmental commitments" described in Chapter 2 of the Draft EIR/EIS, it is objectively unreasonable to conclude that the potential transfer of slightly over 500,000 af/yr and associated groundwater substitutions, cropland idling, and other measures within the selling areas will somehow not cause any significant, unavoidable adverse effects. There are a host of specific reasons why this conclusion is inappropriate, including an overreliance on assumptions that lack a sound evidentiary basis and other factors discussed in the following section of this letter.

Response
The EIS/EIR completes a very rigorous analysis before reaching the conclusions related to the impacts in each resource area. These conclusions are based on the best available tools for analysis and reasonable forecasts of future conditions. The determination that the action alternatives would not result in significant impacts is also based on mitigation measures included in multiple resource areas; several of these mitigation measures could limit transfers below the amounts proposed (such as mitigation in air quality and groundwater resources).

Comment LA14-3

Comment
Altogether, these analytical flaws distort the comparison of the Proposed Action to other alternatives that could reduce environmental effects associated with cropland idling (Alternative 3) and groundwater substitutions (Alternative 4). The deficient analysis of the Proposed Action's environmental effects compromises the analysis of Alternatives 3 and 4, as well as the ultimate conclusion that those alternatives are not "environmentally superior" to the Proposed Action.

Response
Refer to response to Comment NG03-139 for discussion of the environmentally superior alternative.

Comment LA14-4

Comment
The timeframe for analysis—a ten-year period between 2015 and 2024—is also artificial and appears to have been contrived for the purpose of environmental analysis, independent of any proposed transactions or other relevant factors. A shorter transactional timeframe (such as five years) should be used to ensure that environmental effects are appropriately studied as they become apparent, rather than dismissed several years from now by virtue of the inappropriate use of a ten-year period in the Draft EIS/EIR.

Response
During the ten-year implementation period for the range of potential transfer activities evaluated under the Proposed Action, parties wishing to transfer water would submit information to Reclamation to show that the proposed transfer incorporates the provisions included in this EIS/EIR and would not result in any new or substantially more severe environmental impact than those identified in this environmental document. Reclamation would not approve transfers that do not fit within the selected action alternative without additional environmental documentation. See Common Response 14.

Comment LA14-5

Comment
These fundamental flaws in the Draft EIS/EIR are alone sufficient to support revising the document in several respects, as noted more specifically below. The Draft EIS/EIR should also be recirculated for further public review after these deficiencies are addressed.

Response
CEQA requires an EIR to be recirculated for public review if "significant new information" is included, as that term is defined in Section 15088.5(a) of the CEQA Guidelines.

As a result of the public comments received, the Lead Agencies have made some revisions to the Draft EIS/EIR. These revisions include updating the affected environment with additional monitoring data now available and clarifying mitigation measures. The revisions do not constitute significant new information under CEQA and recirculation is not necessary.

Comment LA14-6

Comment
The Draft EIS/EIR fails (albeit understandably) to consider recent information relating to subsidence on the Conaway Ranch during the Summer of 2014. A copy of the report on subsidence produced by MBK Engineers on November 12, 2014 is attached hereto. As that report documents, portions of the Conaway

Ranch subsided by up to 17 centimeters (6.5 inches) in a three-month period. That three-month period coincided with the transfer of about 25,000 af of surface water to the Tehama-Colusa Canal Authority via groundwater substitution.

Response
Subsidence noticed at Conaway Ranch has been documented in Section 3.3.1.3.2. Mitigation Measure GW-1 has been clarified in response to public comments and accounts for the recent information relating to the subsidence on the Conaway Ranch. See Common Response 7 for additional information.

Comment LA14-7

Comment
The County acknowledges that it is not possible to determine the relative contribution of increased groundwater pumping and the fallowing of thousands of acres of farmland on Conaway Ranch to the observed subsidence. However, the overall circumstances support a serious concern that further surface water transfers will cause or contribute to similar effects if up to 35,000 af/year is transferred from Conaway Ranch in the future (in addition to 10,000 af/year that Conaway Preservation Group is contractually obligated to deliver to local cities). This concern is particularly acute because the Yolo Bypass passes through Conaway Ranch. The levees of the Yolo Bypass are already known to suffer from various deficiencies, as documented in the Draft EIR for the Central Valley Flood Protection Plan in 2012 and numerous other public documents. Subsidence can further compromise levee integrity (Draft EIS/EIR at p. 3.3-28) and, in turn, increase public safety risks within Yolo County.

Response
See response to Comment LA09-1 and Common Response 7.

Comment LA14-8

Comment
Further analysis is required in the Draft EIS/EIR to determine the potential magnitude of such effects and, in addition, to enable proper consideration of the findings required for surface water transfers by Water Code § 1745.10 (relating to conditions of long-term overdraft in affected groundwater basins). These are serious concerns that deserve specific attention in the Draft EIS/EIR, which should be recirculated after it is revised to include a discussion of the new information available on subsidence within the Conaway Ranch. The potential for adverse short-term subsidence effects should also be considered, as even subsidence of a limited duration could impact levee integrity and increase public safety risks (as well as the environmental consequences of large-scale inundation of urban areas if the Yolo Bypass levees fail).

Response
See Common Response 7.

Comment LA14-9

Comment
In addition, Mitigation Measure GW-1 (Monitoring Program and Mitigation Plans) is legally inadequate. By its own terms, it applies only if "substantial adverse impacts" are determined to occur as a consequence of increased groundwater pumping due to surface water transfers. (Draft EIS/EIR at p. 3.3-90.) It assumes, without any apparent basis, that such "substantial adverse impacts" are entirely reversible and can be reduced to a less than significant level through mitigation plans backed by "financial assurances." Much more is needed to explain the conclusion that such mitigation plans will be effective, that adequate financial assurances can be provided (particularly for impacts on major public infrastructure such as levees), and that Mitigation Measure GW-1 is otherwise sufficient in all instances to reduce even the short-term adverse effects of subsidence and other effects of groundwater pumping to a less than significant level. Additionally, the Draft EIS/EIR should study mitigation measures (or project alternatives) that include common-sense approaches such as lower levels of transfers and/or related groundwater pumping.

Response
See Common Responses 6 and 7.

Comment LA14-10

Comment
The Executive Summary of the Draft EIS/EIR explains that the proposed transfers are primarily intended is to support agriculture within SLDMA boundaries. Ironically however, all of the identified drawbacks of the "no action alternative" in the Draft EIS/EIR--increased groundwater pumping, cropland idling, and land retirement within the SLDMA--could occur within the selling areas if the transfers proceed. These effects range from minor to significant, as explained in Chapter 3.9 of the document.

Response
Water transfers would not result in land retirement in the seller service area. The EIS/EIR includes mitigation measures to avoid or substantially reduce any potentially significant impacts in the seller service area to a less than significant level.

Comment LA14-11

Comment
Despite this, the Draft EIS/EIR does not contain sufficient mitigation measures or other constraints upon the proposed transfers to ensure that the adverse

effects of water shortages are not simply transferred from the SLDMA to the selling areas. There is no legal or practical reason why this should be so. For instance, the Draft EIR/EIS could easily contain safeguards that limit transfers to the extent necessary to avoid environmentally and/or economically significant effects on groundwater pumping, cropland idling, and land retirement within the selling areas. Such mitigation measures (or project alternatives) should be included for consideration in a recirculated version of the Draft EIS/EIR. More detailed consideration of the potential for Alternatives 3 and 4 to reduce such effects should also be included in the recirculated document.

Response
Chapter 3 identifies mitigation measures that would reduce significant impacts to a less than significant level. The evaluation concluded these mitigation measures were sufficient to reduce impacts to a less than significant level and additional mitigation was not needed. See Common Responses 6, 7, and 9 for additional information. Alternatives 3 and 4 are evaluated in the Draft EIS/EIR at the same level of detail as the Proposed Action.

Comment LA14-12

Comment
The Draft EIS/EIR also takes an inappropriately narrow view of "agricultural impacts." It focuses largely on whether cropland idling and changes in cropping patterns will "substantially decrease" the amount of affected farmland designated Prime Farmland, Farmland of Statewide Importance, or Unique Farmland during the limited term of the transfer program studied in the Draft EIS/EIR. This impact is deemed less than significant under Alternative 2, primarily because cropland idling will be for relatively short periods of time during the ten-year duration of the studied transfers.

Response
The analysis uses criteria from CEQA Appendix G to analyze the significance of impacts to agricultural lands as a result of the alternatives. An impact would be significant if it converted FMMP farmland to non-agricultural uses, conflicted with agricultural zoning or a Williamson Act contract, or resulted in other changes that converted farmland to a non-agricultural use. Under the alternatives, there would be no long-term conversion of farmland to non-agricultural use and there would be no conflict with agricultural zoning or Williamson Act contracts. In order for agricultural lands to be categorized as Important Farmland on the FMMP maps, they must have been used for irrigated agricultural production at some point during the four years prior to the Important Farmland Map date (mapping is completed every two years) and the soils must meet the physical and chemical criteria determined by the USDA NRCS. Therefore, for lands to be reclassified out of Important Farmland categories, the same parcel would need to be idled for four consecutive years. Transfers would not change the soil characteristics of land.

Comment LA14-13

Comment

This analytical approach is flawed because the water transfers facilitated by the Draft EIS/EIR will lead to continued demand (post-2024) for additional water transfers to support agricultural, municipal, and industrial uses within the boundaries of the SLDMWA and other purchasing entities. For this reason, the ten-year term of the environmental analysis is entirely artificial. It has no connection to real-world demands, which will extend long past 2024, nor does it have any apparent connection to legal or other characteristics of the proposed transfers. A short-term view of the environmental and economic effects of creating a water transfer program is therefore inappropriate because it can be seen with reasonable certainty that, analogous to the growth-inducing effects of urban development projects, the demand for such transfers will continue beyond the limited life of the program. The Draft EIS/EIR should be revised to account for the basic reality that water transfers will lead to (and likely increase the demand for) more water transfers, well beyond the ten-year period of the analysis.

Response

Water transfers under the Proposed Action and alternatives would continue from 2015 through 2024 and discontinue after that. Growth inducing impacts are discussed in Chapter 5. Water transfers are not a reliable source of water each year. Transfers depend on willing sellers, hydrologic conditions, regulatory restrictions, and capacity to pump through the Delta. These factors can vary each year and can prevent transfers from occurring. Water transfers would not result in a permanent water source that can be relied on to meet existing or future demands.

Comment LA14-14

Comment

Finally, the potential adverse economic impacts of the proposed transfers are considerable, particularly within Yolo, Colusa, and Glenn Counties. The Draft EIS/EIR notes that, among other things, over 40,000 acres in rice land alone in the Sacramento Region may not be farmed due to the potential water transfers. In those three counties alone, up to 362 jobs may be lost and the projected declines in labor income and economic output are $11.1 million and $45.46 million, respectively.

Response

Section 3.10 discloses the potential economic effects of the proposed alternatives. NEPA does not require a judgment of significance or mitigation measures for economic effects. CEQA does not consider economic or social change resulting from a project as adverse effects on the environment. The economic analysis in Section 3.10 meets the regulatory requirements of NEPA and CEQA.

Comment LA14-15

Comment

These economic effects (and the related potential for indirect environmental effects) deserve considerably more analysis. To use one example, the potential decline of rice cultivation in the Yolo Bypass due to water transfers, ecosystem restoration, and other projects (which should be included in an analysis of cumulative impacts) could lead to a "tipping point"—meaning that rice cultivation ceases to be commercially viable even on unaffected lands throughout the County—due to a decline in rice volumes, the resulting closure of local rice mills, and the eventual rise of unit processing costs to unacceptable levels. None of this appears to have received meaningful consideration in the Draft EIS/EIR.

Response

See response to Comment LA14-14. The analysis of rice crop idling did consider "forward linkages" which represent activities after the rice is harvested, including effects to transportation and rice milling. The impacts shown are inclusive of reductions in output, employment, and income to rice mills and transportation. Additional text was added to Section 3.10.2.1.1 to further explain how IMPLAN calculates forward linkages and long-run effects, which could lead to a "tipping point." IMPLAN calculates the long-run effects of reduced rice milling capacities and does not consider the closure of mills. Mills would shut down when operating revenues can no longer cover variable costs. Rice mills generally service rice growers throughout the valley and not in single counties or local areas, meaning they receive high tonnage of rice from expanded areas. The volume of rice proposed for idling and the frequency of idling transfers would not reduce rice milling capacity to a point where the tonnage of rice milled is less than the shut down volume. Ecosystem restoration in the Yolo Bypass under the BDCP would not be implemented during the timeframe of the potential transfer activities evaluated under the Proposed Action according to the implementation schedule for the BDCP. Nor will the Yolo Bypass Salmonid Habitat Restoration and Fish Passage project be implemented during the timeframe of the Proposed Action. Therefore, these projects are not included in the cumulative analysis. See response to Comment LA13-9 for additional information.

Comment LA14-16

Comment

The Draft EIS/EIS concludes that potential adverse effects on habitat availability and suitability for terrestrial species due to cropland idling/shifting under Alternatives 2 and 4 would be less than significant. This is simply wrong, particularly (though not only) for species that depend on flooded agricultural fields and associated irrigation waterways. Not only does this analytical shortcoming render the Draft EIS/EIR deficient under the California Environmental Quality Act ("CEQA") and the National Environmental Policy

Act ("NEPA"), it also calls into question whether the proposed transfers meet the requirements of the Central Valley Project Improvement Act of 1992 (which prohibits water transfers will adversely affect water supplies for fish and wildlife) and similar provisions of the California Water Code (e.g., Cal. Water Code §§ 1725 and 1736).

Response
The commenter alleges, without providing any supporting evidence, that the Draft EIS/EIR's less than significant conclusion regarding impacts of cropland idling/shifting on terrestrial species is wrong and, therefore, is not in compliance with CEQA, NEPA, CVPIA, and the California Water Code. These impacts are analyzed in detail in Section 3.8, and the findings indicate, based on substantial evidence provided therein and in the related technical appendices, that limiting transfers as described in Section 2.3.2.4 would reduce the effects on agriculture-dependent species to less than significant levels.

Comment LA14-17

Comment
For the giant garter snake, the analysis of these issues in the Draft EIS/EIR is particularly deficient. The analysis at pp. 3-8.68 through 3-8.70 is highly general and simply states the obvious (i.e., that some individual members of the species will be subject to increased predation and other risks due to habitat displacement) before concluding that impacts are unlikely to be significant. The conclusion appears to be nothing more than speculation.

Response
As the commenter notes, page 3.8-69 of the Draft EIS/EIR states that any level of cropland idling/shifting would reduce the availability of stable wetland areas during a particular transfer year and may reduce suitable giant garter snake foraging habitat and increase the risk of predation on individual giant garter snakes. These potential impacts as they pertain to potential water transfer activities are more fully described on page 3.8-70. The document explains that an insubstantial amount of rice acreage would be affected in any given year. See Common Response 10 for additional information.

Comment LA14-18

Comment
Also, the "environmental commitments" described at p. 2-29 are unlikely to be sufficient to protect giant garter snake populations in Yolo County. The commitments primarily limit restrictions on transfers from fields "abutting or immediately adjacent to" the "land side" of the Toe Drain along Willow Slough and Willow Slough Bypass in Yolo County. (Draft EIS/EIS at p. 2-29.) This very narrow restriction that fails to fully account for the wide distribution of the giant garter snake across parcels not immediately adjacent to the Toe Drain.

Accordingly, the Draft EIS/EIR does not sufficiently explain how this restriction supports a conclusion that impacts will be less than significant.

Response
The commenter alleges that the environmental commitments are insufficient to protect giant garter snake in Yolo County because they primarily limit restrictions on transfers to a specific area along Willow Slough and Willow Slough Bypass. The purpose of this restriction is to limit water transfers within areas known to support giant garter snake. In addition to specific locations, districts proposing water transfers from idled rice fields must ensure adequate water in priority habitat areas with a high likelihood of giant garter snake occurrences. These areas are identified on priority habitat maps for each of the water districts potentially participating in long-term water transfers and will be maintained by Reclamation. As part of Reclamation's consideration of individual water transfer requests in Yolo County, these maps will be reviewed to determine if priority habitat could be affected and the seller will be required to demonstrate how these habitat areas will be maintained. Potential dispersal corridors must be maintained within water conveyance structures even if adjacent fields are idled. See Common Response 10 for additional discussion.

Comment LA14-19

Comment
Similarly troubling is the complete absence of any analysis of the potential effects of the proposed water transfers on the Swainson's hawk or migratory waterfowl. Numerous passages in Chapter 3-8 indicate that the authors of the Draft EIS/EIR understand that agricultural fields and natural communities affected by the proposed transfers currently support abundant Swainson's hawk and migratory waterfowl populations. Despite this, however, there is no meaningful analysis of potential impacts on the Swainson's hawk or migratory waterfowl. Effects resulting from the fallowing of fields--and for migratory waterfowl, particularly the loss of up to 40,000 in rice annually--need to be analyzed carefully in the Draft EIS/EIR.

Response
Section 3.8.2.1 of the Draft EIS/EIR describes how wildlife, including birds, could be affected by potential water transfer actions. Impacts on special-status birds resulting from proposed water transfers are more fully described on pages 3.8-74 to 3.8-80 of the Draft EIS/EIR. A discussion specific to Swainson's hawk is provided in Table I-1 in Appendix I, which states that potential water transfer activities may alter the composition of foraging habitat for Swainson's hawk within the transfer areas, but that these areas would still provide suitable foraging habitat as fallowed fields and no net loss of foraging habitat would occur. Fallowing of upland crops may reduce some sources of forage for small rodents, which provide prey for Swainson's hawks, but potential water transfer activities are not expected to substantially alter the prey population because fallowing would result in an insubstantial loss of residual feed in upland

croplands (a maximum 2 percent reduction for Glenn, Colusa, and Yolo counties and a maximum 9 percent reduction within Solano and Sutter counties, as stated on page 3.8-63 of the Draft EIS/EIR). Rice idling would result in an increase in potential foraging areas for Swainson's hawk because fallowed lands provide higher foraging habitat value than rice. Pages 3.8-74 to 3.8-80 of the Draft EIS/EIR include an analysis of impacts on migratory birds. Further discussion of effects on migratory waterfowl is provided in Common Response 13.

Comment LA14-20

Comment
Overall, as this letter describes, the Draft EIS/EIR needs significant revisions and recirculation to meet the requirements of CEQA and NEPA. The County requests notice of any hearings or other public discussions of the Draft EIS/EIR or the water transfers studied therein, as well as copies of any documents subsequently produced under CEQA or NEPA for the proposed transfers. Such notice is required by CEQA, as the County is a "responsible agency" within the meaning of that statute. As noted above, the County is continuing to review the Draft EIS and may submit further comments in early 2014.

Response
See response to Comment LA14-5.

Comment Letter LA15, e-PUR, South Delta Water Agency, Central Delta Water Agency

Comment LA15-1

Comment
The analysis in the EIS/EIR of Groundwater Substitution Measures considered within Alternatives 2 and 3 for Long-Term Water Transfers does not properly account the water available. The analysis of the Groundwater Substitution Measures in the EIS/EIR: - improperly quantifies the groundwater depletions that would result from groundwater extraction; - fails to properly account for the timing and quantity of groundwater flow that would have accreted to the rivers as baseflow absent the groundwater extraction; - fails to accurately quantify the effects of exfiltration from the river to groundwater; and - as a result significant quantities of water are being double counted as between available surface water and extracted groundwater. The proposed mitigation measures are inadequate to offset the impacts, in some cases this is due to the inaccurate accounting of water and in other cases it is because the proposed mitigation is too ill-defined to provide substantive protection against impacts.

Response
The modeling completed by Reclamation as part of the EIS/EIR (SACFEM2013, CalSim, Integrated Demand Calculation [IDC], and TOM)

represents a comprehensive analysis of the timing of groundwater substitution pumping and the impact on surface water features. Each of the simulations involved incorporates the temporal nature of the resources being modeled.

Mitigation Measure GW-1 was modeled after the DRAFT Technical Information for Preparing Water Transfer Proposals. Measure GW-1 provides for the monitoring of groundwater resources to ensure compliance with performance standards and the mitigation of impacts, should they occur. See Common Response 6 for additional information.

Comment LA15-2

Comment
The SACFEM 2013 groundwater model utilized for analysis in the EIS/EIR for Groundwater Substitution Measures does not properly account the losses of water in the rivers. This is true due to a number of deficiencies in the model's simulation code, MicroFEM and the SACFEM2013 model's construction. - SACFEM2013 uses a river stage that does not vary over each time step which in effect makes the river an infinite source of water for each time step.

Response
SACFEM2013 includes monthly stress periods. The assigned stage at a modeled stream node changes with each stress period and is spatially variable within a given modeled stream. During a stress period, a modeled stream node could be a source or sink of water, depending on the position of the modeled water table relative to the assigned stream stage at that node. Thus, a river node in SACFEM2013 includes a two-way boundary condition that governs the groundwater-surface water interaction one month at a time. Appendix M includes the SACFEM2013 User's Manual with more information.

Comment LA15-3

Comment
SACFEM2013 does not accurately account the losses of water in the rivers because it does not contain a mathematical algorithm for accounting the flow or quantity of water in the rivers.

Response
It is a fact that SACFEM2013 is a numerical groundwater flow model that does not compute surface flow in the streams themselves, and some conceptual error is introduced as a result. However, the stages of streams are not expected to change significantly within a single model stress period; thus, it was considered reasonable to use a traditional river (wadi) boundary condition to simulate the groundwater-surface water interaction in SACFEM2013.

Comment LA15-4

Comment
SACFEM2013 does not accurately account the water because it treats flow between the river and aquifer as fully-saturated flow even when the model conditions recognize that hydraulically they are detached.

Response
The assertion contained in the comment is incorrect. MicroFEM accounts for the condition when the modeled water table occurs below the base of the streambed and becomes hydraulically disconnected from the stream. Under this condition, the rate of stream leakage is no longer computed according to the difference in the assigned stream stage and the computed position of the modeled water table (head-dependent), but rather is computed as a constant stream leakage according to the difference in the stream stage and the streambed elevation. When the modeled water table occurs higher than the streambed elevation, the groundwater-surface-water exchange formulation automatically switches back to a head-dependent calculation.

Comment LA15-5

Comment
SACFEM2013 has been configured such that extraction from Groundwater Substitution Measures are hydraulically isolated from the river (for example a vertical anisotropy of 500:1 in hydraulic conductivity at the wells in the model substantially isolates them from the rivers)

Response
The assumed vertical anisotropy in the aquifer sediments reflect the layered nature of the valley fill deposits and does not result in hydraulic isolation of the river system from the effects of groundwater pumping, as evidenced by nonzero stream depletion values.

Comment LA15-6

Comment
SACFEM2013 does not represent accurately the depletions to groundwater that must be refilled by natural recharge or other sources due to its handling the rivers as infinite sources during each model time interval

Response
See response to Comment LA15-3.

Comment LA15-7

Comment
SACFEM2013 is not well calibrated to actual conditions of groundwater elevation near rivers and streams. Due to its lack of calibration to actual

groundwater elevation conditions, the predictive outcomes are not reliable as a basis for assessing the locations of impact and the degree of impact to Water Supply, Groundwater Resources, Water Quality, and Terrestrial Resource considerations.

Response

The state of calibration of SACFEM2013 is well within the minimum standards for model calibration used in the industry (See ASTM D5981-96, 2002).

Comment LA15-8

Comment

Neither the quantity of water nor the timing of its removal from surface water is calculated correctly in SACFEM2013 due to the structural deficiencies identified in our review. One of the essential needs in an EIS/EIR on Groundwater Substitution Measures is accurate estimating of the timing of impacts to the flowing rivers and streams; SACFEM2013 does not provide accurate monthly estimates of when peak streamflow depletions will occur if Groundwater Substitution Measures are imposed in large part because of the hydraulic isolation of the pumping from the rivers configured into the model.

Response

See response to Comment LA15-3.

The assumed vertical anisotropy in the aquifer sediments reflect the layered nature of the valley fill deposits and does not result in hydraulic isolation of the river system from the effects of groundwater pumping, as evidenced by nonzero stream depletion values.

Comment LA15-9

Comment

The magnitude of groundwater depletion is underestimated in SACFEM2013 due to its use of infinite river sources.

Response

SACFEM2013 includes monthly stress periods. The assigned stage at a modeled stream node changes with each stress period and is spatially variable within a given modeled stream. During a stress period, a modeled stream node could be a source or sink of water, depending on the position of the modeled water table relative to the assigned stream stage at that node. Thus, a river node in SACFEM2013 includes a two-way boundary condition that governs the groundwater-surface water interaction one month at a time.

Comment LA15-10

Comment
The Proposed Mitigation GW-1 for aquifer desaturation resulting from Groundwater Substitution Measures, GW-1, will not adequately mitigate the impacts to groundwater users in the Seller's Area. This is due in part to the improper accounting of the exchange of surface water and groundwater in SACFEM2013 which attributes too much of the groundwater elevation variability to seasonal recharge and discharge and does not attribute enough of the variability to long term desaturation. However, the Proposed Mitigation, GW-1, will not adequately mitigate for changes in groundwater storage due to the mitigation measure's reliance upon local groundwater-subbasin management-objectives; those objectives are insufficiently quantified and thereby cannot enable timely mitigation of project impacts from Groundwater Substitution Measures.

Response
Each monitoring and mitigation plan required by Mitigation Measure GW-1 will be developed with the specific conditions related to the transfer in question. Reclamation will need to approve the plan prior to approving the transfer. Common Response 6 provides additional information.

Comment LA15-11

Comment
The mitigation proposed for decreases in groundwater saturation of the uppermost aquifer, GW-1, are inadequately considered. SACFEM2013 does not correctly calculate the drawdown of the unsaturated aquifer and its corresponding increase in the weight of the overburden on under consolidated lithologic layers. This will result in greater impacts from Groundwater Substitution Measures than are recognized in the EIS/EIR due to inelastic subsidence and the resulting permanent loss of aquifer storage in the Seller's Area. The proposed mitigation, GW-1, will only recognize or acknowledge inelastic subsidence due to Groundwater Substitution Measures after it has occurred; thus it cannot restore or offset the permanent impact of subsidence.

Response
See Common Response 7.

Comment LA15-12

Comment
The "post-processing tool" referred to under evaluations of Water Supply for Water Operations Assessment does not properly account for water as it uses SACFEM2013, CalSim II, and a spreadsheet model called the Transfer Operations Model (TOM). The potential impacts to Water Supply from

Groundwater Substitution Measures do not properly account the water the sources available and depleted in the Water Operations Assessment.

Response
This comment states that the models (SACFEM2013, CalSim II, and TOM), do not properly account for water, but the comment letter does not provide examples or quantification of the alleged errors. It is the opinion of Reclamation and SLDMWA that collectively these three models do properly account for water and for the physical effects of each of the transfers analyzed.

Comment LA15-13

Comment
The CalSim II model utilized for analysis in the EIS/EIR does not properly account the losses of water in the rivers nor the quantities of accretionary flow of groundwater to rivers within the area modeled. Calsim II provides limited useful information to assess potential surface water impacts as the model contains unfounded assumptions, errors, and outdated simulation codes. The very poor precision of the surface water delivery model (CalSim II) used for the baseline assessment on quantities of water moving in and around the CVP and SWP leads to problems in accounting for water losses due to existing groundwater extraction and proposed groundwater extraction as Groundwater Substitution Measures.

Response
The comment makes generalized assertions regarding the adequacy of the modeling but does not provide specific comment regarding any alleged errors. In the professional judgment of the technical experts who prepared the EIS/EIR and supporting analysis, collectively the models used properly account for water losses and for the physical effects of transfers. Additionally, the stream-groundwater interaction calculations in CalSim II were not used in the analysis for the effects of groundwater substitution transfers on the surface water system. SACFEM2013 results were used for this portion of the analysis and were incorporated in the surface water analysis in TOM.

Comment LA15-14

Comment
TOM is utilized in the EIS/EIR to assess Impacts to Water Supply from Groundwater Substitution Measures does not and by virtue of its underpinnings of SACFEM2013 and CalSim II cannot properly account the losses of water in the rivers induced by Groundwater Substitution Measures. TOM simulates water made available under each transfer mechanism, subject to various constraints. TOM uses an assumed priority for transfer mechanisms used to make water available under Project alternatives in the following order:

- Groundwater substitution – for alternatives that include this mechanism

- Reservoir release
- Conserved water
- Crop idling – for alternatives that include this mechanism

Response
See response to Comment LA15-13.

Comment LA15-15

Comment
Priorities for transfer mechanisms are necessary to develop groundwater pumping inputs to SACFEM2013 and simulate all transfers in TOM. Thus TOM appears to bookkeep errors in available water derived in SACFEM2013 and CalSim II. It takes input from SACFEM2013 and CalSim II to bookkeep their inaccurate information but provides no feedback to those models.

Response
TOM simulates the effects of transfers on the surface water system and specifically the CVP and SWP. TOM does not "bookkeep errors" that are alleged to occur in SACFEM2013 and CalSim II. It is true there is no feedback from TOM to SACFEM2013 or CalSim II, but such a feedback loop is not necessary for this analysis because the small changes in streamflow calculated in TOM would result in negligible changes in the groundwater model.

Comment LA15-16

Comment
The methodology by which Groundwater Substitution Measures for Long-Term Water Transfers are being considered and analyzed within the EIS/EIR, improperly accounts quantities of water and as a result significant quantities of water are being double counted as between available surface water and extracted groundwater.

Response
The SACFEM2013 model does include time-varying stream stages as stated in Appendix D. This variable stream stage allows for periods of high and low flow in the stream. Boundary conditions for the streams that are estimated to go dry during portions of the year are also modified to "remove" that stream for the period when the stream is expected to be dry. The "Wadi" package within MicroFEM simulates the flow of water between the surface and groundwater system via flow through the streambed. The specified, time-varying stream stage is the critical factor in establishing the flow of water between the surface and groundwater systems. When conditions are calculated as such, the streams in the SACFEM2013 model become detached from the aquifer. At that point, the rate of flow from the surface water to the groundwater is based solely on the

stream stage and not on the difference between the stage and the groundwater table level. This calculation is shown as equation (3) in Appendix D. The anisotropy ratio of 500:1 specified in the model was based on the available data and model calibration. Streams, as mentioned above, contain time-varying stages, and therefore contribute (or accrete) differing flows of water to or from the groundwater system depending on the elevations of the stream stage and the groundwater table during that particular time step.

Comment LA15-17

Comment
Due to the improper accounting of water in Water Supply, the proposed mitigation, WS-1, is inadequate to mitigate the impacts to water availability and water flows into and through the Delta during three important periods of time: (1) the period of Groundwater Substitution pumping, April thru September; (2) the Water Transfers window, July thru September; and, (3) the period following the Water Transfers window, October to April.

Response
See Common Response 8.

Comment LA15-18

Comment
Due to the lack of a specific formulation for the proposed Water Supply mitigation, WS-1, it is unpredictable how the mitigation will be applied. The EIS/EIR references Draft documents on Technical Information for Preparing Water Transfer Proposals (October 2013). (Department of Water Resources and Bureau of Reclamation, 2013. DRAFT Technical Information for Preparing Water Transfer Proposals - Information to Parties Interested in Making Water Available for Water Transfers in 2014, October.) Those documents identify the need for estimating the effects of transfer operations on streamflow and describe the use of a streamflow depletion factor; however they provide no basis for Project Agency approval nor for transfer proponents to submit site-specific technical analysis supporting a streamflow depletion factor. That document which is completely relied upon in establishing proposed mitigation, WS-1, states that:

“Project Agencies are developing tools to more accurately evaluate the impacts of groundwater substitution transfers on streamflow. These tools may be implemented in the near future and may include a site-specific analysis that could be applied to each transfer proposal.” (Ibid, at p.33).

This future action provides no established or predictable basis for the mitigation of streamflow depletions due to Groundwater Substitution Measures. Due to the improper accounting of water in both the groundwater and surface water supply models utilized for Water Supply analysis, reliance upon these models or the analysis in this EIS/EIR by the Project Agencies would result in inappropriate estimation of the streamflow depletion factors (SDF) utilized. Examples of appropriate methodologies for quantifying SDF for Water Supply are provided in Appendices A and B. They result in short-term SDF ranging from 8% to 22% of the Groundwater Substitution Measures after the onset of pumping proposed in the EIS/EIR and long-term cumulative SDF ranging from 34% to 108.5% of annual pumping based on evaluation of the 6-year drought from 1987 to 1992.

The mitigation proposed for loss of Water Supply, WS-1, due to Groundwater Substitution transfers is insufficient. It does not adequately account for the impact from the resulting reductions of water available in the rivers and groundwater due to the improper accounting of water in the EIS/EIR analyses. As detailed in our analysis the mitigation measure proposed has no basis in fact, and if it did the project proponents would find that mitigation of the impacts from Groundwater Substitution Measures are not likely to meet the Project Purpose and Need and the Project Objectives.

Response
See Common Response 8.

Comment LA15-19

Comment
Groundwater Substitution Measures for Long-Term Water Transfers effects on Delta outflows and water quality are not properly considered in the EIR/EIS. The EIS/EIR rates the effects on Delta outflows and the impact to Delta Water Quality as Less Than Significant based on improper accounting of water. The effects and impacts are likely to be Significant and thus will require mitigation.

Reservoir Releases for meeting regulatory requirements and or deliveries to Project Contractors may be diminished by streamflow depletions from current and proposed pumping conditions in areas where groundwater saturation falls below the adjoining river stage. These depletions of water available for transfer via Reservoir Releases are not quantified in the EIS/EIR. The effect of these baseline conditions impacts the availability of water to be transferred down the Sacramento River and through the Sacramento San-Joaquin River Delta to the CVP and SWP pumping stations that pump water south via their respective aqueducts, the Delta-Mendota Canal, and the California Aqueduct.

Response
The Draft EIS/EIR Appendix C describes Delta conditions as necessary to assist in evaluation of potential environmental impacts associated with the Proposed Action within the Delta, including D-1641 requirements. The Delta conditions assessment simulates the hydrodynamics and water quality within the Delta when transfer water is made available by various sellers to determine how and where within the Delta the effects are likely to occur under the alternatives.

Output from the Delta conditions assessment addresses environmental flows under D-1641 as well as other parameters such as water level (stage), water quality, and the biological opinions, and thus provides a basis for environmental assessment. Impacts associated with streamflow depletion from groundwater substitution are included in the modeling effort and evaluated in Section 3.2.

Comment LA15-20

Comment
Terrestrial Resource impacts are not properly accounted in the EIS/EIR due in part to the imprecision and inability of the models to assess dehydration of the soils and groundwater aquifer adjoining both small streams and large rivers.

The Proposed Mitigation, GW-1, for potential impacts to Terrestrial Resources is insufficient to mitigate the impacts since it too is not sufficiently quantified in the EIS/EIR nor in the Groundwater Management Plans (GWMPs) referenced. Existing GWMPs do not contain quantified year on year metrics for subbasin depletion and refill. These GWMPs do not identify acceptable ranges of groundwater elevations for short-term or long-term groundwater that will to sustain primary functions like support for natural riparian communities upon which several endangered species rely.

Response
Impacts on terrestrial resources from reduced flows in small streams and large rivers due to groundwater substitution are described in Section 3.8.2.4.1 of the Draft EIS/EIR. The Draft EIS/EIR acknowledges the limitations of the models where historic flow data is limited or unavailable; however, based on the data that were available and analyses of those data, the Draft EIS/EIR provides a reasonable and appropriate basis for drawing conclusions about the potential impacts of the project. Notwithstanding, clarifying information related to groundwater effects is provided in Common Response 10 and clarifying language regarding vegetation effects has been added to Mitigation Measure GW-1 (see Common Response 10).

Comment LA15-21

Comment
The EIS/EIR evaluates at Section 3.3.2 on Environmental Consequences/Environmental Impacts on Groundwater Levels from the Long-Term Water Transfers lists: (1) increased groundwater pumping costs due to increased pumping depth (i.e. increased depth to water in an extraction well); (2) decreased yields from groundwater due to reduction in the saturated thickness of the aquifer; (3) lowered groundwater table elevation to a level below the vegetative root zone, which could result in environmental effects. It then sets out to evaluate Item (1) under Regional Economics and (3) under Vegetation and Wildlife. Further it states that for Environmental Consequences/Environmental Impacts on Land Subsidence that excessive

groundwater extraction from confined and unconfined aquifers could lower groundwater levels and decrease pore-water pressure. It notes that compression of fine-grained deposits is largely permanent and lists various negative consequences that could result.

Our review finds the evaluation in the EIS/EIR of impacts to Groundwater Resources from Groundwater Substitution Measures does not properly account for water and as a result is either inaccurate or insufficient to evaluate the potential environmental impacts associated with Groundwater Substitution. -Potential Impact Statements from Table ES-4: Groundwater substitution transfers could cause a reduction in groundwater levels in the Seller Service Area.; -Related Alternatives: 2, 3; -Significance to CEQA: S; Proposed Mitigation: GW-1: Mitigation and Monitoring Plans; Significance After Mitigation Pursuant to CEQA: LTS

Response
See response to Comment LA15-16.

Comment LA15-22

Comment
The two assessment methods utilized for Groundwater Resources in the EIS/EIR are a numerical groundwater model, SACFEM2013, and a qualitative assessment for groundwater conditions in the Redding Area Groundwater Basin outside of the numerical groundwater limits.

The SACFEM 2013 groundwater model does not properly account water in an integrated groundwater to surface water system. This is due in part to the shortcomings in the underlying simulation code used, MicroFEM, to construct the SACFEM 2013 groundwater model. (The following terms, referenced herein, are typical of industry nomenclature: Algorithm - an operation or calculation (e.g., the Darcy equation); Simulation Code - a sequence of programming language commands that encapsulates one or more algorithms (e.g., California DWR's IWFM program); and, Model - an application of a simulation code to a site-specific question (e.g., in this EIS/EIR-evaluation the use of MicroFEM and its construction into the groundwater model SACFEM2013) The MicroFEM simulation code selected for evaluation of the significance of potential impacts to groundwater lacks some essential mathematics for evaluation of the issues presented by Groundwater Substitution Measures. MicroFEM is a simulation code only for fully saturated groundwater systems whereas to evaluate the potential impacts and effects of groundwater extraction near rivers in the Sacramento River Basin it is necessary to properly formulate the discharge of water from the rivers when the river at the bottom of its streambed hydraulically detaches from the groundwater aquifer due to aquifer desaturation. While MicroFEM mathematically notes the transition from saturated to unsaturated it calculates the condition of discharge as if it is fully saturated. This is incorrect and produces substantive miscalculation of the rate and quantity of movement of surface water into groundwater and thus the magnitude of the resulting groundwater depletion.

As can be seen in the following illustration (Figure 1) aquifer desaturation and streamflow detachment, will influence the rate of change in groundwater elevations, groundwater flow, and groundwater interaction with surface water bodies, particularly rivers and streams. We address streamflow under Water Supply. SEE FIGURE 1 Groundwater Surface Water Interactions in the Hydrologic Cycle.

The MicroFEM simulation code lacks the algorithm that would account the water loss from the river under unsaturated and partially saturated conditions. In order to properly account water in the groundwater system and represent the changes in the groundwater elevations as well as the streamflow depletion from the rivers and streams induced by Groundwater Substitution Measures, unsaturated or partially saturated groundwater flow algorithms are essential components of the simulation code and/or the quantitative analysis. Since the MicroFEM simulation code does not have proper algorithms to represent streamflow detachment and the resulting flux to groundwater, then as a result neither does SACFEM2013 model, the model upon which Groundwater Resource evaluations are based.

Response
The assertion contained in the comment is incorrect. MicroFEM accounts for the condition when the modeled water table occurs below the base of the streambed and becomes hydraulically disconnected from the stream. Under this condition, the rate of stream leakage is no longer computed according to the difference in the assigned stream stage and the computed position of the modeled water table (head-dependent), but rather is computed as a constant stream leakage according to the difference in the stream stage and the streambed elevation. When the modeled water table occurs higher than the streambed elevation, the groundwater-surface water exchange formulation automatically switches back to a head-dependent calculation.

Comment LA15-23

Comment
As far as potential impacts to river stage heights induced by decreases in groundwater elevations from Groundwater Substitution Measures, MicroFEM has no algorithm to calculate a change in river stage height that governs the rate of accretion or depletion to the river. Thus calculation of fluxes into and out of a river are inaccurate. They are either overestimated or underestimated based on the relative head difference between groundwater and surface water. The flow into or out of the groundwater system (called groundwater surface-water flux hereinafter) is never correct in MicroFEM due to this missing algorithm and capability in the simulation code.

For each time step the SACFEM2013 model has a user-input river stage that is invariant for the monthly time step. This results in substantive problems in properly accounting the depletion of water in the groundwater aquifer and in the groundwater surface-water flux. First with regard to accounting the depletion of groundwater SACFEM2013 does not account for the origin of surface water flowing into the groundwater domain. Surface water flowing into the groundwater domain during each monthly timestep is treated as an infinite source of water; there is no formulation of river flow in the MicroFEM simulation code and hence the SACFEM2013 model has no river flow accounting to provide proper accounting of this lost surface water (That water loss accounting appears to be attempted later under the Transfer Operations Model which we address under Water Supply). A useful publication from the U.S. Geological Survey (USGS) from 1998, Ground Water and Surface Water A Single Resource, identifies that the hydrologic cycle demonstrates that groundwater surface-water flux behaves dynamically and that groundwater is not a source but rather the system of surface water and groundwater is a finite resource defined and governed by local and regional hydrologic and hydrogeologic conditions. (Winter, T.C., J.W. Harvey, O.L. Franke, and W.M. Alley 1998. Ground Water and Surface Water A Single Resource, USGS Circular 1139, pp. 79, p. 2.) This dynamic interaction of groundwater surface-water fluxes within the context that it is finite in quantity and temporally controlled is not the manner in which groundwater modeling has been done for use in the EIS/EIR. Since the source of surface water in SACFEM2013 that satisfies the model estimated drawdown is mathematically infinite, an improper accounting of water available in the system occurs. This results in the double counting of available water as between available groundwater for substitution transfer and available surface water to transfer. In summary the accounting of surface water available to recharge an aquifer in SACFEM2013 is not correct due to the fundamental construct of the model.

Response

Application of fully integrated groundwater-surface water numerical model codes was considered at the onset of the modeling effort. However, the limited use of such models in industry coupled with the very large modeling domain compelled the model development team to use MicroFEM. This is because its mathematical formulation is similar to that of MODFLOW, a modeling industry standard, but with the added flexibility of subarea node refinements available with the finite-element method. While fully integrated numerical surface/subsurface models may someday be readily available and practical to apply to large domains like the Sacramento Valley, it is the model development team's expert opinion that such a modeling endeavor would not have been practical given the current state and availability of such codes. Further, it is important to acknowledge that having more sophisticated codes that can more accurately simulate more complex flow processes does not automatically result in more reliable forecasts.

Comment LA15-24

Comment
Due to the SACFEM2013 model requirement of groundwater surface-water flux being calculated as a fully saturated flow condition, groundwater surface-water flux where the model calculated head near a river reach is below the bottom of the streambed is not properly calculated in SACFEM2013. Rates of inflow to groundwater where this occurs within the model domain for a particular model stress period are overestimated due to both the incorrect mathematical formulation as fully saturated flow and the invariant stage height in that river reach for that stress period (or the following stress period if there were some model carryover of surface water depletions). Furthermore the underestimation of groundwater depletion from that same stress period is error that is carried over to the next stress period. This cumulative error in accounting the temporal depletion of groundwater in SACFEM2013 is significant because the model then subsequently does not have correct quantification of the amount of required refill water to replenish groundwater from both natural recharge and delivery and application of irrigation water. Thus there are problems in accounting water correctly in the connected groundwater and surface water system due to errors in SACFEM2013.

Response
See response to Comment LA15-23.

Comment LA15-25

Comment
Unlike surface water depletions to groundwater, the accretionary flow of groundwater to the river is calculated in SACFEM 2013, but the calculation is inaccurate due to the invariant stage height during each monthly time step in the model.

Response
See response to Comment LA15-23.

Comment LA15-26

Comment
SACFEM2013 contains an unusual model construction feature with respect to natural or crop consumptive use and evapotranspirational loss of water. It utilizes a calculation module in MicroFEM called Drains to simulate evapotranspirational losses and groundwater discharge to land surface outside of a recognized and model surface water course. Drains were set at land surface rather than at root zone depth. This is altogether an unusual construction and one that reduces the quantity of water removed by vegetation as constructed. Additional details on SACFEM2013 model review and issues noted are provided in Attachment C herein.

Response
The drain package was used to represent discharge of groundwater to small scale tributaries of the larger regional streams explicitly simulated in the model. Discharge only occurs in areas of extremely shallow groundwater and mostly during wet climatic periods. The agricultural processes that occur at the land surface (evapotranspiration [ET], irrigation efficiency, soil moisture storage and depletion) are accounted for using the IDC model.

Comment LA15-27

Comment
SACFEM2013 is not well calibrated to actual conditions of groundwater elevation near rivers and streams. There is almost no mention of model calibration in the EIS/EIR; those two words appear once at page D-13. There are a number of standard references on numerical groundwater modelling that emphasize the importance of model calibration.(Reilly, T.E., and Harbaugh, A.W., 2004, Guidelines for evaluating ground-water flow models: U.S. Geological Survey Scientific Investigations Report 2004-5038, 30 p.) (ASTM 2001, D 5981-96 (Reapproved 2002), "Standard Guide for Calibrating a Ground-Water Flow Model Application". Published November 1996, 6 p.) (ASTM 1994, D 5490-93,"Standard Guide for Comparing Ground-Water Flow Model Simulations to Site-Specific Information "Published January 1994, 7 p.) The lack of documentation in the EIS/EIR of model calibration such as how it was conducted and what the degree of precision achieved to which outcomes, is a significant omission. Through sources cited in the EIS/EIR we were able to locate calibration information for SACFEM. (WRIME, 2011. Peer review of Sacramento valley Finite Element Groundwater Model (SACFEM2013), October.) The peer review cited in the EIS/EIR stated: "Review of the representative and other calibration hydrographs reveals that significant calibration issues exists in areas that rely mostly on surface water. This is mainly due to the issues of SacFEM's estimation of stream-aquifer interaction. Calibration quality improves in areas that rely mostly on groundwater."(Ibid, p. 16.)

The model documentation we reviewed demonstrated local errors in predicting groundwater elevation heads that are greater than 65 feet (see Attachment C). (Lawson, Peter, 2009. Documentation of the SacFEM Groundwater Flow Model. CH2MHill Technical Memorandum. Prepared for Bob Niblack, California Department of Water Resources, February. This document is relied upon heavily in the peer review document cited for Section 3.3 of the EIS/EIR: WRIME,2011.) Calibration errors of this magnitude signify that the groundwater elevations for the water table would fall below the bottom of the uppermost layer in SACFEM2013; the significance of this is that MicroFEM simulation code only calculates unconfined flow conditions in the uppermost layer of a particular model such as SACFEM2013. When actual groundwater elevations fall below the bottom of Layer 1 in a number of locations, the model is miscalculating the groundwater flux. This demonstrates that the

SACFEM2013 model was improperly constructed as well as poorly calibrated. Due to its lack of calibration to actual groundwater elevation conditions, the predictive outcomes are not reliable as a basis for assessing the locations of impact and the degree of impact to Water Supply, Groundwater Resources, Water Quality, and Terrestrial Resource considerations. Attachment C herein highlights further critique of the SACFEM2013 based on information found in the EIS/EIR as to the model's construction and documentation that the EIS/EIR relies upon in regard to the model's construction and calibration.

Response
The state of calibration of SACFEM2013 is well within the minimum standards for model calibration used in the industry (See ASTM D5981-96, 2002).

The comments provided in the peer review reflect the state of model calibration of a previous version of SACFEM completed in 2009. Significant model refinements and improvements to model calibration were conducted during the development of SACFEM2013, based on comments provided during the peer review.

Comment LA15-28

Comment
Neither the quantity of water nor the timing of water's removal from surface water is calculated correctly in SACFEM2013 due to the structural deficiencies identified in our review. One of the essential needs in an EIS/EIR on Groundwater Substitution Measures is accurate estimating of the timing of impacts to the flowing rivers and streams; SACFEM2013 does not provide accurate monthly estimates of when peak streamflow depletions will occur if Groundwater Substitution Measures are imposed in large part because of the hydraulic isolation of the pumping from the rivers configured into the model.

Accurately quantifying the changes in groundwater storage and groundwater elevations associated with Groundwater Substitution Measures is foundational to defining the potential impacts and their magnitude, and the metrics for the proposed mitigation measure GW-1.

Response
See response to Comment LA15-16.

Comment LA15-29

Comment
In section 3.3.1.3.1 Redding Area Groundwater Basin the discussion of Groundwater Production, Levels and Storage does not quantify the quantity of current groundwater pumping or the basin safe-yield without mining out groundwater in any of the six subbasins recognized in DWR Bulletin 118. There is no identification of what impacts to base flows occur from current

groundwater extractions for either current Municipal & Industrial (M&I) or applied irrigation. The EIS/EIR does not quantify those groundwater levels (i.e. drawdowns) associated with existing extractions in order to establish what the acceptable groundwater levels (i.e. drawdowns) associated with Groundwater Substitution Measures in this area might be. This is foundational to establish a basis for the proposed mitigation, GW-1, to avoid impacts to existing groundwater users and to avoid impacts to the seasonal base flows in the Sacramento River reaches in the Redding Area Groundwater Basin and those seasonal base flows of the 7 major tributaries to the Sacramento River within the basin. For example our review of the groundwater elevation contours on Figure 3.3-4 indicate that the Sacramento River are between 420 feet and 400 feet above Mean Sea Level between the Clear Creek join and the crossing of the I-5 freeway over the Sacramento at Anderson, CA; since the stream bottom profile of the Sacramento River is approximately 430 feet to 403 feet over this same reach the Sacramento River was losing water in this reach during the Spring of 2013. In addition our review finds that the Sacramento River streambed elevation is above the groundwater elevations of Spring 2013 depicted on Figure 3.3-4 at Colusa, California and southward to the edge of that figure; this means that the Sacramento River from Colusa, California and southward to perhaps Tyndall Landing, California is not only exfiltrating to groundwater but it is also not gaining the accretionary flow of groundwater that historically occurred in these river reaches.

Response
The text in the Groundwater Resources Section (Affected Environment) has been revised to include data on the groundwater level trends. Figures and hydrographs have been provided in Section 3.3.1.3 indicating the current groundwater levels in the Central Valley. These figures and hydrographs show groundwater levels within the Sacramento Valley under current conditions (with current groundwater extractions for either current municipal and industrial or applied irrigation). See Common Response 6 for additional information.

Comment LA15-30

Comment
In Section 3.3.1.3.2 Sacramento Valley Groundwater Basin the discussion of Geology, Hydrogeology and Hydrology notes that it was estimated by the USGS that from 1962 to 2003 that streamflow leakage (also called direct exfiltration) amounted to 19% of total basin recharge and equated to 2,527,000 acre-feet per year (AFY) or 3,490 cubic feet per second of surface-water flow. This quantity of water does not denote the entirety of the streamflow depletion from the basin which is the: denied accretionary groundwater flow to the rivers and streams within the basin. However, it is noted that this USGS estimated leakage-loss that discharges from the rivers and streams to groundwater is accounted in their CVHM model as surface water removed. (11)

(11) Faunt, C.C., ed., 2009, Groundwater Availability of the Central Valley Aquifer, California: U.S. Geological Survey Professional Paper 1766, 225 p.

Response
As noted in Section 3.3.1.3.2, the USGS estimates that 19 percent of groundwater recharge in the Sacramento Valley is from leakage from rivers and streams. The USGS's estimates are based on their studies (Faunt 2009) and included results from the USGS's CVHM model. The text in this section was clarified to represent the source of this estimate as the USGS's CVHM.

Comment LA15-31

Comment
The impact from surface water leakage to support the groundwater elevations reviewed in Section 3.3 is not quantified and the available response of groundwater elevations to Groundwater Substitution Measures is not quantifiable as a result. In other words if one of the principal sources to groundwater is surface water leakage and that leakage has already reached its maximum rate then the impact from further groundwater extraction must take into account that removal from storage and up gradient flow must meet the demand from Groundwater Substitution Measures.

It appears that neither quantitative nor qualitative evaluation of inflow or outflow to rivers and streams has been done in the EIS/EIR using empirical groundwater and surface water elevation data. Our requests for the database of groundwater elevations used in the EIS/EIR did not yield the Spring 2013 groundwater elevation data used to generate Figure 3.3-4. Further neither the report nor the data provided to our request reveal groundwater elevation data for 2013 in the southerly portions of the Sacramento Valley beyond the extent of Figure 3.3.-4. Comparison of empirical (actual) data to mathematical representations in models is essential to assess whether the models are adequately representing the physics of the real-life system being mathematically modeled. Evaluation of empirical data such as land surface, groundwater elevations, and stream stage heights and rated flow rates, enables assessment of the direction of flux and with more sophisticated tools the probable magnitude of flux.

Response
The specific factors surrounding potential groundwater substitution transfers must be presented and reviewed prior to approval. The factors discussed in the comment vary among potential transfers and must be reviewed for consistency with the analysis provided in the EIS/EIR. See Common Response 14.

The SACFEM2013 simulation period runs from water year 1970 though water year 2010. Therefore, it would not be possible to compare model simulation results with empirical groundwater data sets from spring 2013 for any portions of the Sacramento Valley.

Comment LA15-32

Comment
Proposed Mitigation for Potential Effects on Groundwater Resources:

The Proposed Mitigation GW-1 for groundwater pressure decreases (a.k.a. groundwater elevations) resulting from Groundwater Substitution Measures, GW-1, will not adequately mitigate the impacts to groundwater users in the Seller's Area. Proposed Mitigation GW-1 is not quantified or quantifiable as to what groundwater pressure decreases will constitute an impact to water users in the Seller's Area.

The groundwater elevations necessary to mitigate streamflow depletions under proposed mitigation, GW-1, as well as the stated impact of lowered groundwater levels for existing groundwater users must be quantifiable or else the proposed mitigation is insufficient to reduce the impacts from Groundwater Substitution Measures. For example in the Spring 2013, the Sacramento River streambed elevations are below groundwater elevations from Red Bluff, California to roughly Princeton, California (i.e. the Sacramento River is gaining flow from accretionary flows of groundwater in this lengthy reach) as depicted on Figure 3.3-4 of the EIS/EIR.

Response
See Common Responses 6 and 7.

Comment LA15-33

Comment
The proposed framework for GW-1 is based upon a draft application for preparing water transfer proposals for 2014 from DWR and U.S. Bureau of Reclamation and with the statement that this will be updated as appropriate. (12)

The framework provided for groundwater monitoring and the subsequent proposed mitigation in the EIS/EIR provides no substantive criteria for either monitoring or mitigation. With regard to groundwater monitoring for example at page 3.3-88 under Section 3.3.4.1.2 it states "The monitoring program will incorporate a sufficient number of monitoring wells to accurately characterize groundwater levels and response in the area before, during, and after transfer pumping takes place."

There is no attempt at defining the minimum number of wells, a spatial resolution laterally or vertically, nor a timeframe. The subsequent subsection on groundwater level measurement requires measurement of groundwater elevations until March of the year following the transfer; this would imply that impacts from one year's transfer are not anticipated to carry over into the following year or it implies that this is the new baseline for the subsequent year's transfer withdrawal. There is no discussion or mention of a multi-year monitoring program in the EIS/EIR with year over year metrics nor are in the draft application guidance for groundwater transfer proposals. A typical application of such a monitoring program using best available science and practice is to establish groundwater elevations in a base year and then metric changes as relative drawdown; in this manner groundwater depletion within a basin or subbasin can be assessed if it is occurring and this would encompass protections against injurious harm to Groundwater Resources if natural recharge is less than normal or slower than one seasonal cycle in providing recovery of the depletion from Groundwater Substitution Measures coupled with other groundwater uses or fluxes. With regard to proposed mitigation for example at Section 3.3.4.1.3, the EIS/EIR states: "If the seller's monitoring efforts indicate that the operation of wells for groundwater substitution pumping are causing substantial adverse impacts, the seller will be responsible for mitigating any significant environmental impacts that occur." There is no definition provided of what constitutes a substantial adverse impact. Looking back to Section 3.3.2.2 Significance Criteria one finds: "A net reduction in groundwater levels that would result in adverse environmental effects or effects to non-transferring parties" There is no benchmark criterion for mitigation and in fact the EIS/EIR at page 3.3-90 then states: "To ensure that mitigation plans will be feasible, effective, and tailored to local conditions, the plan must include the following elements: 1) A procedure for the seller to receive reports of purported environmental or effects to non-transferring parties; 2) A procedure for investigating any reported effect; 3) Development of mitigation options, in cooperation with the affected parties, for legitimate significant effects; and 4) Assurances that adequate financial resources are available to cover reasonably anticipated mitigation needs."

This text is extremely unclear as to: technically what is the procedure for investigation of effects; what is the meaning of "legitimate significant effects" when a multitude of overlapping influences on groundwater will occur from natural to man-made; and who would be monitoring and reporting on adverse environmental effects if not the Seller's and if so then who would be compensating for that monitoring. Our review finds the GW-1 does not provide adequate mitigation for groundwater decreases in the Seller Service Area as it relies upon poorly defined future actions with no established, reliable, or predictable basis for the monitoring and mitigation.

(12) Department of Water Resources and Bureau of Reclamation, 2013. DRAFT Technical Information for Preparing Water Transfer Proposal – Information to Parties Interested in Making Water Available for Water Transfers in 2014, October.

Response
See Common Responses 6 and 7.

Comment LA15-34

Comment
The groundwater formation in the Seller Service Area west of the Sacramento River is composed of the Tehama Formation.13 The Tehama Formation has exhibited subsidence in Yolo County. According to the EIS/EIR similar formational and hydrogeologic characteristics exist in the Redding Area Groundwater Basin.

Groundwater elevation changes due to long term pumping can increase the effective stress on subsurface materials that are under-consolidated. This is typical of some aquitards whose skeletal materials are typically composed of fine-grained sediments and when deposited by lower-energy hydraulic processes their ionic mineral boundaries keep them under-consolidated. When the effective stress of the soil column on these aquitards is increased due to dehydration of the aquifers above them, their skeletons compact. This is known as inelastic subsidence and it causes both a permanent loss of groundwater aquifer storage capacity and a depression at the land surface (Figure 2).

The groundwater elevations depicted on Figures 3.3-8 and 3.3-9 demonstrate that groundwater elevations in three of the eleven wells selected are at historic lows and under existing hydrogeologic and hydrologic conditions are on decadal declining trends. Specifically wells 11N05E32R001M, 21N03W33A004M, and 15N03W01N001M are all at historic lows at their last measurement discounting for seasonality. Each of these wells is in the western half of the Sacramento Valley Basin and thus would be expected to be overlying the Tehama Formation with its known under-consolidated units. Further groundwater extraction by Groundwater Substitution Measures will further lower groundwater elevations in both the Redding Area Groundwater Basin and the Sacramento Valley Basin. The assessment of changes in groundwater elevations reported at Table 3.3-5 is based on SACFEM2013 modeling and is incorrect due to the deficiencies and built-in errors noted for SACFEM2013 to accurately represent cumulative drawdown from Groundwater Substitution Measures. Moreover without specific well depth information and screened intervals for the handful of monitoring wells noted it is impossible in our review to assess whether they monitor the groundwater table portions of the aquifers; the unit where desaturation occurs and effective stresses that induce permanent land subsidence generally occur.

Response
See Common Responses 6 and 7.

Comment LA15-35

Comment
Proposed Mitigation:

The mitigation proposed for the potential impacts of land subsidence due to decreases in groundwater saturation of the uppermost aquifer, GW-1, is inadequate. The monitoring measures for land subsidence in the EIS/EIR are stated at page 3.3-89 as: “Subsidence monitoring will include determination of land surface elevation in strategic (determined by Reclamation) locations throughout the transfer area at the beginning and end of each transfer year. If the land surface elevation survey indicates an elevation decrease, then the area will require more extensive monitoring…”

Under this monitoring program approach, permanent inelastic subsidence will have occurred prior to detection. Mitigation is offered in the form of reimbursement for infrastructure (e.g. roadway) structural damage due to permanent subsidence (albeit elastic reversible subsidence would likely also cause infrastructural damage). No mitigation is offered for the permanent loss of aquifer storage capacity.

Under this program of monitoring and mitigation it has to be noted at Section 3.3.5 Potentially Significant Unavoidable Impacts that this permanent impact of lost aquifer storage capacity is not mitigated by GW-1. Under Sections 3.3.6.1 and 3.3.6.2 for Cumulative Effects for Alternatives 2 and 3, respectively, which include Groundwater Substitution Measures the cumulative effects noted for land subsidence are stated as: “The groundwater substitution pumping associated with the SWP transfers would occur in an area that is historically not subject to significant land subsidence. In the overall area of analysis, land subsidence is occurring in several areas, as described in Section 3.3.1.3.2.”

The statement is inaccurate. The juxtaposition of Seller locations next to historic subsidence in Yolo County makes the statement inaccurate. The EIS/EIR then goes on to say: “…however, the existing subsidence along with future increases in groundwater pumping in the cumulative condition could cause potentially significant cumulative effects. The impacts of the Proposed Action would be reduced through Mitigation Measure GW-1 (Section 3.3.4.1) to less than significant. Therefore, with implementation of Mitigation Measure GW-1, the Proposed Action’s incremental contribution to subsidence impacts would not be cumulatively considerable.”

The analysis of changes to groundwater elevations leading to this statement is inaccurate and hence the impacts anticipated are underestimated. Perhaps more to the point the Mitigation Measure, GW-1, as defined will not adequately address the impacts of groundwater drawdown on inelastic subsidence and the resulting permanent loss of aquifer storage in the Seller’s Area. The proposed observation of subsidence as mitigation cannot restore or offset the impact of subsidence once it has already occurred.

It is however possible to define a monitoring and mitigation program for the risks and potential impacts of permanent Land Subsidence. Such a program of monitoring and mitigation would require evaluation of historic and current groundwater elevations in the upper groundwater aquifer units over a series of decades long cyclical hydrologic and land use conditions in each Seller Area to determine whether groundwater elevations are at historic lows. If so then mitigation for permanent land subsidence due to Groundwater Substitution Measures would require no Groundwater Substitution Measures for Long Term Water Transfers be approved until groundwater elevations increase above historic lows and within a range that accurate groundwater modeling could demonstrate would not create cumulative lowering of groundwater elevations during the period of approved water transfers.

Response
See Common Response 7.

Section 3.3.1.3.2 discusses groundwater storage trends in the Sacramento Valley. Storage tends to decrease during dry years and increase during wetter periods.

Comment LA15-36

Comment
Water Supply:

At Section 3.1.2 on Environmental Consequences/Environmental Impacts on Water Supply the Assessment Methods states: “Impacts to surface water supplies are analyzed by comparing the conditions in water bodies and surface supplies without implementing transfers to the expected conditions of supplies with implementation”

The quantitative tool to be used in assessing impacts to supplies but not water bodies from water transfers and exports from the Delta is referred to in the EIS/EIR as a “post-processing tool.” The “post processing tool” referred to under evaluations of Water Supply for Water Operations Assessment consists of the use of the SACFEM2013 groundwater model, CalSim II, and a spreadsheet model called the Transfer Operations Model (TOM). Our review will focus on these assessment tools to evaluate potential environmental impacts and consequences from the proposed Long-Term Water Transfers Alternatives.

Section 3.1.2.2 Significance Criteria states: “Impacts on surface water supplies would be considered potentially significant if the long term transfers would: 1) Result in substantial long-term adverse effects to water supply for beneficial uses”. Putting aside the substantive issue of why short-term adverse effects to water supply for beneficial uses is not considered as a criterion, our review finds the evaluation in the EIS/EIR of impacts to Water Supply from Groundwater Substitution Measures to this criterion is either inaccurate or insufficient to evaluate the potential environmental impacts associated with Groundwater Substitution as the methods of Assessment in the EIS/EIR do not properly account water and as a result cannot be relied upon to assess potential impacts and the means of mitigation or the timing of mitigation needs. Analysis of streamflow depletions due to Groundwater Substitution Measures is not analyzed accurately in the EIS/EIR and the loss of surface water to meet Water Supply needs is not properly accounted. This inaccurate accounting results in a fraction of the groundwater extracted being double counted as available surface water for transfer.

Response
Section 3.1.2.4.1 considers changes to water users in the Sacramento Valley as well as CVP and SWP water users that receive water conveyed through the Delta. The EIS/EIR considers how changes in streamflow could affect water supply, and concludes that the potential effects would be focused on CVP and SWP users that receive water conveyed through the Delta. Mitigation Measure WS-1 would avoid or reduce potential water supply impacts to CVP and SWP users. This measure would address the streamflow changes because of groundwater substitution. See Common Response 8 for additional information.

Comment LA15-37

Comment
No Action Alternative Evaluations in EIS/EIR:

It is notable that the No Action Alternative is to look at the Environmental Consequences/Environmental Impacts in water bodies (presumably rivers and reservoirs) and surface supplies while the evaluation for implementing Long-Term Water Transfers is to look at surface supplies with no mention of evaluating impacts to water bodies such as rivers or reservoirs.

The quantitative tool to be used to aid in assessing impacts to surface water supplies and water bodies is CalSim II for the No Action Alternative.

CalSim II works on a monthly time-step to assess SWP and CVP operations. CalSim II generates flows as a water system operational decision support tool. CalSim II is not a hydraulic model and does not include channel characteristics such as channel roughness or cross-section geometry to simulate the water routing. As a result of CalSim II's limitations, the models inability to schedule reservoir releases on a daily basis creates water accounting inaccuracies of losses caused by routing and attenuation of upstream reservoir releases to phenomena such as streamflow depletions. Additionally, CalSim II uses simplified flow routing rules (on a monthly time-step) which result in inaccuracies associated with how the SWP and CVP operate in extreme hydrologic conditions, especially in the driest years (DWR and USBOR, 2004 & Ford et al., 2006). (14)(15)

CalSim II was developed over a decade ago to assess new storage and conveyance facilities in the CVP & SWP systems on a monthly time-step. Use of CalSim II has yielded significant scrutiny on its ability to provide relevant data to assess potential future impacts (Close, A. et al, 2003). The CalSim II model presented in the EIS was used for the baseline conditions (2014 planning horizon) and was not used to assess potential changes resulting in future land use and hydrologic/metrological conditions. The baseline assessment can only assess how the Long-Term Transfer Project would impact the environment if it was in-place from 1970-2003 and therefore cannot assess potential impacts of future conditions that are different than the baseline conditions such as various climate change scenarios.

(14) Department of Water Resources and U.S. Bureau of Reclamation (DWR and USROR, 2004). Peer Review Response: A Report by DWR/Reclamation in Reply to the Peer Review of the CalSim-II Model Sponsored by the CALFED Science Program In December 2003, August, 2004

(15) Ford, D., Grober, L., Harmon, T., Lund, J.(Chair), McKinney, D. (Ford et al., 2006). Review Panel Report San Joaquin River Valley CalSim II Model Review. CALFED Science Program – California Water and Environment Modeling Forum. January 12, 2006.

Response
CalSim II was used as a basis for the subsequent modeling efforts, but was not used alone to simulate potential effects of the action alternatives. As described in detail in Appendix B, the results of CalSim were the basis for detailed analysis in SACFEM2013 (a groundwater model) and the Transfer Operation Model (a tool to simulate how transfers would change operations).

See Common Response 5 for more details of the modeling period of analysis and changes in land use or hydrology in the future.

Comment LA15-38

Comment
The analysis of Environmental Consequences/Environmental Impacts is not done accurately nor with a complete conceptual model of the interactive groundwater and surface water system that constitute the Water Supply. At page 3.1.5 in Section 3.1.2.4.1 the analysis states that groundwater basins are naturally recharged after drawdown by rainfall and surface water to groundwater flux, thereby depleting available in stream flow. It goes on to state that the accretionary flow of groundwater to surface water can be intercepted by groundwater extraction; however, it fails to note that this is a depletion of available surface water and water for other beneficial uses such as the health of the riparian and hyporheic zones. As detailed further in our review that follows a proper conceptual model of the hydrologic system for Water Supply demonstrates that the water deprived for the natural consumptive use, evapotranspiration and potentially evaporation via Groundwater Substitution Measures is the likely conserved-water available. The analysis of Water Supply is improperly conceptualized.

Additionally at page 3.1.6 in Section 3.1.2.4.1 the EIS/EIR states: "Transfers would not affect whether the water flow and quality standards are met… but only Reclamation and DWR water supplies"

The EIS/EIR notes that it is the State and Federal projects responsibility to maintain water quality standards in the Sacramento River, its tributaries, and the Delta. It then anticipates hypothetically that if the streamflow depletion resulting from Groundwater Substitution Measures results in decreased river flows then USBOR and DWR would modify operations by decreasing Delta exports or release of additional water from reservoirs to meet Delta outflow and/or water quality standards; however as documented in Attachment D herein the Federal and State projects were unable to maintain these standards in 2013 due to dry year conditions and a lack of available in-stream flow and releases of water.

Response

Section 3.1.2.4.1 describes the conceptual model of how groundwater substitution transfers could affect water supplies. The potential to affect riparian vegetation is included in Section 3.8, and the potential to affect fisheries is included in Section 3.7.

The EIS/EIR analyzes potential impacts of the action alternatives compared to existing conditions (under CEQA) and the No Action Alternative (under NEPA). The analysis did not identify changes from these baselines that would indicate significant adverse impacts to water quality in the Sacramento Valley or the Delta.

Comment LA15-39

Comment

The quantitative tool used in assessing impacts to supplies but not water bodies from water transfers and exports from the Delta is referred to in the EIS/EIR as a post-processing tool. From Appendix B, "The post-processing tool also includes changes in flows in waterways caused by streamflow depletion from groundwater substitution. Data for the post-processing tool was provided by the SACFEM2013 model, which includes highly variable hydrology (from very wet periods to very dry periods) was used as a basis for simulating groundwater substitution pumping." The EIS/EIR used two other models, CalSim II and a spreadsheet accounting model referred to as TOM, to attempt to properly account streamflow depletions. A general technical reference from the U.S. Geological Survey (USGS) published in 1998 entitled Ground Water and Surface Water - A Single Resource identifies that the hydrologic cycle demonstrates that groundwater is not a source of water but rather behaves as a reservoir, receiving and releasing water as governed by local and regional hydrologic and hydrogeologic conditions.(17) The use of the combination of three models does not properly account for water and thus the evaluation of “how long-term transfers could benefit or adversely affect water supplies” does not accurately identify potential impacts to available-water for Water Supply.

(17) Winter, T.C., J.W. Harvey, O.L. Franke, and W.M. Alley 1998. Ground Water and Surface Water A Single Resource, USGS Circular 1139, pp. 79, p. 2.

Figure 3 depicts the overall hydrologic cycle in Water Supply.

The only source of true supply is precipitation in the form of rain, snow, or dew. Groundwater is not a source but an interactive reservoir. For groundwater in the wells near enough to a river to have the cone of depression reach the river within the hydraulic capture zone of the well the following statement applies: “When pumping of a well near a river begins, water is drawn, at first, from the water table in the immediate neighborhood of the well. As the zone of influence widens, however, it begins to draw a part of its flow from the river and, ultimately, the river supplies the entire flow” - Robert Glover and Glenn Balmer(18)

This clear statement on the depletion of a river flow by the same rate as that withdrawn from the well is the opening of Glover and Balmer’s 1954 paper on their mathematical analysis of river depletion by extraction from a nearby well. Glover and Balmer’s work followed upon the first analysis of the depletion of streamflow induced by an extraction well and its zone of capture done by C.V. Theis of the USGS in 1941.(19)

(18) Glover, R.E. and G.G Balmer. (1954). River depletion resulting from pumping a well near a river. Transactions, American Geophysical Union, v. 35

Figure 3 Hydrologic Cycle Overview with regard to Water Supply Evaluation

Dr. Theis commented in his 1941 paper on one aspect of the analysis of the overall effects of extraction in an alluvial river valley on the flow into and from a river: “…the flux ‘from the river’ will be spoken of in the following treatment, the flux may be either an actual movement of water from the river or a decrease of the customary movement of water to the river” - C.V. Theis

This customary movement of water is also commonly known as the accretionary flow of groundwater to the river; it is accretionary flow of groundwater to a river that provides the observable and measurable flow of water in a free-flowing stream during lengthy dry periods when no rain or snowmelt provides the baseflow in a river or stream (i.e. not an ephemeral stream or arroyo). In the illustration below (Figure 4) it can be seen that consistent with Dr. Theis observation on the flux “from the river” the impact to the river is due to loss of accretionary flow to the river and not as a result of direct streamflow depletion by way of river exfiltration. This phenomena from a well located some distance from the river results in streamflow depletion; the principal difference between this case and the one where the zone of capture to the well reaches the streambed of the river is the timing of the streamflow depletion.

L.K. Wenzel of the USGS in the peer-reviewed Discussion of this seminal paper by Dr. Theis from 1941 offered this observation: “It is possible that in some localities all or a part of the water removed from the well may be obtained indirectly by reducing the amount of water that is transpired by plants from the zone of saturation. This is accomplished, of course, through the lowering of the water-table and capillary fringe to some depth below the roots of the plants.” - L.K. Wenzel(20)

(19) Theis, C.V., 1941, The effect of a well on the flow of a nearby stream: Transactions, American Geophysical Union, v. 22, part 3, p. 734-737.

(20) Wenzel, L.K., 1941, Discussion re: The effect of a well on the flow of a nearby stream: Transactions, American Geophysical Union, v. 22, part 3, p. 737-738.

Figure 4 Cross-Sectional View of Extraction Well Depleting the Accretion of Flow to a River

Figure 5 Plan View of Extraction of Groundwater via a Groundwater Substitution Well from which the Zone of Capture to the Well Does not reach the River Figure 5 illustrates that extraction pumping far back from a river’s edge (e.g. perhaps more than 1-mile) does not capture water directly from the river but instead results in a loss of accretionary flow of groundwater to the river as depicted by the reduced accretionary flow arrows and the diminished riparian zone flora (and in all likelihood impacts the hyporheic fauna near and beneath the riparian zone that supports the food chain for pelagic fish such as salmonids and the habitat for other threatened species). The deprivation of flow to the river from a groundwater extraction well located some distance from the river is ultimately equal to the quantity of extraction; if the flow to the well is drawn from storage then that storage will be replaced eventually by an equivalent quantity of groundwater via direct recharge and indirect groundwater recharge. As Dr. Wenzel’s comment notes the only water not deprived to the river or stream is that water that would otherwise have been withdrawn for consumptive use and evapotranspiration by vegetation that is/was able to utilize water from the zone of saturation (i.e. the water table aquifer).

Evaluation of the timing of streamflow depletion due to groundwater extraction wells was made simpler by a further paper by Dr. Theis and his co-author in 1963. The following graphic (Figure 6) describes the timing of impact to a stream or river’s quantity of flow based upon two primary criteria, the ration of the aquifer storage coefficient to the aquifer transmissivity, S/T, and the distance between the extraction well and the river.(21) The coefficients are as described in the Explanation in the chart with the X-axis denoting the time since pumping began.

(21) Theis, C.V. and C.S Conover. 1963 “Chart for Determination of the Percentage of Pumped Water being Diverted from a Stream or Drain” USGS Water Supply Paper 1545-C. pp. C106-C109.

This method of analysis was then added to by Mahdi Hantush in 1965 by incorporating to the mathematical solution a simplified concept of streambed resistance laterally to groundwater flow by way of a vertical layer of impedance to flow.(22)

This group of two general methods was improved upon further by Jenkins in 1968 in several ways but also in describing the residual effects of “streamflow depletion” (a phrase first coined in Jenkins paper) after pumping ceases. (23) Jenkins’ addition to the field of groundwater and surface-water interconnection at river boundaries, enabled season-to-season carryover of depletions of groundwater storage and the resulting streamflow depletion that can take place over more than one annual hydrologic cycle. Wallace et al. (1990) carried out a similar analysis for cyclic pumping of wells.(24)

(22) Hantush, M.S., 1965. Wells near streams with semi-pervious beds. Journal of Geophysical Research, v. 70, no. 12: pp2829- 2838

(23) Jenkins, C.T., 1968. Techniques for computing rate and volume of stream depletion by wells. Ground Water, v. 6, no. 2: pp 37-46.

(24) Wallace, R.B., Y. Darama, and M.D. Annable, 1990. Stream Depletion by Cyclic Pumping. Water Resources Research v. 26, no. 6, 1263-1270.

Figure 6 Theis’ graphic describing transmissivity and the distance between extraction wells.

Figure 7 Definition Sketch for a partially penetrating well and a river with semi-pervious layer Hunt (1999) Figure 8 Definition Sketch for flow to well in semipermeable aquifer Hunt (2003) Subsequently Bruce Hunt (1999) developed an analytical solution to the question of what is the response in a river that has a lower permeability streambed surrounding it than the permeability of the groundwater aquifer to which it is connected including the conceptualization of an extraction well which only partially penetrates the aquifer adjoining the stream. (25) While the bounding conditions of a homogeneous aquifer of infinite extent are applied to each of the aforementioned methods in order to solve the equations of unsteady flow in which a well or wells are actively extracting constitute an idealized case, the inclusion of a semi-pervious streambed fully to the solution provides an even more realistic estimate of the timing of impact on flow in a river or stream (Figure 7). Lastly, Bruce Hunt (2003) developed an analytical solution to the case of a stream incised into a low permeability layer or formation over top of a more permeable aquifer (Figure 8).(26)

Each of the four analytical mathematical solutions to the question of the impact of extraction well pumping on flow in a stream and the genesis of the water captured by an extraction well remain valid, particularly where the bounding assumptions are met well by the aquifer being pumped. Various mathematical solvers are available to look at streamflow depletion by the appropriate analytical method for each case including some provide by Dr. Bruce Hunt(27); the most recent set of solvers for each of these groundwater to surface-water analytical methods was developed by the USGS (2008).(28) The USGS program STRMDEPL08 enables a sequence of time varying pumping during an irrigation season and it allows for year on year carryover of aquifer depletion to be retained in a subsequent year. This program represents “best available science” for near field assessment of groundwater extraction on the flow in nearby streams. Based upon the information provided in the EIS/EIR with regard to stream aquifer relationships our review determined that the conceptual model of Figure 7, Hunt (1999) best fits the conditions described for the Sacramento Valley. An evaluation of streamflow depletions for select wells near rivers was undertaken for the extended drought period of 1987 to 1992 noted in the EIS/EIR was undertaken and the method and results are presented in Attachment A. These analyses result in a range of streamflow depletion factors (SDF) from in short-term SDF ranging from 8% to 22% by the end of a 1987 extraction scenario proffered in the EIS/EIR and long-term cumulative SDF ranging from 34% to 108.5% of annual pumping based on evaluation of the 6-year drought from 1987 to 1992 again following the extraction scenario proffered in the EIS/EIR due to the cumulative depletion of aquifer storage and the available accretionary flow of groundwater to the river as compared to stream flow from the river to satisfy the capture of water by a groundwater extraction well.

(25) Hunt, B., 1999. Unsteady stream depletion from ground water pumping. Ground Water, 37(1), pp. 98–102.

(26) Hunt, B. 2003. Unsteady Stream Depletion when Pumping from Semiconfined Aquifer. Journal of Hydrologic Engineering, Vol. 8, No. 1, pp. 12-19.

(27) http://www.civil.canterbury.ac.nz/staff/bhunt.asp

(28) Reeves, H.W., 2008,STRMDEPL08—An extended version of STRMDEPL with additional analytical solutions to calculate streamflow depletion by nearby pumping wells: U.S. Geological Survey Open-File Report 2008–1166, 22 p.

Response

In response to the commenter’s description of the models used to analyze streamflow depletion, wording in the EIS/EIR may have created some confusion by referring to the Transfer Operations Model (TOM) as both TOM and as a “post-processing tool.” The clearest illustration of how the three models interact is Figure B-1 in Appendix B. This figure also illustrates how information from one model is used in the other models and which models produce results relied upon in the environmental analysis.

This comment also describes the hydrologic cycle and many of the technical issues that relate generally to stream-groundwater interaction and streamflow depletion, and provides a brief literature review of key papers on these subjects. The Lead Agencies note these generalized comments, which do not discuss or otherwise pertain to the analysis of impacts, mitigation measures, or alternatives in the Draft EIS/EIR.

The commenter also describes the results of an analytical solution from a tool developed by the USGS to estimate streamflow depletion factors. The preparers of the EIS/EIR are familiar with the USGS stream depletion tool, STRMDEPL08, but disagree with the commenter's opinion that this simplified analytical tool represents the "best available science" for this analysis. The analytical solution used in STRMDEPL08 is based on many simplifying assumptions regarding stream and aquifer parameters. Those simplifying assumptions render it considerably less defensible than a well-calibrated, peer-reviewed, three-dimensional, numerical model such as SACFEM2013.

Comment LA15-40

Comment
Assessment of SACFEM2013 Model for Water Supply Analysis in the Post Processing Tool:

The SACFEM2013 model in the EIR/EIS does not account for the streamflow depletions induced by groundwater pumping along the lines of any of the analytical methods identified above from the literature. SACFEM2013 has no river flow accounting to account water flow depletions. As for potential impacts to surface water flow rates due to groundwater accretions or depletions SACFEM2013 does not account the quantity of water flowing within a river. There simply is no algorithm in the MicroFEM code to account for changing rates of streamflow and dynamically changing river stage associated with streamflow. Hence these potential impacts are not accounted in the SACFEM2103 model.(29) As a result of this missing algorithm in the model the outflow of surface water to groundwater in a river reach where Groundwater Substitution Measures lower the modeled head in the upper aquifer (ignoring the numerous errors in the formulation of well extractions and in the SACFEM2013 model hydraulic parameters) (30) below the river bottom water is not properly accounted in SACFEM2013. The loss of surface water flowing into the groundwater domain to satisfy the extraction well demand via streamflow depletion is not accounted. Thus the available Water Supply will not be properly accounted using SACFEM2013 with respect to both the magnitude of the impacts to Water Supply due to Groundwater Substitution pumping and the timing of such impacts to Water Supply and surface water flow in the rivers. This holds for extraction from any of the 327 groundwater extraction wells proposed as a part of Alternatives 2 and 3. This lack of water accounting affects the ability of the "post-processing tool" to properly evaluate water availability under Water Supply due to the shortcomings of the SACFEM2013 model to calculate changes in river flow.

(29) SACFEM2013's agricultral groundwater extraction terms were reportedly developed using the Irrigation Demand Calculator (IDC) within the California Dept. of Water Resources, Integrated Water Flow Model (simulation code). The use of only a portion of the IWFM, simulation code and the manner in which it was done leaves the soil moisture model and the groundwater model uncoupled with no feedback between the two models except that perhaps carried by the user from SACFEM back to the IDC model.

(30) SACFEM 2013 formulation places all extraction wells into Layers 2, 3, and 4 and then artificially imposes a vertical anisotropy of 500:1 at each flow layer.

Response

The SACFEM2013 model uses a monthly time step. Within each time step, the exchange of water between the aquifer and the stream systems is based on a constant river stage. The stages do vary between time steps. Because the quantity of stream flow depletion occurring over a monthly time step in almost all cases is small compared to the flow rates in the streams themselves, stream stage changes due to these depletions would be very small. Varying flow rates within a time step would not result in noticeable changes; therefore, this assumption results in a negligible error in streamflow depletion estimates.

Comment LA15-41

Comment

Further as to the poor accounting of water available to the "post-processing tool," the river outflow is not accounted properly in the SACFEM2013 groundwater model at the river nodes. As mentioned under Groundwater Resources SACFEM2013 sets each river reach's stage height as invariant during a month, irrespective of the groundwater withdrawals. This river stage invariance means that SACFEM2013 calculates as though there is an infinite amount of water in the nearby river (i.e. no streamflow depletion impact on the predicted outflow of water).

Response

The lead agencies considered using fully integrated groundwater-surface water numerical model codes at the beginning of the modeling effort; however, these tools were not determined to be the best option for this application. Fully integrated models have limited use within the industry and have a very large modeling domain. These factors caused the model development team to select MicroFEM. A key reason for this selection is because MicroFEM's mathematical formulation is similar to that of MODFLOW, a modeling industry standard, but with the added flexibility of subarea node refinements available with the finite-element method. While fully integrated numerical surface/subsurface models may someday be readily available and practical to apply to large domains like the Sacramento Valley, it is the model development team's expert opinion that such a modeling effort would not have been practical given the current state and availability of such codes. Further, it is important to acknowledge that having more sophisticated codes that can more accurately simulate more complex flow processes does not automatically result in more reliable forecasts.

Comment LA15-42

Comment
The river inflow (i.e. gaining reaches) is calculated in SACFEM2013. However it is done inaccurately due to the invariant stage height during each monthly time step in the model. This imprecision results in an improper accounting of water. Not surprisingly the peer review for the model done in 2011 found: "Review of the representative and other calibration hydrographs reveals that significant calibration issues exists in areas that rely mostly on surface water. This is mainly due to the issues of SacFEM's estimation of stream-aquifer interaction. Calibration quality improves in areas that rely mostly on groundwater." (31)

Using this mathematical formulation in the algorithm for groundwater to surface water flux, the degree of exfiltration in each month from the river to groundwater is too high if flow and stage in the river decrease due to Groundwater Substitution Measures or alternatively the degree of exfiltration is too low if Water Transfer flows increase river stage during the transfer period of July to September as more of that water would be depleted from the stream and not available to the Buyer's Area. Thus inputs from SACFEM2013 to TOM for subsequent analysis of Water Supply, are inaccurate.

(31) WRIME. 2011. Peer review of Sacramento valley Finite Element Groundwater Model (SACFEM2013), October at page 16

Response
See responses to Comments LA15-40 and LA15-41. The state of calibration of SACFEM2013 is well within the minimum standards for model calibration used in the industry (See ASTM D5981-96, 2002).

Comment LA15-43

Comment
Review of SACFEM2013 by the aforementioned peer review found that SacFEM2013 deep percolation rates are not supported by the fundamental Irrigation Demand Calculation (IDC) module's methodology (a subcomponent of DWR's Integrated Water Flow Model, IWFM simulation code) and

parameters. This results in a disconnection between SacFEM2013 and IDC. They recommended incorporating a feedback loop between the two models (IDC as constructed for SACFEM2013 input, and SACFEM2013) and subjecting them to convergence criteria. Their review states: “SACFEM deep percolation rates are not consistent with other data sets and it should be ensured that they are supported by historical land use, crop mix, and agricultural practices.”

It is unknown whether these recommendations from 2011 to SACFEM2013 were incorporated to SACFEM2013 based on the documentation provided in the EIS/EIR and on the documents requested and received from the project proponents. Further review of SACFEM2013 is provided in Attachment C herein.

Response
The comments provided in the peer review reflect the state of model calibration of a previous version of SACFEM completed in 2009. Significant model refinements and improvements to model calibration were conducted during the development of SACFEM2013, based on comments provided during the peer review.

Comment LA15-44

Comment
Lastly with regard to SACFEM2013 and Water Supply considerations we note that unlike Appendix B of the EIS/EIR on the uncertainties and limitations of TOM and CalSim II, there are no statements in Appendix D of the EIS/EIR or the main body of the EIS/EIR as to the uncertainties in the modeling assumptions or stated limitations on the utility and intended uses of the SACFEM2013 groundwater model.

Looking at “Best Available Science” for evaluation of potential impacts in the EIS/EIR there is a simulation code available from DWR, IWFM, which can better evaluate the time varying mass balance between surface water and groundwater inclusive of losses or gains in soil moisture to crop demand and precipitation. The IWFM simulation code’s capabilities are summarized in Attachment B herein and documented for the current release by DWR. (32) However, the simulation code with these general capabilities was first publicly released in 2003. Further there is an existing model of the Central Valley in IWFM, C2VSim, which is calibrated for the period 1922 to 2009, which was initially released to the public in 2011. The C2VSim model can be run with either a coarse finite element grid (C2VSim-CG with 1,392 elements, run-time 6 minutes) or with a fine finite element grid (C2VSim-FG with over 35,000 elements, run-time 6 hours). For both versions, the elements are grouped into 21 water-budget sub-regions. (33) The C2VSim-CG model was utilized in our review to assess the cumulative impacts.(34) DWR notes that both C2VSim versions will also be useful tools for integrated regional water management plans, planning studies, groundwater storage investigations, assessing infrastructure improvements, evaluating ecosystem enhancement scenarios, conducting climate change studies, and assessing the impacts of changes to water operations. The results of our assessment of relative streamflow depletions in several river reaches brought about by projected use of available transfer volumes in the extended drought of suggest that streamflow depletions of 8% to 22% depending upon the year and the river reach will result from a mass balanced model. In our review the use of C2VSim-CG provides a reasonable estimate of what best available science would reveal. Use of C2VSim-FG would likely improve upon the accuracy of the estimated streamflow depletions resulting from Groundwater Substitution Measures on Water Supply.

(32)
http://baydeltaoffice.water.ca.gov/modeling/hydrology/IWFM/IWFMv4_0/v4_0_331/downloadables/IWFMv4.0.331_TheoreticalDocumentation.pdf.

(33) As reported by the DWR at http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/index_C2VSIM.cfm on November 30, 2014

(34) Informal telephonic requests to DWR's Bay Delta Office for C2VSim-FG on November 13, 2014 revealed that they view the model as not ready yet for public release.

Response
The SACFEM2013 user's manual has been added to the EIS/EIR as Appendix M. This document includes Section 4.3, Potential Sources of Error, which describes some sources of uncertainty in the model.

Appendix D has been updated to include a discussion of the model selection process that identified SACFEM2013 as the best available tool.

Comment LA15-45

Comment
Assessment of the CalSim II Model for Water Supply Analysis in the Post Processing Tool:

As stated previously for the No Action Alternative, the use of CalSim II has yielded significant scrutiny on its ability to provide relevant data to assess potential future impacts (Close, A. et al, 2003).(35) The CalSim II model presented in the EIS was used for the baseline conditions (2014 planning horizon) and was not used to assess potential changes resulting in future land use and hydrologic/metrological conditions. The baseline assessment can only assess how the Long-Term Transfer Project would impact the environment if it was in-place from 1970-2003 and therefore cannot assess potential impacts of future conditions that are different than the baseline conditions such as various climate change scenarios.

(35) Close, A., Haneman, W.M., Labadie, J.W., Loucks D.P. (Chair), Lund, J.R., McKinney, D.C., and Stedinger, J.R. (Close, A. et al.). Strategic Review of CALSIM II and its Use for Water Planning, Management, and Operations in Central California. Submitted to the California Bay Delta Authority Science Program Association of Bay Governments. Oakland, California. December 4, 2003.

Response
See Common Response 5.

Comment LA15-46

Comment
CalSim II does not provide adequate loss factors to assess potential project impacts. The CalSim II model describes the physical system (e.g., reservoirs, channels, pumping plants), basic operational rules (e.g., flood-control diagrams, channel capacity, evaporation, minimum flows, salinity requirements), and priorities for allocating water to different uses (water quality, ecosystems, etc.). As a result of CalSim II's complexity, very important water loss characteristics such as stream reaches losses, deep groundwater percolation, and stream-aquifer interactions are generalized as basin "efficiencies" rather than losses for specific reaches or stream-aquifer interactions. The lack of specific loss characteristics within CalSim II yields inaccuracies specific to even seasonal and annual water accounting losses (e.g., stream-aquifer interactions) that have been identified as potential impacts from the proposed Long Term Water Transfers.

Response
This comment states that CalSim II does not properly account for water or the effects of stream-groundwater interaction. The stream-groundwater interaction calculations in CalSim II were not used in the analysis for the effects of groundwater substitution transfers on the surface water system. SACFEM2013 results were used for this portion of the analysis and incorporated into the surface water analysis in TOM. Analysis of how changes in stream-groundwater interaction may affect surface water flows and CVP/SWP operations was performed on specific stream reaches as suggested.

Comment LA15-47

Comment
Hydrology modeling within CalSim II uses a "depletion analysis" to estimate the historical and projected level flows (Ford 2006). (36) As a result of this, CalSim II requires a calculation to estimate the aggregate stream inflow for each sub-watershed. This calculation is identified as the "closure term" of the hydrologic mass balance and is also how the model encompasses errors

resulting from over/under estimates of water losses. In recent documentation regarding future development of CalSim II into version III, DWR and Reclamation provided a graphic of "closure term" magnitudes. (37)

In this graphic from Draper 2008 (Figure 9), the "closure term" represents a significant amount of error in CalSim that has to be accounted for to create a hydrologic mass balance. Note that this graph is in thousands of acre-feet/year. Thus the "closure term" necessary to correct for water budget errors in CalSim ranges from (2,000,000) AFY in deficit to 3,000,000 AFY in surplus. CalSim II does not account for water on an annual basis with precision.

CalSim II cannot assess how "Long-Term" water transfers would impact future water demands, water supplies, and required water quality and ecosystem management requirements. Hence the analysis of potential impacts to Water Supply based upon CalSim II is insufficient. CalSim II does not provide adequate detail to assess project impacts. The very poor precision of the surface water delivery model (CalSim II) used for the baseline assessment on quantities of water moving in and around the CVP and SWP leads to problems in accounting for water losses due to existing and proposed groundwater extractions.

(36) Ford, D., Grober, L., Harmon, T., Lund, J.(Chair), McKinney, D. (Ford et al., 2006). Review Panel Report San Joaquin River Valley CalSim II Model Review. CALFED Science Program – California Water and Environment Modeling Forum. January 12, 2006

(37) Draper, A. CalSim-III Hydrology Development Project, CalSim III Implementation, MWH Americas, California Water and Environmental Modeling Forum Annual Meeting, 2008 (Look at comment letter for figure)

Response

The existence of a closure term, also sometimes referred to as the basin accretion/depletion, does not indicate that CalSim II does not maintain mass balance or does not adequately simulate CVP/SWP operations for the purposes used in the EIS/EIR. Basin accretion/depletion terms are used in CalSim II to represent inflows and depletions that are not explicitly simulated elsewhere in the model and to ensure the model remains consistent, from a mass balance perspective, with the historically observed water supply. This comment, combined with others from the commenter, seems to indicate a concern that CalSim II was directly used to evaluate the effects of groundwater substitution transfers and resulting streamflow depletions. This was not the case. CalSim II was used to provide the existing conditions operation of the CVP/SWP. The effects of groundwater substitution transfers, streamflow depletions, and all transfers were analyzed in TOM by simulating changes to the existing condition that occur with transfers.

Comment LA15-48

Comment
As noted in the review of CalSim II in Draper (2008) there is a version of CalSim referred to alternately as CalSim III or CalSim 3 that appears to have been in development and use since approximately 2006.

"The C2VSim-CG model is being used as the basis for the groundwater flow component of CalSim 3, and has also been used to investigate how Sacramento Valley water transfers may affect Delta flows and how an extended drought may impact groundwater levels."(38)

It would appear that CalSim III represents "Best Available Science" with its focus on improving the significant shortcomings in CalSim II identified in our review and that of others. However, CalSim III was not utilized for the EIS/EIR. An analysis of the outcomes for the project by way of CalSim III use would apper to represent something approaching best available science on the available windows of water for transfer prior to 2003 and post 2003 to present and beyond. The availability and uses of CalSim III by USBOR for the CVP could not be determined during our review.

(38) As reported by the DWR at http://baydeltaoffice.water.ca.gov/modeling/hydrology/C2VSim/index_C2VSIM.cfm on November 30, 2014

Response
CalSim III has been under development since approximately 2006, but has not been released publicly and does not represent the best available tool at this time.

Comment LA15-49

Comment
Assessment of the Transfer Operations Model for Water Supply Analysis in the Post Processing Tool:

TOM was developed to analyze effects of the Long-Term Water Transfer Project on the CVP, SWP, major rivers, and the Delta. TOM does not provide a specialized groundwater, hydrology, or hydraulic simulations of the Long-Term Water Transfer Project but rather provides water accounting based upon inputs from SACFEM2013 and CalSim II. As a result of the water accounting approach, the inaccuracies within CalSim II (e.g., water losses, closure term error, etc.) and SACFEM2013 (e.g., stream-aquifer interactions, groundwater elevation predictions, etc.) are carried over into TOM to quantify and assess potential impacts resulting from the Long-Term Water Transfer Project.

Response
See response to Comment LA15-13.

Comment LA15-50

Comment

Our review of the TOM model provided by the project proponents at our request yielded a number of errors that were also included in the EIS text. Table 1 presents two examples water transfer volumes that were presented in the EIS/EIR Executive Summary Table 2, EIS/EIR descriptive text of each text from section 3.1.1.3, and TOM. (Look at comment letter for Table 1)

Upon review of Table 1, how specific transfer volumes of water are applied in TOM, CalSim II, and SACFEM2013 is neither understood nor constant. Additionally, specific model descriptions of how CalSim II, SACFEM2013 and TOM account for each water transfers are vague. The EIS states that there is a priority of transfer volumes ("…groundwater substitution and reservoir release are more likely transfer mechanisms than crop idling…", Section B.4.3.1.2) but specifically how each transfer was applied to the time series and into each model are not documented. To understand how each transfer volume is applied in each model is essential to properly assess the validity of the analysis of potential impacts.

Response

Table ES-2 does not include the transfer volumes described in Table 1 of the comment letter. The detailed transfer volumes are included in Table 2-5. The transfer quantity for Garden Highway Mutual Water Company in Section 3.1.1.3 has been corrected in the Final EIS/EIR. The quantities for Conaway Preservation Group are the same in Table 2-5, Section 3.1.1, and Appendix B. The TOM model (described in Appendix B) includes a slightly larger transfer volume from Anderson Cottonwood ID (5,938 acre-feet instead of 5,225 acre-feet in Table 2-5). This small difference reflects a late change in upper limits from Anderson-Cottonwood ID. Because the new quantity was less than the quantity modeled, and the change was small, the modeling was not revised to reflect this small decrease in water availability.

Comment LA15-51

Comment

Within TOM, adjustments in delivered water through the Delta include a portion lost as carriage water which is defined as extra water needed to carry water across the Delta to export facilities. Carriage water is a critical part of the water modeling analyses because the additional water is needed to maintain Delta water quality. Because the majority of the transfer water is made available and diverted upstream of the Delta, TOM assumes carriage percentage adjustments based on the location of the transfer:

1) Transfers from the Sacramento River assume a 20 percent carriage water adjustment;

2) Transfers to Contra Costa Water District assume a 20 percent carriage water adjustment;

3) Transfers from Merced Irrigation District assume a 10 percent carriage water adjustment for water flowing from the San Joaquin River into the Delta.

The use of a single carriage percentage based on location does not adequately address potential impacts to Delta water quality. The concept of carriage water is a complex concept that would require appropriate hydrodynamic models coupled with a hydrology and groundwater model to identify appropriate carriage water volumes over time. The EIS states that the initial estimates for carriage water should later be verified and adjusted and therefore water quality impacts cannot be assessed with the models presented in the EIS/EIR for Long-Term Water Transfers. Additionally, significant stream flow depletion associated with pumping will likely reduce water transfers to the Delta and result in significant water quality impacts and/or limited transfers to water buyers. Therefore, statements with the EIS/EIR claiming limited changes in Delta outflow as well as water quality impacts are unfounded.

Response
Analysis completed in preparation of the EIS/EIR assumed a constant carriage water percentage in order to evaluate through-Delta transfers and the effects on Delta outflow and water quality. The carriage water assumptions used in TOM split how transfer water that enters the Delta leaves the Delta as either Delta outflow or diversions. Results from TOM become the boundary conditions simulated in DSM2, the hydrodynamic model of the Delta used to assess changes in Delta flows and water quality. Therefore, analysis of the effects on Delta water quality provided in the EIS/EIR are representative of what may be expected under each alternative, using the assumed carriage water percentage. The statement "initial estimates for carriage water that must later be verified and adjusted" on page B-6, Appendix B of the EIS/EIR was made to disclose that in actual transfers carriage water is determined based on observed data and conditions before, during, and after the transfer and can vary from the 20 percent estimate used in the EIS/EIR. This statement does not indicate that water quality impacts cannot be assessed with the models used. As the comment suggests, additional factors affect Delta inflow and outflow such as stream-groundwater interaction and changes in upstream reservoir operations. Changes in Delta inflow and outflow from these other physical and operational changes that occur as a result of transfers are also simulated in TOM and passed to DSM2 to evaluate the effects on Delta water quality.

Comment LA15-52

Comment
Carryover of storage water within reservoirs is one of many factors within the EIS/EIR, TOM and CalSim II that lacks a description of application. In other

words there is no detail provided on where each of the water volumes in TOM are derived (e.g. groundwater vs. stored water). As a result of streamflow depletion from Groundwater Substitution Measures, the EIS/EIR identifies that small decreases in water supplies to users could occur when the stored reservoir release transfers decrease carryover storage in reservoirs. These operational controls are very important to how storage facilities would operate during extended dry periods. These operational assumptions within the modeling are not described in the EIS/EIR text or models. Therefore, carryover along with other operational assumptions associated with the Long-Term Water Project is not properly assessed and the resulting operational Water Supply impacts could be significant; these potential and probable impacts to Water Supply are not analyzed in the EIS/EIR for Groundwater Substitution Measures.

Response
Changes in reservoir storage are presented in Appendix B, starting with Figure B-12 on page B-22. Reservoir storage changes are presented for the following reservoirs: Shasta, Folsom, Oroville, Camp Far West, Merle Collins, combined Middle Fork Project reservoirs of French Meadows and Hell Hole, Lake McClure, and New Bullards Bar. Storage is presented for all months, not just carryover storage, and for each alternative.

Comment LA15-53

Comment
Summary of Impact Assessment:

Impacts to Water Supply from the Water Operations Assessment are not fully quantified. The improper accounting of water under Groundwater Substitution Measures results in insufficient control on water accounting such that water lost from river flow due to both the impairment of accretionary groundwater flow to support Project operations and the direct losses from river flow to groundwater extraction wells in the Groundwater Substitution program may be counted twice or more. Evaluation of the effects on Water Supply from the Groundwater Substitution Measures requires adequate and accurate analysis of what the sources of water in Water Supply and what appropriate streamflow depletions are for Groundwater Substitution Measures on top of existing conditions to assess short-term and long-term effects on Water Supply from Long-Term Water Transfers. Further the use of Groundwater Substitution Measures has important impacts to Water Supply in regard to operational flexibility. These have been rated to be Less Than Significant in the EIS/EIR but given the substantive errors noted in assessing available water for Long-Term Water Transfers this likely deserves re-examination.

Response
Specific comments on the modeling tools have been addressed in responses to other comments in letter LA15 (including responses to Comments LA15-2, LA15-3, LA15-4, LA15-5, LA15-6, LA15-15, LA15-16, LA15-21, LA15-22,

LA15-26, LA15-27, LA15-43, LA15-46, and LA15-47). These responses indicate that the modeling effort estimates the changes in surface water flow caused by groundwater recharge in addition to the baseline flux between the river and the aquifer. The contributions from groundwater substitution transfers are not double-counted in this assessment.

Comment LA15-54

Comment
Proposed Mitigation:

Due to the improper accounting of water in Water Supply, the proposed mitigation WS-1 is inadequate to mitigate the likely impacts to water availability and water flows into and through the Delta during three important periods of time: (1) the period of Groundwater Substitution pumping, April thru September; (2) the Water Transfers window, July thru September; and, (3) the period following the Water Transfers window, October to April.

Response
See Common Response 8.

Comment LA15-55

Comment
The Proposed Mitigation WS-1 to address streamflow depletion resulting from Groundwater Substitution Measures is ill defined and will not adequately mitigate the impacts to Water Supply.

Response
See Common Response 8.

Comment LA15-56

Comment
Due to the lack of a specific formulation for the proposed Water Supply mitigation, WS-1, it is unpredictable how the mitigation will be applied. The EIS/EIR references Draft documents on Technical Information for Preparing Water Transfer Proposals (October 2013). (39) Those documents identify the need for estimating the effects of transfer operations on streamflow and describe the use of a streamflow depletion factor; however they provide no basis for Project Agency approval nor for transfer proponents to submit site-specific technical analysis supporting a streamflow depletion factor. That document which is completely relied upon in establishing proposed mitigation, WS-1, states that: "Project Agencies are developing tools to more accurately evaluate the impacts of groundwater substitution transfers on streamflow. These tools may be implemented in the near future and may include a site-specific analysis that could be applied to each transfer proposal."(40)

(39) Department of Water Resources and Bureau of Reclamation, 2013. DRAFT Technical Information for Preparing Water Transfer Proposals – Information to Parties Interested in Making Water Available for Water Transfers in 2014, October.

(40) Ibid, at p. 33.

Response
See Common Response 8.

Comment LA15-57

Comment
This future action provides no established or predictable basis for the mitigation of streamflow depletions due to Groundwater Substitution Measures. Due to the improper accounting of water in both the groundwater and surface water supply models utilized for Water Supply analysis, reliance upon these models or the analysis in this EIS/EIR by the Project Agencies would result in inappropriate estimation of the streamflow depletion factors utilized. Examples of best available science methodologies for quantifying streamflow depletion factors for Water Supply are provided in Attachment A . They result in short-term streamflow depletion factors ranging from in short-term SDF ranging from 8% to 22% of the Groundwater Substitution Measures proposed in the EIS/EIR and long-term cumulative SDF ranging from 34% to 108.5% of annual pumping based on evaluation of the 6-year drought from 1987 to 1992

Response
See Common Response 8.

Comment LA15-58

Comment
The mitigation proposed for loss of Water Supply, WS-1, due to Groundwater Substitution transfers is insufficient. It does not adequately account for the impact from the resulting reductions of water available in the rivers and groundwater due to the improper accounting of water in the EIS/EIR analyses. As detailed in our analysis the mitigation measure proposed has no basis in fact, and if it did the project proponents would find that mitigation of the impacts from Groundwater Substitution Measures are not likely to meet the Project Purpose and Need and the Project Objectives.

Response
See Common Response 8.

Comment LA15-59

Comment
Groundwater Substitution Measures for Long-Term Water Transfers effects on Delta outflows and water quality are not properly considered in the EIR/EIS. The EIS/EIR rates the effects on Delta outflows and the impact to Delta Water Quality as Less Than Significant based on improper accounting of water. The effects and impacts are likely to be Significant and thus will require mitigation.

Response
Appendix C describes Delta conditions as necessary to assist in evaluation of potential environmental impacts associated with implementation of the Proposed Action within the Delta. The analysis applies the DSM2 model to simulate the hydrodynamics and water quality within the Delta when transfer water is made available by various sellers to determine how and where within the Delta the effects are likely to occur under the alternatives. The model outputs Delta conditions for parameters such as water level (stage), water quality, and environmental flows under D-1641, and the biological opinions provide a basis for the environmental assessment of the impacts of the alternative compared to the No Action/No Project Alternative without proposed water transfers. The model is used to compare the extent and significance of any differences resulting from the transfers. In order to conduct a comparative analysis, the model is run twice: once with conditions representing a baseline, and another run with an alternative representing specific changes to Delta operations and/or bathymetry in order to assess the change in modeled outcome due to the given change in model configuration. The assumption is that while the model might not produce results reflecting these changes with absolute certainty, it does produce a reasonably reliable estimate of the relative change in outcome.

Comment LA15-60

Comment
The analysis of Environmental Consequences/Environmental Impacts is not done accurately nor with a complete conceptual model of the interactive groundwater and surface water system depletions that would affect the Federal and State water projects, CVP and SWP, to meet Water Quality requirements. As noted previously the analysis of components for Water Supply is improperly conceptualized and yet finds that streamflow depletion of significance can occur and must be mitigated by application of an appropriately calculated SDF.

Again from page 3.1.6 in Section 3.1.2.4.1 the EIS/EIR states: “Transfers would not affect whether the water flow and quality standards are met…” but only Reclamation and DWR water supplies”

The EIS/EIR anticipates hypothetically that if the streamflow depletion resulting from Groundwater Substitution Measures results in decreased river flows then USBOR and DWR would modify operations by decreasing Delta exports or release of additional water from reservoirs to meet Delta outflow and/or water quality standards; however as documented in Attachment D herein the Federal and State projects were unable to maintain these standards in 2013 due to dry year conditions and a lack of available instream flow and releases of water.

Response
See response to Comment LA12-10.

Comment LA15-61

Comment
Under Assessment Methods at page 3.2-27 in Section 3.2.2.1.1 states that quantitative analysis relies on hydrologic modeling estimated changes in river flow rates and reservoir storage for the CVP and SWP reservoirs and the rivers they influence. The quantitative analysis is left to Appendix B but the main body states that: "If the changes are small and within the normal range of fluctuations (similar to the No Action/No Project Alternative) for that time period, it is … assumed that any water quality impacts would be less than significant"

According to the EIS/EIR: "CalSim II is the latest version of CalSim available for general use. It represents the Central Valley with a node and link structure to simulate natural and managed flows in rivers and canals. It generates monthly flows showing the effect of land use, potential climate change, and water operations on flows throughout the Central Valley." (41)

With Closure Terms to rectify storage and flow on the order of millions of acre-feet per year (as much as 3,000,000 AFY during the model periods simulated for the EIS/EIR), CalSim II is not an adequate tool for assessing whether flow and required storage changes under the proposed Groundwater Substitution Measures are small, normal or significant to enable the assumption of insignificant water quality impacts. Further CalSim II works on a coarse monthly time-step to assess SWP and CVP operations. However, water quality and ecosystem management decisions require a more detailed weekly or daily time-steps to properly account for potential water availability and timing impacts. CalSim II is not the appropriate modeling system to assess the Long-Term Transfer Project which will cause daily flow changes that require water quality and ecosystem management decisions to mitigate impacts before they occur and does not represent best available science (see earlier comment on CalSim III under Water Supply).

(41) EIS/EIR Public Draft Under Review at page C-5

Response
CalSim II represents the best available tool for simulating changes in CVP and SWP operations. This model is the standard for assessing these types of impacts in the Central Valley, and a superior tool is not available.

Comment LA15-62

Comment
Contracted Reservoir Releases by the Sellers may be diminished by streamflow depletions from current pumping conditions in areas where groundwater saturation falls below the river stage adjoining under existing conditions. These depletions of water available for transfer via Reservoir Releases and are not quantified in the EIS/EIR. The effect of these baseline conditions impacts the availability of water to be transferred down the Sacramento River and through the Sacramento San-Joaquin Rivers Delta to the CVP and SWP pumping stations that pump water south via their respective aqueducts, the Delta-Mendota Canal, and the California Aqueduct.

Response
The depletions from the river systems are estimated through the modeling efforts. Reservoir release transfers would result in small increases in flow downstream of the participating reservoirs. For these transfers to increase streamflow depletion, they would have to substantively increase the stage in rivers that are experiencing streamflow depletion. Reservoir release transfers could occur on the American River, Yuba River, Feather River, or San Joaquin River systems. The largest potential transfers could be on the American River from Placer County Water Agency or on the Merced River and San Joaquin River system from Merced ID. As described in Section 3.3, the American River system is disconnected from the groundwater aquifer, so a small increase in water levels in the river would not affect streamflow depletion. The Merced River and San Joaquin River systems do not include groundwater substitution transfers, so this transfer would not affect streamflow depletion. The remaining transfers are small and would not increase water levels in the streams to a level that would increase recharge and streamflow depletion during a reservoir release transfer.

Comment LA15-63

Comment
The quantitative analysis of potential Water Quality impacts to the Sacramento-San Joaquin Delta is provided in Appendix C. Appendix C states at page C-2 that: “The Delta Conditions analysis is performed with the Delta Simulation Model 2 (DSM2). DSM2 setup relies on the output of three additional tools for this Project: CalSim II, the Transfer Operations Model (TOM), and the Delta Island Consumptive Use model (DICU model). CalSim II outputs simulating California’s water delivery system to the Delta are used to supply inflow and export boundary conditions to DSM2.”

Use of a CalSim II model with monthly outputs that are crude approximations of actual system performance at best renders use of these outputs to create daily approximations that are supplied to DSM2 useless in assessing the potential for water quality impacts from proposed Groundwater Substitution Measures that will impair the actual timing of surface-water baseflow as a result of streamflow depletion and the quantity of water available to meet Delta Water Quality requirements.

Response
The CalSim II model represents the best available tool to simulate CVP and SWP operations. This tool, in combination with DSM2, sets the standard for analysis of system operations effects on streamflow and Delta water quality, water levels, and circulation. No superior tools exist.

Comment LA15-64

Comment
Proposed Mitigation:

Our review finds that the Less Than Significant assessment in the EIS/EIR lacks sufficiently accurate analysis as to available flows and storage of water in the Sacramento River watershed by virtue of the precision of the models used in the quantitative assessment. Mitigation is likely required to assure sufficient baseflow and stored water availability for CVP and SWP operating requirements for Water Quality.

Response
While the models may not produce results reflecting these changes with absolute certainty, they do produce a reasonably reliable estimate of the relative change in outcome. These changes in outcome aid the understanding of potential environmental effects of the action alternatives; the assessment of these effects did not identify the need for additional mitigation.

Comment LA15-65

Comment
Assessment methods in the EIS/EIR for riparian, wetland, and natural in-stream community (e.g. fauna in the hyporheic zone such as Caddis fly larvae) impacts include SACFEM2013. Reportedly SACFEM2013 predicted changes in groundwater elevations over time were used to assess the potential impacts of groundwater depletion on stream flows in small tributaries and associated natural communities. However, it should be noted that in wetland and riparian habitats, groundwater typically ranges from eight feet to just below the ground surface Faunt (2009). (42) As noted previously under the discussion of Groundwater Resources evaluations, SACFEM2013 contains an unusual model construction feature using model "Drains" with respect to riparian habitats consumptive use of water, its evapotranspiration of water, and groundwater

discharge to land surface outside of a recognized and model surface water course. Drains were set at land surface rather than at root zone depth. Thus SACFEM2013 is highly imprecise in its ability to discern where and how much a riparian or riverine habitat is utilizing groundwater or residual soil moisture (see earlier commentary on the decoupling of the soil moisture model from the SACFEM2013 groundwater model)

The EIS/EIR notes that: "…groundwater modeling results indicate that shallow groundwater is typically deeper than 15 feet in most locations under existing conditions, and often substantially deeper…"(43)

Modeling is not the best available science for this analysis when empirical data are available to assess actual or anticipatable depth to a phreatic surface or the capillary fringe of water rising above the phreatic surface in native sediments and soils. For example groundwater elevations of Spring 2013 depicted on Figure 3.3-4 along the Sacramento River main stem from Red Bluff, California to roughly Princeton, California are above the streambed elevations. This indicates that the Sacramento River is gaining flow from accretionary flows of groundwater in this lengthy reach, and the phreatic surface of groundwater would be expected to be eight feet or less below ground surface along the riparian corridor of the river with possible wetlands. Similarly groundwater elevations depicted on Figure 3.3-4 along the Feather River from Oroville to Live Oak are above the streambed elevations. Conditions for the riparian corridor and potential wetlands may exist based on these data. The areas where groundwater elevations are below the elevation of the bottom of river courses was noted in the discussion of Groundwater Resources; yet an analysis of near river and stream course depths to groundwater or the capillary fringe can be reasonably estimated from the data. Data are better than models for current or historic conditions analysis.

Terrestrial Resource impacts are not properly accounted in the EIS/EIR due in part to the imprecision and inability of the models to assess dehydration of the soils and groundwater aquifer adjoining streams and large rivers.

(42) Faunt, C.C., ed., 2009, Groundwater Availability of the Central Valley Aquifer, California: U.S. Geological Survey Professional Paper 1766, 225 p

(43) EIS/EIR Public Draft at page 3.8-32

Response
See Common Response 11. The analysis was based on thresholds that conservatively estimate the potential for effects.

Comment LA15-66

Comment
Proposed Mitigation GW-1 is not quantified or quantifiable as to what groundwater pressure decreases will constitute an impact to natural communities in and near small streams in the Seller Service Area.

The groundwater elevation changes within a conceptual monitoring plan that would be necessary to mitigate stream flows supporting natural communities in small streams under proposed mitigation, GW-1, must be quantifiable or else the proposed mitigation is insufficient to reduce the impacts from Groundwater Substitution Measures. The proposed mitigation, GW-1, is not sufficiently quantified in the EIS/EIR nor in the Groundwater Management Plans (GWMPs) referenced. Existing GWMPs do not contain quantified year on year metrics for subbasin depletion and refill within acceptable ranges to sustain primary functions like support for natural communities.

Response
See Common Responses 10 and 11.

Comment LA15-67

Comment
Much of the discussion of small streams is applicable to large rivers. Additional considerations are noted in the following discussion that demonstrate a finding of Less Than Significant is apparently due to a faulty analysis of the type of impacts, and their foreseeable magnitude and likelihood of creating Significant impact to habitat supported by large rivers.

Water transfers would affect flows in the rivers and creeks adjacent to and downstream of the areas where transfer activities (of all kinds) would occur. Changes in stream flows that would result within the Seller Service Area may affect natural communities, such as riverine, riparian, seasonal wetland, and managed wetland natural communities, which are reliant on CVP and SWP operational outcomes with Water Transfers such as surface-water flow velocity, surface-water quality (in particular water temperature both released and exchanged with groundwater), and the accretion or depletion of groundwater near surface. These operational outcomes and effects could propagate downstream of the areas/locations where pumping occurs.

Response
See Common Response 11.

Comment LA15-68

Comment
The extraction scenarios proffered in the EIS/EIR will cumulatively over time and space reduce the available accretionary flow of groundwater to the large

rivers in addition to the loss of water directly from the adjoining large river, where proximate to a well or wells, to satisfy the capture of water by groundwater extraction wells used for Long-Term Water Transfers as Groundwater Substitution Measures.

Response
See Common Response 11.

Comment LA15-69

Comment
Releases of storage water within reservoirs is one of many factors within TOM and CalSim II that lack a sufficient description for the analyses required here for natural habitat flow requirements. An adequate form of model would incorporate anticipated timing of natural flow impacts and controlled releases for Water Transfers. Again the best available science would include implementation of the IWFM simulation code to an appropriately configured model. Due to the IWFM codes ability to account stream flows dynamically in the simulation code's algorithms the timing and magnitude of flows could be quantified. From this foundational quantification additional models on river flow velocities, bed scour, temperatures and other attributes of Seasonally Varying Flow (SVF) that has been found to be essential to riverine habitat. (44) In other words there is no detail provided on where each of the water volumes in TOM are derived (e.g. groundwater vs. stored water). As a result of streamflow depletion from Groundwater Substitution Measures, the EIS identifies that small decreases in water supplies to users could occur when the stored reservoir release transfers decrease carryover storage in reservoirs. These operational controls are very important to how storage facilities would operate during extended dry periods.

(44) Risley, John, Wallick, J.R., Waite, Ian, and Stonewall, Adam, 2010, Development of an environmental flow framework for the McKenzie River basin, Oregon: U.S. Geological Survey Scientific Investigations Report 2010-5016, 94 p.

Response
The best available tool to predict hydrology under various operational scenarios, CalSim II, is configured to use historical hydrology data. Additional information on groundwater model selection has been added to Appendix D.

Comment LA15-70

Comment
A reanalysis of the potential impacts of Water Transfers is required using best available science to ascertain the magnitude of potential impacts, system operational constraints on those impacts, and the method and implementation of mitigation, if needed.

Response
The preparers of the EIS/EIR used the best available science to conduct the analyses.

Comment LA15-71

Comment
The findings of Less Than Significant for Fisheries is not supported by the analytical tools based upon the preceding analyses of Groundwater Resources and Water Supply and should be revisited as to availability of water to support riparian and hyporheic zones along the waterways for habitat support for species of special interest identified in Section 3.7.1.2 and as to timing and quantity impacts of river flows due to streamflow depletions evaluated under Water Supply.

Response
The impacts analysis looked at the full range of potential effects to all target species in all waterways that could potentially be affected by each alternative using the best available science and analytical tools possible. The approach is described in Section 3.7.2.1., significance thresholds are listed in Section 3.7.2.2, and the results for each alternative are provided in Sections 3.7.2.3 through 3.7.2.6. The methods, logic, and science behind the findings of less than significant for biological impacts are supported in these sections.

Comment LA15-72

Comment
SACFEM2013 is built using the MicroFEM simulation code. MicroFEM as a groundwater simulation code cannot accurately calculate some of the key physical processes in the water budget such as evapotranspiration within a shallow groundwater aquifer. It is unable to simulate the physical processes and fully account the changes in surface water flow and groundwater to surface water exchange. A proper basis for the selection of a proprietary model code, that has not been independently verified as to its numerical solution's accuracy, and that does not contain necessary algorithms and proper mathematical formulations to the questions at hand, is not provided in Appendix D.

The EIS/EIR in Appendix B states: "SACFEM2013 is a full water budget based, transient groundwater flow model that incorporates all groundwater and surface water budget components on a monthly timestep over the period of simulation. SACFEM2013 provides very high resolution estimates of groundwater levels and stream flow effects due to groundwater pumping within the Sacramento Valley."

This statement is not accurate and is notably not repeated in the text of Appendix D.

Response
The SACFEM2013 User's Manual has been incorporated into the EIS/EIR as Appendix M to provide additional information on the model. The user's manual explains that SACFEM2013 includes transient agricultural water budget components that were simulated using the Integrated Water Flow Model Demand Calculator. Appendix D has been updated to include information on the model selection process that identified SACFEM2013 as the best available tool. The SACFEM model underwent a peer review process (WRIME 2011) that led to development of the SACFEM2013 model.

Comment LA15-73

Comment
The documentation of SACFEM2013 is grossly inadequate. The documentation of SACFEM2013 is less than that found for SACFEM in 2011. There is no calibration data provided. No discussion of model residuals or fit to any type of observed data. There is no quantification of model uncertainty or limitations provided in Appendix D. In our review we have been unable to comprehend the model from its documentation. Instead it has required exploring primary data inputs through the GIS database from which it was constructed.

SACFEM2013 is built in Version 4.10 of MicroFEM. No documentation for this version of the code is cited or provided.

Vertical Structure goes to base of the freshwater aquifer and treats that boundary as a no-flow boundary.

Response
A more detailed user's manual for the SACFEM2013 model used for the analysis has been included in the Final EIS/EIR as Appendix M.

The most recent documentation for the MicroFEM code can be found on the developer's web site: http://www.microfem.com/

Comment LA15-74

Comment
Head Dependent Boundaries

Surface Water fluxes

1) 50 individual streams are simulated using the “wadi” package in the current version of SACFEM2013

2) User specified stream stage

2a) Transient monthly “varying distributions” of stream-stage height were developed for each reach with no documentation of how this was calculated)

2b) User specified stream stage imposes error on model outcomes

3) Model calculated head is driver on gradient vs. user specified stage.

4) Streambed Conductance (from subformula)

4a) Dr = streambed thickness = uniformly assumed to be 1 meter

4b) Kv = streambed conductivity

4b1) Assumed to be 2 meters/day on the eastside, and

4b2) 5 meters/day on the westside, two exceptions on Eastside for Bear River and Big Chico Creek

4b3) Review and use of model input data Kv as found in the GIS files to the Delta Water Agencies found Kv values in the eastside ranging from 1 meter/day to 0.1 meter/day in the locations selected.

4c) L = stream length represented by the model node

4d) A = nodal area

4e) W = “field width” of the reach represented by L

4e1) Wetted Stream width taken from aerial photographs at two locations

Appendix D comments that stream length is generally overestimated at river confluences. Manual adjustments were noted without description of how these were calculated.

Streambed elevations were developed from a DEM; there is an odd note of the DEM resolution being lower than stream node resolution when stream node resolution is reported to be on the order of 250 meters and conventional DEM resolution is on the order of 10 to 30 meters with a precision of plus/minus approximately 8 feet.

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Regarding the last sentence, this statement was in error. This condition does not exist with the SACFEM2013 grid.

Comment LA15-75

Comment
SACFEM2013 used the Drain package to simulate the upper land-surface groundwater boundary condition across the domain. Efflux nodes only that are

head dependent. Elevation of drain set at land surface. Why were drains not set to the root zone depth to represent ET from the groundwater domain? Formulas provided for the drain stage are underdocumented

Response
The Drain package was used to represent discharge of groundwater to small scale tributaries of the larger regional streams explicitly simulated in the model. Discharge only occurs in areas of extremely shallow groundwater and mostly during wet climatic periods. The agricultural processes that occur at the land surface (ET, irrigation efficiency, soil moisture storage and depletion) are accounted for using the IDC model.

Comment LA15-76

Comment
Specified Flux Boundaries

These denote boundaries where a influx or outflux of water occurs at a set rate per period that is user specified and not model calculated. Specified flux boundaries were set for:

1) Deep Percolation

2) Mountain Front Recharge

3) Urban Pumping

Deep percolation of water

This was reportedly done by surface water budget approach

1) Water budget estimated using spatial information

1a) Land use

1b) Cropping patterns

1c) Source of Agricultural Water

1d) Surface water availability in different year types and locations

1e) Spatial distribution of precipitation

2) Components

2a) Deep percolation of applied water

2b) Deep percolation of precipitation

2c) Agricultural pumping

3) Developed by intersecting

3a) GIS data developed by DWR (no citation) – Transient Condition on Land Use

3b) With SACFEM model grid

4) Results in a land use for each groundwater model node

5) GIS data on water district and non-district areas derived

6) Water source information to the areas(where does this come from? – no citation or methodology described)

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Most comments and questions regarding model development, input data, and calibration for the SACFEM2013 model are addressed in the document SACFEM2013 Sacramento Valley Finite Element Groundwater Flow Model User's Manual (February 2015), which is included in the Final EIS/EIR as Appendix M. The commenter is referred to this document in response to this specific comment. Additionally, because the SACFEM model has been revised and improved multiple times since its initial development, where any inconsistencies in data and descriptions used in model development may exist between the 2015 User's Manual and other model documentation, the 2015 User's Manual should be considered the definitive source.

Comment LA15-77

Comment
Methodology for Surface Water Budget

The methodology is underdocumented. Semi physically based soil moisture accounting model used; it is not clear if this is IDC Historic precipitation data simulates root zone processes and calculates applied water demand and deep percolation past the root zone for each node.

Deep percolation was split between applied water and precipitation. Split was dependent on the season and availability of water from each source.

Their calculated values for deep percolation were reportedly compared to DWR Estimated Values for the Year 2000 (no citation). They corresponded with DWR Northern District staff (no citation of who) They adjusted soil parameters in root zone model to reportedly match volumes of percolation to DWR (no citation of DWR data source nor provision of data).

Agricultural Pumping calculated from demand for applied water (no mention found of crop typing or climatic drivers on water demand for applied water) compared to source water availability from surface sources via GIS intersection of districts

1) Split out of groundwater and surface water for certain areas

2) Or all groundwater

3) Mention of a "level of development simulation of CVP operations" was used to calculate availability of surface water

4) Agricultural pumping applied to Layers 2, 3, and 4 only. There is no clear basis for this placement of pumping.

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Layers 2 through 4 represent depth intervals from approximately 100 feet through 550 feet below ground surface (bgs) depending on location. These are the main producing zones for most of the irrigation wells in the Sacramento Valley.

See response to Comment LA15-76.

Comment LA15-78

Comment
Mountain Front Recharge

Utilized an annual formula from Turner 1991 for a Mediterranean climate and converted the total deep percolation estimated per upper watershed into monthly quantities by looking at streamflows in "ungauged" sections of Deer Creek. Water inserted into Layer 1 at the model boundary.

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Comment LA15-79

Comment
Urban Pumping

Used groundwater use data form Urban Water Management Plans, for population centers above 5,000 people that rely on groundwater. For areas that did not have UWMPs used 271 gpd per person times census to get to groundwater use. Areas of North Sacramento County pumping/usage were stated as consistent with the local SacIGSM model (Note that SacIGSM is built in a predecessor code to IWFM)

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Comment LA15-80

Comment
No Flux Boundaries

Bottom of Layer 7, the freshwater interface.

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Comment LA15-81

Comment
Aquifer Properties

To develop hydraulic conductivity they reportedly used 1,000 wells within model domain with construction information and specific capacity data on Well Completion Reports. Shallow wells (<100 feet) and those with production below 100 gpm were eliminated for aquifer properties (except at the margins of the model domain where aquifers were presumed to be thin). Specific capacity data were converted to calculated transmissivity (T) using an empirical method that is not accurate. A specific capacity can be strongly influenced by turbulent head losses at the well if the pumping rate of the well is high relative to the length of well screen and the well screen open area. The calculated T value was reportedly divided by screen length to derive initial Kh.

They state there is not enough data to define depth dependent Kh. Cooper-Jacob confined aquifer method was assumed in their analysis of aquifer transmissivity.

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Comment LA15-82

Comment
Peer Review Comments

Deep Percolation

1) IDC calculated deep percolation rates are excessive

1a) Deep percolation reduction factors were created for IDC outputs before use in SacFEM

2) SacFEM deep percolation rates are not supported by the fundamental IDC model methodology and parameters resulting in a disconnect between SacFEM and IDC.

2a) Recommended incorporating a feedback loop between the 2 models and subjecting them to convergence criteria

2b) SacFEM deep percolation rates are not consistent with other data sets and it should be ensured that they are supported by historical land use, crop mix, and agricultural practices

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required.

Comment LA15-83

Comment
Stream Aquifer interaction

1. The flow exchanged between streams and aquifers is a function of head difference between groundwater elevation and stream stage with impedance by streambed resistance; 2) The assumption of constant stream stage results in stream-aquifer relationship dependent on streambed resistance and groundwater elevation; 3) Assumption of constant stage is not valid; 4) Recommended that SacFEM use time varied stream stage data

The 2011 peer review contained a primary statement of revisions to SACFEM from 2009 that: “Documentation on SacFEM and the IDC Model – Model documentation, with appropriate level of detail on data collection, analysis, and input data preparation should be developed.”

Response
The comment provides a summary of the assumptions made and the methodology used for model development. No response is required. Comment is noted.

A comprehensive user's guide to SACFEM2013 that provides the information requested by the commenter is included in the Final EIS/EIR as Appendix M.

Comment LA15-84

Comment
Model Calibration Information

The following model calibration figures were obtained from the 2009 and 2011 SACFEM model documentation. (SEE ORIGINAL COMMENT FOR FIGURE)

This model calibration demonstrates that in several areas model estimates exceed actual measured data by more than 65 feet, the thickness of Layer 1 in SACFEM2103. This is notable in the region around 150 feet MSL on the attached chart, B-9, found in the 2011 model documentation. Additional calibration figures by well are found on the pages that follow and demonstrate a lack of fit to trend or data at many wells.

Response
The commenter is referring to the 2009 version of SACFEM that was submitted for peer review. Significant improvements to model calibration were achieved during development of SACFEM2013. Overall, the goodness-of-fit to historical groundwater levels achieved by SACFEM2013 is similar to or better than those associated with other regional models of the Sacramento Valley (e.g., CVHM and C2VSIM).

Comment Letter NG01, Kit Custis, AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group

Comment NG01-1

Comment
This letter provides comments and recommendations on the information provided in the September 2014 Draft Long-Term Water Transfer Environmental Impact Statement/Environmental Impact Report (Draft EIS/EIR) prepared by the U.S. Bureau of Reclamation (BoR) and San Luis & Delta-Mendota Water Authority (SLDMWA). This document evaluates the potential impacts of alternatives over a 10-year period, 2015 through 2024, for transferring Central Valley Project (CVP) and non-CVP water from north of the Sacramento-San Joaquin Delta (Delta) to CVP contractors south of the Delta. These transfers require the use of CVP and State Water Project (SWP) facilities. This Draft EIS/EIR evaluated impacts of alternatives for water transfers made available through groundwater substitution, cropland idling, crop shifting, reservoir release, and conservation.

This letter focuses mostly on the groundwater substitution element of the transfers for the Sacramento Valley groundwater basin and proves comments and recommendations regarding the potential impacts, technical information submitted, and monitoring and mitigation measures. Comments and recommendations are also provided regarding the biological resources, crop idling/crop shifting when those resources or activities impact or are impacted by the groundwater substitution transfers. This letter has two parts. The first part comments on the Draft Long-Term Water Draft EIS/EIR. The second part provides additional technical information on surface water-groundwater interactions that are relevant to the evaluation of potential impacts from the proposed water transfers, monitoring during the transfers and designing and implementing mitigation measures.

Response

Potential effects from groundwater-surface water interaction associated with groundwater substitution transfers are analyzed throughout Section 3, not just in the groundwater resources analysis. Section 3.1 discusses potential effects to surface water supply, Section 3.7 analyzes potential effects to fisheries, Section 3.8 assesses potential effects to riparian vegetation, and multiple other sections (Sections 3.2, 3.15, 3.16, and 3.17, among others) include modeling results that reflect changes in streamflow caused by groundwater-surface water interaction.

Comment NG01-2

Comment

1. Comments and Recommendations on the Draft Long-Term Water Transfer Draft EIS/EIR. The Draft EIS/EIR evaluated a number of potential environmental impacts from the groundwater substitution transfers using a finite element groundwater model, SACFEM2013. The potential impacts evaluated include: groundwater levels; surface water flow; water quality; biological resources, including vegetation, wildlife and fisheries; and the associated cumulative effects and impacts. Two mitigation measures, WS-1 and GW-1, are provided for monitoring and mitigating potential impacts from groundwater substitution transfers. I will provide comments and recommendations on these topics following seven comments and recommendations on general issues, assumptions and methods that are used throughout the Draft EIS/EIR.

General Comments:

1. The Draft EIS/EIR has an underlying assumption that specific information on each proposed transfer will be evaluated in the future by the Bureau of Reclamation, the California Department of Water Resources (DWR), perhaps the California State Water Resources Control Board (SWRCB), and local agencies, presumably the County, or other designated local agency (Sections 1.5, 3.1.4.1-WS-1 and 3.3.4.1-GW-1). The Draft EIS/EIR relies on the results of the SACFEM2013 groundwater modeling effort to validate the conclusion of less than significant and reasonable impacts that cause no injury from the groundwater substitution transfer pumping. This conclusion is reached based on model simulation results, and assumption of

implementation of mitigation measures WS-1 and GW-1. However, the Draft EIS/EIR provides only limited information on the wells to be used in the groundwater substitution transfers (see Table 3.3-3), and no information on non-participating wells that may be impacted. Information that is still needed to evaluate the potential impacts simulated by the groundwater modeling and the potential significance of the groundwater substitution transfer pumping includes, but isn't limited to:

a. proposed transfer wells locations that are sufficiently accurate to allow for determination of distances between the wells and areas of potential impact,

b. the distances between the transfer wells and surface water features,

c. the number of non-participating wells in the vicinity of the transfer wells that may be impacted by the pumping,

d. the distance between the transfer wells and non-participant wells that may be impacted by the transfer pumping, including domestic, public water supply and agricultural wells,

e. the number of non-participating wells in the vicinity of the transfer wells that can be expected to be pumped to provide public water supply or irrigation water during the same period as the transfer pumping,

f. the amount of well interference anticipated at each of the non-participating domestic, public water supply and agricultural wells in the vicinity of transfer wells,

g. the aquifers that the non-participating wells in the vicinity of the transfer wells are drawing groundwater from,

h. groundwater level hydrographs near the non-participating and participating transfer wells, to document the pre-transfer trends and fluctuations in groundwater elevations in order to evaluate the current conditions and serve as a reference for monitoring impacts from transfer pumping,.

i. the identity and locations of wells that will be used to monitor groundwater substitution transfer pumping impacts, the aquifers these wells are monitoring, frequency for taking and reporting measurements, and the types and methods for monitoring and reporting,

j. groundwater level decline thresholds at each monitoring well that require actions be taken to reduce or cease groundwater substitution transfer pumping to prevent impacts from excessive drawdown, including impacts to non-participating wells, surface water features, fisheries, vegetation and wildlife, other surface structures, and regional economics.

This list addresses only the minimum of information needed about the groundwater wells and does not address other elements of the groundwater substitution transfer, which I will discuss under separate sections, including the WS-1 and GW-1 mitigation measures, the SACFEM2013 groundwater modeling effort, and stream depletion impacts.

I recommend the Draft EIS/EIR be revised to include the additional well information and monitoring requirements listed above. I recommend that mitigation measures WS-1 and GW-1 be revised to provide specific requirements for monitoring, thresholds of significance, and actions to be taken when the thresholds are exceeded.

Response
Note the locations of the transfer wells are shown in Figures 3.3-28 through 3.3-33. The scale of these figures has also been increased to make them easier to review. The exact location/coordinates of groundwater substitution wells are confidential and cannot be disclosed in a public document.

The SACFEM 2013 User's Manual has been included in the Final EIS/EIR as Appendix M, and it includes more information about groundwater pumping in the Sacramento Valley that is not transfer-related pumping. Mitigation Measure GW-1 discussed in Section 3.3.4.1 will monitor groundwater levels during transfers to ensure compliance with performance criteria and avoid potentially significant effects. See Common Responses 4 and 6 for additional information.

Comment NG01-3

Comment

2. The only maps provided by the Draft EIS/EIR that show the location of the groundwater substitution transfer wells, and the rivers and streams potentially impacted are the simulated drawdown Figures 3.3-26 to 3.3-31, which are at a scale of approximately 1 inch to 18 miles on letter size paper. These figures show clusters of wells and several rivers, creeks and canals. A few are labeled, but apparently not all of the streams and creeks evaluated for groundwater substitution impacts are shown. Figures 3.7-1 and 3.8-2 show the major rivers and reservoirs evaluated in the biological analyses, and Tables 3.7-2, 3.7-3, and 3.8-3 list up to 34 small rivers or creeks that were apparently evaluated for stream depletion using the SACFEM2013 groundwater model. Without river/stream/creek labels on the drawdown figures at a scale that allows for reasonable measurement and review, it is difficult to determine the anticipated drawdown at the 34 small rivers and creeks or other important habitat areas.

Response
Figures 3.3-26 through 3.3-31 from the Long-Term Water Transfers Public Draft EIS/EIR (revised to Figure 3.3-28 through 3.3-33 in the Final EIS/EIR) have been revised to show results at a finer resolution to facilitate the

measurement of distances. Each of the rivers/streams simulated in the SACFEM2013 model are shown in these figures.

Comment NG01-4

Comment

The Fisheries Section 3.7, and Vegetation and Wildlife Section 3.8 provide discussions of the potential impacts from groundwater substitution transfer induced stream depletion (Sections 3.7.2.1.1, 3.8.2.1.1, and 3.8.2.1.4). The Well Acceptance Criteria of Table B-1 in Appendix B of the October 2013 joint DWR and BoR document titled Draft Technical Information for Preparing Water Transfer Proposals (DTIPWTP) lists in the table footnotes eight major and three minor surface water features tributary to the Delta that are affected by groundwater pumping. Apparently, the Well Acceptance Criteria in Table B-1 will be applied to these eleven surface water features as part of mitigation measure GW-1. Whether the Well Acceptance Criteria will also be applied to the creeks listed in Tables 3.7-2, 3.7-3 and 3.8-2 is not specifically stated in the Draft EIS/EIR or GW-1.

Response

The comment is incorrect. Mitigation Measure GW-1 does not include or rely upon the well acceptance criteria specified in the Draft Technical Information for Preparing Water Transfer Proposals.

Comment NG01-5

Comment

The lack of maps with sufficient detail to see the relationship between the wells and the surface water features prevents adequate review of the Draft EIS/EIR analysis to determine whether mitigation measures WS-1 and GW-1 will be effective at mitigating pumping impacts. As I will discuss in Part 2 of this letter, the distance between a surface water feature and a pumping well is a critical parameter in estimating the rate and duration of stream depletion. Maps are needed of each seller's service area at a scale that allows for reasonably accurate measurement of distances between the groundwater substitution transfer wells and surface water features, other non-participating wells, proposed monitoring wells, fisheries, vegetation and wildlife areas, critical surface structures, and regional economic features.

Response

See response to Comment NG01-3.

Comment NG01-6

Comment

I recommend the Draft EIS/EIR be revised to provide additional maps of each seller's service area at a scale that allows for reasonably accurate measurement of distances between the groundwater substitution transfer wells and surface water features listed in Tables 3.7-2, 3.7-3, 3.8-3 and B-1 as well as other non-listed surface water dependent features such as wetlands and riparian areas, non-participating wells, the proposed monitoring wells, wildlife areas, critical surface structures, regional economic features, and other structures that might be impacted by groundwater substitution pumping.

Response
See response to Comment NG01-3.

Comment NG01-7

Comment

3. The Draft EIS/EIR evaluated a number of potential environmental impacts from the groundwater substitution transfers using the finite element groundwater model SACFEM2013. The results of the modeling effort were used in the assessment of the potential biological resource impacts from reductions in surface water flows caused by groundwater substitution transfer pumping (pages 3.7-18 to 3.7-30, and 3.8-67). The Draft EIS/EIR assumes that SACFEM2013 model results are sufficiently accurate to justify removing most of the small creeks from a detailed effects analysis (Table 3.7-3 and 3.8-3).

Statements are given that the mean monthly reduction in the Sacramento, Feather, Yuba and American rivers will be less than 10 percent (pages 3.7-25 and 3.8-49) and that other stream requirements of flow magnitude, timing, temperature, and water quality would continue to be met. However, actual SACFEM2013 model results on anticipated changes in flow, temperature and water quality are not provided for all of the surface water features that may be potentially impacted by the groundwater substitution transfer projects. Creeks that passed a preliminary screening, Tables 3.7-3 and 3.7-4, were selected to be modeled by water year type for stream depletion that exceeds 1 cubic feet per second (cfs) and 10% reduction in mean monthly flow. Results of the modeling effort are presented in Tables 3.8-4 to 3.8-7.

Response
See Sections 3.7.2.1 and 3.8.2.1 of the Draft EIS/EIR and Common Response 11. The SACFEM 2013 model assessed the changes in surface water features for the small creeks for each month in the period of analysis. The Lead Agencies used these results to determine if the stream had the potential for a change of more than 10 percent of flow or 1 cfs.

Comment NG01-8

Comment
The Draft EIS/EIR notes that not all surface water features were evaluated because some lacked sufficient historical flow data, or they were too small to

model (page 3.7-20). The Draft EIS/EIR then assumes that the pumping impacts to un-modeled small surface water features are similar to nearby modeled features. No maps with sufficient detail are provided to allow for determination of the spatial relationship between the modeled and un-modeled surface water features, or the relationship between the groundwater substitution transfer wells and the modeled and un-modeled surface water features (see comment no. 2). The distance between a well and a surface water feature is a critical parameter in determining the rate and timing of surface water depletion resulting from groundwater pumping. The validity of the assumption that the un-modeled surface water features will respond similarly to the modeled is dependent on the distance between them and their respective distances to the pumping transfer well(s). I will discuss in more detail in Part 2 the importance of distance in the calculation of stream depletion.

Response
Wells were added to the seller map in Chapter 2.

Comment NG01-9

Comment
The Draft EIS/EIR also provides Figures B-5 and B-6 of Draft EIS/EIR Appendix B that graph in aggregate the changes in stream-aquifer interactions, presumably equal to changes in stream flow, based on the SACFEM2013 simulations. While these graphs are interesting for several reasons, they don't provide information specific to each seller service area on flow losses expected in each river and creek. No figures are provided that show the longitudinal- or cross-sections of channel where impacts are expected, or the rate of stream depletion in each channel section. Maps with rates and times of stream depletion by longitudinal channel section are needed to allow for an adequate review of the Draft EIR/EIS conclusion of less than significant and reasonable impacts with no injury. These maps are also needed to evaluate the specific locations for monitoring potential impacts.

Response
Rates and locations of streamflow depletion are not consistent for each waterway, but vary for each month of the 33-year modeling period because of different pumping patterns and hydrology. This produces too much data to summarize in a map (or a series of maps). The results were examined in detail for the analyses in Sections 3.1, Water Supply; 3.7, Fisheries; and 3.8, Vegetation and Wildlife to determine the locations where additional analysis was needed related to these resources. A summary of the results is included in Appendix B, and additional data relevant to the environmental analyses is found in Sections 3.1, 3.7, and 3.8.

Comment NG01-10

Comment
Statements are made in Section 3.7 that reductions in surface flow due to groundwater substitution pumping would be observed in monitoring wells in the region as required by mitigation measure GW-1. Thus detailed maps that show the locations of the monitoring wells and the areas of potential impact along with the rates and seasons of anticipated stream depletion are needed for each service area. These maps are also needed to allow for evaluation of the cumulative effects whenever pumping by the multiple sellers can impact the same resource. Without site-specific information on expected locations and changes in flow at each potentially impacted surface water feature, it's difficult to evaluate the adequacy of any monitoring effort.

Response
There were no effects found on fisheries and mitigation measures are unnecessary. References to environmental commitments were removed from the fisheries section (Section 3.7) to avoid confusion.

Comment NG01-11

Comment
I recommend the Draft EIS/EIR be revised to provide additional information on the anticipated changes in surface water flow, temperature, water quality and channel geomorphology for each river, creek and surface water feature in the areas of groundwater substitution transfer pumping. In addition, I recommend that maps showing the along channel longitudinal sections, the maximum anticipated changes in flow rate, water temperature, water quality, and the timing of the maximum anticipated rate of stream depletion due to groundwater substitution transfer pumping be provided at an appropriate scale to allow for adequate measurement and review in the Draft EIS/EIR, and for use in the WS-1 and GW1 mitigation monitoring programs.

Response
The analysis provided represents the best available science and analytical tools, consistent with professional practice. Much of the information requested by the commenter has already been provided in the analysis. Some of the information (e.g., water temperature and water quality modeling in potentially affected surface water features) cannot be obtained because no tools are available to provide it. Instead, changes in flow were used as a proxy for changes in temperature and water quality.

Comment NG01-12

Comment
4. The results of the SACFEM2013 simulation are used to evaluate stream depletion quantities and impacts for vegetation and wildlife resources that

> are dependent on surface water (Sections 3.7 and 3.8), and to determine the expected lowering of groundwater levels in the areas of transfer pumping (Section 3.3). The groundwater substitution transfer pumping simulation was run from water year (WY) 1970 to WY 2003 and assumed 12 periods of groundwater substitution transfer at various annual transfer volumes as shown in Figure 3.3-25. The apparent Draft EIS/EIR baseline for analysis of groundwater pumping impacts ends with WY 2003 because of limitations of the CalSim II surface water operations model. The CalSim II model was jointly developed by DWR and BoR and is used to determine available export capacity of the Delta. The WY 2003 time limitation was adopted in the SACFEM2013 groundwater-modeling effort apparently because if the desire to combine the simulation of groundwater impacts with estimating the timing of when groundwater substitution water could be transferred through the Delta (Section 3.3.2.1.1). The description of the SACFEM2013 modeling effort states that the volume of groundwater pumping was determined by "comparing the supply in the seller service area to the demand in the buyer service area" (page 3.3-60).

Response
Comment noted.

Comment NG01-13

Comment
While this is an interesting modelling exercise, and much can be learned from it, the simulations didn't evaluate the impacts of pumping the maximum annual amount proposed for each of the 10 years of the project. It is important that with any simulation used to analyze potential project impacts that the maximum levels of stress, pumping, proposed by the project be simulated at each of the project locations for the entire duration of the project. This is especially important whenever the simulations are used to justify the conclusion that project impacts will be less than significant, reasonable and cause no injury. Because the groundwater modeling effort didn't include the most recent 11 years of record, it appears to have missed simulating the most recent periods of groundwater substitution transfer pumping and other groundwater impacting events, such as recent changes in groundwater elevations and groundwater storage (DWR, 2014b), and the reduced recharge due to the recent 11 years into account, the results of the SACFEM2013 model simulation may not accurately depict the current conditions or predict the effects from the proposed groundwater substitution transfer pumping during the next 10 years.

Response
See Common Response 5. Additionally, NEPA and CEQA do not require that the analysis include the "worst case possible;" rather, it should focus on the "most likely" scenario. It is not reasonably foreseeable that the maximum annual volumes of groundwater substitution transfers will occur every year for ten consecutive years. Sellers identified maximum annual quantities as an

upper limit to what they may make available, and it is unlikely these volumes would or could be provided for ten consecutive years. Additionally, many sellers would reduce the water quantity available for transfer under certain hydrologic conditions such as when Sacramento River Settlement Contract allocations are less than 100 percent, or in consecutive dry years.

Comment NG01-14

Comment
Although the Draft EIS/EIR project description is specific on the volumes and periods of groundwater substitution transfer pumping as shown in Tables 2-4 and 2-5, the write-up of the groundwater modeling effort aggregated the volume pumped (Sections 3.3.2.4.2 and B.4.3.1.2 in Appendix B). The simulated volume of groundwater pumped doesn't reach the maximum being requested by the project in any individual year or for all ten years (Figures B-4 in Appendix B and 3.3-25). Note, the annual groundwater substitution transfer amounts shown in Figure B-4 in Appendix B are not the same as the amounts simulated by the SACFEM2013 model as shown in Figure 3.3-25. The presentation of the SACFEM2013 model results in Sections 3.3.2.4.2 and B.4.3.1.2 don't tabulate or provide detailed maps by seller service area on the pumping rates, cumulative pumped volumes, pumping times and durations, or which aquifers were pumped in the simulations. The model documentation doesn't provide the maximum drawdown or the expected centers of maximum drawdown for each seller service area.

Response
Figure B-4 illustrates the annual groundwater substitution transfer supply identified by the sellers for years with available export capacity and transfer demand. This figure is not intended to illustrate the volume of simulated groundwater pumping in SACFEM2013, because in some years the supply can exceed the available export capacity or transfer demand (e.g., 1989). The groundwater substitution quantities illustrated in Figure B-3 illustrate the volume of simulated pumping and are the same as those illustrated in Figure 3.3-27. Table 2-5 provides the maximum total volume of water that may be transferred via groundwater substitution along with the time of the transfer. Figures in Section 3.3 (e.g., Figure 3.3-28) show the location of the groundwater substitution pumping wells included in this EIS/EIR. Table 3.3-3 lists the range of pumping rates and pumping depths associated with each potential groundwater substitution transfer, by seller. Figures 3.3-28 through 3.3-33 provide contours of the change in groundwater level (drawdown) due to the proposed action. These contour plots show the areas where drawdown may be higher versus those where it may be lower. Figures 3.3-34 through 3.3-38 (and Appendix E) show the timing of drawdown due to the proposed action at several locations throughout the Sacramento Valley.

Comment NG01-15

Comment

The documentation of the SACFEM2013 model results should also discuss the variations in potential impacts that might result from pumping transfer wells other than those simulated. If the groundwater simulation didn't pump all of the transfer wells listed in Table 3.3-3 for each seller at their maximum rate, then the modeling documentation should describe how the impacts from the simulation should be evaluated for the non-simulated transfer wells and for those well simulated at less than maximum pumping. For example, if the modeling effort provides the pumping time and distance drawdown characteristics of each well this information can be used to estimate the drawdown at different distances, pumping rates, and durations of pumping (see pages 238 to 244 in Driscoll, 1986). The Draft EIS/EIR should provide the time-drawdown and the distance-drawdown hydraulic characteristics for each groundwater substitution transfer well so that non-simulated impacts can be estimated. The Draft EIS/EIR should then describe a method(s) for estimating the drawdown at different distances, rates and durations of pumping so that non-participant well owners can estimate and evaluate the potential impacts to their well(s) from well interference due to the pumping of groundwater substitution transfer well(s).

Response

The project description developed in Section 2 provides the maximum volumes that may be transferred as part of the EIS/EIR (Table 2-4). Table 2-5 further divides the volumes from Table 2-4 into volumes for each transfer method. The data in Table 3.3-3 lists the number of wells and range of individual well pumping rates. To provide a conservative assessment of potential impacts, this EIS/EIR simulated the concurrent groundwater substitution pumping of all the wells in Table 3.3-3. Pumping fewer wells and/or pumping wells at lower rates would likely result in lesser impacts than those presented in this EIS/EIR.

Comment NG01-16

Comment

Because the rate of stream depletion is scaled to pumping rate and because the model documentation doesn't indicate the pumping locations, rate, volumes, times or durations that produced the pumped volumes shown in Figure 3.3-25, or the stream depletions shown in Figures B-5 and B-6 in Appendix B, there is uncertainty whether the SACFEM2013 modeling simulated the maximum rate of stream depletion for the proposed 10-year project. The annual volume of groundwater pumping shown in Figure 3.3-25 are less than the maximum requested, and pumping for a continuous 10 years was not simulated. This suggests that the stream-interaction values or stream depletion(?) shown in Figures B-5 and B-6 of Appendix B are not the maximum level of impact that might occur from the 10-year project.

Response
It is unclear what the commenter meant by "the rate of stream depletion is scaled to pumping rate." Stream depletions illustrated in Figures B-5 and B-6 are the simulated stream depletion for the simulated pumping scenario. All quantities of water available for transfer analyzed in the document were developed in close coordination with the individual sellers and are generally considered to be conservative estimates that represent the maximum volume of water that could be made available. Therefore the analysis includes estimates of potential maximum streamflow depletions for a reasonable volume and frequency of transfer over the life of the project. Finally, NEPA and CEQA do not require that the analysis include the "worst case possible;" rather, it should focus on the "most likely" scenario.

Comment NG01-17

Comment
Without information on the rate, timing and duration of the groundwater pumping, there can be no evaluation of whether the annual simulated impacts are representative of the two pumping seasons listed in Table 2-5, or just a single 3-month pumping season. Whenever the simulated annual pumping rate was greater than the single season maximum of 163,571 acre-feet (AF), two seasons of pumping are required, but the percentage in each season is unknown. If the simulated pumping time represents only one season or a mixture of the two seasons, then the simulation may not reflect the actual timing and/or duration of maximum groundwater substitution pumping impacts proposed in Table 2-5. If a simulation doesn’t evaluate the project under existing conditions or simulate the maximum stress allowed by the project description, then it raises a question of whether the Draft EIS/EIR adequately evaluated the projects potential impacts. Without thorough documentation of the SACFEM2013 groundwater impact simulation, it is difficult to review and analyze the model’s predictions for potential impacts from each seller’s groundwater substitution transfer project, or use the model results in designing and setting impact thresholds for the groundwater monitoring required in mitigation measure GW-1.

Response
Section 3.3 includes additional information on the number of wells, depth, and pumping rates. Appendix B has been updated to include monthly transfer amounts from each seller over the period of analysis.

Comment NG01-18

Comment
I recommend the Draft EIS/EIR be revised to provide a more complete description of the SACFEM2013 groundwater modeling effort, including tabulation of the groundwater substitution pumping rates, volumes durations, and dates for each simulated well; the hydraulic characteristics of each well

simulated; the aquifer(s) pumped by each simulation well; the impacts from the maximum proposed pumping, annually and during the 10-years of the proposed project; sufficiently detailed maps of the well locations in each seller's service area that non-participants and the public can use to identify any well's relationship to the groundwater substitution transfer wells and understand the potential impacts to groundwater levels. I recommend the Draft EIS/EIR provide, for each transfer well, the pumping time and distance drawdown characteristics such that drawdown for durations, distances and rates of pumping other than those simulated can be estimated. I recommend the Draft EIS/EIR also provide an explanation of why the simulation is representative of the current (2014) conditions, how the simulation can be used to assess current and future conditions, and how the simulation can be used to evaluate, monitor and set impact thresholds for future impacts from the 10-year project at the maximum groundwater substitution transfer pumping volumes listed in Tables 2-4 and 2-5.

Response

Appendix B has been updated to include monthly transfer amounts from each seller over the period of analysis. The SACFEM 2013 User's Manual has been added to the Final EIS/EIR as Appendix M to provide more information about the groundwater model. See Common Response 5.

Comment NG01-19

Comment

5. The Draft EIS/EIR was written from the perspective of the process of transferring surface waters through the Delta. This surface water point of view has carried over into some of the analyses of impacts and mitigations for groundwater pumping. For example, the discussions of potential impacts to surface water users, fisheries, and other stream dependent biological resources are thought of as occurring "downstream" of the groundwater substitution wells. While it is correct that groundwater pumping can impact down gradient resources, pumping can also affect up gradient and lateral resources. A pumped well creates a depression in the surrounding aquifer, often referred to as a "cone of depression." Thus, the area of impact around a pumping well is not a single point, but a region whose extent is sometimes called the "area, radius or zone of influence." The length of stream affected by groundwater pumping is related to the distance between the well and the stream (Figures 16 and 29 from Barlow and Leake, 2012; Exhibits 1.1 and 1.2). Miller and Durnford (2005) noted that for an ideal aquifer and stream at longer durations of pumping, when the stream depletion rate approaches the well pumping rate, 50% the stream depletion occurs within a stream reach length of twice the distance between the stream and well, and 87% of the depletion occurs within a reach length of 10 times the stream to well distance. Obviously, for non-ideal aquifers and streams the length of stream depleted will vary from the ideal, but this illustrates that stream depletion caused by a pumping well is not focused at

one point, but occurs along a length of stream with impacts that occur upstream and downstream from the point on the stream that is typically closest to the well.

Response

Figures 3.3-28 through 3.3-33 show the spatial distribution of the change in groundwater level described by the commenter. The modeling developed in this EIS/EIR incorporates the physical distribution of pumping wells and streams in the calibrated three-dimensional SACFEM2013 model. The simulation of stream-groundwater interaction in the model incorporates the spatial decline in groundwater levels related to the layout of the simulated stream network.

Comment NG01-20

Comment

Because groundwater is generally flowing, the water table or piezometric surface has a slope. This slope causes the cone of depression around a pumping well to elongate along the direction of regional flow. The elongated cone of depression is often referred to as a “capture zone” (Frind and others, 2002) and determining its extent is a basic part of a pump and treat groundwater cleanup program (USEPA, 2008a). This “capture zone” is related to stream depletion capture because the pumping well intercepts groundwater that would eventually discharge to surface water or be used by surface vegetation. If the “capture zone” extents far enough it may cross a surface water feature and induce greater seepage. However, unlike the capture needed for a contaminant plume, stream depletion can occur without the actual molecule of water that enters the well having to originate from the stream (Figure 29; Exhibit 1.2).

Response

See response to Comment NG01-19.

Comment NG01-21

Comment

The stream depletion occurs when groundwater is either intercepted before reaching the stream or seepage from the stream is increased. This water only has to backfill the change in storage caused by pumping, it doesn’t have to enter the well. The “capture zone” also extends upgradient to the recharge area that’s the normal source of water flowing past the well. The aquifer recharge that flows past the pumping well may be derived from a wide mountain front area, it could be a section of another river that crosses the “capture zone”, or an overlying area of agricultural irrigation. In a complex hydrogeologic setting, numerical modeling that utilize particle tracking is needed to define where a pumping well is recharged and where it may deplete surface water features (Frind and others, 2002; Franke and others, 1998).

Response
See response to Comment NG01-19.

Comment NG01-22

Comment
The concepts of a wide zone of influence and an elongated "capture zone" are important for the Sacramento Valley groundwater substitution transfers projects because the analysis and monitoring of potential pumping impacts requires a multidirectional evaluation. It can't be assumed that stream depletion impacts from pumping occur only downstream from the point on the stream closest to the pumping well. Any monitoring of the effects of groundwater substitution pumping on surface or ground water levels, rates and areas of stream depletion, fisheries, vegetation and wildlife impacts, and other critical structures needs to cover a much wider area than what is needed for a direct surface water diversion. This is a fundamental issue with the Draft EIS/EIR. The environmental analyses, monitoring requirements and mitigation measures appear to be developed without adequately considering the multidirectional, wide extent of potential impacts from groundwater substitution transfer pumping.

Response
See response to Comment NG01-19.

Comment NG01-23

Comment
I recommend the Draft EIS/EIR be revised to address the wide extent of potential impacts for groundwater substitution transfer pumping. This should include conducting numerical modeling of the groundwater basin using particle tracking to determine which surface water features and other structures are potentially impacted by the pumping of each transfer well and to determine the extent of stream depletion along each potentially impacted surface water feature. The monitoring and mitigation measures WS-1 and GW-1 should also be revised to account for a wide area of potential impact from groundwater substitution transfer pumping.

Response
See responses to Comments NG01-15 and NG01-19. Both of the mitigation measures mentioned by the commenter (WS-1 and GW-1) apply for all transfers covered by this EIS/EIR. See Common Responses 6, 7, and 8 for additional information.

Comment NG01-24

Comment

6. The Draft EIS/EIR is written with the assumption that project specific evaluation for each seller agency will be done at a later time by the BoR and/or DWR, and at the local level (see Section 3.3.1.2.3, mitigation measure GW-1 in Section 3.3.4.1, and Section 3.1 in the DTIPWRP).

Response

The Draft EIS/EIR provides detailed analysis of the envrironmental effects of a range of potential transfer activities. The Draft EIS/EIR does not indicate that subsequent project-level evaluation will be completed for each transfer. Rather, the Lead Agencies would review proposed transfers to consider whether they are analyzed in this EIS/EIR, and to verify that the transfers include the mitigation measures specified in this EIS/EIR. See Section 1.6 of the Draft EIS/EIR for additional information. See Common Response 14.

Comment NG01-25

Comment

The Draft EIS/EIR lists in Table 3.3-1 and Table 3-1 of the DTIPWRP the Groundwater Management Plans (GMP), agreements and county ordinances that regulate the sellers at a local level. The Draft EIS/EIR discusses only two county ordinances, the Colusa Ordinance No. 615 and Yolo Export Ordinance No. 1617, one agreement, the Water Forum Agreement in Sacramento County, and one conjunctive use program, the American River Basin Regional Conjunctive Use Program. The Table 3-1 in the DTIPWRP lists short descriptions of the county ordinances related to groundwater transfers, if one exists. These descriptions don’t always identify the actual ordinance number that applies to a groundwater substitution transfer, but sources for additional information are provided in the table.

Response

Section 3.3.1.2.3 has been revised to include all pertinent groundwater substitution transfers related ordinances and GMPs within the area of analysis (i.e. area underlying transfer-related pumping).

Comment NG01-26

Comment

The DTIPWRP (page 27) and GW-1 (page 3.3-88) instructs the entity participating in a groundwater substitution transfer that they are responsible for compliance with local groundwater management plans and ordinances. Except for the brief discussion of the two ordinances, one agreement, and one conjunctive use program listed above, the Draft EIS/EIR doesn’t describe the requirements of local GMPs, ordinances, and agreements listed in Tables 3.3-1 (page 3.3-8) and Table 3-1 (page 27). Thus, the actual groundwater substitution transfer project permit requirements, restrictions, conditions, or exemptions required for each seller service area by BoR, DWR, and one or more County GMP or groundwater ordinance will apparently be determined at a future date. It follows that any actual monitoring requirements, mitigation measures, thresholds of significance required by BoR, DWR or local governing agencies will also be determined at a future date. The mechanism for the public to participate in the determination of the actual groundwater substitution transfer project permit requirements, restrictions, conditions, mitigation measures or exemptions isn't specified in the Draft EIS/EIR.

Response

See response to Comment NG01-25. Reclamation will ensure that all groundwater substitution transfers comply with applicable regulations during the water transfer review and approval process that occurs when specific individual proposals are presented. The public scoping and review periods of the EIS/EIR solicited public opinion on the range of potential transfer activities to be evaluated under the Proposed Action, and provided the public with opportunities to comment on the significance criteria, impact analysis, and mitigation. See Common Responses 6 and 9 for additional information.

Comment NG01-27

Comment

Addition information is needed on what the local regulations require for exporting groundwater out of each seller's groundwater basin. The Draft EIS/EIR needs to discuss how the local regulations ensure that the project complies with California Water Code (WC) Sections 1220, 1745.10, 1810, 10750, 10753.7, 10920-10936, and 12924 (for more detailed discussion of these Water Codes see Draft EIS/EIR Section 3.3.1.2.2). Although the Draft EIS/EIR doesn't document, compare or evaluate the requirements of all local agencies that have authority over groundwater substitution transfers in each seller service area, the Draft EIS/EIR concludes that the environmental impacts from groundwater substitution transfer pumping by each of the sellers will either be less than significant and cause no injury, or be mitigated to less than significant through mitigation measures WS-1, and GW-1 with it's reliance on compliance with local regulations. Because the spatial limits of groundwater substitution pumping impacts are controlled by hydrogeology, hydrology, and rates, durations and seasons of pumping, the impacts may not be limited to the boundaries of each seller's service area, GMPs, or County. There is a possibility that a seller's groundwater substitution area of impact will occur in multiple local jurisdictions, which should results in project requirements coming from multiple local as well as state and federal agencies. The Draft EIS/EIR doesn't discuss which of the multiple local agencies would be the lead agency, how an agreement between agencies would be reached, or how the requirements of the other agencies will be enforced. The Draft EIS/EIR only briefly mentions the Northern Sacramento Valley Integrated Regional Water Management Plan (IRWMP) (page 3.3-91 and -92) and doesn't mention the American River

IRWMP (http://www.rwah2o.org/rwa/programs/irwmp/), the Yuba County IRWMP (http://yubairwmp.org/the-plan-irwmp/content/irwmp-plan), or the Yolo County IRWMP (http://www.yolowra.org/irwmp.html). The Draft EIR/EIS doesn't provide information on the water management requirements of the IRWMP covering each seller service area or how the groundwater substitution transfers will be accounted for in the IRWMP process.

Response
Proposed groundwater substitution transfers are subject to the ordinances of the county where groundwater substitution is occurring; if transferring agencies cross political boundaries, the wells within each area would be subject to those ordinances. Section 3.3.1.2.3 has been revised to include all pertinent groundwater substitution transfers related ordinances within the area of analysis where groundwater substitution pumping would occur.

Comment NG01-28

Comment
Because the Draft EIS/EIR requires that each individual transfer project meet the requirements of Water Code sections listed above, and because it assumes that each of the sellers will separately comply with all federal, state and local regulation, GMPs, IRWMPs, ordinances or agreements, the Draft EIS/EIR should provide an analysis of how these local regulations, GMPs, ordinances or agreements will ensure each seller's project achieves the goals of no injury, less than significant and reasonable impacts. Each seller's project analysis should identify what future analyses, ordinances, project conditions, exemptions, monitoring and mitigation measures are required to ensure that each of the seller's project meets or exceed the goals of the Draft EIS/EIR.

Response
See response to Comment NG01-2.

Comment NG01-29

Comment
I recommend the Draft EIS/EIR be revised to include a discussion and comparison of the local regulations, GMPs, IRWMPs, ordinances and agreements that govern each of the seller's proposed groundwater substitution transfers. I recommend each analysis demonstrate that each seller's project will meet or exceed the environmental protection goals of the Draft EIS/EIR. I recommend an analysis that compares local and regional management plans, ordinances, regulations, and agreements with the monitoring and mitigation measures in the Draft EIS/EIR to identify any additional mitigation measures needed to ensure compliance with local, regional, state and federal regulations. I recommend an analysis that includes: (1) a discussion on how the local lead agency will be determined; (2) how multiagency jurisdictions will be enforced;

(3) how conflicts between different local, regional, state and federal regulatory jurisdictions will be resolved; and (4) how public participation will occur.

Response
Buyers and sellers are required to comply with any local requirements for water transfers approval (see Section 3.3.1.2). See Common Response 14.

Comment NG01-30

Comment

7. The Draft EIS/EIR provides only one groundwater elevation map of the Sacramento Valley groundwater basin, Figure 3.3-4, which shows contours from wells screened from a depth greater than 100 feet to less than 400 feet below ground surface (bgs) (>100 to < 400 feet bgs) and only for the northern portion of the proposed groundwater substitution transfer seller area. The Draft EIS/EIR doesn’t provide maps showing groundwater elevations, or depth to groundwater, for groundwater substitution transfer seller areas in Placer, Sutter, Yolo, Yuba, and Sacramento counties.

Response
Section 3.3.1.3 has been revised to include additional change in groundwater elevation contour maps at varying aquifer depths. Section 3.3.1.3 has been revised to include groundwater elevation hydrographs for representative wells within Yolo, Sutter, and Sacramento counties.

Comment NG01-31

Comment
The DWR provides on a web site a number of additional groundwater level and depth to groundwater maps at: http://www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/gw_level_monitoring.cfm#Well%20Depth%20Summary%20Maps.

For example, there are maps that show the change in groundwater levels from the spring of 2004 to spring of 2014 for shallow screened wells (<200 feet bgs), intermediate wells (>200 to <600 feet bgs), deep wells (>600 feet bgs), and well screened in the >100 to < 400 feet bgs interval. In addition, the DWR web site has a series of well depth summary maps for Butte, Colusa, Glenn, and Tehama counties, and the Redding Basin that show the density of wells screened at less than 150 feet bgs, and between 150 and 500 feet bgs, along with contours of the depth to groundwater in the summer of 2013. There are also numerous other groundwater elevation contour maps on DWR’s web page, going back to 2006. Historical and recent groundwater elevation and depth contours maps for Placer, Sutter, Yolo, Yuba, and Sacramento counties may be available from the groundwater substitution transfer sellers, other water agencies in those counties, the IRWMP documents, or technical reports on groundwater management (for example, Northern California Water Association, 2014a, b, and c).

Response
See Common Response 4 regarding revisions made to Section 3.3.1.3. Additional figures and information from DWR have been included in the Final EIS/EIR.

Comment NG01-32

Comment
Historic change and current groundwater contour maps are critical to establishing an environmental baseline for the groundwater substitution transfers. This information is needed to evaluate the impacts from groundwater substitution transfers because it establishes the present groundwater basin conditions and document the changes and trends in groundwater levels in the last 10-plus years, which were not simulated by the SACFEM2013 modeling.

Response
Section 3.3.1.3 establishes the existing conditions of the groundwater basins. As discussed in Common Response 4, Section 3.3.1.3 has been revised to include additional information regarding current groundwater conditions within the Sacramento Valley.

Comment NG01-33

Comment
Information on the depth to shallow groundwater is critically important because of the analysis of impacts to vegetation and wildlife in Section 3.8 assumed, based on the results of the SACFEM2013 model, that the current depth to shallow groundwater is greater than 15 feet bgs for most of the Sacramento Valley groundwater basin (page 3.8-32). Because the simulation showed a condition of greater than 15 feet depth to groundwater, the Draft EIS/EIR concluded that impacts from lowering of the shallow water table as a result of the groundwater substitution transfer pumping would be less than significant (page 3.8-47).

Response
The Draft EIS/EIR acknowledges that groundwater substitution for the range of potential water transfer activities analyzed under the Proposed Action could decrease available groundwater for natural communities. As described in the analytical methods and impact analysis, the reductions in groundwater below 15 feet in depth are not likely to affect surface vegetation; therefore, Reclamation and SLDMWA concluded that a substantial adverse impact will not occur and that the impacts are less than significant. However, in an abundance of caution, vegetation effects are further addressed in Mitigation Measure GW-1. See Common Responses 10 and 11.

Comment NG01-34

Comment
This assumption however appears to conflict with the DWR shallow well depth summary maps (DWR, 2014a) that show contours of the depth to groundwater in wells less than 150 feet bgs in the summer 2013. These maps show extensive areas around the Sutter Buttes and to the north were the depth to groundwater is less than 10 feet and 20 feet (Exhibit 2.1). These maps also show extensive areas where the depth to groundwater is less than 40 feet, a depth significant to some tree species such as the valley oak (page 3.8-32). There is also a recent trend of lower groundwater levels in a number of areas in the Sacramento Valley as shown on the DWR 2004 to 2014 groundwater change maps for shallow, intermediate, deep aquifer zones available from the web site listed above (DWR, 2014b). Exhibit 2.1 has a composite map of the shallow zone well depth maps and traces of the shallow zone 2004 to 2014 groundwater elevation change contours.

Response
See response to Comment NG01-33.

Comment NG01-35

Comment
These groundwater elevation, depth and changes in elevation maps are important for documenting baseline groundwater conditions. The recent trend of decreased groundwater levels should be included in the analysis of groundwater substitution pumping impacts because the drawdowns shown in Figures 3.3-26 to 3.3-31 will interact with existing conditions, and may cause additional long-term decreases in groundwater levels. The Draft EIS/EIR's assessment of the impacts from groundwater substitution transfer pumping to existing and future wells, fisheries, vegetation and wildlife, and surface structures should factor in these recent trends in groundwater levels and not rely solely on SACFEM2013 model simulations that ended in 2003. In addition, the hydrographs in Appendix E that show the SACFEM2013 model results should identify wells near the selected 34-hydrograph locations where groundwater level measurements have been taken and show these actual groundwater levels on the hydrographs. Currently the public is left with the task of finding groundwater level data near the 34 selected hydrograph locations and then validating the simulation results by making comparisons between the simulated water levels and the actual water levels. This model validation task should be part of the Draft EIS/EIR.

Response
Section 3.3.1.3 has been revised to include additional information regarding recent groundwater conditions. See Common Response 4 regarding changes made to Section 3.3.1.3. Note that while the groundwater model simulates impacts from the Proposed Action under past hydrologic conditions (WY 1970-

2003), information from the affected environment section that describes current hydrologic conditions and the groundwater modeling results were used to determine the conclusions drawn in the EIS/EIR. Also, see Common Response 5. Model validation and calibration was completed as noted in Appendix D.

Comment NG01-36

Comment
I recommend the Draft EIS/EIR be revised to include maps of recent groundwater levels and depths to groundwater along with changes in groundwater levels and depths for at least the last 11 years for all of the counties where the seller agencies propose a groundwater substitution transfer project. I recommend that the Draft EIS/EIR be revised to provide additional verification of the SACFEM2013 model results by comparing them to measured groundwater levels in the vicinity of the 34 selected modeling hydrograph locations. I also recommend the hydrographs of actual water level measurements in the vicinity be included on the simulation hydrographs, so that the public can review the accuracy of the simulation. I recommend contour maps showing the current depth to groundwater be made from actual shallow groundwater measurements and that these contours be shown on maps of the surface water features identified and evaluated in Draft EIS/EIR Sections 3.3-Groundwater, 3.7-Fisheries (Table 3.7-3), and 3.8-Vegegation and Wildlife (Table 3.8-3). I recommend that the SACFEM2013 simulation drawdowns be combined with the current (2014) groundwater elevations for each groundwater substitution transfer aquifer to show the cumulative impacts of the 10-year project on existing groundwater elevations.

Response
Section 3.3.1.3 has been revised to include recent groundwater trends information. Additional groundwater levels hydrographs and groundwater elevation figures have been included in Section 3.3.1.3. See Common Response 4.

SACFEM2013 model calibration has been completed as noted in Appendix D and in the User's Manual (Appendix M).

Comment NG01-37

Comment
Groundwater Model SACFEM2013. A finite element groundwater model, SACFEM2013, was used to evaluate the potential for changes in groundwater levels and stream depletion from groundwater substitution transfer pumping during the 10-year period of the project. The results of the simulations were used to evaluate the impacts to fisheries, vegetation and wildlife (Section 3.7 and 3.8). Section 3.3.2.1 discusses the use of the model for estimating regional groundwater level declines due to groundwater substitution pumping. Figures 3.3-26 to 3.3-31 provide simulated changes in groundwater elevation or head

for three intervals, up to 35 feet bgs, 200 to 300 feet bgs, and 700 to 900 feet bgs. Figures 3.3-32 to 3.3-40 and Appendix E provide hydrographs of model simulations for 34 selected locations shown on the simulated groundwater elevation change maps. Sections 3.7.2.1.1, 3.7.2.1.3, 3.7.2.4.1, 3.8.2.1.1, 3.8.2.1.4, and 3.8.2.4.1 provide discussion on the potential impacts of groundwater substitution transfer pumping on fisheries, vegetation and wildlife resources from a drop in the shallow groundwater table and depletion of stream flows.

The SACFEM2013 model was set up to simulate transient flow conditions from WY 1970 to WY 2010 (page 3.3-60). Historic data from 1970 to 2003 were use to estimate the potential impacts from groundwater substitution transfers during the 10-year period of the project. The simulation terminated at 2003 because that was the last simulation period available for the CalSim II model, a planning model designed to simulate operations of the CVP and SWP reservoirs and water delivery systems. Additional SACFEM2013 model documentation is given in Appendix D, which provides information on the model gridding, layering, assumptions and calculation methods. Several of the model designs and parameters selected likely influenced the model's ability to predict future impacts from the 10-year groundwater substitution transfer project. Those include: the time period of the model, the assumptions about the amount and frequency of groundwater substitution pumping, the model's nodal spacing, estimates of aquifer properties, the number of streams simulated, streambed parameters, and specified-flux boundaries. There are at least two other groundwater simulation models developed for the Sacramento Valley, a U.S. Geological Survey model, USGS-CVHM (Faunt, ed., 2009) and a DWR-C2VSim model (Brush and others, 2013a and 2013b).

A comparison between the SACFEM2013 and these two other models provides an interesting assessment of how these three models estimated the hydrogeologic character and conditions of the Sacramento Valley. A comparison also demonstrates that there is no one correct groundwater model, that models with different parameter distributions can achieve reasonable calibration. With models of differing hydrogeologic characteristics, the predictions of future impacts by each model should be expected to differ. Determining which of the models accurately predicts future impacts requires the validation of each model's prediction with new field data. The Draft EIS/EIR mitigation measures for groundwater substitution transfer pumping shouldn't assume that the SACFEM2013 model results are all that is needed to demonstrate no injury and less than significant impacts from the proposed project. Validation of the model-based conclusion of no impacts requires collection of new field data and comparison to simulation predictions throughout and beyond the 10-year project.

Response

In the early stages of developing this EIS/EIR, Reclamation determined that the modeling of groundwater substitution pumping impacts was critical.

Reclamation conducted a model selection process that reviewed the existing available groundwater models. Text has been added to Appendix D that describes the model selection process. The User's Manual for SACFEM2013 has been added to the EIS/EIR as Appendix M to provide additional information. Both of the other models mentioned by the commenter (CVHM and C2VSIM) were described in this model selection process.

See response to Comment NG01-2 for additional information.

Comment NG01-38

Comment
A comparison of portions of the SACFEM2013 simulation for the Draft EIS/EIR with the two other models is given below. 8. Period of Modeled Historic Groundwater Conditions – Although the model simulation period ended in 2003, the Draft EIS/EIR indicates that the model was run to 2010, but the results were not provided. From the model write-up it is unknown whether the latest groundwater elevations were a factor in the modeling effort. The simulation hydrographs in Appendix E terminate in 2004. Apparently, the hydrologic conditions for the latest 10 years are not included because the Draft EIS/EIR doesn't discuss how the model simulations agree with the current baseline conditions. Specifically, the change in groundwater elevation between 2004 and 2014 as document by DWR (2014b) in a series of three maps. I've provided in attached Exhibits 3.1 to 3.3 maps that are composites of DWR's 2004 to 2014 groundwater change maps with Draft EIS/EIR Figures 3.3-29, 3.3-30 and 3.3-31, the SACFEM2013 1990 hydrologic conditions simulations of drawdown by zone. The 1990 hydrologic condition was selected for comparison because the sequence of groundwater pumping events is the closest match to the actual pumping requested in the Draft EIS/EIR. Note that the depth intervals of the two sets of maps don't exactly coincide, but they are generally grouped as shallow, intermediate and deep aquifers.

Exhibits 3.1 to 3.3 show that the simulated changes in groundwater elevation from the 10-year groundwater substitution transfer project appear to widen the existing groundwater depressions. The pumping depression southwest of Orland will expands to the east and northeast, as will the depression in the Williams area. A pumping depression will develop in the Live Oaks area and to the east. In the southeastern Sacramento area, the pumping depression from the 10-year project will apparently extent southeastward beyond the limits of the Sacramento Valley transfer project boundary. Combining the existing areas of recent sustained groundwater drawdown with the additional drawdown from the groundwater substitution transfer pumping could slow the recovery of groundwater elevations. The 10-year project pumping east of Orland may connect the two existing groundwater depressions around Orland and Chico to create one large depression. Because the DWR 2004 to 2014 groundwater change maps don't extend completely to the southern portions of the Sacramento Valley groundwater substitution transfer area in Placer, Sutter, Yolo, Yuba, and Sacramento counties, no evaluation can be made about the impact of 10 years of groundwater substitution transfer pumping on existing groundwater conditions in those or adjacent areas.

I recommended the Draft EIS/EIR be revised to discuss how the SACFEM2013 simulations incorporate the changes in groundwater level from 2004 to 2014 in assessing the potential impacts from the proposed 10 years of groundwater substitution transfer pumping. I recommended this discussion include evaluation of the rate and duration of groundwater level recovery that factors in the existing (2014) groundwater levels. I also recommend the Draft EIS/EIR be revised to discuss how during the 10 years of project transfers through the Delta will be made with a CalSim II model that's only current to the year 2003.

Response

The available simulation period of the SACFEM2013 model is from WY 1970 through WY 2010. However, SACFEM2013 was only run through WY 2003 for the analysis described in the EIS/EIR. The simulation was terminated in 2003 because the analysis also relied on information from the CalSim model. CalSim model results are only available through 2003.

The CalSim model, which covers conditions only through 2003, is meant to represent future conditions by simulating the varying hydrologic conditions that have occurred between 1970 and 2003. No model can be built to include future conditions as they have not yet occurred. However, using historical hydrologic conditions as guidance in understanding potential future impacts is common. See Common Response 5.

Section 3.3.1.3, Affected Environment, has been expanded to include additional data related to recent changes in groundwater levels. See Common Response 4.

Comment NG01-39

Comment

9. Simulation Pumping Volume and Frequency - The model simulated a series of groundwater pumping events in 12 out of the 34 years of simulation (page 3.3-60). The logic of a multiyear, variable hydrology simulation was that it allowed for evaluation of the cumulative effects of pumping in previous years (page 3.3-61). Figure 3.3-25 shows the simulated periods of groundwater substitution transfer pumping. The 1990 simulation period most closely matches the multiyear pumping being requested by the 10-year project. The 1990 simulation period included groundwater pumping 7 out of 10 years, with pumping values ranging from approximately 95,000 acre-feet per year (AFY) to approximately 262,000 AFY, as measured from Figure 3.3-35. Note the actual pumping rates, volumes, and pumping durations were not provided in the simulation documentation. Apparently, none of the modeled groundwater substitution pumping simulation periods was given the actual maximum groundwater substitution pumping value of

290,495 AFY as calculated from Table 2-5. The time-weighted annual average pumping rate for the 1990 simulation period is approximately 126,900 AF, as measured from Figure 3.3-35. This represents approximately 44% of the maximum pumping rate requested in the Draft EIS/EIR (126,900 AF/290,495 AF = 0.437). Therefore the SACFEM2013 Draft EIS/EIR simulations may only represent a portion of the project's potential impacts from groundwater substitution transfer pumping.

I recommend the Draft EIS/EIR be revised to discuss how the SACFEM2013 simulations provide a full and accurate estimation of the potential impacts from the groundwater substitution transfer pumping throughout the 10-year project. I also recommend the Draft EIS/EIR be revised to include SACFEM2013 simulations at the maximum requested annual volume of 290,495 AF for each of the 10 years of pumping.

Response

See response to Comment NG01-13. Information about pumping in each year of the simulation has been included in Appendix B.

Comment NG01-40

Comment

10. Simulation Grid Size - The SACFEM2013 documentation states that the grid used for groundwater substitution transfer simulations has 153,812 nodes and 306,813 elements (page D-3 of Appendix D). The model nodal spacing varies from 410 feet to 3,000 feet, with an approximate nodal spacing of 1,640 feet along streams and flood bypasses. While this nodal spacing is reasonable for regional groundwater simulations, the results of the simulations may not provide the detail needed to evaluate drawdown interference between the groundwater substitution transfer wells and adjacent non-participating wells. Information is needed on the locations of the groundwater substitution transfer wells and the adjacent non-participating wells in order to determine whether the current simulation grid spacing can accurately estimate well interference. The Draft EIS/EIR analysis of groundwater substitution pumping impacts should be based on an appropriate model grid spacing to establish accurate maximum thresholds for well interference caused by the transfer well pumping. The Draft EIS/EIR should provide sufficient information that an owner of a non-participating well can determine accurately the maximum anticipated increase in drawdown at their well during the 10 years of groundwater substitution transfer pumping. Whether this amount of increased drawdown is significant at each nonparticipating well is a matter of the current well design and groundwater conditions at each well. The Draft EIS/EIR should establish values for the maximum allowable well interference drawdown from groundwater substitution transfer pumping, which should be based on the costs and inconvenience of lowering the water level. The Draft EIS/EIR should establish the economic costs and level of injury that are reasonable

for a non-participating well owner to assume and will keep the impacts from the 10-year project in compliance with the no injury rule as required by WC Section 1706, 1725 and 1736 (Section 1.3.2.3).

I recommend the Draft EIS/EIR be revised to discuss how the maximum thresholds for water level drawdown due to well interference from groundwater substitution transfer pumping will be established for non-participating wells, and provide a process for assigning a threshold to each non-participating well, along with monitoring requirements and specific mitigation measures should the threshold be exceeded. The Draft EIS/EIR also should be revised to provide the threshold values for well system repair costs used in set the maximum allowable well interference drawdown, along with the documentation and analysis of why the well interference drawdown and cost thresholds are considered reasonable and result in no injury to non-participating well owners, and comply with the Water Code.

Response

As described in the Project Description (Chapter 2), the range of potential transfer activities analyzed under the Proposed Action and its alternatives are examined "valley-wide." Therefore, all of the potential groundwater substitution transfers were simulated simultaneously in the SACFEM2013 model. The drawdown contour figures presented in Section 3.3.2 show the potential decline in groundwater elevation (beyond the existing conditions). These figures have been expanded (i.e., zoomed in) to provide additional details regarding the extent of the simulated drawdown.

See Common Responses 6 and 7 for additional information.

Comment NG01-41

Comment

11. Simulation Hydrogeologic Parameter Values - The SACFEM2013 model was developed with seven layers of varying thickness that extend from the shallow water table to the base of fresh water. The USGS-CVHM model has ten layers, while the DWR-C2VSim model has 3 layers. All of the models assume that the uppermost layer, layer 1, was unconfined and the lower layers are confined aquifer. The hydrogeologic parameters values differ for each of these models as shown in a summary table in Exhibit 4.1. Both the CVHM and C2VSim models divided the Central Valley in to 21 subregions (Figure 3, Brush and others, 2013a; Exhibit 4.4). The SACFEM2013 doesn't use subregions from the Sacramento Valley model. As discussed below, the SACFEM2013 appears to use the same distribution of the horizontal hydraulic conductivity, Kh, for all model layers (Figure D-4 of Appendix D). Both the CVHM and the C2VSim models appear to have more varied hydraulic conductivity distributions then SACFEM2013.

Development of the SACFEM2013 simulations used horizontal hydraulic conductivity values derived from the well logs of large-diameter irrigation wells. Shallow and low-yielding wells, less than 100 gallons per minute (gpm), and domestic-type wells were not used (page D-12 of Appendix D). The values of specific capacity (gallons per minute per foot of drawdown) from the DWR well completion reports were used to estimate transmissivity around a well using an empirical equation for confined aquifer developed from Jacob's modified nonequilibrium equation (see equation 8 page D-13 and Appendix 16D of Driscoll, 1986 in Exhibit 4.6). Transmissivity was converted to Kh by assuming the aquifer thickness was equal to the length of the well screen interval. These well Kh values were then averaged using a geometric mean with surrounding wells within a critical distance of 6 miles. The results of the geometric mean averaging were then gridded using a kriging to produce Kh values across the modeled area (Figure D-4 in Appendix D). The transmissivity of each model layer was then calculated at each node by multiplying the kriged geometric mean value of Kh by the aquifer layer thickness. The vertical hydraulic conductivity, Kv, was calculated by assuming a uniform Kh:Kv ratio of 50:1 for layer 1 and 500:1 for layers 2 to 7.

The CVHM model (Faunt, ed., 2009) used the percentage of coarse-grained material from well logs and boreholes as the primary variable in a sediment texture analysis of the Central Valley, which was divided into nine textural provinces and domains (Figures A10 to A14; Exhibits 4.7a to 4.7i). The Sacramento Valley has three textural domains, Redding, eastern, and western Sacramento domains (page 30, Faunt, ed., 2009). The coarse-grained fraction was correlated to horizontal (Kh) and vertical (Kv) conductivity (page 154, Faunt, ed., 2009). The Kh values were estimated using kriging and a weighted arithmetic mean, a type of power mean, whereas the Kv value estimates used either a harmonic or geometric mean. Faunt (ed., 2009) notes that the arithmetic mean is most influenced by the coarser-grained material, whereas the fine-grained material more heavily weights both the harmonic and geometric means. Figure C14 (Exhibit 4.7j) shows the relationship between the percentage of coarse-grained deposits and hydraulic conductivity for the different types of means. For the Sacramento Valley the texture-weighted power-mean value was -0.5, a value midway between the harmonic and geometric means (Table C8, Exhibit 4.3).

Table C8 lists the end member hydraulic conductivity values used in the CVHM model with those for the Sacramento Valley ranging from 670 feet/day (ft/day) for coarse-grained to 0.075 ft/day for fine-grained. The table also lists field and laboratory values of Kh and Kv for coarse and fine-grained deposits. The Redding textural domain has the highest percentage of coarse-grained material of the three in Sacramento Valley, a mean of 39 percent, with the western portion becoming coarser with depth (page 30, Faunt, ed., 2009). The western and eastern Sacramento domains are finer-grained, with the eastern mean at 32 percent coarsegrained deposits, and the western mean at 25 percent. Figure

A15B(A?) (Exhibit 4.7k) shows the cumulative distribution of kriged sediment textures for each layer of the CVHM model for the Sacramento Valley. Figures A12A to A12E (Exhibits 4.7c to 4.7g) show the distribution of coarse-grained deposits in CVHM groundwater model layers 1, 3, Corcoran Clay, 6 and 9 for the Sacramento and San Joaquin Valleys. Isolated coarser-grained deposits that occur in layer 1 are associated with the Sacramento River, distal parts of fans from the Cascade Range and northern Sierra Nevada, and the American River (page 30, Faunt, ed., 2009; Figure A14, Exhibit 4.7i). Although the texture maps, Figures A12A to A12E of CVHM, and the hydraulic conductivity distribution map of Figure D4 of SACFEM2013, show different characteristic of each model's hydraulic conductivity, they can be compared by their visual complexity. The CVHM texture also varies by model layer, whereas the SACFEM2013 apparently applied the same Kh distribution to each layer. The CVHM western and eastern Sacramento domains appear to have smaller coarse-grained areas than the SACFEM2013 higher hydraulic conductivity areas (Figures A12, C14 and A15 in Exhibits 4.7c, 4.7j, and 4.7k versus D4 in Appendix D). Figure 12E (Exhibit 4.7g) shows layer 9 with high percentages of coarse-grained deposits that have higher Kh values (Figure C14) in the western parts of the Redding (10) and northern western portion of the western Sacramento (11) province. Whereas Figure D4 of SACFEM2013 shows these same areas as having the lowest Kh values, suggesting finer-grained textures dominate.

The C2Vsim model divided the Sacramento Valley into seven subregions, as did the USGSCVHM model. Like the USGS model, hydraulic conductivity varies with the three model layers for the Sacramento Valley. The spatial variability of the Kh and Kv values for the C2VSim model is greater than with the SACFEM2013 model (compare Figures 34 and 35 from Brush and others, 2013a in Exhibits 4.8a to 4.8f to Figures D4 of Appendix D). Table 5 of Brush and others, 2013a (Exhibit 4.2) shows the range of model parameters for the saturated groundwater portion of the C2VSim model. Kh values range from 2.2 ft/day to 100 ft/day, and Kv from 0.005 ft/day to 0.299 ft/day. The highest Kh value for the C2VSim model is less than for SACFEM2013 (100 ft/day vs 450 ft/day), while the lowest values are lower (0.005 ft/day vs <0.1 ft/day).

I recommend the Draft EIS/EIR discuss the uncertainty in aquifer hydraulic parameter estimations for the groundwater substitution transfer pumping simulations and the sensitivity of the model results to the uncertainty in the groundwater hydraulic parameters. I recommend the Draft EIS/EIR discuss how the uncertainty in hydraulic conductivity parameters influences: (1) estimates of potential stream depletion (Section 3.3), (2) evaluations of fisheries impacts (Section 3.7), (3) evaluations of vegetation and wildlife impacts (Section 3.8), and (4) the screening procedures that removed a number of the small streams from further environmental impact analysis (Table 3.7-3 and 3.8-3).

Response

The content of this comment is simply a factual re-statement of how the SACFEM2013, CVHM, and C2VSIM models are constructed and parameterized. Additional information on sensitivity studies completed as part of the modeling efforts has been added to Appendix D. The SACFEM2013 User's Manual has been added to the Final EIS/EIR as Appendix M.

Comment NG01-42

Comment

12. Simulation Groundwater Storage Parameters - The SACFEM2013 simulations assigned to the upper unconfined model layer 1 a uniform specific yield (Sy) value of 0.12 (dimensionless) (page D-14 in Appendix D; Exhibit 4.1). For the confined model layers 2 to 7 a uniform specific storage, Ss, value of 6.5 x 10-5 per foot (ft) was used (page D-14 of Appendix D; Exhibit 4.1). Both the CVHM and C2VSim simulations used a range of values of Sy and Ss that were more variable than SACFEM2013 (Exhibits 4.1, 4.8n, and 4.8o). The CVHM simulation used a range of Sy and Ss values, (CVHM Table C8, Exhibits 4.3). The CVHM simulation also used a range of Ss values for coarse-grain elastic and fine-grained elastic and inelastic deposits to simulating subsidence from groundwater pumping. The C2VSim simulations used a range of Sy values for model layer 1 and separate ranges of Ss values for layers 2 and 3 (C2VSim Table 5, Exhibits 4.2; Exhibits 4.8g to 4.8i). The C2VSim and CVHM models assigned a range of coefficients for elastic (Sce) and inelastic (Sci) deposits used in simulating subsidence (Exhibits 4.1, 4.8j to 4.8m). Note, the Ss values are multiplied by the aquifer thickness at each model node at to obtain the dimensionless value of storativity (S) for confined aquifers (S = Ss x thickness), which is similar to the dimensionless Sy parameter for an unconfined aquifer.

   I recommend the Draft EIS/EIR discuss the uncertainty in aquifer storage parameter estimations for the groundwater substitution transfer pumping simulations and the sensitivity of the model results to the uncertainty in the groundwater storage parameters. I recommend the Draft EIS/EIR discuss how uncertainty in groundwater storage parameters influences: (1) estimates of potential stream depletion (Section 3.3), (2) evaluations of fisheries impacts (Section 3.7), (3) evaluations of vegetation and wildlife impacts (Section 3.8), and (4) the screening procedures that removed a number of the small streams from further environmental impact analysis (Table 3.7-3 and 3.8-3).

Response

Information on sensitivity studies completed as part of the modeling effort has been added to Appendix D.

Comment NG01-43

Comment

13. Simulation River and Stream Parameters - All three models simulated the interactions between the groundwater and streams or rivers. The rate and direction of movement of water between streams and shallow groundwater is governed by the vertical hydraulic conductivity of the streambed, Kvb, thickness of the streambed, m, the wetted perimeter of the stream, w, and the difference in elevation between groundwater table and stream. The hydraulic parameters of a streambed are combined into a term called conductance, C, which is calculated as the product of Kvb times the wetted perimeter divided by the streambed thickness (C = [Kvb x w]/m).

    The SACFEM2013 simulations assigned all eastern streambeds draining from the Sierra Nevada a Kvb value of 6.56 ft/day (2 meters/day), except the Bear River and Big Chico Creek, whose values were unstated (page D-7 of Appendix D). For all western streambeds draining the Coast Ranges, a higher value of Kvb at or above 16.4 ft/day (5 meters/day) was assigned. Figure 3.3-24 in the Draft EIS/EIR shows the SACFEM2013 groundwater boundary and the simulated rivers and streams. This map may not be showing all of the small streams evaluated in the simulation based on the streams listed in Tables 3.7-3 and 3.8-3 (also see general comment no. 2).

The streambed Kvb values used in CVHM simulation are shown in Figure C26 (Exhibit 5.3). The values of Kvb for the Sacramento Valley varying from approximately 0.04 ft/day to 5.6 ft/day are shown in Figure C26. Results of the CVHM simulation of surface water-groundwater interactions, gains and losses, from 1961 to 1977 are compared to measured and simulated stream gauge values in Figures C19A and C19B (Exhibits 5.4a and 5.4b).

The C2VSim simulations also used varying values for streambed Kvb ranging from 0 to 44 ft/day with a mean of 1.8 ft/day and lake bed Kvb of 0.67 ft/day (page 100, Brush and others, 2013a; Exhibit 5.1). Simulated streambed conductance values are shown in Figure 40 of Brush and others, 2013a (Exhibit 5.2).

I recommend the Draft EIS/EIR discuss the uncertainty in streambed parameter estimations for the groundwater substitution transfer pumping simulations and the sensitivity of the model results to the uncertainty in the hydraulic characteristics of the streambeds. I recommend the Draft EIS/EIR discuss how uncertainty in the hydraulic characteristics of the streambeds influences: (1) estimates of potential stream depletion (Section 3.3), (2) evaluations of fisheries impacts (Section 3.7), (3) evaluations of vegetation and wildlife impacts (Section 3.8), and (4) the screening procedures that removed a number of the small streams from further environmental impact analysis (Table 3.7-3 and 3.8-3).

Response
Information on sensitivity studies completed as part of the modeling effort has been added to Appendix D.

Comment NG01-44

Comment
14. Groundwater Flow Between Sub-regions - Of the three previously discussed regional groundwater models for the Sacramento Valley, only the reports for the C2VSim simulation provided information on the volume of groundwater that flows laterally among groundwater subregions. The C2VSim simulation results show that groundwater flow between subregions has changed significantly in some areas (Figures 81A to 81C of Brush and others, 2013a and Figure 39 of Brush and others, 2013b; Exhibits 6.1a to 6.1c and 6.2). The SACFEM2013 simulations results presented in the Draft EIS/EIR don't provide information on the exchange between subregion areas used in simulations by the USGS (Faunt, ed., 2009) and DWR (Brush and others, 2013a and 2013b). Therefore, the flow of groundwater between the subregions and/or counties of the 10-year project's groundwater substitution transfer sellers wasn't evaluated for potential impacts on neighboring areas. The loss or gain of groundwater from neighboring subregions should be evaluated in the Draft EIS/EIR.

Accounting for subsurface flow among subregions is an important part of the water balance because it is measures of the amount of impact that groundwater pumping in one subregion has on it's neighboring subregions. The subsurface inter-basin movement of groundwater is an important element in the analysis of the environmental impacts from the 10-year groundwater substitution transfer projects because the groundwater substitution transfer pumping by sellers in one region can have a significant impact on the groundwater levels, storage and stream depletion in adjacent regions.

The C2VSim simulations calculated the volume of groundwater that flowed between the subregions and presented the results for three decades, 1922-1929, 1960-1969, and 2000- 2009, and for the total simulation period, 1922-2009. Tables 10 through 13 (Brush and others, 2014a; Exhibits 6.3a to d) provide the sum of inter-region groundwater flow for each model subregion, but not the individual values of flow among adjoining subregions. Figures 81 and 39 (Exhibits 6.1a to 6.1c and 6.2) give the simulated annual volume of inter-region flow for the three decades and from 1922 to 2009. An estimate of a portion of the long-term changes in groundwater storage in each subregion can be made by comparing the change in annual volume and flow direction between sub-regions.

For example, in the 1922 to 1929 simulation period subregion 9 (Sacramento-San Joaquin Delta received 81,000 AFY of groundwater flow from adjoining subregions 6, 8, 10 and 11 (Exhibit 6.1a). By 1969 the simulation shows that subregion 9 was still receiving a small volume, 2,000 AFY, of groundwater flow from subregion 6, but losing approximately 56,000 AFY to subregions 8, 10, and 11 (Exhibit 6.1b). A change in groundwater storage from 1929 to 1969 in the Delta of 135,000 AFY; from a plus 81,000 AFY to a minus 54,000 AFY. For 2002-2009, the simulation shows that the Delta still receiving a small volume, 4,000 AFY, of groundwater flow from subregion 6, but now losing 137,000 AFY to subregions 8, 10 and 11 (Exhibit 6.1c). A loss in storage in the Delta of 214,000 AFY from 1929. The 2000-2009 simulation period shows that subregion 8 is receiving a large portion of the groundwater flow out of the Delta, 112,000 AFY, a reversal in groundwater flow direction and a cumulative annual loss to the Delta from 1922-1929 of 147,000 AFY. Subregion 8 in turn loses 17,000 AFY of groundwater flow to subregion 7 in 2000-2009, and receives 123,000 AFY from subregion 11 (Exhibit 6.1c). A reversal of 1922-1929 when subregion 8 received 1,000 AFY from subregions 7 and gave 1,000 AFY to subregion 11.

The 10-year transfer project proposes under the groundwater substitution to pump up to approximately 75,000 AFY from subregions 7 and 8, Table 2-5. This additional pumping will likely cause additional groundwater to flow from the subregion 9, the Delta, and subregion 11 into subregion 8, and eventually to subregion 7. Similar shifts in direction and annual volumes of groundwater flow have occurred with the other Central Valley subregions. The changes direction and volume of flow between the Delta and surrounding subregions appear to be the largest shift in groundwater flow for in Sacramento Valley area.

I recommend the Draft EIS/EIR be revised to evaluate the subsurface flows between subregions in Sacramento Valley due to the proposed groundwater substitution transfer pumping. I recommend the Draft EIS/EIR be revised to include groundwater model simulations that account for the rates, volumes, times, and changes in direction of groundwater flow between the seller pumping areas and the surrounding non-participating regions. I recommend the Draft EIS/EIR also analysis the short- and long-term impacts from the changes in subregional groundwater flow caused by the 10-year transfer project.

Response

SACFEM2013 is a finite element groundwater flow model with a model domain that extends throughout the Sacramento Valley. The model domain is subdivided into over 300,000 elements, with the model simulating flow into and out of all of these elements during each stress period of the simulation. It is not necessary to identify "subareas" of the model grid to accurately represent subsurface flow, and therefore account for "the rates, volumes, times, and changes in direction of groundwater flow between the seller pumping areas and the surrounding non-participating regions." This is accounted for within each SACFEM2013 simulation.

Comment NG01-45

Comment
Mitigation Measure WS-1. 15. The purpose of mitigation measure WS-1 as stated in Draft EIS/EIR Section 3.1.4.1 is to mitigate potential impacts to CVP and SWP water supplies from stream depletion caused by groundwater substitution transfer pumping. The stream depletion factor (BoR-SDF) is imposed by the BoR and DWR because they will not move transfer water if doing so violates the no injury rule (page 3.1-21). The no injury rule is discussed in Section 1.3.2.3 and cites CA WC Sections 1725, 1736 and 1706. The language from WC 1736 that also requires transfers to not result in unreasonable effects to fish, wildlife, or other instream beneficial uses is discussed in the subsequent Section 1.3.2.4.

Draft EIS/EIR Sections 3.1.2.4.1 (page 3.1-15) and 3.1.6.1 (page 3.1-21) discuss the impacts from groundwater substitution transfers on surface water. On page 3.1-16 the Draft EIS/EIR states that groundwater recharge, presumably greater because of groundwater substitution pumping, occurring during higher flows would decrease flow in surface waterways. During periods of high flow, the decrease in surface flow won't affect water supplies or the ability to meet flow or quality standards. The document also states that if groundwater recharge occurs during dry periods, presumably occurring when groundwater substitution transfers are needed, groundwater recharge would decrease flows and affect BoR and DWR operations. BoR and DWR would then need to either decrease Delta exports or release additional flows from surface storage to meet the required standards. These statements are followed by seemly conflicting statements that: Transfers would not affect whether the water flow and quality standards are met, however, the actions taken by Reclamation and DWR to meet these standards because of instream flow reductions due to the groundwater recharge could affect CVP and SWP water supplies. (page 3.1-16). Increased releases from storage would vacate storage that could be filled during wet periods, but would affect water supplies in subsequent years if the storage is not refilled. (page 3.1-17).

Response
As stated in Section 3.1.2.4.1, "If decreased river flows affect the ability to meet these standards, Reclamation and DWR would need to either decrease Delta exports or release additional flow from upstream reservoirs to meet flow or water quality standards. Transfers would not affect whether the water flow and quality standards are met, however, the actions taken by Reclamation and DWR to meet these standards because of instream flow reductions due to the groundwater recharge could affect CVP and SWP water supplies. Decreased streamflows during dry periods could affect CVP and SWP supplies in the near term or longer term." Implementation of Mitigation Measure WS-1 will lessen

the potentially significant impact of Alternatives 2 and 3 to a less-than-significant level. See Common Response 8 for additional information.

Comment NG01-46

Comment
The potential for the reduction in surface water storage to eventually cause reductions in streamflow and water quality isn't clearly addressed in the Draft EIS/EIR. Overall, the increased supplies delivered from water transfers would be greater than the decrease in supply because of streamflow depletion; however, the impacts from streamflow depletion may affect water users that are not parties to water transfers. On average, the losses due to groundwater and surface water interaction would result in approximately 15,800 AF of water annually compared to the No Action/No Project Alternative, or approximately a loss of 0.3 percent of the supply. (page 3.1-18). In a period of multiple dry years (such as 1987-1992), the streamflow depletion causes a 2.8 percent reduction in CVP and SWP supplies, or 71,200 AF. (page 3.1-18). To reduce these effects, Mitigation Measure WS-1 includes a streamflow depletion factor to be incorporated into transfers to account for the potential water supply impacts to the CVP and SWP. Mitigation Measure WS-1 would reduce the impacts to less than significant. (page 3.1-18).

Additional information on the requirements of WS-1 appears to be contained in the October 2013 joint DWR and BoR document titled Draft Technical Information for Preparing Water Transfer Proposals (DTIPWTP) because the discussion in that document's Section 3.4.3 on estimating the effects of transfer operations on streamflow says that a default BoR-SDF of 12 percent will be applied "unless available monitoring data analyzed by Project Agencies supports the need for the development of a transfer proposal site-specific SDF" (page 33). The document also states that: Although real time streamflow depletion due to groundwater substitution pumping for water transfers cannot be directly measured, impacts on streamflow due to groundwater pumping can be modeled. Project Agencies have applied the results from prior modeling efforts to evaluate potential groundwater transfers in the Sacramento Valley to establish an estimated average streamflow depletion factor (SDF) for transfers requiring the use of Project Facilities.

Response
See Common Response 8.

Comment NG01-47

Comment
I have several comments on this analysis of stream depletion impacts and mitigation measure WS-1: a. Sections 2.3.2.2 and 2.3.2.3 discuss potential groundwater substitution and crop idling transfers and the limitations on the timing of the transfers. Transfers typically occur from July to September, but

could also occur from April to June if conditions in the Delta allow for transfer. Surface water to be used in groundwater substitution and crop idling transfers would be stored during April to June if the condition of the Delta is unacceptable for transfer.

My understanding of the BoR-SDF in mitigation measure WS-1 is that at the same time transfer surface waters are flowing towards the Delta, a portion of that water is assigned to the waterway to “offset” or compensate for stream depletion caused by groundwater substitution pumping. The Draft EIS/EIR doesn’t seem to address the issue of how to compensate for groundwater substitution pumping impacts occurring before or after the transfer water flows to the Delta, the long-term losses caused by the pumping in subsequent years, and cumulative impacts from multiple years of pumping by all sellers. Yet the Draft EIS/EIR acknowledges that stream depletion is cumulative and a cumulative increase in depletion can be significantly greater than with a single event (Section 4.3.1.2 in Appendix B). The SACFEM2013 simulation shows that stream depletion will continue for a number of years after the groundwater substitution pumping event (Figures B-4, B-5 and B-6 in Draft EIS/EIR Appendix B). Mitigation measure WS-1 doesn’t appear to fully address how mitigation will occur for stream depletion impacts from groundwater substitution pumping during entire duration of the impact.

I recommend mitigation measure WS-1 be revised to clearly address how reductions in stream flows caused by groundwater substitution transfer pumping will be mitigated to less than significant for all of the times when stream depletion is occurring, including the time before and after the water is physically transferred; long-term impacts; and cumulative impacts from multiple sellers over multiple years of participating in groundwater substitution transfers.

Response
See Common Response 8.

Comment NG01-48

Comment

b. Although mitigation measure WS-1 doesn’t state that its implementation is linked to the October 2013 DTIPWTP (that linkage is part of mitigation measure GW-1), the DTIPWTP discusses the use of the BoR-SDF in the methodology for determining the amount of water available for groundwater substitution transfer, and the effects of the groundwater substitution pumping on streamflow in Section 3.4 (page 31). Item 5 on page 31 gives the formula for using four steps in determining the amount of transferable water, one of which is subtraction of the estimated streamflow reduction. Section 3.4.3 states on page 33 of the DTIPWTP that: Although real time streamflow depletion due to groundwater substitution pumping for water transfers cannot be directly measured, impacts on streamflow due to groundwater pumping can be modeled. Project Agencies have applied the results from prior modeling efforts to evaluate potential groundwater transfers in the Sacramento Valley to establish an estimated average streamflow depletion factor (SDF) for transfers requiring the use of Project Facilities. Project Agencies will apply a 12 percent SDF for each project meeting the criteria contained in this chapter unless available monitoring data analyzed by Project Agencies supports the need for the development of a transfer proposal site-specific SDF. Project Agencies are developing tools to more accurately evaluate the impacts of groundwater substitution transfers on streamflow. These tools may be implemented in the near future and may include a site-specific analysis that could be applied to each transfer proposal.

Mitigation measure WS-1 states on page 3.1-21 that: The exact percentage of the streamflow depletion factor will be assessed and determined on a regular basis by Reclamation and DWR, in consultation with buyers and sellers, based on the best technical information available at that time. The percentage will be determined based on hydrologic conditions, groundwater and surface water modeling, monitoring information, and past transfer data.

From these statements it appears that: (1) the BoR, DWR and other Project Agencies have previously analyzed the amount of stream depletion caused by past groundwater substitution transfers, and (2) the default of 12% BoR-SDF may not be applied to groundwater substitution during the 10 years of transfers because transfer-specific studies will be needed. The Draft EIS/EIR doesn’t provide information or cite references on the previous modeling and/or monitoring efforts to determine the correct stream depletion factor. It also doesn’t provide specific information on the method(s) and review process to be used in implementing mitigation measure WS-1, or what additional assessments are needed to determine the “exact percentage” for the BoR-SDF. Mitigation measure WS-1 appears to require that the assessment, the calculation methodology, and determination of the correct BoR-SDF be done at a future time. The Draft EIS/EIR doesn’t state whether other regulatory agencies and/or the public will have an opportunity in the future to review and comment on the methodology and determination of the “exact percentage” of the BoR-SDF for each groundwater substitution transfer seller. The Draft EIS/EIR also doesn’t state whether other regulatory agencies and/or public comments will be considered by BoR and DWR in determining the BoR-SDF percentage.

Response

See Common Response 8.

Comment NG01-49

Comment
The statement that real time stream depletion can't be directly measured contradicts other statements in the Draft EIS/EIR, requirements of mitigation measure GW-1, and the scientific literature. For example: Section 3.5 of the DTIPWTP states that one of the objectives of the monitoring plan is to: Determine the extent of surface water-groundwater interaction in the areas where groundwater is pumped for the transfer. (page 34). This objective is in the project's monitoring program therefore it appears to indicate that some method is available for monitoring the surface water-groundwater interactions, not just the pre-pumping model simulations.

Response
Real-time streamflow monitoring during a transfer cannot identify what the streamflow would have been absent a transfer because hydrologic conditions vary every year and the baseline is unknown. Monitoring efforts can provide useful information, primarily related to whether depletions in major waterways follow trends similar to past years. Additionally, groundwater level monitoring provides information to indicate the timing and location of groundwater recharge. Monitoring can provide useful information for estimating potential effects, and that utility is identified in multiple places in the EIS/EIR.

Comment NG01-50

Comment
The Fisheries (3.7) and Vegetation Wildlife (3.8) sections of the Draft EIS/EIR appear to state that flow reductions in surface waterways caused by groundwater substitution pumping will be monitored. Paragraphs similar to the ones given below state that monitoring wells are part of the mitigation measure for surface waters: In addition, flow reductions as the result of groundwater declines would be observed at monitoring wells in the region and adverse effects on riparian vegetation would be mitigated by implementation of Mitigation Measure GW-1 (See Section 3.3, Groundwater Resources), because it requires monitoring of wells and implementing a mitigation plan if the seller's monitoring efforts indicate that the operation of the wells for groundwater substitution pumping are causing substantial adverse impacts. The mitigation plan would include curtailment of pumping until natural recharge corrects the environmental impact. Therefore, the impacts to fisheries resources would be less than significant in these streams. (pages 3.7-26 and 3.7-56). In addition, the Proposed Action has the potential to cause flow reductions of greater than ten percent on other small creeks where no data are available on existing streamflows to be able to determine this. The impacts of groundwater substitution on flows in small streams and associated water ways would be mitigated by implementation of Mitigation Measure GW-1 (see Section 3.3, Groundwater Resources) because it requires monitoring of wells and implementing a mitigation plan if the seller's monitoring efforts indicate that

the operation of the wells for groundwater substitution pumping are causing substantial adverse impacts. The mitigation plan would include curtailment of pumping until natural recharge corrects the environmental impact. Implementation of these measures would reduce significant effects on vegetation and wildlife resources associated with streams to less than significant. (pages 3.8-51, 3.8-58 and 3.8-68).

Response
See Common Responses 6 and 10.

Comment NG01-51

Comment
All of these statements seem to contradict the statement in mitigation measure WS-1 that stream depletion can't be measured in real time. Although the Draft EIS/EIR doesn't provide the technical method(s) for determining surface water flow using monitoring in groundwater wells, it's reliance on mitigation measure GW-1 to ensure that streamflows are adequate implies that a method is available. Because WS-1 and GW-1 both have one of the same objectives, to mitigation streamflow losses due to groundwater substitution pumping, the mitigation measure are linked. Thus, the real time monitoring of groundwater intended to mitigate streamflow losses under GW-1 might also facilitate real time monitoring of streamflow needed for WS-1. I'll provide in Part 2 of this letter some additional discussion and references to scientific literature on studies and methods for measuring stream seepage and stream depletion caused by groundwater pumping.

I recommend the Draft EIS/EIR be revised to clearly discuss the methods available for determining the value of the BoR-SDF for each groundwater substitution transfer well. I recommend the Draft EIS/EIR be revised to discuss the procedure for Project Agency review and approval, along with process for review and comment by other public agencies and the public. I recommend the Draft EIS/EIR be revised to discuss the methods and results of prior BoR-SDF determinations. I recommend the Draft EIS/EIR be revised to define the data needed to determine the "exact percentage" of stream depletion from groundwater substitution pumping during the 10-year transfer project, the technical method(s) that will be used to calculate the amount of stream depletion and the BoR-SDF, and the method(s) for monitoring surface water flow losses and verifying the effectiveness of the BoR-SDF and mitigation measure WS-1.

Response
See response to Comment NG01-49 for information on why real-time streamflow monitoring cannot estimate streamflow depletion because without-transfer conditions are not known.

See Common Response 8 for more information on the streamflow depletion factor.

Comment NG01-52

Comment

c. Section 3.4.1 of the DTIPWTP discusses calculation of baseline groundwater pumping for groundwater substitution transfers. Baseline groundwater pumping and stream depletion reduction are part of the four-step process for determining the amount of transferable water (page 31). Water transfer sellers wanting to use groundwater substitution pumping are requested to submit information to: Identify all wells that discharge to the contiguous surface water delivery system within which a well is proposed for use in the transfer program, and The amount of groundwater pumped monthly during 2013 for each well that discharges to the contiguous surface water delivery system.

Section 3.4.2 discusses measuring groundwater pumping provided for groundwater substitution transfers and states that: Sellers should provide pumping records from all wells that discharge to a contiguous surface water delivery system used in groundwater substitution transfers. (page 32)

The requirement that the groundwater transfer pumping baseline and metering of transfer pumping be conditioned on the water being discharged to the contiguous surface water delivery system suggests that if the groundwater substitution pumping discharges to a non-contiguous surface water or directly to a field that the establishment of a pre-transfer pumping baseline and transfer metering aren't required. Is that the case? If it is the case, then how is the amount of transferable water determined whenever the groundwater substitution transfer pumping doesn't discharge to a contiguous surface water deliver system? If the pre-transfer baseline pumping is removed from the calculation, does that increase or decrease the amount of transferable water and how does that change the BoR-SDF requirement? Is metering required for groundwater substitution transfer wells that don't discharge to a contiguous surface streams water delivery system? If not, how will measurement of transferred water and the required amount of the BoR-SDF be verified? All of these factors are relevant because they are linked to mitigation measure WS-1 through the DTIPWTP four-step process to determine the amount of transferrable water. The amount of transferrable water incorporates the BoRSDF to prevent injury and reduce groundwater substitution pumping stream depletion impacts to less than significant.

I recommend the Draft EIS/EIR be revised to provide a discussion of how the baseline for pre-transfer groundwater pumping will be determined and how metering of all groundwater substitution transfer pumping for wells will be done regardless of whether the well discharges to a contiguous surface water delivery system. I recommend the Draft EIS/EIR be revised to discuss how the BoR-SDF will be determined, monitored, and it's effectiveness verified for all groundwater substitution transfer wells regardless of whether the well discharges to a contiguous surface water delivery system.

Response
All groundwater pumping wells that are part of a groundwater substitution pumping transfer must be metered.

Comment NG01-53

Comment
Mitigation Measure GW-1. 16. The Draft EIS/EIR has only two mitigation measures that apply to the groundwater substitution transfers, WS-1 and GW-1. GW-1 is the principle mitigation measure for the 10-year transfer project's Draft EIS/EIR and is discussed in Section 3.3.4.1. The requirements contained in the October 2013 joint DWR and BoR Draft Technical Information for Preparing Water Transfer Proposals (DTIPWTP) and its 2014 Addendum are included in GW-1 by reference. The monitoring and mitigation measures of GW-1 are generally statements of objectives and requirements for development in the future monitoring and mitigation plans that are approved by BoR and perhaps DWR. GW-1 doesn't appear to provide any future opportunity for review and comment by parties that may be impacted by the groundwater substitution transfers such as the non-participating well owners, the public, or other regulatory agencies. GW-1 has statements such as: The monitoring program will incorporate a sufficient number of monitoring wells to accurately characterize groundwater levels and response in the area before, during, and after transfer pumping takes place. (page 3.3-88) The monitoring program will include a plan to coordinate the collection and organization of monitoring data, and communication with the well operators and other decision makers. (page 3.3-89) Potential sellers will also be required to complete and implement a mitigation plan. (page 3.3-89) To ensure that mitigation plans will be feasible, effective, and tailored to local conditions, the plan must include the following elements: (page 3.3-90 and 3.3-91) 1. procedure for the seller to receive reports of purported environmental or effects to non-transferring parties; 2. A procedure for investigating any reported effect; 3. Development of mitigation options, in cooperation with the affected parties, for legitimate significant effects 4.Assurances that adequate financial resources are available to cover reasonably anticipated mitigation needs. Reclamation will verify that sellers adopt and implement these measures to minimize the potential for adverse effects related to groundwater extraction. (page 3.3-91).

GW-1 does have some specifics on requirements for the frequency of groundwater level monitoring, such as weekly monitoring during the transfer period (page 3.3-89). Requirements for the frequency of reporting are less specific. Summary tables to BoR during and after transfer-related groundwater pumping, and a summary report sometime after the post-project reporting period. The project reporting period extends through March of the year following the transfer (page 3.3-90). The requirement for only a single year of groundwater monitoring appears to be insufficient given the duration of the simulated pumping impacts (see Figure B-5 in Appendix B). Other reporting requirements such as groundwater elevation contour maps are given as "should be included" rather than "shall be included" (page 3.3-90).

The BoR should already have monitoring and mitigation plans and evaluation reports based on the requirements of the DTIPWTP for past groundwater substitution transfers, which likely were undertaken by some of the same sellers as the proposed 10-year transfer project. The Draft EIS/EIR should provide these existing BoR approved monitoring programs and mitigation plans as examples of what level of technical specificity is required to meet the objectives of GW-1 that include: (1) mitigate adverse environmental effects that occur; (2) minimize potential effects to other legal users of water; (3) provide a process for review and response to reported effects; and (4) assure that a local mitigation strategy is in place prior to the groundwater transfer (page 3.3-91). In addition, examples of periodic reporting tables and final evaluation reports should be provided to demonstrate the effectiveness of the GW-1 process at preventing or mitigating impacts from the groundwater substitution transfer pumping. Other deficiencies in GW-1 have been discussed above in my comments nos. 1, 2, 3, 5, 6 and 15, and below in comment no. 18.

I recommend the Draft EIS/EIR be revised to include specifics on additional requirements that must be part of mitigation measure GW-1 including: (1) required distances from wells and surface water features, and aquifer zones for groundwater elevation monitoring; (2) the duration of the required post-transfer monitoring that accounts for the effects of the 10 years of pumping; (3) specifics requirements on scale and detail for maps, figures and tables needed to document groundwater substitution pumping impacts; and (4) specific threshold for changes in groundwater elevation, groundwater quality and subsidence that will be considered significant. I recommend the Draft EIR/EIS be revised to provide existing BoR approved monitoring and mitigation plans and reports for past groundwater substitution transfers as examples of the types of technical information necessary to ensure no injury with less than significant impacts and appropriate mitigations. I recommend the Draft EIS/EIR be revised to provide specifics on how the public will be able to participate in the BoR and DWR approval and revision process for the 10-year transfer project monitoring and mitigation plans. I also recommend the Draft EIS/EIR revise GW-1 to include the issues discussed elsewhere in my comments nos. 1, 2, 3, 5, 6, 15 and 18.

Response

See Common Responses 6, 7, and 8. The DRAFT Technical Information for Preparing Water Transfer Proposals was not incorporated by reference, but used as a resource during development of the mitigation measures.

As described in the Project Description (Chapter 2), the proposed project and its alternatives are viewed as a potential "valley-wide" project. Therefore, all potential groundwater substitution transfers were simulated simultaneously in the SACFEM2013 model. The drawdown contour figures presented in Section 3.3.2 show the potential decline in groundwater elevation (beyond the existing conditions). These figures have been expanded (i.e., zoomed in) to provide additional details regarding the extent of the simulated drawdown.

Comment NG01-54

Comment

Water Quality. 17. The Draft EIS/EIR discusses water quality in Section 3.2, but focuses on potential impacts to surface waters. Discussions of impacts from groundwater substitution transfer pumping on groundwater quality are given in Section 3.3 (pages 3.3-33 to 3.3-35). The Draft EIS/EIR discusses the potential for impacts to groundwater quality from migration of contaminants as a result of groundwater substitution pumping, but provides only a general description of the current condition of groundwater quality. Section 3.3 gives the following statements on water quality: Groundwater Quality: Changes in groundwater levels and the potential change in groundwater flow directions could cause a change in groundwater quality through a number of mechanisms. One mechanism is the potential mobilization of areas of poorer quality water, drawn down from shallow zones, or drawn up into previously unaffected areas. Changes in groundwater gradients and flow directions could also cause (and speed) the lateral migration of poorer quality water. (pages 3.3-59 and 3.3-60). Degradation in groundwater quality such that it would exceed regulatory standards or would substantially impair reasonably anticipated beneficial uses of groundwater; or (page 3.3-61) Additional pumping is not expected to be in locations or at rates that would cause substantial long-term changes in groundwater levels that would cause changes to groundwater quality. Consequently, changes to groundwater quality due to increased pumping would be less than significant in the Redding Area Groundwater Basin. (page 3.3-66) Inducing the movement or migration of reduced quality water into previously unaffected areas through groundwater pumping is not likely to be a concern unless groundwater levels and/or flow patterns are substantially altered for a long period of time. Groundwater extraction under the Proposed Action would be limited to short-term withdrawals during the irrigation season. Consequently, effects from the migration of reduced groundwater quality would be less than significant. (page 3.3-83). Groundwater extracted could be of reduced quality relative to the surface water supply deliveries the seller districts normally receive; however, groundwater quality in the area is normally adequate for agricultural purposes. Distribution of groundwater for municipal supply is subject to groundwater quality monitoring and quality limits prior to distribution to customers. Therefore, potential impacts to the distribution of groundwater would be minimal and this impact would be less than significant. (page 3.3-84).

The Draft EIS/EIR notes that several groundwater quality programs are active in the seller regions (pages 3.3-6 to 3.3-10). No maps are provided that show the baseline groundwater quality and known areas of poor or contaminated groundwater. Groundwater quality information on the Sacramento Valley area is available from existing reports by the USGS (1984, 2008b, 2010, and 2011) and Northern California Water Association (NCWA, 2014c). The Draft EIS/EIR doesn't compare the known groundwater quality problem areas with the SACFEM2013 simulated drawdowns to demonstrate that the proposed projects won't draw in or expand the areas of known poor water quality. The Draft EIS/EIR analysis doesn't appear to consider the impacts to the quality of water from private wells. Pumping done as part of the groundwater substitution transfer may cause water quality impacts from geochemical changes resulting from a lowering the water table below historic elevations, which exposes aquifer material to different oxidation/reduction potentials and can alter the mixing ratio of different quality aquifer zones being pumped. Changes in groundwater level can also alter the direction and/or rate of movement of contaminated groundwater plumes both horizontally and vertically, which may expose non-participating wells to contaminants they would not otherwise encounter.

Response

The water quality information provided in Section 3.3.1.3 is provided as a summary of water quality in the project area. Groundwater quality monitoring is required as part of Mitigation Measure GW-1. The water quality monitoring required is discussed in Section 3.3.4.1. As a reference, the DRAFT Technical Information for Preparing Water Transfer Proposals also provides information on the groundwater quality assessment and monitoring that is required. This document also includes the more comprehensive testing that may be required, depending on location conditions.

Potential water quality impacts to third party (i.e., private) wells and the mitigation of these impacts are covered by Measure GW-1. See Common Responses 6 and 7 for additional information.

Comment NG01-55

Comment

As noted above in my general comment no. 7, the DWR well depth summary maps for the northern Sacramento Valley show that there are potentially thousands of private well owners in and adjacent to the proposed project areas of the groundwater substitution drawdown. Exhibit 2.1 has a composite map of DWR's northern Sacramento Valley well depth summary maps (DWR, 2014a) for the shallow aquifer zone, wells less than 150 feet deep and the areas of groundwater decline from 2004 to 2014 (DWR, 2014b). Exhibit 7.1 has a table that summarizes the range of the number of shallow wells by county that lie within the areas of groundwater decline from 2004 to 2014. In my general comment no. 5, I discussed the concept of capture zones for wells and the need for groundwater modeling using particle tracking to identify the areas where a well receives recharge. Particle tracking to define a well capture zone(s) can also be used to determine if known zones or areas of poor or contaminated water will migrate as a result of the groundwater substitution transfer pumping. Particle tracking can also identify private and municipal wells that lie within the capture zone of a groundwater substitution transfer well and might experience a reduction in water quality from the transfer pumping. Particle tracking can identify locations where mitigation monitoring of groundwater quality should be conducted to quantify changes in groundwater quality.

Response
The groundwater modeling conducted using SACFEM2013 was used to develop the areas where changes in groundwater levels can potentially occur due to groundwater substitution pumping. Identification of each private well that may or may not be impacted is not possible given the number of wells. Mitigation Measure GW-1 provides for monitoring of groundwater conditions in the area of a potential groundwater substitution transfer. Common Response 6 provides additional information.

Comment NG01-56

Comment
Even though there are already a number of shallow wells impacted by historic groundwater level declines, the Draft EIS/EIR reaches the conclusion that the groundwater substitution transfer pumping will not cause injury or a significant impact to groundwater quality. This conclusion is reached in part because the assumed beneficial use of groundwater substitution pumped water is agricultural, or urban, where the quality of water delivered is monitored by an urban water agency. Only these two beneficial uses are assumed even though Table 3.2-2 lists numerous other uses for waters in the seller service areas. The Draft EIS/EIR doesn't provide sufficient information on existing water quality conditions in the Sacramento Valley to allow for evaluation of potential geochemical changes that groundwater substitution pumping might cause. The Draft EIS/EIR sets a standard of significance in degradation of groundwater quality that requires contaminants exceed regulatory standards or impair reasonably anticipated beneficial uses (page 3.3-61). This standard of significance ignores the regulatory requirements of the Water Quality Control Basin Plans (Basin Plans) http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/index.shtml). The Draft EIS/EIR only briefly discusses the role of the Basin Plans in maintaining water quality (page 3.2-7). In addition this water quality threshold of significance likely violates the State Water Resources Control Board Resolution No. 68-16, titled Statement of Policy with Respect to Maintaining High Quality of Waters in California, that states: "Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies became effective, such existing high quality will be maintained until it has been demonstrated to the state that any change will be

consistent with the maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies." "The nondegradation policy of the State Board (Resolution No. 68-16) applies to surface and groundwaters that are currently better quality than the quality established in 'adopted policies.' In terms of water quality objectives, the basin plans are the source of adopted policies."

I recommend the Draft EIS/EIR be revised to document the known condition of the groundwater quality in the Sacramento Valley and Redding Basin and include available maps. I recommend that this assessment evaluate the potential impacts from migration of known areas of poor groundwater quality that could be further impaired or spread as a result of the groundwater substitution transfer pumping. I recommend a groundwater quality mitigation measure be provided for evaluation the existing water quality in wells (assuming owner cooperation) within and adjacent to known areas of poor groundwater quality that lie within and adjacent to the simulated groundwater transfer drawdown areas, especially those that lie within the capture zone. I recommend the groundwater quality mitigation measure include: (1) procedures for sampling wells, (2) methods of water quality analysis, (3) a QA/QC program, (4) standards and threshold for water quality impairment consistent with public health requirements and Basin Plan beneficial uses and SWRCB Resolution No. 68-16, (5) provisions for independent oversight and review by regulatory agencies and affected well owners, and (6) specific reporting and notification requirements that keep the owners of nonparticipating wells, the public, and regulatory agencies informed. I recommend the groundwater quality mitigation measure include provisions for modification and/or treatment of non-participating wells should the quality of water delivered be significantly altered by groundwater substitution transfers. I recommend the groundwater quality mitigation measure be in effect during the 10-year period of transfer pumping and the following recovery period until groundwater flows return to the pre-project condition. I recommend the Draft EIS/EIR also require a funding mechanism for implementing the groundwater quality mitigation measures for the entire 10-year duration of the groundwater substitution transfers and the recovery period. I recommend the costs of the groundwater quality mitigation monitoring be the responsibility of the project proponents, not the non-participating wells owners or the public. These costs should include reimbursement of any costs incurred by regulatory agency oversight and costs incurred by non-participating well owners.

Response
See response to Comment NG01-54.

Comment NG01-57

Comment
Subsidence. 18. The impacts of subsidence due to groundwater substitution transfer pumping are discussed in Section 3.3. Section 3.3.1.3.2 discusses

groundwater-related land subsidence and notes that Global Positioning System (GPS) surveying is conducted by DWR every three years at 339 elevation survey monuments throughout the northern Sacramento Valley (page 3.3-28). In addition, eleven extensometers, as shown in Figure 3.3-11, monitor land subsidence. Figure 3.3-11 provides graphs of the subsidence for five of the eleven extensometers; no information is provided on the results on the GPS surveys. Mitigation measure GW-1 also incorporates by reference the October 2013 DTIPWRP and its 2014 Addendum. The DTIPWRP doesn't add any additional monitoring or mitigation requirements for subsidence, stating that areas that are susceptible to land subsidence may require land surface elevation surveys, and that the Project Agencies will work with the water transfer proponent to develop a mutually agreed upon subsidence monitoring program (pages 34 and 37). Apparently the Draft EIS/EIR expects that the mutually agreed upon subsidence monitoring programs will be a future mitigation measure. The Draft EIS/EIR doesn't discuss how other regulatory agencies or the public will participate in the reviewing and commenting on any future subsidence mitigation measure.

Response
See Common Response 4 regarding revisions to the Affected Environment section. Subsidence trends as documented in DWR's Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California (DWR 2014) have been added to Section 3.3.1.3.

See Common Response 7.

Comment NG01-58

Comment
The Draft EIS/EIR relies on local GMPs and county ordinances to prevent impacts from subsidence, but doesn't discuss any specific monitoring or mitigation measures for each proposed groundwater substitution transfer pumping area (page 3.3-7). The Draft EIS/EIR acknowledges that subsidence has occurred in the past in portions of the Sacramento Valley in Yolo County (page 3.3-29), and that the Redding groundwater basin has never been monitored (page 3.3-17). Yet only a qualitative assessment of potential project impacts was done by comparing SACFEM2013 simulated groundwater drawdowns with areas of existing subsidence and by comparing estimates of pre-consolidated heads/historic low heads (page 3.3-61).

Response
Potential for subsidence within the area of analysis was identified using a combination of (1) current subsidence trends and (2) comparing calculated historic low groundwater levels since 2008 and the simulated change in groundwater level due to transfer pumping. See Common Response 7.

Comment NG01-59

Comment

The Draft EIS/EIR relies on the mitigation measure GW-1 to prevent and remedy any significant impacts from subsidence. The requirements in mitigation measure GW-1 for subsidence impacts specify that the BoR will determine, apparently in the future and only when mutually agreed upon, the “strategic” monitoring locations throughout the transfer area where land surface elevations will be measured at the beginning and end of each transfer year (page 3.3-89). When the land surface elevation survey indicates an elevation decrease in an area, more subsidence monitoring will be required, which could include: (1) extensometer monitoring, (2) continuous GPS monitoring, or (3) extensive land-elevation benchmark surveys conducted by a licensed surveyor. More extensive monitoring will be required for areas of documented historic or higher susceptibility to land subsidence (page 3.3-89). The Draft EIS/EIR concludes that with these subsidence monitoring mitigation measures of GW-1, impacts will be reduced to less than significant (page 3.3-66).

Exhibits 8.1a to 8.1c provides composite maps using as a base DWR’s Spring 2004 to 2014 Change in Groundwater Elevations (DWR, 2014b) for the shallow (less than 200 feet bgs), intermediate (200 to 600 feet bgs) and the deep (greater than 600 feet bgs) aquifer zones in the northern Sacramento Valley. A map of the natural gas pipelines in the Sacramento Valley (Exhibit 8.6) has been scaled and combined with Exhibits 8.1a to 8.1c. Exhibit 8.2 depicts on DWR’s (2014b) intermediate zone change in groundwater elevation map, the locations of extensometers and the GPS subsidence grid (from Figure 6 in DWR, 2008; Exhibit 8.4), and the known subsidence area southeast of Williams and into Yolo County (from Draft EIS/EIR Figure 3.3-11)).

The subsidence area in Yolo County isn’t fully shown on the DWR’s 2014 groundwater elevation change maps, but is shown in the composite maps (Exhibits 8.1a to 8.1c). These exhibits and Exhibit 8.2 show that the western line of extensometers lies along the eastern edge of the intermediate zone of greatest groundwater elevation change, and aligns with the central axis of the mapped changes in groundwater elevation in deeper aquifer zone. The extensometers don’t appear to lie within the area of known subsidence southeast of Williams and into Yolo County (Figure 3.3-11). The GPS subsidence grid network does extend across eastern portion of the known subsidence area southeast of Williams and into Yolo County depicted in Figure 3.3-11 and the groundwater elevation change in the intermediate aquifer zone southwest of Orland (Exhibit 8.2).

Response

See Common Response 7.

Comment NG01-60

Comment
Although there are several areas in the Sacramento Valley of known decrease in groundwater elevations, known areas of subsidence (Faunt, ed., 2009; Exhibit 8.3), and apparently a GPS network with repeated elevation measurements (Exhibit 8.4), the Draft EIS/EIR doesn't provide any specific information on the "strategic" locations where groundwater substitution pumping done under the 10-year transfer project will require additional subsidence monitoring. The historic subsidence data along with the GPS grid elevation data, historic groundwater elevation change data and the future areas of drawdown from the 10 years of groundwater substitution pumping shown in Figures 3.3-26 to 3.3-31 should be sufficient information to develop the initial "strategic" locations for monitoring potential subsidence. The Draft EIS/EIR should be able to provide the specific thresholds of subsidence that will trigger the need for additional extensometer monitoring, continuous GPS monitoring, or extensive land-elevation benchmark surveys by a licensed surveyor as required by GW-1. The Draft EIS/EIR should also specify in mitigation measure GW-1, the frequency and methods of collecting and reporting subsidence measurements, and discuss how the non-participating landowners and the public can obtain this information in a timely manner. In addition, the Draft EIS/EIR should provide a discussion of the thresholds that will trigger implementation of the reimbursement mitigation measure required by GW-1 for repair or modifications to infrastructure damaged by non-reversible subsidence, and the procedures for seeking monetary recovery from subsidence damage (page 3.3-90). The revised Draft EIS/EIR should review the information provided by Galloway and others (2008), and the Pipeline Research Council International (2009) regarding land subsidence hazards.

Response
See Common Response 7.

Comment NG01-61

Comment
An objective of the mitigation measure GW-1 is to mitigate adverse environmental effects from groundwater substitution transfer pumping (page 3.3-88). As part of the preliminary assessment of potential environmental impacts from subsidence due to groundwater substitution pumping, a review and determination of the critical structures that might be impacts is recommended. There are a number of critical structures in the Sacramento Valley that may be susceptible to settlement and lateral movement. These include natural gas pipelines, gas transfer and storage facilities, gas wells, railroads, bridges, water and sewer pipelines, water wells, canals, levees, other industrial facilities. Exhibits 8.5 to 8.11 provide several maps of gas pipeline, and gas and oil related facilities obtained from the web sites of the CA Energy Commission (CEC) and the CA Department of Conservation's Division of Oil,

Gas and Geothermal Resources (DOGGR). In addition, composite maps (Exhibits 8.1a to 8.1c) are provided that show the locations of the natural gas pipelines (Exhibit 8.6) with the DWR 2004 to 2014 change in groundwater elevation maps (DWR, 2014b). Additional maps of railroads, bridges, canals, levees, water and sewer pipelines and important industrial facilities should be sought and the location of those structures compared to the potential areas of subsidence from groundwater substitution transfer pumping. Specific “strategic” subsidence monitoring locations should be given in mitigation measure GW-1 based on analysis of the susceptible infrastructure locations and the potential subsidence areas. The local, state and federal agencies that regulate these critical structures and pipelines as well as the facility owners should be contacted for information on the limitations on the amount of movement and subsidence the infrastructures can withstand. The limitations on movement and subsidence should be incorporated into any triggers or thresholds for additional monitoring and implementing mitigations needed to reduce subsidence impacts to less than significant and cause no injury.

I recommend that: (1) the Draft EIS/EIR be revised to provide information on initial “strategic” locations and types of subsidence monitoring that are necessary based on the existing conditions and the proposed groundwater substitution pumping areas; (2) the Draft EIS/EIR and mitigation measure GW-1 be revised to provide specific thresholds of subsidence that will trigger the need for additional subsidence monitoring; (3) mitigation measure GW-1 be revised to include the frequency and methods of collecting and reporting subsidence measurements; (4) the Draft EIS/EIR discuss how the non-participating landowners and the public can obtain subsidence information in a timely manner; (5) the Draft EIS/EIR and GW-1 be revised to provide the thresholds that trigger implementation of the reimbursement mitigation measure required by GW-1 for repair or modifications to infrastructure damaged by nonreversible subsidence along with the procedures for seeking monetary recovery from subsidence damage; and (6) the Draft EIS/EIR be revised to provide a map and inventory of critical structures in the Sacramento Valley that may be susceptible to settlement and lateral movement. These structures should include natural gas pipelines, gas transfer and storage facilities, gas wells, power plants, railroads, bridges, water and sewer pipelines, water wells, canals, levees, other industrial facilities. I further recommend that the Draft EIS/EIR solicit advice from local, state and federal agencies, as well as the infrastructure owners on the amount of subsidence that these critical structures and pipelines can withstand, and provide copies of their responses and incorporate their requirements in mitigation measure GW-1 to ensure the stability and function of these facilities.

Response
See Common Response 7.

Comment NG01-62

Comment
Geology and Seismicity. 19. Environmental impacts from the project to geologic and soil resources are discussed in Section 3.4 of the Draft EIS/EIR. The Draft EIS/EIR assumes that because the projects don't involve the construction or modification of infrastructure that could be adversely affected by seismic events, seismicity is not discussed in this section. The Geology and Soils section therefore focused on chemical processes, properties, and potential erodibility of soils due to cropland idling transfers. Impacts of subsidence are discussed in Section 3.3 of the Draft EIS/EIR and above in my comment no. 18.

The Draft EIS/EIR reasoning that because the projects don't involve new construction or modification of existing structures that there are no potential seismic impacts from the activity undertaken during the transfers is incorrect. The project area has numerous existing structures that could be affected by the groundwater substitution transfer pumping, specifically settlement induced by subsidence. Although the seismicity in the Sacramento Valley is lower than many areas of California, it's not insignificant. There is a potential for the groundwater substitution transfer projects to increase the impacts of seismic shaking because of subsidence causing additional stress on existing structures. The discussion in Section 3.3 on potential subsidence from groundwater substitution pumping was only qualitative because the SACFEM2013 simulations didn't calculate an estimate of subsidence from the transfer projects (page 3.3-61). The subsidence assessment also didn't acknowledge or consider the numerous natural gas pipelines or other critical facilities and structures that occur the Sacramento Valley. Exhibits 8.5 to 8.11 provide a series of maps that show some of the major natural gas pipelines, oil refineries, terminal storage, and power plants in the Sacramento Valley. In addition, there are a number of railroads, bridges, canals, and water and sewer pipelines within the transfer project area. As I discussed in my comment no. 18 on subsidence impacts, some of these existing structures and pipelines are sited within or traverse areas of known subsidence, existing areas of large groundwater drawdown, and areas within the proposed groundwater substitution transfer pumping. There are a number of technical documents on seismic impacts to pipelines (O'Rouke and Norberg, 1992; O'Rouke and Liu, 1999, 2012) as well as a proceeding from a recent ASCE conference on pipelines (Miami, Florida, August 2012).

Response
Groundwater substitution transfers could not increase the potential for seismic shaking. See Common Response 7 regarding mitigation for subsidence.

Comment NG01-63

Comment
The characteristics of future seismic shaking in California can be assessed using the following web resources provided by the California Geological Survey

(CGS) in conjunction with the U.S. Geological Survey and other academic and professional organizations: 1. California Fault Activity Map web site: http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html 2. Probabilistic Seismic Hazard Mapping web site: http://www.consrv.ca.gov/cgs/rghm/psha/pages/index.aspx 3. Probabilistic Seismic Ground Motion Interpolator web site: http://www.quake.ca.gov/gmaps/PSHA/psha_interpolator.html 4. Earthquake Shaking Potential for California Map web site: http://www.conservation.ca.gov/cgs/information/publications/ms/Documents/MS48_revised.pdf

In addition to the potential impacts to existing infrastructure from seismic shaking, the occurrence of faults within the Sacramento Valley may influence the movement of groundwater. The USGS-CVHM groundwater model (Faunt, ed., 2009) incorporated a number of horizontal flow groundwater barriers (Figure C1-A, pages 160, 203, and 204; Exhibits 9.1, 9.2, 9.3a and 9.3b) that appear to align with faults shown in a series of screen plots from the interactive web site 2010 Fault Activity Map for California (CGS, 2010) (Exhibits 9.4a to 9.4d, 9.5 and 9.6). The SACFEM2013 model documentation didn’t indicate that faults were considered as potential flow barriers and the resulting simulation maps in Figures 3.3-26 to 3.3-31don’t show any flow barriers. I recommend that the Draft EIS/EIR be revised to: (1) assess the potential environmental impacts from seismic shaking on critical structures and pipelines in areas of potential subsidence caused by the groundwater substitution transfer pumping; (2) provide maps that identify and locate existing pipelines and critical structures such as storage facilities, railroads and bridges within the areas affected by groundwater substitution pumping; (3) solicit and provide results of the advice from local, state and federal agencies, as well as the infrastructure owners, on the amount of subsidence that these critical structures and pipelines can withstand under in both static and seismic conditions; (4) provide a mitigation measure(s) that addresses the requirements for monitoring the subsidence in the area of these critical structures and pipelines; and (5) provide specific monitoring and reporting requirements for potential seismic impacts to critical structures that includes establishing any additional structures for monitoring and taking subsidence measurements, and conducting additional periodic surveys of ground elevation and displacement.

I recommend the Draft EIS/EIR be revised to provide the thresholds that trigger implementation of the reimbursement mitigation measure required by GW-1 for repair or modifications to infrastructure that may be damaged by seismic movement in areas that have exceeded the thresholds for non-reversible subsidence, and provide procedures for seeking monetary recovery from subsidence damage. I also recommend the Draft EIS/EIR be revised to discuss the importance and impacts of the horizontal flow barriers and/or faults within the Sacramento Valley on the results of the drawdown and stream depletion simulations of SACFEM2013.

Response
Groundwater substitution transfers could not increase the potential for seismic shaking. See Common Response 7 regarding mitigation for subsidence.

Comment NG01-64

Comment
II. Additional Technical Information Relevant to the Assessment of Potential Environmental Impacts from the 10-Year Groundwater Substitution Transfers. Historic Changes in Groundwater Storage. 20. The Draft EIS/EIR provides SACFEM2013 simulations of groundwater substitution transfer pumping effects for WY 1970 to WY 2003. The discussion of the simulation didn't provide specifics on how the model simulated the current conditions of the Sacramento Valley groundwater system or the potential impacts from the 10-year groundwater substitution transfer project based on current conditions. A DWR groundwater contour map, Figure 3.3-4, shows the elevations in the spring of 2013 for wells screened at depths greater than 100 ft. bgs. and less than 400 ft. bgs. Figures 3.3-8 and 3.3-9 provide the locations and simulation hydrographs for selected monitoring wells in the Sacramento Valley. Appendix E provides additional monitoring well simulation hydrographs for selected wells at locations shown on Figures 3.3-26 to 3.3-31. As discusses above in comments no. 7, these hydrographs appear to show only simulated groundwater elevations. Actual measured groundwater elevations are needed to evaluate the accuracy of the simulations. The Draft EIS/EIR briefly discusses on page 3.3-12 the groundwater production, levels and storage for the Redding Basin, and on pages 3.3-21 to 3.3-27 there is a similar discussion for the Sacramento Valley. Faunt (ed., 2009) is cited for the conditions of the Sacramento Valley groundwater budget and Figure 3.3-10, taken from Faunt (ed., 2009; Figure B9; Exhibit 10.2a), shows the historic change in groundwater storage in the Central Valley as determined by the CVHM model simulations. Based in part on the information in Faunt (ed., 2009), the Draft EIS/EIR concludes that the Sacramento Valley basin's groundwater storage has been relatively constant over the long term, decreasing during dry years and increasing during wetter periods. However, the Draft EIR/EIS's discussion of the status of groundwater in the Sacramento Valley doesn't utilize all of the information on groundwater storage or water balance available in Faunt (ed., 2009), more recent simulation studies by Brush and others (2013a and 2013b), or the summary of groundwater conditions in recent reports by the Northern California Water Association (NCWA) (2014a and 2014b).

Response
The baseline simulation does not include any groundwater substitution transfers that are proposed as part of this EIS/EIR. The simulation is compared to separate simulation that adds in the substitution pumping. A comparison of the change in water level is presented in Section 3.3.2. It should be noted that hydrograph Figures 3.3-32 through 3.3-40 in the Public Draft EIS/EIR and those in Appendix E do not represent actual monitoring well locations. The

locations shown were selected to be distributed across the valley to provide the general trends the model simulates as a result of the groundwater substitution pumping. See Common Response 5 for additional information.

The affected environment section has been revised to include cumulative change in storage as simulated by CVHM and C2VSim models. Though the conclusions drawn by CVHM and C2VSim differ with respect to simulated storage capacity in the San Joaquin Valley, both models indicate storage capacities in the Sacramento Valley have remained steady since the 1920s. Additionally, Section 3.3.1.3.2 has been revised to include monthly groundwater storage estimates for the Sacramento and San Joaquin Valleys from Famiglietti et al. 2011. See Common Response 4 for additional information.

Comment NG01-65

Comment

Faunt (ed., 2009) provides in Table B3 (Exhibit 10.1) selected average annual hydrologic budget values for WYs 1962-2003. In addition, Figures B10-A and B10-B of Faunt (ed., 2009) show bar graphs for the average annual groundwater budget for the Sacramento Valley and the Delta and Eastside Streams (Exhibits 10.2b and 10.2c). Table B3 gives the water balances for subregions in the Sacramento Valley (1 to 7) and the Eastside Streams (8). Table B3 gives values for the net storage from specific yield and compressibility of water; positive values indicate an increase in storage, while a negative value is a decrease. For Sacramento Valley, the sum of the annual average from 1962 to 2003 in net storage is given as -99,000 AFY and for the Eastside streams -26,000 AFY. Unfortunately, the components in Table B3 don’t seem to be a complete groundwater water budget, so following the calculations of the average annual net change in groundwater storage isn’t obvious. Figures 10A and 10B (Exhibits 10.2a and10.2b), however, do provide bar graphs of the groundwater water budgets with values for the entire Sacramento Valley and the Delta and Eastside Streams. If it’s assumed that groundwater pumping shown as a negative value in Figures 10A and 10B represents an outflow from groundwater storage, then other negative values would also be considered outflows. Positive values are therefore assumed to be inflows to groundwater storage.

For the entire Sacramento Valley (subregions 1 to 7), Faunt (ed., 2009) shows the net change in annual groundwater storage as the sum of the negative outflows and positive inflow in Figure 10A at a negative 650,000 AFY (-0.65 million AFY) (2.88 – [0.29+0.03+1.66+1.37+0.18] = 2.88 – 3.53 = -0.65). The values in Figure 10B can be summed in a similar manner and yield a net change in storage of a positive 90,000 AFY for the Delta and Eastside Streams. Unfortunately, the bar graph in Figure 10B for the Eastside Streams (subregion 8) doesn’t have numerical values. A visual comparison of the inflow and outflow bars suggests that for subregion 8 the outflows, mostly pumping, are at or slightly greater than the inflows.

Response
See response to Comment NG01-64.

Comment NG01-66

Comment
The groundwater budget information by Faunt (ed., 2009) can be compared with two other more recent sources of Sacramento Valley information contained in four documents, Brush and others (2013a and 2013b) and NCWA (2014a and 2014b). Brush and others report on the recent version of the C2VSim groundwater model (version R374) and provide simulation results. The NCWA reports also used the C2VSim (R374) model, but provided additional analysis and results of the historic land development, water use and water balances in Sacramento Valley. Some of the information developed by Brush and others (2013a and 2013b), and Faunt (ed., 2009) on the condition of the Sacramento Valley groundwater system was previously discussed in my comments on the SACFEM2013 model simulations, nos. 8 to 14.

Response
See Common Response 4 and response to Comment NG01-64.

Comment NG01-67

Comment
My comment no. 14 on groundwater flow between subregions is also relevant to this discussion of the historic changes in groundwater storage. Accounting for the transfer of groundwater between regions is critical for understanding the impacts of pumping in one region or area on the adjacent regions. The sources of water backfilling a groundwater depression don't all have to come from surface waters, ie., stream depletion, precipitation, deep percolation, and artificial recharge. Some of that "recharge" can come from adjacent aquifers by horizontal and vertical flow. When pumping creates a depression in the water table or piezometric surface, the depression steepens the gradient thereby increasing the rate of flow towards it; the depression can also change the direction of groundwater flow. Often the "recharge" to a pumping depression comes from adjacent groundwater storage that lies outside the zone of influence of the pumping. When the rates and volumes of recharge from surface waters are insufficient to rapidly backfill a pumping depression, the impact on groundwater storage and elevations in adjacent regions increases.

Response
The SACFEM2013 model is a representation of the alluvial groundwater system in the Sacramento Valley. This model does not prohibit groundwater flow between areas/subbasins. Therefore, the groundwater substitution pumping simulated as part of this EIS/EIR allows for the potential flow between different regions in the model. The extent of that flow depends on local conditions

including aquifer properties (storage properties, hydraulic conductivity), deep percolation, and interaction with streams.

Comment NG01-68

Comment
Brush and others (2013a) provide a breakdown of water budget by subregion, Tables 10 to 13 (Exhibits 6.3a to 6.3d), but only for the selected three decades (1922-1929, 1960-1969, and 2000-2009), and for the total modeled period from 1922 to 2009. They do provide values for the change in groundwater storage for all 21 of the Central Valley subregions and 5 hydrologic regions. Of particular importance to the discussion of the current condition of the groundwater basin are the results of the C2VSim simulations of the annual average change in groundwater storage for each of the three decades and from 1922 to 2009, Tables 10 to 13 (Exhibits 6.3a to 6.3d). For the Sacramento Valley (subregions 1 to 7), Table 10 lists the 1922-2009 change in storage as -165,417 AFY (I'm assuming the units of the table are acre-feet), and for the Eastern Streams (subregion 8) -135,304 AFY. For the most recent decade, 2000-2009, the average annual change in groundwater storage has increased in both the Sacramento Valley and the Eastern Streams to -303,425 AFY and -140,715 AFY, respectively (Table 13). Although the tables in Brush and others don't list the groundwater flow between subbasins, Figures 81A to 81C (2013a) and Figure 39 (2013b) (Exhibits 6.1a to 6.1c and 6.2) provide this information for the selected decades and for the total simulation period. As discussed above in my comment no. 14, the change in interbasin groundwater flow can be significant particularly when recharge in a region is deficient. The Draft EIS/EIR should specifically discuss and account for any changes in the rate and direction of interbasin groundwater flow. Interbasin groundwater flow may become a hidden long-term impact that increases the time needed for recovery of groundwater levels from groundwater substitution transfer pumping, and can extend the impact from groundwater substitution transfer pumping to areas outside of the groundwater substitution transfer seller's boundary.

Response
See response to Comment NG01-67.

Comment NG01-69

Comment
Two recent reports on the condition of groundwater in the Sacramento Valley are provided by the Northern California Water Association (NCWA, 2014a and 2014b). Tables 3-6, 3-7, and 3-8 in the NCWA technical supplement report (2014b; Exhibits 10.5a to 10.5c) provide water balance information for the Sacramento Valley for the same three decades as Brush and others (2013a). The NCWA tables separate the water balance elements into three types, land uses (Table 3-6), streams and rivers (Table 3-7), and groundwater (Table 3-8). The values of the change in groundwater storage given in Table 3-8 are similar

to those given by Brush and others (2013a). The NCWA technical supplement report (2014b) also provides additional information on the 1922 to 2009 water balance through the use of graphs and bar charts. Figures 3-22 and 3-24 (Exhibits 10.6c and 10.6d) provide graphs of simulated estimates of annual groundwater pumping in the Sacramento Valley and the annual stream accretion. Positive stream accretion occurs when groundwater discharges to surface water, negative when groundwater is recharged. Other graphs include simulated deep percolation, Figures 3-26 and 3-27 (Exhibits 10.6e and 10.6f), annual diversions, Figures 3-19 and 3-20 (Exhibits 10.6a and 10.6b), and relative percentages of surface water to groundwater supplies, Figure 3-29 (10.6g).

The NCWA technical supplement report (2014b) notes in Sections 3.8 and 3.8.4 that negative changes in groundwater storage... suggest that the groundwater basin is under stress and experiencing overdraft in some locations. Review of the Sacramento Valley water balance, as characterized based on C2VSim R374 and summarized in Tables 3-6 through 3-8 reveals substantial changes in water balance parameters over time that affect overall groundwater conditions.… Over time, it appears that losses from surface streams have increased as a result of declining groundwater levels. The declining levels result from increased demand for groundwater as a source of supply without corresponding increases in groundwater recharge. (page 41) A contributing factor to the decrease in accretions to rivers and streams over the last 90 years is that deep percolation of surface water supplies (and other forms of recharge) has not increased in a manner that offsets increased groundwater pumping. (page 48).

The simulated groundwater pumping graph in NCWA Figure 3-22 and stream accretion graph in NCWA Figure 3-24 were combined into one graph by scaling and adjusting their axes (Exhibits 10.7). The vertical scales of these two graphs were adjusted so that a zero value of stream accretion aligned with 1.5 million acre-feet (MAF) of annual groundwater pumping. This alignment was done to reflect the fact that in the early 1920s, groundwater pumping was approximately 0.5 MAF per year (MAFY) while stream accretion was approximately 1.0 MAFY. As shown in the combined graph, stream accretion generally decreases at approximately the same rate as groundwater pumping increases. Thus, at a point of no appreciable groundwater pumping, pre-1920s, the total long-term average annual stream accretion was likely 1.5 MAF, based on the C2VSim simulations.

Response

Section 3.3.1.3, Affected Environment has been revised to clarify the impacts of current drought conditions to the groundwater resources within the area of analysis. Additional data and figures on cumulative change in storage have also been included in Section 3.3.1.3. See Common Response 4 for additional information.

The Lead Agencies acknowledge there is a wealth of supplemental groundwater data available that is not included in the groundwater resources section. The Lead Agencies have collected and presented sufficient data from reputable sources to accurately represent current conditions of groundwater resources within the area of analysis. The information presented in the EIS/EIR provides substantial evidence in support of the evaluation of impacts of the proposed alternatives.

Comment NG01-70

Comment
Drawn on top of the stream depletion and groundwater pumping graphs are several visually fit, straight trend lines. These lines, which run from 1940 to the mid-1970s and the late 1980s to mid-1990s, are mirror images reflected around the horizontal 0 accretion axis. Information provided at the bottom of the composite graph was taken from NCWA Tables 3-7 and 3-8 (Exhibits 10.5b and 10.5c). The slope of the trend line from 1940 to the mid- 1970s is approximately (+-)27,000 AFY, and (+-)85,000 AFY in the late 1980s to the mid- 1990s; a 3-fold increase in slope. After the mid-1990s the slope of groundwater pumping flattens to be similar to that of the 1940s–mid-1970s, while the stream depletion line became almost flat, ie., no change in rate of accretion. The reason for the stream depletion rate being flat is unknown, but there are several factors that could contribute to a fixed rate of stream accretion.

First, after depleting 1.5 MAFY from the Sacramento Valley streams, the surface waters may not be able to provide much more, at least no increase to match the pumping. Second, this may also be a consequence of the model design because the number of streams simulated was limited. Third, the model's grid may not extend out far enough to encompass all of the streams that contribute to groundwater recharge. More information on the areas of where streams gain and lose in the Sacramento Valley is needed to determine if there are any sections of stream, gaining or losing, that might still have the ability to interact at a variable rate in the future, ie., during and after the 10-year groundwater substitution transfer project.

Response
See response to Comment NG01-69.

Comment NG01-71

Comment
A third graph is drawn on the composite accretion-pumping graph in Exhibit 10.7 that shows the C2VSim simulated cumulative change in groundwater storage for the Sacramento Valley from 1922 to 2009. This graph was taken from Figure 35 of Brush and others, 2013b (Exhibit 10.4). A straight trend line with a negative slope of approximately -163,417 AFY is drawn on top of the third graph, which is the value for average annual change in storage from 1922

to 2009 given in Table 10 of Brush and others (2013a; Exhibit 6.3a) for the seven subregions of the Sacramento Valley. The selected graph of the cumulative change in groundwater storage is one of three available.

The graph of cumulative change in groundwater storage for the Sacramento Valley in Figure 35 differs from the graph in Figure 83 in Brush and others (2013a; Exhibit 10.3) and in Figure B9 of Faunt (ed., 2009; Exhibit 10.2a). Both of Figure 83 and Figure B9 show a gain in groundwater storage with their Sacramento Valley graphs lying generally above the horizontal line of zero change in storage. The cumulative change in groundwater storage graph from Figure 35 (Exhibit 10.4) was selected because: 1. its slope is a close match for the average annual change in storage from 1922 to 2009 of -163,417 AFY given in Table 10, 2. the values for change in groundwater storage in the three selected decades are all negative (Table 3-8, NCWA, 2014b), which the other two graphs don't clearly indicate, 3. the calculation of average annual change in groundwater storage from 1962 to 2003 shown in Table B3 and Figures B10-A and B10-B of Faunt (ed., 2009) are negative, which conflicts with Figures B9 and 83, and 4. change in DWR groundwater elevation maps from spring 2004 to spring 2014 (Exhibit 3.1, 3.2 and 3.3) suggest that there are significant regions of the Sacramento Valley that have lost groundwater storage, which suggests that the current condition is one of a loss in storage rather than a gain.

Additional review and analysis of the changes in groundwater storage in the Sacramento Valley is needed. Any additional review of changes in groundwater storage in the Sacramento Valley should consider the recent changes in groundwater elevations such as those shown in DWR (2014b) for WYs 2004 to 2014, and Figures 2-4 and 2-5 of NCWA, 2014b (Exhibit 10.8 and 10.9), as well as other studies such as the support documents for the regional IRWMPs.

I recommend the Draft EIS/EIR be revised to provide a more comprehensive assessment of the historic change in groundwater storage in the Sacramento Valley groundwater basin, and other seller sources areas within the proposed 10-year groundwater substitution transfer project. I also recommend that the Draft EIS/EIR be revised to include an assessment of the impacts of groundwater flow among subregions due to the proposed 10-year groundwater substitution transfer project.

Response
See response to Comment NG01-69.

Comment NG01-72

Comment
The Concept of the Stream Depletion Factor, SDF. 21. The Draft EIS/EIR proposes that a stream depletion factor, BoR-SDF, be applied to groundwater substitution transfers as mitigation for flow losses due to groundwater pumping. The Draft EIS/EIR implies that the BoR-SDF will be a fixed percentage of the

transferred groundwater substitution water. The main text of the Draft EIS/EIR doesn't clearly specify the BoR-SDF percentage, but appended documents state that the default is 12%, unless available monitoring data analyzed by Project Agencies supports the need for the development of a transfer proposal site-specific SDF (page 33 in the DTIPWTP). Elsewhere in the Draft EIS/EIR, the average annual surface water–groundwater interaction losses are estimated at approximately 15,800 AF and in multiple dry years losses of 71,200 AFY are anticipated (page 3.1-18). The Draft EIS/EIR proposes mitigation measure WS-1, which utilizes the BoR-SDF with the transfers to account for the losses from stream depletions, and thereby reduces the water supply impacts to less than significant (page 3.1-18). As I discussed above in my comment no. 9, the maximum annual groundwater substitution pumping is 290,495 AF as calculated from Table 2-5. The estimated annual average surface water–groundwater interaction loss of 15,800 AF is 5.4 % of the maximum allowable annual groundwater substitution transfer, while a loss of 71,200 AF is 24.5%.

The use of a fixed percentage of transfer water to mitigate increased stream flow losses from the groundwater substitution pumping may not result in the reduction of stream flow impacts to less than significant. I've discussed above in my comment no. 15 several of the issues about the design of mitigation measure WS-1. The following are additional comments on WS-1 specific to the fixed percentage BoR-SDF and how it differs from the concept of stream depletion commonly used in scientific literature.

Response
The Draft Technical Information for Preparing Water Transfers Proposals was not included in the Draft EIS/EIR as an "appended document." The Technical Information paper describes the information that DWR and Reclamation need as part of a transfer proposal. This document changes annually to reflect lessons learned during transfer implementation, and in the future it will reflect the mitigation requirements included in this EIS/EIR if an action alternative is identified to move forward. The current requirements in the Technical Information paper should not be considered as mitigation requirements in this document unless they are specifically called out as mitigation measures. See Common Response 8 for more information on the streamflow depletion factor.

Comment NG01-73

Comment
Jenkins (1968a and b; Barlow and Leake, 2012) defined the "stream depletion factor" (herein called the Jenkins-SDF) as the product of the square of the distance between a well and a surface water body (a2) multiplied by the storage coefficient (S or Sy) divided by the transmissivity (T) (Jenkins-SDF = distance2 x storage coefficient/transmissivity = a2 x S/T) (see Table 1 and page 14 in Barlow and Leake, 2012). The units of the Jenkins-SDF are in time, ie., days, years, etc. The Jenkins-SDF also occurs in Theis' well function, W(u) (see pages 136 and 150 in Domenico and Schwartz, 1990). Domenico and Schwartz

(1990) showed that the Jenkins-SDF can be expressed as a dimensionless Fourier number, which occurs in all unsteady groundwater flow problems. The Jenkins-SDF has several other important characteristics that are not part of the BoR-SDF, which likely influence the actual rate and volume of surface water lost due to groundwater substitution transfer pumping.

Response
The EIS/EIR is not referring to the cited definitions of a streamflow depletion factor. The streamflow depletion factor is defined in Mitigation Measure WS-1, and it has been clarified based on public comments received on the draft document. See Common Response 8 for more information.

Comment NG01-74

Comment
1. The value of stream depletion varies with the duration of pumping and unlike the BoR-SDF isn't a fixed value. For an ideal aquifer (homogeneous, isotropic and infinite), two ideal curves normalized to the Jenkins-SDF value can be created that show stream depletion as a percentage of the total pumping rate or total pumped volume against the normalized logarithm of pumping time (see Figure 1 from Miller and Durnford, 2005; Exhibit 11.1). In Figure 1, equation no. 1 shows the instantaneous rate of stream depletion as a percentage of the maximum pumping rate versus the logarithm of normalized time, and equation no. 2 shows the volume of depletion as a percentage of the total volume pumped versus the logarithm of normalized time. Jenkins somewhat arbitrarily defined his SDF as the pumping duration equal to the calculated stream depletion factor (a2 x S/T). Jenkins noted that for the ideal aquifer at the time of the SDF, the cumulative volume of water depleted from the stream equals 28% of the total volume pumped (Jenkins, 1968a; Wallace and Durnford, 2005 and 2007). As shown in Figure 1 in Exhibit 11.1, when the actual pumping duration is normalized to the Jenkins-SDF, the ideal volume curve always goes through 28% when the pumping time equals the Jenkins-SDF (time/SDF = 1; Jenkins, 1968a).

Response
See response to Comment NG01-73. The calculations of the percentage for streamflow depletion would be different under Mitigation Measure WS-1 because the definition of the streamflow depletion factor is different.

Comment NG01-75

Comment
2. An important factor in the Jenkins-SDF is that stream depletion varies with the square of the distance between the well and the stream, whereas, the depletion rate varies only linearly with changes in S or T. The ratio of T/S is also called the hydraulic diffusivity, D, which has units of length2/time (see Table 1 and Box A in Barlow and Leake, 2012). The rate that hydraulic stress

propagates through an aquifer is a function of the diffusivity. Greater values of D result in more rapid propagation of hydraulic stresses. Barlow and Leake (2012) note that the ratio T/S (or T/Sy) controls the timing of stream depletion and not each value individually. Streamflow depletion can occurs more rapidly in confined aquifers than in unconfined aquifers because S is much smaller than Sy, resulting in a larger D value.

Response
The formulas cited reflect ways to estimate streamflow depletion, but the analysis in the EIS/EIR uses a detailed groundwater model rather than an overall formula. The SACFEM2013 groundwater model is a calibrated groundwater model for the Sacramento Valley that estimates groundwater movement before, during, and after a groundwater substitution transfer. More information about the model is included in the Groundwater Resources section (Section 3.3) and in Appendix D.

Comment NG01-76

Comment

3. For a given duration of pumping, the percentage of instantaneous depletion is greater than the percentage of volume depleted. For the ideal aquifer at a pumping duration equal to the Jenkins-SDF value, the instantaneous depletion is 48% of the maximum pumping rate, while the cumulative volume of depletion is 28% of the total pumped volume (Figure 1, Exhibit 11.1). For a non-ideal aquifer where numerical simulations are needed to estimate stream depletion, eg., the SACFEM2013 simulations, the time when the cumulative volume of stream depletion is at 28% of the total volume pumped can be used as an “effective” Jenkins-SDF to allow for evaluation and comparison of potential impacts from pumping.

Response
See response to Comment NG01-75.

Comment NG01-77

Comment

4. Stream depletion continues to occur after pumping ceases. Jenkins (1968a, b) referred to this as residual depletion. Depending on the duration of pumping and the value of the Jenkins-SDF, stream depletion can be greater after pumping ceases (see pages 42 to 45 in Barlow and Leake, 2012). Barlow and Leake (2012 on page 43) give the following five key points regarding stream depletion after cessation of pumping: a. Maximum depletion can occur after pumping stops, particularly for aquifers with low diffusivity or for large distances between pumping locations and the stream. b. Over the time interval from when pumping starts until the water table recovers to original pre-pumping levels, the volume of depletion will equal the volume pumped. c. Higher aquifer diffusivity and smaller distances

between the pumping location and the stream increase the maximum rate of depletion that occurs through time, but decrease the time interval until water levels are fully recovered after pumping stops. d. Lower aquifer diffusivity and larger distances between the pumping location and the stream decrease the maximum rate of depletion that occurs through time, but increase the time interval until water levels are fully recovered after pumping stops. e. Low-permeability streambed sediments, such as those illustrated in figure 11, can extend the period of time during which depletion occurs after pumping stops. f. In many cases, the time from cessation of pumping until full recovery can be longer than the time that the well was pumped.

Response

As discussed in response to Comment NG01-75, the EIS/EIR uses the SACFEM2013 groundwater model to estimate groundwater-stream water interaction. The SACFEM2013 modeling effort also identified that recharge from streams would continue after the transfer occurs, and this concept is discussed in more detail in Section 3.3.2.4.2. See Common Response 8 for more information about how the streamflow depletion factor addresses the timing of groundwater recharge.

Comment NG01-78

Comment

5. As noted above in key point no. 4b, the volume of stream depletion will eventually equal the total pumped volume. The time required for full aquifer recovery from pumping depends on the value of the Jenkins-SDF, availability of water to capture, the rate and duration of recharge above what normally occurs, and other factors like the streambed sediment permeability and aquifer layering. Figure 1 in Exhibit 11.1 also shows that for an ideal aquifer the time needed to reach 95% depletion is approximately 127 times the Jenkins-SDF value. This is consistent with the estimates made by Wallace and others (1990) in Table 3 (Exhibit 11.2) on the time it takes to reach 95% depletion, which they consider a point where a new dynamic equilibrium is established. Although the 127-times-SDF multiplier assumes continuous pumping, the fact is the time for full recovery by residual depletion without pumping shouldn't be any sooner than it takes to obtain 95% stream depletion with pumping. In other words, rate and volume of loss from a stream can't be any higher without pumping than with pumping, all other parameters being equal. This means that without some additional source of recharge above what normally occurs, including natural wet and dry cycles, the total time required to achieve full recovery from the 10 years of groundwater substitution transfer pumping will be much longer than the 5 years cited in the Draft EIS/EIR (pages 3.3-80). For additional discussion of the stream depletion under natural variations in recharge and discharge see Maddock and Vionnet (1998).

Response

The analysis in Section 3.3 regarding the time required for groundwater recharges uses results from the SACFEM2013 groundwater model. This model is a calibrated model for the Sacramento Valley, and reflects local conditions rather than the conditions in an "ideal aquifer." The estimates of recharge timing were based on results from the best available tool.

Comment NG01-79

Comment

Another factor that isn't clearly acknowledged in the Draft EIS/EIR is the difference between the instantaneous depletion rate and cumulative volumetric depletion rate. The Draft EIS/EIR appears to focus on cumulative volumetric depletion in mitigation measure WS-1. However, the instantaneous stream depletion rate is probably more important when evaluating impacts to fisheries and stream habitat. The instantaneous rate of flow, instantaneous depth of flow and the corresponding instantaneous wetted perimeter of flow at any point in a stream are the best measures of habitat value to the fish and other water dependent species. The cumulative volume of stream depletion relative to the total pumped volume, on the other hand, can't be easily translated stream to instantaneous flow, water depth or wetted perimeter at a point in a stream because discharges having different hydrographs can result in the same total volume of flow. For example, if I estimate that the stream depletion during a 3- to 6-month period of groundwater substitution pumping will be a maximum of 1 cubic-foot-per-second, I can evaluate the significance of this change to the stream's habitat value using the stream's historic hydrograph and fluvial geomorphology. However, if I estimate that over the same period of pumping the stream will lose, at the end of pumping, a total 12 percent of the total volume pumped, I can't determine what changes will occur in the habitat function of the stream at a specific time and place. Perhaps, if I assume that the cumulative volume of stream depletion increases linearly with time, going from zero at time zero, to 12% at the end of pumping, then I could also assume that the instantaneous rate of stream depletion would also change linearly from 0% at the start to 24% of the pumping rate at the end of pumping. Remember that in this case the area under the instantaneous depletion curve is triangular, and therefore the maximum instantaneous depletion rate would be twice the total cumulative depletion rate. In reality, the ratio of instantaneous to volumetric depletion for the ideal Jenkins-SDF curves vary with pumping duration; the ratio is approximately 1.7:1 for time/SDF = 1 (Figure 1, Exhibit 11.1). Figure 1 also shows for the ideal curve that when the instantaneous depletion (eq. 1) is 24%, the volumetric depletion is 10% (eq. 2), a ratio of 2.4:1, and when eq. 1 is at 83%, eq. 2 is at 70%, a ratio of 1.19:1.

Response

The EIS/EIR analyzed streamflow depletion impacts using model results that indicate changes in flow per month, not changes in volume. The water supply section presents annual changes in volume supplied to CVP and SWP contractors; however, this information is based on the changes in monthly flows from the models. Appendix B provides more details.

Effects to fisheries and vegetation and wildlife are analyzed in Sections 3.7 and 3.8, respectively. These sections present changes in flow rates for potentially affected streams. These effects analyses are not based on volumetric changes.

Comment NG01-80

Comment
Mitigation measure WS-1 appears to be based on the cumulative volume of water pumped for each period of groundwater substitution transfers, not the instantaneous rate of stream depletion caused by the pumping. Mitigation measure WS-1 uses of a fixed value for compensating stream losses, which is inconsistent with the hydraulics of stream depletion. Because stream depletion actually increases with pumping time, mitigation measure WS-1 needs to specify the maximum duration of pumping allowed, ensuring that the depletion rate stays below the WS-1 value, ie., 12%. This maximum duration of pumping should be established based on impacts to stream habitat from instantaneous changes in stream flow, not the cumulative change in volume. The maximum duration of allowable pumping would change with the distance between the well and stream and with the diffusivity around each well because these control the rate of stream depletion. The well acceptance criteria in Table B-1 of Appendix B in the DTIPWTP suggests that some calculation has been made to establish the specified setback distances, but no methodology or calculation is given in the Draft EIS/EIR. The Draft EIS/EIR should document how the maximum allowable stream depletion rate, instantaneous and volumetric, and the associated maximum duration of pumping will be calculated for each well in the groundwater substitution transfer project.

Response
As discussed in response to Comment NG01-79, the modeling effort resulted in monthly changes in flow rates for surface water bodies. This information was the basis for the assessment of water supply impacts. As described in Section 3.1.2.4.1, streamflow depletion changes would not affect water supplies during wetter periods. During dry periods, the CVP and SWP would alter operations to continue to meet water quality and flow standards, which could affect water in storage or Delta exports. The model simulates these changes and determines whether the changes would affect water supplies.

Mitigation Measure WS-1 addresses these potential effects to water supplies, which were calculated based on changes in flows from the modeling effort. Mitigation Measure WS-1 does not identify a streamflow depletion factor of 12 percent. See Common Response 8 for more information about Mitigation Measure WS-1.

Comment NG01-81

Comment

Although the Draft EIS/EIR doesn't fully evaluate the potential stream depletion that may occur with the proposed 10-year groundwater substitution transfer project, another report prepared by CH2MHill (2010) and submitted to DWR provides additional analysis on the simulated impacts from the 2009 groundwater substitution transfers. The simulations of the 2009 transfer impacts were done using the SACFEM model, presumably an earlier version of the SACFEM2013 model. Figures 4, 5 and 6 in the CH2MHill 2010 report provide simulation graphs of stream depletion for three groundwater substitution transfer periods, 1976, 1987 and 1994 (Exhibits 11.3a to 11.3c). Graphs (a) to (c) in each figure appear somewhat like Figures B-5 and B-6 in Appendix B of the Draft EIS/EIR in that they show a depletion peak shortly after pumping starts, with a gradual decay following the cessation of pumping. Graphs (d) of Figures 4, 5 and 6 are not provided in the Draft EIS/EIR, but provide important additional information. These (d) graphs show the cumulative depletion for each of the three scenarios and are essentially the volumetric depletion curve of eq. 2 in Miller and Durnford's Figure 1 (Exhibit 11.1). These cumulative volume depletion curves are important because they show the time needed to fully recover from the three groundwater substitution transfer pumping events. For example, Figure 4(d) shows that recovery from the pumping event in 1976 is only approximately 60% after 25 years; much longer than the 5 years for 55% to 75% recovery stated in the Draft EIS/EIR (pages 3.3-70). For comparison, Figure 4(d) of CH2Mhill (2010) is plotted on Miller and Durnford's Figure 1 in Exhibit 11.1 by normalizing the values plotted in 4(d) by an effective Jenkins-SDF value of 2.4 years. Notice that for the simulated Figure 4(d) Jenkins-SDF curve, depletion initially occurs sooner than with an ideal aquifer, but then depletion slows. At 127 times the SDF, approximately 300 years, the depletion is at approximately 80%.

A point can be identified on each graph (d) where the volume of stream depletion is equal to 28%, the Jenkins-SDF point, and the time since pumping started measured. For example, in Figure 4(d) approximately at approximately 2.4 years after the beginning of pumping the volume of depletion reaches 28%. For Figure 5(d) the time to 28% is similar, estimated at 2.3 years. The time interval to 28% volumetric depletion in Figure 6(d) is significantly greater at an estimated 7.5 years. The results presented in both Figures 4 and 5 are from simulation of stream depletion during dry or critically dry years followed by normal or dry years, while the simulation scenario of Figure 6 is for a critical year followed by wet years. All of the cumulative (d) graphs are filtered for the Delta conditions. This may be the reason it takes longer for stream depletion to reach 28% during a wet period than dry period when one might expect the opposite because of the increased stream flow would provides more water for recharge.

Response
The referenced report was completed using a previous version of SACFEM, and the information contained in the report is outdated. The Draft EIS/EIR analysis uses the updated model, now named SACFEM2013. The Draft EIS/EIR includes similar analyses of modeling results, but with the updated model version. Section 3.1 provides an analysis of how streamflow depletion could affect water supply, and additional detail is included in Appendix B. Section 3.3 assess groundwater level recovery, and additional model results are included in Appendix E.

Comment NG01-82

Comment
The point of this discussion is that the simulated stream depletions from the SACFEM2013 modeling can also be presented as cumulative depletion response curves that are normalized by the effective Jenkin-SDF time. The stream depletion can then be estimated for any rate or duration of pumping at an individual well when the stream depletion response curves given as percentages of both the maximum pumping rate and total volume pumped are normalized to the effective Jenkins-SDF (without the Delta conditions filter). Losses for different distances between the well and surface water feature can be roughly estimated without the need to run another simulation by adjusting the Jenkins-SDF curves by the ratio of the square of the different distances. Cumulative depletion for different pumping rates during and following the 10-year groundwater substitution transfer project can be estimated by the principle of superposition (Wallace and other, 1990; Barlow and Leake, 2012). As I discussed in my comment no. 15b, additional discussion is needed in the Draft EIS/EIR on how the amount of stream depletion for WS-1 is calculated. This discussion should include normalized stream depletion response curves for each groundwater substitution transfer well so that impacts from pumping can be estimated for different pumping durations and rates.

Response
While it may be possible to perform the analysis suggested by the commenter, it is unclear how the analysis would be used to analyze the environmental effects of the range of potential transfer activities under the Proposed Action. The simplified, analytical approach of the Jenkins-SDF suggested by the commenter was not used as it does not represent the best available science.

Comment NG01-83

Comment
Barlow and Leake (2012) provide an extensive discussion of the factors controlling stream depletion including several misconceptions (pages 39 to 45). Review of their discussion of stream depletion misconceptions is recommended as part of any revision of the Draft EIS/EIR. Barlow and Leake identified the following misconceptions regarding stream depletion (page 39): 1)

Misconception 1. Total development of groundwater resources from an aquifer system is “safe” or “sustainable” at rates up to the average rate of recharge. 2) Misconception 2. Depletion is dependent on the rate and direction of water movement in the aquifer. 3) Misconception 3. Depletion stops when pumping ceases. 4) Misconception 4. Pumping groundwater exclusively below a confining layer will eliminate the possibility of depletion of surface water connected to the overlying groundwater system.

I recommend that the Draft EIS/EIR be revised to document stream depletion response curves for each groundwater substitution transfer well. These response curves should be normalized to the effective Jenkins-SDF value, given as a percentage of the pumping rate and total pumped volume, along with the distance between the well and the modeled surface water feature. Multiple stream depletion response curves should be provided, if necessary. I recommend that the Draft EIS/EIR be revised to review how the BoR-SDF value accounts for the variability in rate and volume of stream depletion. I recommend that the Draft EIS/EIR be revised to document how the maximum allowable instantaneous and volumetric stream depletion rates, and the associated maximum duration of pumping will be calculated for each well in the groundwater substitution transfer project to ensure that the BoR-SDR provides adequate flow mitigation. I recommend that the Draft EIS/EIR be revised to discuss how WS-1 addresses the common stream depletion misconceptions noted by Barlow and Leake (2012).

Response
The project team is familiar with USGS Circular 1376, Streamflow Depletion by Wells – Understanding and Managing the Effects of Groundwater Pumping on Streamflow by Barlow and Leake. SACFEM2013 results are consistent with the physical effects of groundwater pumping on streamflow as described in Barlow and Leake. The simplified, analytical approach of the Jenkins-SDF suggested by the commenter was not used as it does not represent the best available science.

Comment NG01-84

Comment
Measurement of Stream Seepage in Real Time. 22. Barlow and Leake (2012) state that methods for determining the effects of pumping on stream flow follow two general approaches: (1) collection and analysis of field data, and (2) analytical and numerical modeling (page 50). The Draft EIS/EIR states in the DTIPWTP that stream depletion can’t be measured in real time (page 33) and instead relies on simulations of groundwater pumping to determine impacts to surface waters. As discussed in my comment no. 15b, the Draft EIS/EIR also states that monitoring of surface water-groundwater interaction is part of mitigation measures WS-1 and GW-1. The statement that stream depletion measurements, ie., stream seepage rates, surface water depths, and surface flows, can’t be done in “real time” conflicts with scientific literature.

Measurements of stream flow and water depth are fundamental to stream surveys. Although measurement of the seepage rate from or into a stream is done less often and is generally more difficult than other direct surface water measurements, procedures for making these measurements are well documented (Barlow and Leake, 2012; Rosenberry and LaBaugh, 2008; Zamora, 2008; Stonestrom and Constantz, ed., 2003; Constantz, 2008; Kalbus and others, 2006). Linking field measurements to changes in stream flow and seepage to adjacent groundwater pumping is made more difficult because of the lag between the start of pumping and stream response, damping of the pumping response with increases in distance between the well and measured surface water body, and the variation in seepage rate with the increases in pumping time or pumping cycles. Measurements of surface water and groundwater flow are also difficult because of inherent measurement errors that are sometimes greater than the change in flow being sought. Barlow and Leake (2012) discuss the measurement of stream depletion and conclude that: Two general approaches are used to monitor streamflow depletion: (1) short-term field tests lasting several hours to several months to determine local-scale effects of pumping from a specific well or well field on streams that are in relative close proximity to the location of withdrawal and (2) statistical analyses of hydrologic and climatic data collected over a period of many years to test correlations between long-term changes in streamflow conditions with basinwide development of groundwater resources. Direct measurement of streamflow depletion is made difficult by the limitations of streamflow-measurement techniques to accurately detect a pumping-induced change in streamflow, the ability to differentiate a pumping-induced change in streamflow from other stresses that cause streamflow fluctuations, and by the diffusive effects of a groundwater system that delay the arrival and reduce the peak effect of a particular pumping stress. (Page 77).

The Draft EIS/EIR provides the following statements in the DTIPWTP regarding groundwater substitution transfers, which are therefore part of mitigation measure GW-1: 1)… must account for … the extent to which transfer-related groundwater pumping decreases streamflow (resulting from surface water-groundwater interaction), and the timing of those decreases in available surface water supply. (page 25); 2) Project Agencies are developing tools to more accurately evaluate the impacts of groundwater substitution transfers on streamflow. These tools may be implemented in the near future and may include a site-specific analysis that could be applied to each transfer proposal. (page 33); 3) Water transfer proponents transferring water via groundwater substitution transfers must establish a monitoring program capable of identifying any adverse transfer related effects before they become significant. (page 34);

The objectives of the DTIPWTP groundwater substitution transfer-monitoring program include: 4) Determine the extent of surface water-groundwater interaction in the areas where groundwater is pumped for the transfer; 5) Determine the direct effects of transfer pumping on the groundwater basin, observable until March of the year following the transfer; 6)Assess the magnitude and potential significance of any effects on other legal users of water, instream beneficial uses, the environment, and the economy. (page 34).

All of these statements and monitoring objectives imply that measurement of impacts to surface water from groundwater substitution transfer pumping is possible. While measurement of stream depletion is complex and problematic, it is possible. The conflicting statements in the Draft EIS/EIR that "real time" measurements can't be done while apparently including a requirement for field monitoring of the effects of stream depletion in mitigation measures WS-1 and GW-1 need further explanation.

I recommend that the Draft EIS/EIR be revised to evaluate and discuss the methods, techniques and procedures available for monitoring and measuring the rate, volume and impacts of stream depletion due to groundwater substitution transfer pumping. The revised Draft EIS/EIR should provide specific mitigation measures, procedures and methods for monitoring groundwater substitution transfer pumping impacts on surface water features, including the frequency of monitoring and reporting.

Response

See response to Comment NG01-49 for information on why real-time streamflow monitoring cannot estimate streamflow depletion because without-transfer conditions are not known. Also note that the Draft Technical Information for Preparing Water Transfer Proposals is not part of the Long-Term Water Transfer EIS/EIR, as described in response to Comment NG01-72.

See Common Response 7 for more information on the streamflow depletion factor.

Comment NG01-85

Comment

Other Available Data to Consider in the Establishing Baseline Conditions 23. The Draft EIS/EIR for the 10-year long-term water transfer project should provide a review of the existing technical documents that describe historic environmental, surface water and groundwater conditions in the Sacramento Valley. The information in these technical documents is critical for establish an accurate and complete environmental baseline and for evaluating the potential impacts from future water transfers. Exhibit 12.1 provides an annotated bibliography provided by researchers with AquAlliance (Nora and Jim) of some of the available technical reports on groundwater resources in the Sacramento Valley. In addition to creating a complete bibliography of relevant technical reports, the Draft EIS/EIR should provide an index map showing the areas or locations covered by each report should be developed. For an example of an index map, see the 1:250000 scale regional geologic map sheets produced by the California Geological Survey.

Response
See Common Response 4.

Comment NG01-86

Comment
Other information is likely available from local government agencies that would document the current condition of the groundwater basin both quantity and quality. For example, Exhibit 12.2 has a list provide by B. Smith, a researcher with AquAlliance, of recently well permits issued since January 1, 2009 for wells that have gone dry in Shasta County. A GIS should be used to plot the locations of the wells that have gone dry. The locations of these dry wells should then be compared to the current groundwater levels, past groundwater substitution transfer pumping areas, and the proposed 10-year long-term project pumping areas. This type of spatial analysis would help to establish an accurate baseline on groundwater elevations and impacts on existing wells, and provide the foundation for assessing the potential impacts from the 10-year long-term groundwater substitution transfer pumping. Other relevant information on baseline conditions in the 10-year Transfer Project area can be found in the Integrated Regional Water Management Plans for the Northern Sacramento Valley Basin, the American River Basin, Yuba County, and Yolo County, see my comment no. 6.

I recommend the Draft EIS/EIR be revised to provide an annotated bibliography and index map(s) of all documents that are relevant to proposed 10-year long-term water transfer project and describe or provide data on the historic and environmental, surface water and groundwater baseline conditions in the Sacramento Valley. I also recommend the Draft EIS/EIR be revised to provide information from local and regional agencies on the conditions of wells within their jurisdictions covering at least the last 10 years. This local information should include, if available, replacement well permits issued for dry wells, complaints or treatment systems installed because of poor water quality, and damage to infrastructure from subsidence or settlement. I recommend this information be mapped and compared to areas of past groundwater substitution transfer pumping, areas of known groundwater level depression, and the pumping area for the proposed 10-year project.

Response
Information has been added to Section 3.3.1.3. Information from DWR on wells going dry has been documented in this section. See Common Response 4 and response to Comment NG01-69.

Comment Letter NG02, ECONorthwest, AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group

Comment NG02-1

Comment
The US Bureau of Reclamations and San Luis & Delta-Mendota Water Authority released the Public Draft of the Long-Term Water Transfers Draft Environmental Impact Statement/Environmental Impact Report (LTWT) in September 2014. The purpose of the LTWT, as we understand, is to evaluate the potential impacts of three proposed water-transfer alternatives, as well as a no action alternative. AquAlliance asked ECONorthwest to critique and provide written comments on the LTWT.

In general, the analysis described in the LTWT suffers from significant omissions and errors. These omissions and errors matter. As written the report provides stakeholders and decisions makers with a biased and incomplete description of the environmental and economic consequences of water transfers. In the following sections of this report we describe our critiques in detail. Our major critiques include the following.

Response
Responses have been provided to all detailed comments in the submitted comment letter. This comment is assumed to be an introductory comment that does not require a substantive response.

Comment NG02-2

Comment
The LTWT ignores relevant background information about the affected environment that would have helped inform the analysis. The LTWT provides a cursory description of the relevant affected environment that paints an incomplete picture of the context within which water transfers would happen. A more complete, accurate and up-to-date description would have included, for example: information from the many recent reports on California's climate and groundwater conditions; current data on water transfers; and, a market analysis of water prices, prices for agricultural commodities and how price changes influence the number and volumes of water transfers. As such, the deficient description is the shaky foundation upon which a lacking analysis rests. The resulting effort yields questionable results regarding the likely future frequency and amounts of water transfers and their environmental and economic consequences.

Response
As described in CEQA Section 15125(a), "The description of the environmental setting shall be no longer than is necessary to an understanding of the significant effects of the proposed project and its alternatives." This EIS/EIR

included substantial information about the affected environment/environmental setting for each resource area in Section 3. Commenters suggested additional information that may help readers understand the potential impacts of the action alternatives, and this information has been included where relevant. More details are included in responses to comments that suggested specific information to include. Some of the examples cited (such as recent reports on groundwater conditions) may not have been available during preparation of this document and have been added to the Final EIS/EIR. Current data on water transfers is included in Section 1.4.2.

Comment NG02-3

Comment
The LTWT relies on outdated and incomplete data. The analysis described in the LTWT relies on obsolete data for certain key variables and ignored other relevant data and information. For example, the analysis assumes a price for water that bears no resemblance to the current reality. It also ignored relevant research results on the impacts of groundwater pumping on stream flow depletion and the current status of groundwater levels as provided by monitoring wells. The water transfers at issue in the LTWT would not happen in an economic vacuum. Growers and water sellers and buyers react to changing prices and market conditions. The analysis described in the LTWT, however, is silent on these forces and how they would influence water transfers.

Response
The baseline information included in the EIS/EIR represents the most recent available information at the time the draft was developed. The price of water reflects a price of past water transfers from a series of years before 2014. The analysis has been updated with a higher price to incorporate the most recent price paid for water transfers. Section 3.3 has been updated with more extensive existing conditions information on groundwater levels. See Common Responses 4 and 5. Buyers and sellers do respond to varying market conditions and negotiate prices and quantities each year. The quantities in the EIS/EIR reflect the maximum potential quantities that can be transferred, though the actual quantities are likely to be lower based on demand, seller interest, and available capacity to pump through the Delta.

Comment NG02-4

Comment
The LTWT underestimates negative impacts on the regional economy in the sellers area. The LTWT acknowledges that negative economic impacts would be worse if water transfers happen over consecutive years. The analysis, however, estimates impacts for single-year transfers, ignoring the data on the frequency of recent consecutive-year transfers. The analysis also fails to address the extent to which water transfers cause economic harm to water-based recreational activities.

Response
NEPA does not require a judgment of significance or mitigation measures for economic effects. CEQA does not consider economic or social change resulting from a project as adverse effects on the environment. Still, as stated in Section 3.10, cropland idling transfers under the Proposed Action are the lowest priority transfers for buyers and would not occur every year in which transfers are implemented. The evaluation in Section 3.10 on regional economies quantifies the effects of a maximum idling action in a single year. During review of the results in response to this comment, the analysis was revised. The updated results reflect greater economic impacts, but continue to be a small percentage of the regional economy and, thus, the relative effect is similar to the previous results. Section 3.10 states, "It is not likely that all the acreage would be idled in a single year. Since the maximum crop acreage would not be idled in most years, the average annual effect would be even less." Text has been added to assessment methods and the regional economic evaluations to further explain how the economic modeling results relate to consecutive year transfers. Section 3.15 evaluated impacts to recreation and did not find any significant impacts; therefore, there would be no indirect effect to economies from changes in recreation and these effects were not evaluated in Section 3.10.

Comment NG02-5

Comment
The LTWT finds significant negative effects but the vague and incomplete proposed monitoring and mitigation plans would not address these effects. The LTWT proposed both a monitoring and mitigation program for significant negative impacts. Implementing these programs would take planning, effort and financial resources on the part of sellers, injured third parties, and regulatory agencies. The LTWT does not include these costs. The monitoring program is vague and depends on potential sellers implementing the program. This conflict of interest pits financial gain from water sales against complete and impartial monitoring efforts. This opens the door to lax, biased, or incomplete monitoring, which could lead to negative environmental and economic consequences for third parties. The monitoring program includes monitoring subsidence, however, the program is vague on requirements and what amount of subsidence would trigger a halt in water transfers. Injured third parties would bear the costs of bringing to the sellers' attention harm caused by groundwater pumping. The analysis described in the LTWT assumes that disagreements regarding third-party damages would be settled cooperatively between third parties and sellers, without presenting evidence substantiating such an optimistic assumption. The LTWT is silent on the economic consequences of sellers and injured third parties not cooperatively agreeing on harm and compensation.

Response
See Common Responses 6, 7, and 8.

Comment NG02-6

Comment
The LTWT ignores the environmental externalities and economic subsidies that water transfers support. The LTWT lists Westlands Water District as one of the CVP contractors expressing interest in purchasing transfer water. The environmental externalities caused by agricultural production on Westlands are well documented, as are the economic subsidies that support this production. To the extent that the water transfers at issue in the LTWT facilitate agricultural production on Westlands, they also contribute to the environmental externalities and economic subsidies of that production. The LTWT is silent on these environmental and economic consequences of the water transfers.

Response
See response to Comment NG02-51.

Comment NG02-7

Comment
The LTWT underestimates the cumulative effects of water transfers. Cumulative effects analyses under NEPA and CEQA are intended to identify impacts that materialize or are compounded when the proposed action is implemented at the same time as or in conjunction with other actions. The LTWT addresses cumulative effects for each resource area and provides a global description of the methods and actions considered for analysis in each resource area. The analysis, however, provides cursory discussion of potential cumulative effects for the regional economy, and ignores the full range of possible cumulative outcomes associated with the proposed transfer

Response
Cumulative effects to regional economies are described in Section 3.10.4. The analysis uses both a project and projection approach to evaluate cumulative effects. These approaches are described in Chapter 4. Use of both approaches incorporates consideration of a broad range of potential cumulative projects that could impact regional economies, as described in Section 3.10.4.

Comment NG02-8

Comment
The US Bureau of Reclamations (BOR) and San Luis & Delta‑Mendota Water Authority (SLDMWA) released the public draft of the Long‑Term Water Transfers Draft Environmental Impact Statement/Environmental Impact Report (LTWT) in September 2014. The LTWT covers water transfers that would happen between 2015 through 2024. Because the transfers would use federal and state infrastructure, the LTWT must comply with NEPA and CEQA guidelines. BOR is the lead agency regarding NEPA requirements, and

SLDMWA is the lead agency for CEQA requirements. [Footnote: LTWT, page 1-1, 2-1.]

The premise underlying the proposed water transfers is that sellers, mostly in the Sacramento Valley, would idle cropland, switch to less water---‐intensive crops, and/or substitute groundwater for surface water, and send the surface water they would otherwise have used through the Bay Delta to buyers in the south.

The proposed transfers would happen within a context of environmental conditions that both highlight the increasing demand for water throughout California and raise concerns regarding the environmental and economic effects of the water transfers at issue in the LTWT. These conditions include: 1.Current drought conditions of historic proportion coming on the heals of consecutive dry years. 2.Increasing concerns over the demands on groundwater and groundwater conditions throughout the state, including in the Sacramento Valley. 3.Increasing competition for water from all user groups including agricultural, municipal and industrial users, and environmental requirements that help protect habitats and water quality.

Within this context, regulatory agencies face increasing demands from stakeholders for transparent decisions that rely on the best available science and information when balancing competing demands. For example, the relevant NEPA requirements for the LTWT analysis include: “Rigorous exploration and objective evaluation of all reasonable alternatives, …” [Footnote: LTWT page 2-1]

AquAlliance asked ECONorthwest to review the LTWT and provide comments on the extent to which the analysis described in the report fulfills the NEPA requirement. We describe the results of our initial review and critique of the document in this report. The relatively short public comment period limited the extent of our review. Should the comment period be extended or reopened, we may expand and revise our comments.

The remainder of our report is as follows. In the next section, Section 2, we comment on the LTWT’s incomplete description of the affected environment within which the water transfers would happen. We cite sources with relevant information that if included would yield a more complete and comprehensive description of the affected environment. In Section 3 we highlight deficiencies in the data and analysis described in the LTWT. For example, we note that the model relies on outdated prices for water and agricultural commodities—two central components of the analysis. The analysis also estimates that water transfers would happen in a static environment where water prices and commodity prices remain fixed. These conditions do not reflect the dynamic reality of water demands and use. In Section 4 we note instances in which the analysis described in the LTWT underestimates the impacts of water transfers on the regional economy in the source‐water areas. In Section 5 we draw attention to some of the deficiencies of the proposed monitoring and mitigation programs that the LTWT's authors claim will adequately address any negative effects of the transfers. These deficiencies include the inherent conflicts of interests in the programs, excluding the costs of the programs, and vague and ill‑defined critical components of the programs. In Section 6 we describe some of the environmental and economic externalities associated with the use of the transferred water. In Section 7, we list some of the deficiencies in the analysis of cumulative effects. For example, the analysis ignores the impacts of transfers that would happen in addition to those at issue in the LTWT.

Response
The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements. Responses have been provided to all detailed comments in the submitted comment letter. This comment is assumed to be an introductory comment that does not require a substantive response.

Comment NG02-9

Comment
2 The LTWT ignores relevant background information about the affected environment that would have helped inform the analysis The LTWT provides a cursory description of the relevant affected environment that paints an incomplete picture of the context within which water transfers would happen. A more complete, accurate and up-to-date description would have included, for example: information from the many recent reports on California's climate and groundwater conditions; current data on water transfers; and, a market analysis of water prices, prices for agricultural commodities and how price changes influence the number and volumes of water transfers. As such, the deficient description is the shaky foundation upon which a lacking analysis rests. The resulting effort yields questionable results regarding the likely future frequency and amounts of water transfers and their environmental and economic consequences. Specific concerns regarding the LTWT's incomplete description of the affected environment in the Sacramento Valley include the following.

Response
See response to Comment NG02-3.

Comment NG02-10

Comment
Incomplete description of current climate conditions. According to the California Department of Water Resources (DWR), 2013 was the driest year on record for many parts of the state. [Footnote: California Department of Water Resources (DWR). 2014a. Public Update for Drought Response Groundwater Basins with Potential Water Shortages and Gaps in Groundwater Monitoring. April 30. Page ii.] Such drought conditions are one reason given for why

growers and municipal and industrial (M&I) users in the south would purchase water from other parts of California. The analysis described in the LTWT fails to acknowledge, however, that other parts of the state, including the Sacramento Valley, also feel the effects of drought. How agricultural and M&I water users in the north respond to recent drought conditions would affect water transfers. The authors of the LTWT exclude these factors from their analysis.

For example, in a recent letter to the BOR, the Glenn-Colusa Irrigation District (GCID) indicated they were developing a groundwater supplemental supply program and that developing this program takes priority over participating in water transfers as described in the LTWT. “GCID’s position is that it will pursue, as a priority, the proposed Groundwater Supplemental Supply Program over any proposed transfer program within the region, including Reclamation’s Long-Term Water Transfer Program (LTWTP).” “… It is important to underscore that GCID would prioritize pumping during dry and critically dry water years for use in the Groundwater Supplemental Supply Program, and thus wells used under that program would not otherwise be available for USBR’s LTWTP.” [Footnote: Bettner, T. 2014. Letter to Brad Hubbard, Bureau of Reclamation re Draft EIS/EIR on Proposed Long‑Term Water Transfer Program. Glenn‑Colusa Irrigation District. October 14. Pages 1 and 3.]

GCID’s focus on its own groundwater program over BOR water transfers is notable because the LTWT lists GCID as a potential seller with the largest volume of water for sale, 91,000 af. [Footnote: LTWT, Table 2-4, page 2-14] GCID’s reasons for pursuing its groundwater supply program include concerns over water availability during dry years. “The primary objective is to develop a reliable supplemental water source for GCID during dry and critically dry years. The proposed goals are as follows: 1. Increase system reliability and flexibility 2. Offset reductions in Sacramento River diversions by GCIS during drought years to replace supplies for crops and habitat 3. Periodically reduce Sacramento River diversions to accommodate fishery and restoration flows 4. Protect agricultural production” [Footnote: Bettner, 2014, page 2]

Response

The range of potential transfer activities evaluated in this EIS/EIR consists of voluntary transactions between willing buyers and sellers that may or may not occur over the 10-year period analyzed in the document, based on a host of factors that vary from year to year. See responses to comments in letters LA05 and LA06 for more information on potential transfers from Glenn-Colusa ID. See Common Response 4 for more information about existing conditions for groundwater resources.

Comment NG02-11

Comment

A related point is that the LTWT fails to discuss the possibility that current climate and water conditions may represent a new benchmark rather than a deviation from past trends. The increasing number of years with water transfers (described below), and reports on climate change and its impacts on water conditions, are two arguments in support of exploring this point. For example, according to a report commissioned by the Northern California Water Association (NCWA), “This year [2014] we face unprecedented drought conditions, following a decade of relatively dry years and increased demands on our groundwater resources. These increased demands have two principal causes. The reduced availability of surface water during dry years brings a predictable shift towards greater use of groundwater. The second is expanding and intensifying agricultural land use within the Sacramento Valley, together with increasing urban water demands, leading to increased reliance on groundwater even in ‘normal’ years.” [Footnote: Davids Engineering, Macaulay Water Resources, and West Yost Associates (DMW). 2014. Sacramento Valley Groundwater Assessment Active Management – Call to Action. Prepared for Northern California Water Association. June. Page 2.]

Response
See Common Response 5.

Comment NG02-12

Comment
Fails to consider concerns regarding the oversubscription of water resources. The analysis described in the LTWT fails to acknowledge the problem of supporting water transfers using “paper water,” or oversubscribed water in the Sacramento Valley. A report on water transfer issues in California describes one aspect of this problem. “The inability of interested parties to agree on the volume of transferable water associated with the short-term fallowing of agricultural lands has caused substantial controversy and delays in approving certain water transfer proposals. The primary issue for interested parties is whether a fallowing-based transfer proposal would actually increase the burden on the CVP and SWP to maintain water quality and flow conditions in downstream portions of the Sacramento River and Delta because upstream transfer proponents were allowed to transfer what might prove to be ‘paper’ water.” [Footnote: The Water Transfer Workgroup. 2002. Water transfer issues in California. Final Report to the California State Water Resources Control Board. June, page 20.]

Stakeholders in the Sacramento Valley concerned about this problem researched the extent of paper water and found that rights to water significantly exceed available supply. Testimony by the California Water Impact Network submitted to the State Water Resources Control Board concluded that, “The ratio of total consumptive use claims to average unimpaired flow in the Sacramento River Basin is about 5.6 acre-feet of claims per acre-foot of unimpaired flow.” [Footnote: Stroshane, T. 2012. Testimony on water availability analysis for Trinity, Sacramento, and San Joaquin River basins tributary to the Bay‑Delta Estuary. October 26. California Water Impact

Network. For Workshop #3 Analytical Tools for Evaluating the water Supply, Hydrodynamic, and Hydropower Effects of the Bay‑Delta Plan November 13 and 14, 2012. Page 11.] Thus, claims on water in the Sacramento Valley significantly exceed the available supply.

Response
As described in Section 2.3.2.1, "To make water available, the seller must take an action to reduce consumptive use or use water in storage. Water transfers must be consistent with State and Federal law, as discussed in Chapter 1. Transfers involving water conveyed through the Delta are governed by existing water rights, applicable Delta pumping limitations, reservoir storage capacity and regulatory requirements." By definition, water transfers using "paper water" accounting would not occur. See Common Response 14.

Comment NG02-13

Comment
Incomplete description of current groundwater conditions. The LTWT excluded current information on groundwater conditions in the Sacramento Valley. This information includes concerns regarding historically low groundwater levels in certain areas of the Sacramento Valley, related concerns over subsidence caused by depleted groundwater, and a lack of groundwater monitoring information.

According to the DWR, groundwater levels are decreasing through out California, including in the Sacramento Valley. Groundwater levels decreased since the spring of 2013, and “notably” since the spring of 2010. [Footnote: DWR, 2014a, page ii.] A related point, according to the DWR, is that there are “significant” gaps in groundwater monitoring data for areas throughout the state, including the Sacramento Valley. [Footnote: DWR, 2014a, page ii.] There’s also a lack of understanding regarding groundwater recharge and interactions between surface and groundwater in the Sacramento Valley. According to the NCWA report, “[G]roundwater changes can take many years to become apparent, and we have not yet been able to measure with certainty the long‑term impacts of the current level of groundwater use as it affects our measures of sustainability.” “Persistently declining groundwater levels in many areas of the Sacramento Valley over the past decade reveal that groundwater discharge exceeds recharge. Simply put: if the objective is to stem or reverse the trend, the groundwater balance must be adjusted either by putting more water into the ground or taking less out.”[Footnote: DMW, 2014, page 10]

Response
See Common Response 4 and response to Comment NG01-69.

Comment NG02-14

Comment

According to the DWR, the Sacramento River hydrologic region has 23 groundwater basins ranked “high” or “medium” as described by the CASGEM groundwater basin prioritization study. These rankings describe a groundwater basin’s importance in meeting demands for urban and agricultural water use. The San Joaquin River hydrologic region has nine “high,” or “medium” ranked basins. [Footnote: DWR, 2014b. California Groundwater Elevation Monitoring Basin Prioritization Process. June. Page 5.]

A recent report from Glenn County indicates that current groundwater levels in the county are at the lowest levels recorded going back to the start of record keeping in the 1920s. “Data in reference to groundwater levels has been collected from both private and dedicated monitoring wells located within Glenn County, in some cases dating as far back as the 1920’s. The lowest levels in these wells were most frequently associated with measurements from the 1976-77 monitoring period, which coincided with one of the more severe droughts in California’s history. In the years following the 76-77 drought, groundwater levels often approached these historic lows but rarely fell below them. However, recent (2012-13) data indicate levels in many wells have declined below those historic thresholds and are now at the lowest levels observed since monitoring began.” [Footnote: Glenn County Water Advisory Committee, Ad-hoc Committee. 2014. Report on Groundwater Level Declines in Western Glenn County. May 6. Page 5.] “Readily available monitoring data obtained through DWR’s California Statewide Groundwater Elevation Monitoring (CASGEM) is available for 100 wells, and of those 100, 21 still show their lowest levels as occurring in 1977, while 21 had an all-time low water surface elevation level in 2013, and an additional 15 wells reached their lowest point in 2009-2012. Therefore, one out of every five monitored wells in the area was at its lowest-ever recorded level in 2013, and one out of every three wells monitored in the area was at its lowest-ever recorded level between 2009 and 2013.” [Footnote: Glenn County Water Advisory Committee, Ad-hoc Committee. 2014. Report on Groundwater Level Declines in Western Glenn County. May 6. Page 6.]

Response

See Common Response 4 and response to Comment NG01-69.

Comment NG02-15

Comment

Regarding the limited groundwater modeling described in the LTWT, consulting hydrologist Kit Custis comments, “Because the groundwater modeling effort [described in the LTWT] didn’t include the most recent 11 years record, it appears to have missed simulating the most recent periods of groundwater substitution transfer pumping and other groundwater impacting events, such as recent changes in groundwater elevations and groundwater storage [citation omitted], and the reduced recharge due to the recent periods of drought. Without taking the hydrologic conditions during the recent 11 years into account, the results of the SACFEM2013 model simulation may not accurately depict current conditions or predict the effects from the proposed groundwater substitution transfer pumping during the next 10 years." [Footnote: Custis, K. 2014. Letter to Barbara Vlamis, November 10. RE: Comments and recommendations on U.S. Bureau of Reclamation and San Luis & Delta-Mendota Water Authority Draft Long-Term Water Transfer DRAFT EIS/EIR, dated September 2014. Page 5.]

Response
See Common Response 5.

Comment NG02-16

Comment
The DWR reports that areas of the Sacramento Valley are at risk for subsidence from depleted groundwater. Most of the groundwater basins susceptible to future subsidence are also ranked "high" and "medium" priority by the CASGEM groundwater basin prioritization analysis. According to the DWR and based on data from 2008 through 2014, approximately 36 percent of long-term wells surveyed in the Sacramento Valley are at or below the historical spring low levels. Another measure indicates that 50 percent of groundwater levels in 18 groundwater basins in the Sacramento Valley are at or below historical spring low levels. [Footnote: DWR, 2014c. Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California. Pages 9, 11.] A white paper by a consulting engineer on groundwater use and subsidence in the Sacramento Valley noted that subsidence may happen years after groundwater pumping and that real-time monitoring of groundwater pumping "will generally tend to underestimate the long-term settlement of the ground surface." [Footnote: Mish, D. 2008. Commentary on Ken Loy GCID Memorandum. Page 4.]

Subsidence can cause substantial economic harm. According to a report by consulting engineers studying subsidence in California, "Land subsidence has been discovered in many areas of the state, causing billions of dollars of damage. Impacts from subsidence fall into the following categories: 1. Loss of conveyance capacity in canals, streams and rivers, and flood bypass channels; 2. Diminished effectiveness of levees; 3. Damage to roads, bridges, building foundations, pipelines, and other surface and subsurface infrastructure; and 4. Development of earth fissures, which can damage surface and subsurface structures and allow for contamination at the land surface to enter shallow aquifers." [Footnote: Borchers, J. and M, Carpenter. 2014. Land Subsidence from Groundwater Use in California. Luhdorff & Scalmanini Consulting Engineers. Support provided by the California Water Foundation. April. Page ES-2.]

Response
Section 3.3 documents areas within the Central Valley where subsidence has been noticed, or which have a higher potential for subsidence based on geology or groundwater levels decreasing below historic lows. See Common Response 7.

Comment NG02-17

Comment
Subsidence in Colusa, Yolo and Solano counties in the Sacramento Valley during the 1976-77 drought caused widespread well casing damages, which made some wells unusable. [Footnote: Borchers, J. and M. Carpenter. 2014. Land Subsidence from Groundwater Use in California. Luhdorff & Scalmanini Consulting Engineers. Support provided by the California Water Foundation. April. Page ES-3.] A recent series of reports by the Stanford Woods Institute for the Environment and the Bill Lane Center for the American West at the Water in the West center at Stanford University describe the subsidence concerns regarding groundwater pumping in California, including the Sacramento Valley. [Footnote: Water in the West. 2014. Understanding California's Groundwater. waterinthewest.stanford.edu.] Custis notes the types of infrastructure in the Sacramento Valley susceptible to damage from subsidence, "There are a number of critical structures in the Sacramento Valley that may be susceptible to settlement and lateral movement. These include natural gas pipelines, gas transfer and storage facilities, gas wells, railroads bridges, water and sewer pipelines, water wells, canals, levees, other industrial facilities." [Footnote: Custis 2014, Page 28]

Response
Section 3.3 evaluates effects of subsidence in Colusa, Yolo, and Solano Counties. See Common Response 7.

Comment NG02-18

Comment
In response to concerns over groundwater use and related issues, the California legislature recently passed, and Governor Brown signed into law, the Sustainable Groundwater Management Act (Act). [Footnote: opr.ca.gov/s_groundwater.php] The Act will affect groundwater users including those supplying water transfers. The LTWT makes no mention of how the Act could affect the context within which water transfers would happen, or the transfers themselves. This is a significant omission.

Response
Section 3.3.1.2 has been revised to include a summary of the Sustainable Groundwater Management Act.

Comment NG02-19

Comment
Carriage Water Costs. The LTWT assumes that required carriage water component of water transfers from the Sacramento River will account for 20 percent of transferred water. “Transfers from the Sacramento River assume a 20 percent carriage water adjustment to maintain Delta salinity.” [Footnote: LTWT page B-18.]

Recent data on the percentage of required carriage water are higher than the 20-percent assumption in the LTWT. For example, the DWR describes a recent carriage water percentage of 30. “Another cost related to transferring water is carriage water… For the Sacramento River, this has generally been about 20 percent of the transfer water… It is worth noting, however, that in 2012 and 2013 carriage water losses for the Sacramento River were as high as 30 percent of transfer water.” [Footnote: California Department of Water Resources. 2013. California Water Plan 2013 Update. Bulletin 160-13. Volume 3 Resource Management Strategies. Pages 8-9.]

To the extent that carriage water requirements exceed 20 percent, the LTWT overestimates the amount of water delivered south through the Bay Delta to water purchasers, and thus the economic benefits of these transfers.

Response
The description of carriage water in Section 2.3.2.4 has been revised for clarity. Carriage water includes water to maintain water quality in the Delta as well as conveyance losses, as described in the comment. The precise amount of carriage water is calculated during the transfer based on real-time monitoring information in the Delta. The typical amount for transfers from the Sacramento Valley is about 20 to 30 percent, and the typical amount for transfers from the San Joaquin Valley is about 10 percent.

Comment NG02-20

Comment
Data and modeling ignore recent trends in water transfers.   Using water data from 1970 through 2003, the LTWT estimates that future water transfers will happen on average 12 out of 33 years. [Footnote: LTWT, page 3.3-60 and -61.] Twelve of 33 years is a transfer probability of approximately 36 percent. By ignoring water data for years after 2003, the analysis excludes relevant information on the more recent dry trend and current historical drought. For example, Table 1-3 on page 1-17 of the LTWT lists years and amounts of water transfers from 2000 through 2014. This data shows that water transfers happened in 9 of the previous 15 years, or a transfer probability of 60 percent, almost double that used in the LTWT. For years after 2003, transfers happened in eight out of 11 years, for a transfer percent of approximately 73.

Other sources of data on the frequency of water transfers do not support the LTWT's water-transfer results. For example, a report by the Western Canal Water District (WCWD) includes a table showing water transfers from the Sacramento Valley through the Bay Delta from 2001 through projected 2010. The information in this table shows transfers happening in eight out of ten years. [Footnote: Western Canal Water District (WCWD). 2009. Initial Study and Proposed Negative Declaration for Western Canal Water District 2010 Water Transfer Program. Western Canal Water District, Richvale, California. January. Page 25.] A similar report by WCWD in 2014 included a table of water transfers for years 2006 through projected 2014. The data in that table shows transfers happening during seven of nine years. [Footnote: WCWD. 2014. Initial Study and Proposed Negative Declaration for Western Canal Water District 2014 Water Transfer Program. Western Canal Water District, Richvale, California. February. Page 25.] Taken together, these two reports show water transfers from the Sacramento Valley south through the Bay Delta in 11 out of 14 years between 2001 through 2014. This works out to a transfer probability of approximately 79 percent.

These results demonstrate two important points. First, using a transfer probability of 36 percent greatly underestimates the actual years that transfers happened post-2003, the last year of data in the LTWT analysis. Underestimating transfers leads to underestimating the environmental and economic effects of the transfers.

Response
See Common Response 5.

Comment NG02-21

Comment
Second, the data upon which conclusions in the LTWT rest do not depict actual conditions post-2003. That is, by relying on flawed or incomplete data, models that use this data produce flawed or biased results. The estimated transfer frequency (36 percent of years), does not match the recent actual transfer frequency (60, 73, or 79 percent, depending on the source and years included).

At an October 21st, 2014 public hearing in Chico, California on the LTWT, a consultant working with BOR on the LTWT commented on the water model and the 1970 through 2003 data upon which the model relies. In response to questions about why the model did not include data from the previous ten years, or why the period of analysis was not extended out to the current drought situation, the consultant replied that the modeling tools "are not up-to-date." [Footnote: Transcript of October 21, 2014 public hearing in Chico, California on the LTWT EIS/EIR; Hacking, H. 2014. "Sacramento Valley water transfer idea leaves locals fuming. ChicoER News, October 22, 2014, http://www.chicoer.com.]

Response
See Common Response 5.

Comment NG02-22

Comment
According to resource agencies in California, variable, even extreme climate and rainfall conditions are the norm. Climate change is projected to make these trends worse and increase prediction uncertainties. The recent Bay Delta Conservation Plan describes this uncertainty, “Variability and uncertainty are the dominant characteristics of California’s water resources.” [Footnote: California Department of Water Resources (DWR). 2013. Bay Delta Conservation Plan. Public Draft. November Sacramento, CA. Prepared by ICF International (ICF 00343.12). Sacramento, CA. Page 5-1.] “Precipitation is the source of 97% of California’s water supply. It varies greatly from year to year, by season, and by where it falls geographically in the state. With climate change, the state’s precipitation is expected to become even more unpredictable.” [Footnote: DWR, 2013. Page 5-2] “However, the total volume of water the state receives can vary dramatically between dry and wet years. California may receive less than 100 MAF of water during a dry year and more than 300 MAF in a wet year (Western Regional Climate Center 2011).” [Footnote: DWR, 2013, page 5-2] “The geographic variation and the unpredictability in precipitation that California receives make it challenging to manage the available runoff that can be diverted or captured in storage to meet urban and agricultural water needs.” [Footnote: DWR, 2013, page 5-2.] “Historically, precipitation in most of California has been dominated by extreme variability seasonally, annually, and over decade time scales; in the context of climate change, projections of future precipitation are even more uncertain than projections for temperature. Uncertainty regarding precipitation projections is greatest in the northern part of the state, and a stronger tendency toward drying is indicated in the southern part of the state.” [Footnote: DWR 2013, page 5-2.]

Consultants working for the BOR admit that the water model and data upon which the LTWT analysis and conclusions rest are not up to date. We note above the model’s unreliability and poor projection capabilities regarding water transfers post-2003. The DWR concludes that variability and extremes characterize the state’s weather and rainfall conditions, and that climate change is increasing this variability and uncertainty. Taken together, these facts raise questions regarding the veracity of the projected water transfers described in the LTWT, and the estimated environmental and economic consequences of those transfers.

Response
Appendix B summarizes the analytical approach used for the water operations assessment. CalSim II was selected to simulate the surface water system and was used because it represents "the best available model assumptions developed

by Reclamation as of January 2014" (see page B-2). It is acknowledged that California's water resources are highly variable, but these hydrologic variables are captured in the CalSim II model because it considers "82 years of historical hydrology from water year 1922 through 2003" (see page B-4). The baseline study used by CalSim II was revised by the project team and Reclamation to consider "an existing level of development, requirements, and projects" (see page B-5). Because of these considerations, the interaction of the three models used in the analysis (CalSim II, SACFEM2013, and TOM) represent the best available tools to capture any variability from climate change and any associated environmental consequences. See Common Response 5 for additional information.

Comment NG02-23

Comment
The analysis does not adequately take into account recent trends in agricultural production. Not included in the LTWT's description of current conditions are recent trends in agricultural production that affect groundwater use and conditions in the Sacramento Valley. For example, according to a recent report, approximately half the increase in irrigated acres in the Sacramento Valley since 2008 (approximately 200,000 acres), happened on lands not served by surface water suppliers. Irrigating these lands takes approximately 300,000 acre-feet (af) of groundwater per year. [Footnote: DMW, 2014, page 7.]

Response
Section 3.3 presents existing conditions for groundwater resources. The section has been expanded to include more information on groundwater levels and trends, which account for agricultural use of groundwater. See Common Response 4. Additional economic baseline condition information on agricultural acreage has also been provided in Section 3.10. Common Response 5 and Appendix M include information about the land use information used in model development.

Comment NG02-24

Comment
A related point is the lack of discussion or analysis in the LTWT of trends in prices for agricultural goods produced with surface and groundwater, trends in prices for water, and how these factors affect grower decisions. For example, the analysis fails to address the extent to which historically high prices for water (discussed below) increase groundwater mining and sale in the Sacramento Valley, and how this affects water transfers and their environmental and economic consequences.

Response
Crop prices do not vary based on use of groundwater or surface water. Data on crop prices has been added to the existing conditions in Section 3.10. Growers

voluntarily participate in water transfers and likely consider many factors in their decision to participate, including crop prices, market conditions, production costs, cropping rotations, and many other reasons. These reasons are not the subject of this EIS/EIR. The EIS/EIR evaluates a maximum set of transfers that could occur in the Sacramento Valley. High prices for water do not change the maximum amount of water that could be transferred and there would be no impacts other than those disclosed in the EIS/EIR.

Comment NG02-25

Comment
Another agricultural trend not discussed in the LTWT, but which has implications for water transfers and their consequences, is the increasing use of pressurized irrigation methods in the Sacramento Valley. Pressurized irrigation reduces groundwater recharge by limiting water percolation. Some growers supply their pressurized irrigation systems using groundwater, even when they have access to surface water. According to the report commissioned by the NCWA, “The increasing use of pressurized irrigation systems using groundwater is likely to be an increasingly important factor in the overall management of groundwater and surface water in the Sacramento Valley as a whole, particularly as such system displace the use of available surface water.” [Footnote: DMW, 2014, page 8.]

Response
Section 3.3 describes effects to groundwater levels as a result of water transfers. SACFEM2013 was used for groundwater modeling and groundwater recharge is an input to the model, as described in Appendix D. The cited Northern California Water Association (NCWA) report also states that "From the standpoint of groundwater management, adoption of high-efficiency pressurized systems has a desirable effect in areas irrigated with groundwater because less groundwater pumping is needed to meet demands” (NCWA 2014, page 8).

Comment NG02-26

Comment
In response to the recent trend in high prices for almonds, olives, walnuts and other tree crops, growers in the San Joaquin and Sacramento Valleys planted more acres of these tress and other permanent---‐type crops, and less acres of lower valued annual crops. Such a change increases and “hardens” demand for water in both valleys because growers no longer have the flexibility of idling these acres in response to drought. [Footnote: DMW, 2014, page 7.] Thus, one of the arguments in support of water transfers—that growers south of the Bay Delta planted increased acres of tree crops that have higher water demands—also affects growers and water use and demands north of the Bay Delta. The LTWT is silent on these trends or how they would influence future water transfers from the Sacramento Valley.

Response
The Draft EIS/EIR evaluates the environmental and economic effects of a range of potential water transfers. The Lead Agencies have identified a purpose and need for these potential transfer activities and have identified alternatives that involve only willing sellers. The purpose of the EIS/EIR is not to evaluate the economic conditions that have resulted in the need for water transfers. Further, water transfers are not a reliable source of water to meet San Joaquin Valley demands. Water transfers are a supplemental source. They are not acquired every year and cannot be relied on in dry and critical years because of limits in export capacity at the Delta pumps.

Comment NG02-27

Comment
3 The LTWT relies on outdated and incomplete data. In addition to the deficiencies described in previous sections, the analysis described in the LTWT relies on obsolete data for certain key variables. The analysis also ignored other relevant data and information. These shortcomings include the following.

The LTWT assumes a price for water that bears no resemblance to the current reality. The analysis described in the LTWT assumes a price of water of $225 per af of water. [Footnote: LTWT, page 3.10-27.] This amount drastically underestimates the current price for water. Dollar amounts for water trades are not readily available to the public. However, information on the current price of water from news articles and other sources reveals a range of current prices that exceed $225 by a significant amount.

A report by Bloomberg News on the impacts of drought on water prices reports water prices of $1,000 to $2,000 per af. The article also quotes a spokesman for the BOR, “The rising prices are ‘a function of supply and demand in a very dry year and the fact that there are a lot of competing uses for water in California,’ said Mat Maucieri, a spokesman for the Bureau of Reclamation.”[Footnote: Vekshin, A. 2014. “California Water Prices Soar for Farmers as Drought Grows,” Bloomberg. July 24. http://www.bloomberg.com.]

An article in the Sacramento Bee on water transfers noted that one buyer was paying “in the neighborhood of $500 to $600 an acre-foot.” [Footnote: Garza, M. 2014. “The Conversation: A controversial water transfer worth millions.” The Sacramento Bee. May 25. http://www.sacbee.com/opinion/the-conversation/article99570.html.] The Glenn-Colusa Irrigation District commenting on the LTWT noted that the $225 per af price used in the analysis was the price paid for water over eight years ago. [Footnote: Glenn-Colusa Irrigation District. 2014. Board of Directors Meeting of November 6, 2014, Item 6.]

Water users, sellers and buyers would surely respond differently to a market price of water of $1,000 to $2,000 per af, than they would to a price of $225.

As such, the extent to which growers idle cropland, switch to less water intensive crops, and substitute groundwater for surface water in the LTWT likely does not reflect this difference. As we note below, missing from the LTWT analysis is an assessment of the economics of water markets, how sellers and buyers respond to changing water prices, and how this affects the type and amount of water transfers.

Response
Water transfer prices have varied in past years. From 2008 to 2013, SLDMWA agencies paid in the range of $100 per AF to $250 per AF for north-of-Delta water transfers. The price of $225 per AF used in the analysis is within this range. This price was arrived at based on best available data at the time and discussions with the buyers and sellers. Prices paid for water transfers in 2014 were not available at the time the analysis was completed. SLDMWA paid $500 per AF for north-of-Delta transfers in 2014, which is substantially higher than in previous years because of the extreme shortage experienced in 2014 and may not be a permanent trend. The higher price provides an economic benefit in the Seller Service Area.

The analysis in Section 3.10 has been updated with a higher price to incorporate the 2014 water transfer price. See response to Comment NG02-26. The Draft EIS/EIR does not evaluate economic conditions that lead to a grower's decision to participate in water transfers. Transfers are between willing sellers and willing buyers. The Lead Agencies have limited the upper quantity of transfers in the proposed alternatives, so a higher water transfer price cannot change the maximum amount transferred.

Comment NG02-28

Comment
Ignored impacts on tax revenues to local governments from IMPLAN results. The LTWT describes estimating impacts of water transfers on employment, labor income and total value of output using IMPLAN. [Footnote: LTWT, page 3.10-21] IMPLAN is a commonly used software and data package that helps analysts estimate economic impacts of policy changes or compare economic impacts of allocation alternatives, e.g., alternative logging proposals or alternative water-transfer amounts. According to the IMPLAN website, IMPLAN "… allows an analyst to trace spending through an economy and measure the cumulative effects of that spending." [Footnote: IMPLAN web site, implan.com/index.php?option=com_glossary&id=236&letter=E.] IMPLAN traces the economic benefits of increased spending as it works its way through an economy, or, when spending decreases, the negative economic impacts of decreased spending. From our own experience using IMPLAN, and from information on the IMPLAN website, in addition to the employment, labor income and total value of output reported in the LTWT, IMPLAN also quantifies the impacts of alternatives on government finances and tax revenues. [Footnote: IMPLAN.

https://implan.com/index.php?option=com_content&view=article&id=532:532&catid=233:KB16.] For example, the IMPLAN website describes how the software can estimate state, local, and federal tax amounts collected (or lost) as a result of a change in an economy, such as reduced agricultural activity. [Footnote: IMPLAN. https://implan.com/index.php?option=com_content&view=article&id=532:532&catid=233:KB16.]

Even though IMPLAN calculates impacts of alternatives on local government finances and tax revenues, the analysis described in the LTWT does not report these results. That is, the authors apparently choose not to report the output from IMPLAN on how the transfer alternatives would affect the dollar amounts of tax revenues to local governments as a result of the reduced agricultural activity and spending. Instead, the report notes that impacts "to local government finances, including tax revenues and costs, are described qualitatively." [emphasis added] [Footnote: LTWT, page 3.10-24.] The report does not explain why the analysts chose to address impacts on local tax revenues of the water-transfer alternatives qualitatively, rather than rely on the estimates of tax impacts produced by IMPLAN.

Response
IMPLAN does calculate impacts to state and local and federal taxes. The impacts are calculated based on tax receipts and not tax rates. State and local tax impacts are presented together and cannot be broken out separately; IMPLAN does not have the underlying data required to do this. The economic analysis focuses on regional economies composed of counties, and the inclusion of state and local tax impacts from IMPLAN does not show the impacts to the actual regional economies evaluated in the analysis. However, the tax impacts from the IMPLAN analysis were calculated and have been included in the section with the explanation that the state and local tax impacts cannot be broken down any further.

Comment NG02-29

Comment
Ignored own research results on stream flow depletion factors. The LTWT makes no mention of the results from studies of the impacts of groundwater pumping in support of water transfers on stream flow depletion. A technical memo on the impacts of groundwater pumping on stream flow depletion describes the analysis and concludes that, "The effect of groundwater substitution transfer pumping on stream flow, when considered as a percent of the groundwater pumped for the program, is significant." [Footnote: Lawson, P. 2010. Technical Memorandum. Groundwater Substitution Transfer Impact Analysis, Sacramento Valley. CH2MHill. March 29. Page 8.] "The three scenarios presented here estimated effects of transfer pumping on stream flow when dry, normal, and wet conditions followed transfer pumping. Estimated stream flow losses in the five-year period following each scenario were 44, 39,

and 19 percent of the amount of groundwater pumped during the four-month transfer period." [Footnote: Lawson, 2010, Page 8.]

In spite of these results, information distributed by the DWR and BOR to those interested in making water transfers in 2014, cites a stream flow depletion factor of 12 percent. [Footnote: DWR and BOR, 2014. Addendum to DRAFT Technical Information for Preparing Water Transfer Proposals. Information to Parties Interested in making Water Available for water Transfers in 2014. January. Page 33.] It's not clear how BOR justifies using a 12-percent depletion factor when analyses conducted by their contractors found depletion factors of 44, 39 and 19 percent.

We understand that the same SACFEM model that produced other results in the LTWT also produced the stream flow depletion factors. [Footnote: LTWT, page 3.3-60] Yet, while the LTWT reports other results from SACFEM, it makes no mention of these results. It also ignores the assumed 12-percent depletion factor cited by DWR and BOR. Instead, it states that stream flow depletion will be studied at a later date. [Footnote: LTWT, page 3.1-21] This approach ignores their own modeling results on stream flow depletion.

Response
The referenced technical memo was completed using a previous version of SACFEM, and the information contained in the report is outdated. The Draft EIS/EIR analysis uses the updated model, now named SACFEM2013. The Draft EIS/EIR includes similar analyses of modeling results, but with the updated model version. Mitigation Measure WS-1 does not identify 12 percent as the streamflow depletion factor. See Common Response 8 for more information on the streamflow depletion factor.

Comment NG02-30

Comment
Incomplete and selective use of information from groundwater monitoring wells. The LTWT omits a significant concluding passage when describing results from a groundwater monitoring well in the Sacramento Valley. For well 21N03W33A004M, the LTWT states, "Water levels at well 21N03W33A004M generally declined during the 1970s and prior to import of surface water conveyed by the Tehama‑Colusa Canal. During the 1980s, groundwater levels recovered due to import and use of surface water supply and because of the 1982 to 1984 wet water years [citation omitted]." [Footnote: LTWT, page 3.3-22] The document cites a DWR report from 2014 on drought response and gaps in groundwater monitoring. [Footnote: LTWT, page 3.3-22] The description in the DWR report, however, includes this additional concluding passage that the LTWT authors excluded, "Water levels declined again in the 2008 drought period, followed by a brief recovery during 2010 to 2011, and then returning to 2008 levels (which are notably lower than the 1977-79 drought levels)." [Footnote: DWR, 2014a, page 24] [emphasis added] The omission matters as it

completely changes the conclusion regarding current groundwater conditions as reported by the well.

The description in the LTWT of results from well 15N03W01N001M match those from the DWR source document. That description concludes, "… After the 2008‐2009 drought, water levels declined to historical lows. Water levels recovered quickly during 2010 and 2011, then after returned to the trend of long-term decline." [LTWT, page 3.3-22] [emphasis added]

Taken together these results indicate a long-term trend in declining groundwater levels in areas around the wells. The LTWT discounts or ignores these results instead favoring results from other wells. On this point, consulting hydrologist Custis describes other relevant data on groundwater monitoring, "The Draft EIS/EIR doesn't provide maps showing groundwater elevations, or depth to groundwater, for groundwater substitution transfer seller areas in Sutter, Yolo, Yuba, and Sacramento counties. The DWR provides on a web site a number of additional groundwater level and depth to groundwater maps at: [website omitted]." [Footnote: Custis 2014, pages 9-10]

Custis notes other deficiencies of the groundwater monitoring as described in the LTWT. "…[T]he Draft EIS/EIR provides only limited information on the wells to be used in the groundwater substitution transfers [citation omitted], and no information on the non-participating wells that may be impacted." [Footnote: Custis 2014, page 2.] Custis goes on to list other recommended groundwater monitoring information that the LTWT does not include. [Footnote: Custis 2014, page 2].

Response
Note the EIS/EIR states, "Even though groundwater levels at wells 21N03W33A004M and 15N03W01N001M are generally showing a declining trend, groundwater levels in other wells in the basin have remained steady, declining moderately during extended droughts and recovering to pre-drought levels after subsequent wet periods."

See Common Response 4.

Comment NG02-31

Comment
A related point is the available monitoring data from past water transfers. DWR and BOR apparently already collect information on the impacts of groundwater pumping in support of water transfers on groundwater levels. [Footnote: See for example, DWR and BOR, 2014. DRAFT Technical Information for Preparing Water Transfer Proposals. Information to Parties Interested in making Water Available for water Transfers in 2014. January; DWR and BOR. 2013. DRAFT Technical Information for Preparing Water Transfer Proposals. Information to Parties Interested in Making Water Available for Water

Transfers in 2014. October.] The LTWT makes no mention of this data or how it could help inform the analysis of impacts of water transfers at issue in the LTWT on groundwater levels and related concerns. It would seem that BOR has available data relevant to its analysis described in the LTWT but makes no use of this data. On this point Custis notes, “The BoR should already have monitoring and mitigation plans and evaluation reports based on the requirements of the DTIPWTP for past groundwater substitution transfers, which likely were undertaken by some of the same sellers as the proposed 10-year transfer project.” [Footnote: Custis 2014, page 24]

Response
Monitoring data from 2014 transfers will not be available until May 2015. Final Monitoring Reports from 2013 transfers (Anderson-Cottonwood ID 2014; Conaway Preservation Group 2014; Eastside MWC 2014; Glenn-Colusa ID 2014; Pleasant Grove Verona MWC, 2014; Pelger MWC, 2014; Reclamation District 1004 2014; and Te Velde Revocable Family Trust 2014) are included in the references section of this document. The groundwater monitoring information indicated that groundwater levels had recovered after 2013 transfers.

Comment NG02-32

Comment
The analysis relies on outdated prices for agricultural commodities. The analysis described in the LTWT uses outdated prices for agricultural commodities to estimate the volume and value of water transfers. The analysis relies on prices for rice, processing tomatoes, corn and alfalfa from 2006 through 2010. [LTWT, page 3.10-27, -28] The analysis compares the price of water, which as we note above bears no resemblance to current prices, with prices for agricultural commodities to estimate cases in which selling water is more profitable than producing crops. Using outdated commodity prices compounds the error of using water prices that greatly underestimate actual prices. The combined effect is misleading results and conclusions regarding the degree of participation by growers in the water transfer program.

Response
The EIS/EIR is not evaluating the degree to which growers will opt to participate in potential transfer activities. In developing alternatives, the Lead Agencies coordinated with the sellers to identify transfer quantities and methods, which translates into the willingness of some growers to participate in the transfers at some time in the transfer period. The Lead Agencies did not use prices for agricultural commodities to estimate the volume and value of water transfers, as suggested by the comment. Further, transfers are entirely voluntary for the buyers and sellers. See response to Comment NG02-27 for additional information. The agricultural prices used were the most recent prices available at the time the analysis was completed. The analysis has been updated with crop prices through 2012.

Comment NG02-33

Comment
No mention of how prices for water and agricultural commodities could impact the affected environment, water transfers and their environmental and economic consequences. The water transfers at issue in the LTWT would not happen in an economic vacuum. Growers and water sellers and buyers react to changing price and market conditions. The LTWT, however, is silent on these forces and how they would influence water transfers.

The analysis depicted in the LTWT assumes a static water price of $225 per af and prices for agricultural commodities as they existed in 2006 through 2010. [Footnote: LTWT, page 3.10-27] Such a static analysis provides a single estimate, or a snapshot view, of estimated water transfers. A more informative and useful analysis would have described how changing water and commodity prices influence the conclusions re the number and volumes of water transfers. Such a sensitivity analysis would allow readers to better compare current or expected future prices with prices in the analysis to see how these conditions affect results.

Response
See responses to Comments NG02-26, NG02-27, and NG02-32. The EIS/EIR evaluates the economic effects of the maximum amount of cropland idling acres for the alternatives. The analysis has been revised with updated water transfer prices and crop prices. The purpose of the Draft EIS/EIR is to evaluate environmental impacts related to the alternatives, not to evaluate how changing prices can affect transfer quantities. The Lead Agencies set maximum quantities for each alternative in coordination with the sellers.

Comment NG02-34

Comment
The LTWT is also silent on likely transaction costs and how they influence water transfers. Water transactions, particularly out-of-basin and cross-Delta, would require a diverse and substantial set of transaction costs that are not quantitatively included in the analysis. Omitting these transaction costs either overestimates the benefit potential to buyers and sellers of these transactions, or implies that these transaction costs will be borne by the public. Communication, information, and contracting costs have long inhibited water markets in California, and while mechanisms for overcoming these challenges have improved, they do have real costs, particularly across diverse regions and incorporating farmers using differing operations. [Footnote: Haddad, B. M. 2000. Rivers of Gold: Designing Markets to Allocate Water in California. Island Press.] Transaction costs are hurdles to transactions, functionally a third party that must be satisfied before the buyer and seller can find opportunities to both be made better off by the transaction. For example, if a seller is willing to

sell water at $250 per af, and a buyer is willing to pay $300 per af, if there are $60 per af in transaction costs, the transaction cannot efficiently take place.

Cross-Delta transaction would also impose a number of costs on the Delta conveyance system. Pumping costs at Banks and Jones Pumping Plants should be incorporated into transaction costs. Transactions could also affect congestion and overall capacity for these plants and the SWP and CVP systems overall. Energy, management, staffing, delays, and other costs and impositions could arise that would either require compensation by the buyers and sellers, or externalities on other parties.

Permitting, liability, and long-term protection of water rights all contribute to additional concerns for buyers and sellers that functionally generate additional forms of transaction costs. If these are incorporated into willingness-to-pay for buyers and willingness-to-accept for sellers, the transactions become less desirable. Alternatively, if these costs are borne by public agencies, as with the variety of other transaction costs mentioned above and referenced qualitatively throughout the LTWT, the burden for taxpayers could be substantial. These public contributions require demonstration of benefits to the public as a whole. The LTWT does not demonstrate benefits to portions of the public that are not party to transactions. On this point Custis notes, "Because the spatial limits of groundwater substitution pumping impacts are controlled by hydrogeology, hydrology, and rates, durations and seasons of pumping, the impacts may not be limited to the boundaries of each seller's service area, GMPs [groundwater management plan], or County. There is a possibility that a seller's groundwater substitution area of impact will occur in multiple local jurisdictions, which should results [sic] in project requirements coming from multiple local as well as state and federal agencies. The Draft EIS/EIR doesn't discuss which of the multiple local agencies would be the lead agency, how an agreement between agencies would be reached, or how the requirements of the other agencies will be enforced." [Footnote: Custis 2014, page 9]

Overall, the estimates of benefits and costs of transactions, as well as identification of efficient transactions, do not include the diverse and substantial set of transaction costs that cross-Delta transfers would require. Therefore the analysis either overestimates the benefits of the LTWT, or hides public costs to manage and overcome these transaction costs.

Response

An EIS is not required to contain a cost-benefit analysis if such an analysis is not relevant to the choice among action alternatives. The potential transfer activities evaluated under the Proposed Action and alternatives are voluntary transactions. The economic analysis in the EIS/EIR is not an evaluation of willingness to pay for water transfers. Transfer costs are negotiated between buyers and sellers. Buyers and sellers consider transaction costs when negotiating the price of water. Reclamation does not have input into or influence over the prices negotiated by buyers and sellers. The Long-Term

Water Transfers EIS/EIR is a streamlining tool and would reduce transaction costs because it identifies buyers and sellers, maximum transfer quantities, transfer methods, and required mitigation. The buyers and sellers do not need to negotiate these factors or complete the environmental compliance each year and therefore, actual transaction costs may reduce as a result of the Long-Term Water Transfers EIS/EIR.

Comment NG02-35

Comment
Underestimates economic effects on regional economy in sellers area. In the sections above, we describe omissions and errors regarding the estimated number and volumes of water transfers. Some of these errors could lead to underestimating the number and volume of water transfers, some could have the opposite effect. In this subsection we focus on additional examples of how the LTWT likely underestimates the number and volume of water transfers that will happen in the future. By underestimating the water transfers the LTWT also underestimates the negative impacts of the transfers on the regional economy in the sellers area. The negative economic effects listed in the LTWT include: 1.Approximately 500 lost jobs in Glenn, Colusa, Yolo, Sutter, Butte and Solano counties. 2.Over $20 million in lost labor income and over $61 million in lost economic output in these same counties. 3.Unquantified but increased pumping costs for water users in areas where groundwater levels decline. 4.Unquantified but negative affects on other local economic effects. 5.Unquantified but negative affects on tenant farmers. [Footnote: LTWT, page 3.10-45 and -46.]

The LTWT analysis of some regional economic effects assumes non-consecutive years of water transfers. If water transfers happen in consecutive years, impacts would be greater than reported in the LTWT. “Local effects would be more adverse if cropland idling transfers occurred in consecutive years. Business owners would likely be able to recover from reduced sales in a single year, but it would be more difficult if sales remained low for multiple years.” [Footnote: LTWT, page 3.10-33]

As shown in LTWT Table 1-3 on page 1-17, from 2004 through 2014, there have been eight water-transfer years out of 11, and 5 cases of consecutive transfer years. Given these recent conditions, it is likely that consecutive years of water transfers will happen more frequently than assumed in the LTWT.

Response
The Lead Agencies have not underestimated the volume of potential water transfers. The alternatives include a maximum quantity of water transfers by transfer methods that are evaluated in this EIS/EIR. The buyers cannot purchase additional water for transfer without further environmental documentation. Section 3.10 evaluated the maximum quantity of water transfers under the alternatives. Section 3.10 has been updated with additional

text on the effects of consecutive transfers. Common Response 5 includes more information about the frequency of transfers.

Comment NG02-36

Comment

Incomplete description of impacts on pumping costs. The LTWT reports that farmers in the Sacramento and San Joaquin Valleys pay water-pumping costs of approximately $0.32 per af. [Footnote: LTWT, page 3.10-24] The LTWT analysis estimates that as a result of groundwater-substitution transfers, pumping costs for “many growers” would increase by $0.32 to $1.60 per af. [Footnote: LTWT, page 3.10-36] This represents a non-trivial increase of 100 to 500 percent. In some cases, cost increases could be $6.40 to $8.00 per af. [Footnote: LTWT, page 3.10-36.] Expressed on a percentage basis these amounts are increases of 2,000 to 2,500 percent. The LTWT describes these increases in pumping costs as “adverse.” The analysis, however, does not report a total estimated increase in pumping costs or describe the increase as a percentage of current costs, either of which would have helped the reader better understand the significance of the increase. [Footnote: A related point is that Figures 3.10-5 and 3.10-6 are confusing in that the captions include “September 1990” and “September 1976,” respectively. The discussion on page 3.10-36, which introduces the figures, makes no mention of these dates or their significance.] A related point is that the analysis of pumping costs in the LTWT relies on results from the water modeling, the deficiencies of which we describe above and elsewhere in this report. It’s also not clear from the description of the analysis if the “adverse” effects on pumping costs apply only to those participating in water transfers, or also affect third parties that will not benefit from the transfers.

Response

The analysis shows a relative increase in pumping costs for areas where groundwater levels would decline as a result of transfers. Data is not available to estimate a total increase in pumping costs. The percentages calculated by the commenter are incorrect. Pumping costs would increase by $0.32 per AF per foot of lift. Growers are already pumping a certain depth so pumping an AF one additional foot would be an increase in $0.32, which would be a much smaller percentatge of overall pumping costs, not the large percentages indicated in the comment. Further, pumping costs are a small fraction of the total production costs for growers. Section 3.3 includes the groundwater evaluation and a discussion of the years shown on the figures. A reference to this section has been added in Section 3.10. The discussion in Section 3.10 states, "Decreased groundwater levels would increase pumping costs for nearby well owners who are not participating in groundwater substitution transfers."

Comment NG02-37

Comment
No mention of costs of deepening or installing new wells. The LTWT makes no mention of increased costs of deepening or installing new wells as a result of the impacts of groundwater pumping on groundwater levels. As we note above in section 2 under the description of current groundwater conditions, the CASGEM groundwater basin prioritization study lists 23 basins in the Sacramento Valley ranked "high" or "medium" dependent on groundwater. These basins support private residential wells, public water supply wells, and irrigation wells. [Footnote: DWR, 2014b, pages 2-5.] Recent news reports describe the intensity of well drilling operations in California's Central Valley. [Footnote: Howard, B.C. 2014. California drought spurs groundwater drilling boom in Central Valley. National Geographic. August 15. http://news.nationalgeographic.com/news.2014/08/140815-central-valley-california-drilling-boom-groundwater-drought-wells/; Khokha, S. 2014. Drought has drillers running after shrinking California water supply. National Public Radio. June 30. http://www.npr.org/2014/06/30/325494399/drought-has-drillers-running-after-shrinking-california-water-supply.] To the extent that groundwater pumping in support of water transfers lowers groundwater levels, some current water users depending on groundwater may face increased costs of deepening or installing new wells. The analysis described in the LTWT does not address these costs.

Response
A discussion of the costs of deepening existing wells or installing new wells has been added to Section 3.10.

Comment NG02-38

Comment
Underestimates the significance of impacts on unemployment rates. Any negative impacts of water transfers on agricultural production and related unemployment effects, would take place against a backdrop of already hurting economies. As Figure 3.10-7 illustrates, current unemployment rates in the seller counties runs between approximately 8 and 18 percent. The LTWT analysis estimates that water transfers will idle approximately 500 workers in the Sacramento Valley. The analysis assumes that impacts of transfers on unemployment would be temporary. "Reductions in employment associated with cropland idling transfers would contribute to unemployment in the region. However, cropland idling effects are temporary and under the Proposed Action, cropland idling transfers would not occur each year over the 10-year period." [Footnote: LTWT, page 3.10-49] As we note above, however, data on the frequency of recent water transfers do not support the LTWT assumptions regarding infrequent future water-transfer years. Thus, the LTWT analysis likely underestimated the negative impacts of the plan on unemployment in the Sacramento Valley.

Response
Text has been added to Section 3.10 to further discuss the effects of consecutive year transfers. See response to Comment LA14-14.

Comment NG02-39

Comment
No mention of economic harm to local economies from lost water-based recreational activities. The analysis of regional economic effects in the LTWT focuses on impacts of water transfers on agricultural production and related businesses. The LTWT ignores other negative impacts on the regional economy. For example, the LTWT is silent on the impacts of water transfers on reservoirs such as Lake Oroville and others in the sellers area, and the related impacts on the region's water-based recreational economy. In their letter commenting on the LTWT, the Butte County Board of Supervisors noted their concerns that the LTWT "… failed to take into account the reduction in stream flows and the lowering of Lake Oroville that will harm the local economy." [Footnote:] Teeter, D. 2014. Letter to Brad Hubbard, BOR, and Frances Mizuno, SLDMWA, November 25. Re: Long-Term Water transfers Program Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). Page 2.] In an earlier letter to Governor Brown commenting on the BDCP, the Butte County Board of Supervisors noted the importance of the lake to the region's economy, and the fact that the State of California has not fulfilled commitments made regarding developments at Lake Oroville. [Footnote: Lambert, S. 2012. Letter to The Honorable Edmund G. Brown, Jr. August 14. Re: Butte County's Opposition to the Bay Delta Conservation Plan (BDCP). August 14. Page 2.] Ignoring the potential impacts of water transfers on Lake Oroville and the associated economic impacts compounds the negative effects of the State's failure to fulfill past commitments at the lake.

Response
Economic effects from recreation are generally related to changes in visitor attendance and associated changes in visitor spending in the regional economy. The Draft EIS/EIR evaluates impacts to recreation in Section 3.15. The analysis found no significant impacts to recreation activities or visitor attendance associated with the proposed alternatives. Therefore, an economic analysis was not necessary. Visitor spending and contributions to the local economies would be similar to existing conditions and to the No Action Alternative.

Comment NG02-40

Comment
Arbitrary limits on crop idling. The analysis in the LTWT relies on arbitrary limits on crop idling as a means of avoiding negative economic impacts. The DWR and BOR document that provides technical guidance for those interested in making water transfers describes the possibility of negative economic effects of crop idling, however, the guidelines for the amount of idling that would

cause economic harm appear arbitrary. The relevant passage from the document states, "Cropland idling/crop shifting transfers have the potential to affect the local economy. Parties that depend on farming-related activities can experience decreases in business if land idling becomes extensive. Limiting cropland idling to 20 percent of the total irrigable land in a county should limit economic effects." [Footnote: DWR and BOR, 2013. DRAFT Technical Information for Preparing Water Transfer Proposals. Information to Parties Interested in Making Water Available for Water Transfers in 2014. October. Page 22.] [emphasis added] While the statement may be true, it lacks the analytical rigor that would satisfy NEPA requirements for, "Rigorous exploration and objective evaluation of all reasonable alternatives, …" [Footnote: LTWT page 2-1] As such, the guidelines on crop idling seem arbitrary rather than the result of rigorous and objective analysis.

Response
The limits on cropland idling (established in Chapter 2 for each action alternative) were developed with the sellers and are not arbitrary limits. The sellers provided water quantities and likely crops to be idled in their service areas. The text quoted in the comment refers to the 2013 Draft Technical Information For Preparing Water Transfer Proposals and is not in the EIS/EIR. The analysis discloses the economic effects of a maximum potential idling action for the proposed alternatives.

Comment NG02-41

Comment
Table 3.10-22 lists the total number of acres affected by cropland idling in the analysis described in the LTWT. As shown in this table, approximately 60,000 acres could be idled in Glenn, Colusa, Yolo, Sutter, and Butte counties. [Footnote: LTWT, page 3.10-26] In the table below [See Original Comment Letter], we show the total number of acres of irrigable land in each county, and 20 percent of these acres. According to the guidelines noted above, up to 257,000 acres could be idled in these counties without significant economic effects. This seems doubtful. Rather than relying on arbitrary rules of thumb and assumed limited economic effects of idling, a more complete and transparent assessment of the economic effects of water transfers would take an analytical and quantified approach.

Response
As stated in response to Comment NG02-40, the cropland idling acreages were not developing using a 20 percent criterion. The quantities were developed in coordination with sellers and represent the maximum acreages that can be idled under the alternatives. The Draft EIS/EIR does not say that "up to 257,000 acres can be idled without significant economic effects" and does not include or evaluate that amount in the alternatives.

Comment NG02-42

Comment

5 The LTWT finds significant negative effects but the vague and incomplete proposed monitoring and mitigation plans would not address these effects. The LTWT concludes that water transfers will have some significantly negative impacts on groundwater resources. As we note in earlier sections of this report, the analysis described in the LTWT likely underestimates the negative effects of water transfers. For example, the analysis likely underestimates the frequency of water-transfer years, and so the negative effects of the transfers. The analysis also ignores negative impacts on water-based recreational activities and the associated negative economic consequences. The monitoring and mitigation plans focus only on the negative effects listed in the LTWT. Thus, they would address only a subset of the likely total negative economic consequences of the water transfers. In addition, the vague and incomplete proposed monitoring and mitigation plans would not adequately address those negative effects listed in the LTWT. Concerns regarding these plans include the following.

Response

The Draft EIS/EIR evaluates impacts to all environmental resources potentially affected by the proposed alternatives in Chapter 3 and includes mitigation measures to reduce impacts to a less-than-significant level. See Common Response 6 for additional information regarding groundwater mitigation, and Common Response 5 for additional information about transfer frequency. See response to Comment LA14-14 relative to NEPA and CEQA requirements for the evaluation of economic effects. NEPA and CEQA do not require mitigation for economic effects. See response to Comment NG02-39 related to recreation impacts.

Comment NG02-43

Comment

The LTWT ignored the costs of monitoring and mitigation. The LTWT proposes both a monitoring and mitigation program for significant negative impacts of water transfers on groundwater resources. Implementing these programs would take planning, effort and financial resources. The LTWT, however, does not include these costs in their analysis of alternatives. For example, water sellers would be required to monitor and record groundwater conditions and coordinate with regulators regarding the impacts of their groundwater pumping on groundwater levels. Water seller will incur costs monitoring, measuring, recording, and reporting the necessary information. The LTWT excludes these and related costs from the analysis. Likewise, the mitigation of negative groundwater consequences would also require time, effort, and costs to water sellers, third parties negatively affected by groundwater pumping, and regulators. LTWT excludes these costs as well.

Response
An EIS is not required to contain a cost-benefit analysis if such an analysis is not relevant to the choice among action alternatives. Water transfer prices are negotiated between buyers and sellers. Mitigation and monitoring costs are incorporated in the price for water transfers. Reclamation also incurs costs for reviewing water transfer proposals and monitoring. These costs are not required to be disclosed in a NEPA document.

Comment NG02-44

Comment
The monitoring and mitigation programs include inherent conflicts of interests. The monitoring program as described in the LTWT is vague and depends on sellers implementing the program. This conflict of interest pits financial gain from water sales against complete and impartial monitoring efforts. This opens the door to lax, biased, or incomplete monitoring, which could lead to negative environmental and economic consequences for third parties not part of the water transfers. The monitoring program includes provisions for a coordination plan that would share information among “well operators and other decision makers.” [Footnote: LTWT, page 3.3-89.] Such confidential results would keep other stakeholders in the dark regarding the impacts of water transfers. Given the fact that multiple wells belonging to multiple property owners can access the same groundwater aquifer, and that groundwater pumping can affect flows of surface water, such a confidential program seems counter to the wellbeing of the regional economy in the sellers area. An open monitoring program with public results would better communicate the potential environmental and economic risks of groundwater pumping in support of water transfers. If the seller’s monitoring program finds that water sales are causing “substantial adverse impacts” [Footnote: LTWT, page 3.3-90] the seller will be responsible for implementing a mitigation program. The conflict of interest is obvious.

One method of avoiding the obvious conflicts of interests is requiring monitoring by independent third parties not involved with or affected by groundwater pumping in support of water transfers. Such monitoring could be detailed, transparent and public, which would alleviate concerns over the risks and consequences of negative environmental and economic effects of groundwater pumping. Mitigation decisions and requirements should likewise be detailed, transparent and public for the same reasons.

Response
See Common Response 6. Reclamation is responsible for ensuring that appropriate monitoring and mitigation is completed as needed for each transfer (as indicated in Appendix K, the Mitigation Monitoring and Reporting Plan). Buying and selling agencies involved in transfers are public information; however, Reclamation and sellers keep personal information on individual growers who participate confidential for privacy and security purposes. A third party is not needed to conduct oversight.

Comment NG02-45

Comment
Insufficient monitoring period. As described in the LTWT, groundwater levels would be monitored through March of the year following a transfer. It's not clear that this limited monitoring period is sufficiently long enough to track potential impacts on groundwater of water transfers. For example, the report cited above for the NCWA states, "…[G]roundwater changes can take many years to become apparent, and we have not yet been able to measure with certainty the long-term impacts of the current level of groundwater use as it affects our measures of sustainability." [Footnote: DMW, 2014, page 10]

An insufficient monitoring period could underestimate the impacts of groundwater pumping on groundwater levels and impacts on stream flow depletions. Lowering groundwater level and increasing stream flow depletions would generate negative environmental and economic impacts. The monitoring period in the LTWT may cause analysts to underestimate the environmental and economic effects of the water-transfers alternatives.

Response
See Common Responses 6 and 7.

Comment NG02-46

Comment
Insufficient monitoring for land subsidence. The monitoring program includes monitoring subsidence, however, the program is vague on monitoring requirements and what amount of subsidence would trigger a halt in water transfers. Custis describes a number of technical deficiencies in the proposed mitigation plan. "The Draft EIS/EIR should be able to provide the specific thresholds of subsidence that will trigger the need for additional extensometer monitoring, continuous GPS monitoring, or extensive land-elevation benchmark surveys by a licensed surveyor as required by GW-1. The Draft EIS/EIR should also specify in mitigation measure GW-1, the frequency and methods of collecting and reporting subsidence measurements, and discuss how the non-participating landowners and the public can obtain this information in a timely manner. In addition, the Draft EIS/EIR should provide a discussion of the thresholds that will trigger implementation of the reimbursement mitigation measure required by GW-1 for repair or modifications to infrastructure damaged by non-reversible subsidence, and the procedures for seeking monetary recovery from subsidence damage [citation omitted]." "Specific 'strategic' subsidence monitoring locations should be given in mitigation measure GW-1 based on analysis of the susceptible infrastructure locations and the potential subsidence areas." [Footnote: Custis 2014, page 28.]

Implementing the Custis recommendations will take time and financial resources for water sellers, local jurisdictions and third parties negatively affected by groundwater pumping. The LTWT does not include the costs of these measures in the analysis. Thus, the costs of the water transfers described in the LTWT underestimate the true costs of the program.

Response
Refer to Common Response 7 for more information regarding subsidence monitoring and mitigation.

Comment NG02-47

Comment
Vague significance criteria. The mitigation program includes a number of vague descriptions of critical components. Relevant missing descriptions include details on: 1. How regulators and stakeholders would define “substantial adverse impacts” from groundwater pumping. 2. What constitutes a “significant” increase in pumping costs suffered by injured third parties. 3. Required modifications to damaged third-party infrastructure or the installation of new infrastructure. 4. The procedure that injured third parties would use when making claims against a seller. 5. The procedure that regulators and stakeholders would use when investigating third-party claims. 6. What constitutes “legitimate significant effects” on third parties. [Footnote: LTWT, page 3.3-88 through -91]

A vague and ill-defined mitigation program increases risks of environmental and economic harm, and shifts the costs of such harm from water sellers to third parties and society in general. The analysis described in the LWTW does not identify, describe or quantify these risks, costs and consequences. A related point is that the LTWT makes no mention of BOR addressing these or similar issues as part of reviewing past annual water transfers. Including such information from past water transfers – if BOR considered these effects – in the LWTW could help illustrate or describe the uncertainties listed above.

Response
See Common Response 6.

Comment NG02-48

Comment
The mitigation plan puts costs on to injured third parties. Injured third parties bear the costs of bringing to the sellers’ attention harm caused by groundwater pumping. Also, the LTWT states that proposed mitigation options would be developed “in cooperation” [Footnote: LTWT page 3.3-91.] with injured third parties. This approach places costs on injured third parties rather than on sellers. That is, those who would not benefit financially from the program bear the costs of bringing negative impacts to the sellers’ attention. They also would incur costs of documenting and presenting their damages in the context of an ill-defined mitigation program. This raises equity concerns that those suffering

costs of the program bear the additional costs of identifying, describing and calling attention to their costs. The analysis described in the LTWT further assumes that disagreements regarding third-party damages would be settled cooperatively, without presenting evidence substantiating such an optimistic assumption. The LTWT is silent on the economic consequences of sellers and injured third parties not cooperatively agreeing on harm and compensation. As we note above, information the BOR collected from past water transfers may help inform the types and amounts of costs that injured third parties could incur as a result of the water transfers at issue in the LTWT.

Response
See Common Response 6.

Comment NG02-49

Comment
BOR's role in monitoring and mitigation. The LTWT describes a substantive role for BOR in the monitoring and mitigation program, without specifics of how BOR would implement its responsibilities. Topic not addressed include: 1. The costs to BOR of monitoring and mitigation. 2. The details of interactions between sellers, injured third parties, and BOR staff regarding the details of monitoring and mitigation. 3. The details of collecting, organizing and publishing relevant details of monitoring and mitigation. 4. The details of decision making processes that affect monitoring and mitigation. 5. The details of interactions between BOR and other federal or state agencies, and BOR and local jurisdictions.

Response
The Mitigation Monitoring and Reporting Plan is included as Appendix K in the Final EIS/EIR, and it includes more information about mitigation and monitoring responsibilities. See Common Response 14.

Comment NG02-50

Comment
Lead CEQA agency. SLDMWA is the lead state agency regarding CEQA compliance. It is also one of three potential buyers for the transferred water. [Footnote: LTWT EIS/EIR, Table 1-2, page 1-5. The other two buyers are Contra Costa Water District and the East Bay Municipal Utility District.] This arrangement creates a conflict of interest in that the lead CEQA agency also has a self interest in facilitating the water transfers. As described on their website, SLDMWA delivers approximately 3 million af of water to member agencies. [Footnote" SLDMWA web site, www.sldmwa.org/learn-more/about-us/.] SLDMWA has a financial and operational interest in delivering water to its members. Thus, SLDMWA is not an impartial agent. The LTWT provides no information on why SLDMWA is the lead state agency and not the California Department of Water Resources.

Response
See Common Response 1.

Comment NG02-51

Comment
6 The LTWT ignores the economic costs of environmental externalities and subsidies that water transfers support. The LTWT lists Westlands Water District as one of the CVP contractors expressing interest in purchasing transfer water. [Footnote: LTWT, page 1-5] The environmental externalities caused by agricultural production in Westlands are well documented, as are the economic subsidies that support this production. To the extent that the water transfers at issue in the LTWT facilitate agricultural production in Westlands, they also contribute to the environmental externalities and economic subsidies of that production. The LTWT is silent on these environmental and economic consequences of the water transfers.

Response
Water transfers are one of several management actions favored under state and federal law. Chapter 3 evaluates effects of water transfers on environmental resources in the buyer service area. Potential impacts are fully disclosed and have not been ignored. Specifically, Section 3.3 discusses the effects to water quality of the use of water transfers on agricultural land in the buyer service area, including Westlands Water District. Economic subsidies are set by government policies outside of the scope of potential activities evaluated in this EIS/EIR.

Comment NG02-52

Comment
In this section we summarize recent information on the environmental externalities and economic subsidies of agricultural production on Westlands that water transfers would support.

The environmental and economic externalities of Westlands have a long history. For decades, high levels of selenium have posed a serious environmental threat to drinking water, soil quality, and agriculture in the Westlands Water District. [Footnote: Environmental Working Group. 2010a, September 28. Throwing Good Money at Bad Land. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land] This naturally occurring element leaches into soil and drinking water when irrigation water is applied and when significant levels accumulate, has been known to cause deformities and death in wildlife and human beings. [Footnote: Environmental Working Group. 2010a, September 28. Throwing Good Money at Bad Land. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land] The most extreme example of this type of degradation occurred from 1981-1986 during the

Kesterson Disaster, when the federally operated San Luis Unit diverted selenium- rich wastewater into the Kesterson National Wildlife Refuge, killing over one thousand birds and causing severe birth defects. [Footnote: Environmental Working Group. 2010a, September 28. Throwing Good Money at Bad Land. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land; Environmental Working Group. 2010b, September 28. U.S. Taxpayers Paid nearly $60 million to Farmers on Westlands Toxic Lands. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land; Luoma, Samuel N. and Teresa S. Presser. (2000). Forecasting Selenium Discharges to the San Francisco Bay-Delta Estuary: Ecological Effects of a Proposed San Luis Drain Extension. U.S. Geological Survey. (Open-File Report 00-416). Menlo Park, California.]

Response
See response to Comment NG02-51.

Comment NG02-53

Comment
Current environmental concerns. Since the Kesterson Disaster, the Westlands has followed a “no-discharge policy” where irrigated wastewater is reused on agricultural land or stored in groundwater aquifers. [Footnote: State of California. Central Valley Regional Water Quality Control Board. Irrigated Lands Program – Development of the Long-term Program. http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/new_waste_discharge_requirements/western_tulare_lake_basin_area_wdrs/index.shtml#octdec2013.] In spite of the well-documented concerns regarding selenium contaminated runoff from Westlands, as yet there is no official monitoring of selenium levels in the district. [Footnote: State of California. Central Valley Regional Water Quality Control Board. Irrigated Lands Program – Development of the Long-term Program. http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/new_waste_discharge_requirements/western_tulare_lake_basin_area_wdrs/index.shtml#octdec2013.] The San Luis Act (1960) gives the BOR, not the Westlands Water District, responsibility for disposing of Westland Water, [Footnote: US Bureau of Reclamation. 2012a, August 7. CVP Ratebooks - Irrigation, 2012. Retrieved from http://www.usbr.gov/mp/cvpwaterrates/ratebooks/irrigation/2012/index.html; U.S. Bureau of Reclamation. 2012b, September. San Luis Unit Drainage, Central Valley Project. Reclamation: Managing Water in the West. Retrieved from http://www.usbr.gov/mp/PA/docs/fact_sheets/San_Luis_Drainage.pdf.] but as of yet neither entity has implemented any meaningful solution. This failure prompted the Westlands District to bring a lawsuit against the BOR in 1995, which was finally brought to the Ninth Circuit Court of Appeals in 2000. [Footnote: US Bureau of Reclamation. 2012a, August 7. CVP Ratebooks - Irrigation, 2012. Retrieved from

http://www.usbr.gov/mp/cvpwaterrates/ratebooks/irrigation/2012/index.html; U.S. Bureau of Reclamation. 2012b, September. San Luis Unit Drainage, Central Valley Project. Reclamation: Managing Water in the West. Retrieved from http://www.usbr.gov/mp/PA/docs/fact_sheets/San_Luis_Drainage.pdf.] The court upheld a lower court's decision to force the BOR to provide drainage to the district but allowed that solutions other than a drain might be considered. [Footnote: US Bureau of Reclamation. 2012a, August 7. CVP Ratebooks-Irrigation, 2012. Retrieved from http://www.usbr.gov/mp/cvpwaterrates/ratebooks/irrigation/2012/index.html; U.S. Bureau of Reclamation. 2012b, September. San Luis Unit Drainage, Central Valley Project. Reclamation: Managing Water in the West. Retrieved from http://www.usbr.gov/mp/PA/docs/fact_sheets/San_Luis_Drainage.pdf.]

At first, it seemed that large-scale retirement of farmland was the solution favored by both the Westlands and the federal government. [Footnote: Westlands Water District. 2001, October 16. Why Land Retirement Makes Sense for Westlands Water District. Westlands Water District.] In 2001, the District released a fact sheet entitled "Why Land Retirement Makes Sense for the Westlands Water District" advocating for a possible deal with the federal government that would retire up to 200,000 acres of agricultural land. According to the federal government's National Economic Development analysis, this option would result in an economic gain of $3.6 million per year excluding any additional savings as a result of reduced crop subsidies. [Footnote: Westlands Water District. 2001, October 16. Why Land Retirement Makes Sense for Westlands Water District. Westlands Water District; Sharp, Renée. 2010, September 28. Throwing Good Money at Bad Land. Environmental Working Group. Retrieved from http://www.ewg.org/agmag/2010/10/throwing-good-money-after-bad-lands.] Instead, after more than a decade of negotiations, the federal government and the Westlands Water District finally signed an agreement in 2014 which lifts the federal government's obligation to provide drainage to the district, forgives the nearly $400 million the district owes to the federal government for its part in the construction of the Central Valley Project (CVP), assures the district almost 900,000 acre---‐feet of water per year from the CVP, and requires only 100,000 acres of land be retired. [Footnote: California Water Impact Network. 2014, October 16. Obama Selling Out California to Westlands Water District. California Water Impact Network. Retrieved from http://www.c-win.org/content/media-release-obama-selling-out-california-westlands-water-district-secret-deal-forgives-gov; US Department of the Interior. 2013, December 6. PRINCIPLES OF AGREEMENT FOR A PROPOSED SETTLEMENT BETWEEN THE UNITED STATES AND WESTLANDS WATER DISTRICT REGARDING DRAINAGE. Retrieved from www.c-win.org/webfm_send/453; Boxall, Bettina. 2014, October 21. Amid California's drought, a bruising battle for cheap water. Los Angeles Times. Retrieved from http://www.latimes.com/local/california/la-me-westlands-20141021-story.html#page=2.] This leaves over 100,000 more acres of selenium---‐degraded land that the Westlands Water District will now need to decide how to drain in the years to come. [Footnote: Environmental Working Group. 2010a, September 28. Throwing Good Money at Bad Land. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land.] In addition, while the BOR's Environmental Assessment found that there would be no significant environmental impact as a result of the interim renewal contracts with the Westlands and other CVP districts, several environmental groups have criticized the study as violating federal environmental requirements, including the National Environmental Policy Act of 1969. [Footnote: US Bureau of Reclamation. 2013, December 7. Central Valley Interim Renewal Contracts for Westlands Water District, Santa Clara Valley Water District, and Pajaro Valley Water Management Agency 2014-2016. (FONSI-13-023). Sacramento, CA; Minton, Jonas, Kathryn Phillips, et al. 2014, January 14. The Environmental Assessment [EA] for Westlands Water District et. al. Central Valley Project Interim 6 Contract Renewals for Approximately 1.2 MAF of water [Letter to Rain Emerson, Bureau of Reclamation].]

Response

Constituents of concern are considered as part of the impact evaluation for water quality.

Comment NG02-54

Comment

Economic subsides to the Westlands water district. As the largest water district in California and the largest recipient of water under the Central Valley Project, the Westlands Water District receives significant crop, water, and power subsidies to supplement its agricultural activities. According to a report by the Environmental Working Group, between 2005 and 2009, the federal government issued almost $55 million of counter cyclical and direct crop subsidies to 356 individuals in the district. [Footnote: Environmental Working Group. 2010a, September 28. Throwing Good Money at Bad Land. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land; Environmental Working Group. 2010b, September 28. U.S. Taxpayers Paid nearly $60 million to Farmers on Westlands Toxic Lands. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land.] The district's 350 farms networks are entitled to over 1.1 million acre-feet of water per year, more than twice the allocation of the City of Los Angeles. [Footnote: Boxall, Bettina. 2014, October 21. Amid California's drought, a bruising battle for cheap water. Los Angeles Times. Retrieved from http://www.latimes.com/local/california/la-me-westlands-20141021-story.html#page=2; Environmental Working Group. 2005, September 14. Soaking Uncle Sam: Why Westlands Water District's New Contract is All Wet. Environmental Working Group. Retrieved from http://www.ewg.org/research/soaking-uncle-sam.] In 2002, the group estimated that the federal government paid $110 million per year in water subsidies, making its water drastically less expensive than that allocated to urban households. [Footnote: Boxall, Bettina. 2014, October 21. Amid California's drought, a bruising battle for cheap water. Los Angeles Times. Retrieved from http://www.latimes.com/local/california/la-me-westlands-20141021-story.html#page=2; Environmental Working Group. 2005, September 14. Soaking Uncle Sam: Why Westlands Water District's New Contract is All Wet. Environmental Working Group. Retrieved from http://www.ewg.org/research/soaking-uncle-sam; Environmental Working Group. 2007, May 30. Power Drain: The Biggest Winner: Westlands. Environmental Working Group. Retrieved from http://www.ewg.org/research/power-drain/biggest-winner-westlands.] In 2002, the Westlands Water District received more than $70 million in power subsidies. Although the Westlands receives 25% of all water from the CVP, it consumes 60% of the electricity required to deliver water to all districts and 60% of all government granted power subsidies to the CVP. [Footnote: Environmental Working Group. 2007, May 30. Power Drain: The Biggest Winner: Westlands. Environmental Working Group. Retrieved from http://www.ewg.org/research/power-drain/biggest-winner-westlands.]

As mentioned above, the federal government has subsidized the Central Valley Project since its construction. While farmers were meant to pay $1 billion of the $3.6 billion project cost fifty years after its completion, it's estimated that by 2008, only 20% of that debt had been repaid. [Footnote: Environmental Working Group. 2010a, September 28. Throwing Good Money at Bad Land. Environmental Working Group. Retrieved from http://www.ewg.org/Throwing-Good-Money-at-Bad-Land.]

Response

See response to Comment NG02-51.

Comment NG02-55

Comment

7 The LTWT underestimates the cumulative effects of water transfers. Cumulative effects analyses under NEPA and CEQA are intended to identify impacts that materialize or are compounded when the proposed action is implemented at the same time as or in conjunction with other actions. In Chapters 3 and 4, the LTWT addresses cumulative effects for each resource area and provides a global description of the methods and actions considered for analysis in each resource area. Section 3.10 provides a cursory discussion of potential cumulative effects for the regional economy, but ignores the full range of possible cumulative outcomes associated with the proposed action.

According to NEPA and CEQA requirements, cumulative effects analysis must examine the possibility of effects occurring across several dimensions. When multiple projects produce effects within the same geographic and temporal range, they may: 1. Expand or contract the set of possible impacts. 2. Increase or decrease the likelihood of specific potential impacts. 3. Accelerate or decelerate the timing of specific potential impacts. 4. Change the trajectory of potential impacts. 5. Increase or decrease the economic importance of specific potential impacts. 6. Shift the distribution of uncertainty or risk borne by different groups.

Cumulative effects may arise as multiple projects interact in a linear fashion, resulting in impacts that are additive. Interactions might also be non-linear, either offsetting each other to be less than additive, or exacerbating each other to be greater than additive. The LTWT does not adequately consider cumulative effects within this framework, so misses important interactions that could result in significant impacts beyond those identified for the project alone.

One of the greatest potential sources of cumulative impacts is non-CVP water transfers. Although transfers under the SWP were considered, the possibility of other transfers occurring was not. Additional transfers would have similar impacts in the sellers' region, and may also lead to net effects that exceed sustainable thresholds and have a larger impact than each would individually. For example, the analysis 1. Ignores cumulative effects of additional water transfers on water prices, and fails to examine the effects of price on the decisions and behaviors of farmers in the context of other water transfers. 2. Ignores effects resulting from additional water transfers that have the potential to influence agricultural prices, and how those agricultural prices influence decisions about water transfers. 3. Treats effects as "temporary" and thus not significant, and thereby fails to adequately account for potential thresholds in the local agricultural economy where short-term effects would become long-term effects. 4. Assumes mitigation for groundwater effects of the proposed action would make farmers whole, so fails to properly account for potential threshold effects in groundwater resources, and associated costs to farmers. 5. Ignores the possibility that increased uncertainty related to groundwater levels, agricultural market conditions, etc. from the proposed action, in conjunction with other actions, would adversely affect farmers. 6. Ignores the cumulative effects of additional water transfers on environmental resources and conditions including aquatic, riparian, terrestrial and avian species and habitats.

Response

Transfers that move water out of the Sacramento Valley must convey water through state or federal facilities. CVP transfers are covered in the Proposed Action and DWR helped to identify SWP transfers that are covered in the cumulative analysis. Refuge water transfers have been added to the cumulative analysis. Additional transfers would not occur without Reclamation or DWR approval; therefore, all relevant transfers were evaluated in the cumulative analysis. The cumulative effects of all water transfers are discussed in all resource sections in Chapter 3, including those that address fisheries and vegetation and wildlife.

Comment Letter NG03, Barbara Vlamis, Bill Jennings, Jason Flanders, AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group

Comment NG03-1

Comment
AquAlliance, California Sportfishing Protection Alliance ("CSPA"), and Aqua Terra Aeris submit the following comments and questions for the Bureau of Reclamation ("Bureau") and the San Luis Delta Mendota Water Authority's ("SLDMWA") ("Lead Agencies") Draft Environmental Impact Statement ("EIS") and Environmental Impact Report ("EIR") ("EIS/EIR"), for the 2015-2024 Long Term North-to-South Water Transfer Program ("Project" or "2015-2024 Water Transfer Program").

AquAlliance exists to sustain and defend northern California waters. We have participated in past water transfer processes, commented on past transfer documents, and sued the Bureau twice in the last five years. In doing so we seek to protect the Sacramento River's watershed in order to sustain family farms and communities, enhance Delta water quality, protect creeks and rivers, native flora and fauna, vernal pools and recreational opportunities, and to participate in planning locally and regionally for the watershed's long-term future. The 2015-2024 Water Transfer Program is seriously deficient and should be withdrawn. If the Bureau and DWR are determined to purse water transfers from the Sacramento Valley, AquAlliance requests that the agencies regroup and prepare an adequate programmatic EIS/EIR.

This letter relies significantly on, references, and incorporates by reference as though fully stated herein, for which we expressly request that a response to each comment contained therein be provided, the following comments submitted on behalf of AquAlliance:

- Custis, Kit H., 2014. Comments and recommendations on U.S. Bureau of Reclamation and San Luis & Delta-Mendota Water Authority Draft Long-Term Water Transfer DRAFT EIS/EIR, Prepared for AquAlliance. ("Custis," Exhibit A)

- ECONorthwest, 2014. Critique of Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report Public Draft, Prepared for AquAlliance. ("EcoNorthwest," Exhibit B)

- Mish, Kyran D., 2014. Comments for AquAlliance on Long-Term Water Transfers Draft EIR/EIS. ("Mish," Exhibit C)

- Cannon, Tom, Comments on Long Term Transfers EIR/EIS, Review of Effects on Special Status Fish. Prepared for California Sportfishing Protection Association. ("Cannon," Exhibit D)

In addition, we renew the following comments previously submitted, attached hereto, as fully bearing upon the presently proposed project and request:

- 2009 Drought Water Bank ("DWB"). (Exhibit F)

- 2010-2011 Water Transfer Program. (Exhibit G)

- 2013 Water Transfer Program. (Exhibit G)

- 2014 Water Transfer Program. (Exhibit G)

- C-WIN, CSPA, AquAlliance Comments and Attachments for the Bay Delta Conservation Plan's EIS/EIR. (Exhibit H)

- AquAlliance's comments on the Bay Delta Conservation Plan's EIS/EIR. (Exhibit H)

- CSPA's comments on the Bay Delta Conservation Plan's EIS/EIR. (Exhibit H)

Response
See Common Response 2. The comment letters provided by Custis, ECONorthwest, Mish, and Cannon have been responded to individually as letters NG01, NG02, NG04, and NG05, respectively. The comments and documents contained in Exhibits F-H pertain to other actions and projects separate from, and independent of, the action alternatives under consideration. Written responses to these materials have been provided (or will be provided) in conjunction with the final NEPA/CEQA environmental review documents for those other actions/projects.

Comment NG03-2

Comment
I. The EIS/EIR Contains an Inadequate Project Description.

A "finite project description is indispensable to an informative, legally adequate EIR." County of Inyo v. City of Los Angeles (1977) 71 Cal.App.3d 185, 192. CEQA defines a "project" to include "the whole of an action" that may result in adverse environmental change. CEQA Guidelines § 15378. A project may not be split into component parts each subject to separate environmental review. See, e.g., Orinda Ass'n v. Board of Supervisors (1986) 182 Cal.App.3d 1145, 1171; Riverwatch v. County of San Diego (1999) 76 Cal.App.4th 1428. Without a complete and accurate description of the project and all of its components, an accurate environmental analysis is not possible. See, e.g., Santiago County Water Dist. v. County of Orange (1981) 118 Cal.App.3d 818, 829; Sierra Club v. City of Orange (2008) 163 Cal.App.4th 523, 533; City of Santee v. County of San Diego (1989)214 Cal.App.3d 1438, 1450; Blue Mountains Biodiversity Project v. United States Forest Service, 161 F.3d 1208, 1215 (9th Cir. 2008). As discussed, below, and in the expert reports submitted by Custis, EcoNorthwest, Cannon, and Mish on behalf of AquAlliance, the EIS/EIR fails to comport with these standards.

Response
The EIS/EIR includes three action alternatives that describe a full and complete set of measures to address the purpose and need and project objectives. See Common Response 14.

Comment NG03-3

Comment
a. The Project / Proposed Action Alternative Description Lacks Detail Necessary for Full Environmental Analysis.

Actual transfer buyers, sellers, modes, amounts, criteria, market demands, availability, and timing, are undisclosed.

The Proposed Action Alternative is poorly specified and needs additional clarity before decision-makers and the public can understand its human and environmental consequences. The Lead Agencies tacitly admit that they have no idea how many acre-feet of water may be made available, by what mechanism the water may be made available (fallowing, groundwater substitution, or crop changes), or to what ultimate use (public health, urban, agricultural) the water may be put.

Glenn Colusa Irrigation District is listed as the largest potential seller, but its General Manager, Thad Bettner, asserted publicly on October 7, 2014 that the district hadn't committed to the 91,000 AF found in Table ES-2 (Potential Sellers). GCID subsequently sent the Bureau a letter that states that GCID plans to pursue its own Groundwater Supplemental Supply Program and that, "It is important for Reclamation to understand that GCID has not approved the operation of any District facilities attributed to the LTWTP Action/Project that is presented in the draft EIR/EIS." The letters continues stating that, "It is important to underscore that GCID would prioritize pumping during dry and critically dry water years for use in the Groundwater Supplemental Supply Program, and thus wells used under that program would not otherwise be available for the USBR's LTWTP." First, these public and written comments contradict the EIS/EIR on page 3.8-37 where it states that, "The availability of supplies in the seller service area was determined based on data provided by the potential sellers." Second, the largest potential seller in the 2015-2024 Water Transfer Program is seemingly unable or unwilling to participate in the groundwater substitution component during dry and critically dry years. In addition, GCID has stated that "it will not participate in a groundwater substitution transfer, and for land idling reduce the acreage from 20,000 acres to no more than 10,000 acres." Similarly, the Sacramento Suburban Water District received $2 million from the Governor's Water Action Plan to move groundwater to member agencies that have been "[h]eavily dependent on

Folsom reservoir," according to John Woodling of the Sacramento Regional Water Authority. 3 Woodling continues that, "During these dry times, the groundwater basin really is our insurance policy," (Id). Knowing that smart water managers are very aware of this fact, why would Sacramento Suburban Water District turn around and propose to sell 30,000 AF of water to the out-of-region buyers through groundwater substitution transfers during the Project's "[d]ry and critically dry years"? In short, the EIS/EIR has no way of knowing what transfers may occur, and when.

Response
Chapter 2 identifies potential sellers, types of transfer actions, upper limits of water potentially available for transfer actions, and timing of the potential transfer actions in Table 2-5 (for Alternative 2), Table 2-7 (for Alternative 3), and Table 2-8 (for Alternative 4). Because the source of transfers could shift between years, all transfers identified in Chapter 2 are included in the environmental analysis in Section 3. See responses to comment letters LA05 and LA06 to better understand potential transfers from Glenn-Colusa ID. Sacramento Suburban WD indicates a maximum transfer of up to 30,000 AF, but this transfer would only occur in years when the transfer fits into the district's overall water management plans.

Comment NG03-4

Comment
It is also not possible to determine with confidence just how much water is requested by potential urban and agricultural buyers and how firm the requests are. What are SLDMWA's specific requests for agricultural or urban uses of Project water? What are the SLDMWA's present agricultural water demands for the 850,000 acres that it serves? Left to guess at the possible requests for water, we look at the 2009 DWB where there were between 400,000 and 500,000 AF of presumably urban buyer requests alone (which had priority over agricultural purchases, according to the 2009 DWB priorities) and a cumulative total of less than 400,000 AF from willing sellers. It is highly possible, based on the example during the 2009 DWB, that many buyers are not likely to have their needs addressed by the 2015-2024 Water Transfer Program. How would this affect the project objectives and purpose? How would this affect variable circumstances for other proposed transfers?

The EIS/EIR also fails to address the ability and willingness of potential buyers to pay for Project water given the supplies that may be available. Complaints from agricultural water districts were registered in the comments on the Draft Environmental Water Account EIS/EIR and reported in the Final EIS/EIR in January 2004 indicating that they could not compete on price with urban areas buying water from the EWA. Given the absence of priority criteria, will agricultural water buyers identified in Table ES-1 have the ability to buy water when competing with urban districts? Moreover, since buyers are not disclosed in the EIS/EIR for non-CVP river water, these further effects on water market conditions and competition between agricultural and urban sectors is impossible to evaluate. Who are the buyers that may request non-CVP river water, and what are their maximum requests? That DWR is not the CEQA lead agency further complicates the evaluation of competition for water in the EIS/EIR.

Response

Demands for transfers are driven by overall water demands in each buyer's district and supplies available in each year. The buyers develop a water needs assessment to estimate their future agricultural and M&I water demands. The agricultural water demands are based on crop water requirements and take into account irrigation efficiency, precipitation, acreage, and conveyance lossses. The urban water demands are based on population and per capita demands for residential water demand and total industrial and commerical needs, and also account for losses. The districts compare demands to water sources, including CVP water, and quantities to determine water needs. The districts assume full CVP water contract deliveries for quantities, but, as seen in past years, often receive only a percentage of their CVP contract allocations. This creates a need for supplemental supplies, including water transfers. The following are some examples of buyers' water needs assessments and the resulting demand for water transfers.

- Del Puerto Water District has estimated future agricultural demands to be 142,735 AF and assumes maximum CVP Contract Total supplies of 140,210 AF and groundwater supply of 3,000 AF.
- Mercy Springs Water District has estimated future agricultural water demands to be 16,765 AF and has estimated unmet water demands to be 9,725 AF. The district has a Contract Total of 7,040 AF.
- Pacheco Water District has estimated future agricultural water demands to be 11,630 AF and has a Contract Total of 10,080 AF and local supplies of 4,399 AF.
- Panoche Water District has estimated a total future agricultural water demand of 92,816 AF and has a Contract Total of 94,000 AF.
- San Benito County Water District has total future agricultural and M&I demands of 60,158 AF and a Contract Total of 43,000 AF and groundwater supply of 26,000 AF.
- San Luis Water District has estimated a total future agricultrual water demand of 119,356 AF and a Contract Total of 125,080 AF and groundwater supply of 5,000 AF.
- Santa Clara Valley Water District has estimated total future agricultural and M&I water demands of 595,574 AF. Total future supplies include a

Contract Total of 152,500 AF, SWP supply of 74,000 AF, local supply of 164,800, transfers or recycled water of 14,400 AF, and groundwater supply of 33,000 AF, for a total of 438,700 AF. The district estimates an unmet demand of 156,874 AF.

- Westlands Water District has estimated total future agricultural water demands of 1,228,398 AF and M&I demand of 4,938 AF. The district has a Contract Total of 1,150,000 AF and groundwater supply of 175,000 AF.

As seen in their water needs assessment, the buyers assume a maximum CVP contract delivery to meet future demands. Therefore, any reduction in CVP deliveries can create an unmet demand and potential need for water transfers. Water transfers are not intended to meet all the unmet demands for districts. They are immediate and flexible supplemental supplies to reduce effects of a shortage but are not expected to make up for entire shortages experienced by buyers. Generally, demands for water transfers are greater than the available transfers and the capacity to move water through the Delta; therefore, the EIS/EIR includes upper limits for transfers driven by these two factors (as described in more detail in Appendix B).

Water transfer prices for both CVP and non-CVP supplies are set between willing sellers and willing buyers. Potential SWP buyers of SWP transfers are listed in Table 4-2. SLDMWA has purchased water transfers in past years despite urban water transfers also occurring at sometimes higher prices. Therefore, SLDWMA and its member agencies have not been priced out of the water transfer market and would continue to negotiate water transfers in the future with willing sellers. See response to Comment NG02-34 regarding willingness to pay. See Common Response 1 regarding the CEQA lead agency.

Comment NG03-5

Comment

Nor does the 2015-2024 Water Transfer Program prevent rice growers (or other farmers) from “double-dipping,” but actually encourages it. Districts and their growers have opted to turn back their surface supplies from the CVP and the State Water Project and substitute groundwater to cultivate their rice crop—thereby receiving premiums on both their CVP contract surface water as well as their rice crop each fall when it goes to market. There appear to be no caps on water sale prices to prevent windfall profits to sellers of Sacramento Valley water — especially for crops with high market prices, such as rice.

The EIS/EIR is inadequate because it fails to identify and analyze the market context for crops as well as water that would ultimately influence the size and scope of the 2015-2024 Water Transfer Program.4 The Project’s sellers and buyers are highly sensitive to the influences of prices—prices for water as well as crops such as rice, orchard and vineyard commodities, and other field crops.

It is plausible that crop idling would occur more in field crops, while groundwater substitution would be more likely for orchard and vineyard crops. However, high prices for rice—the Sacramento Valley's largest field crop—undermines this logic and leads to substantial groundwater substitution. These potential issues and impacts should be recognized in the EIS/EIR because crop prices are key factors in choices potential water sellers would weigh in deciding whether to idle crops, substitute groundwater, or decline to participate in the Project altogether.

Response
Reclamation has an approval process in place to ensure that real water is transferred in groundwater substitution and cropland idling transfers. For cropland idling transfers, irrigation of the crop is not allowed. Groundwater substitution allows the crop to be irrigated with groundwater and the grower to produce the crop. See Common Response 14. All transfers are between willing sellers and willing buyers; therefore, growers' participation is voluntary. Growers likely consider crop prices in deciding whether to participate or not. Also, buyers and sellers negotiate the water transfer price, and growers likely consider the water transfer price in their decision to participate in transfers. Reclamation is not involved in setting the price. An EIS/EIR is not required to evaluate costs of an alternative and does not assess a grower's decision to participate in transfers. See response to Comment LA14-14. Economic effects related to third parties are described in Section 3.10. The Proposed Action and alternatives place maximum quantities on all transfer types; therefore, the amount of groundwater substitution and cropland idling that could occur is limited.

Comment NG03-6

Comment
To enable a more complete and discrete project description, the EIS/EIR should propose criteria other than price alone to manage allocation of state water resources. The EIS/EIR should consider some priority criteria as was included in the 2009 Drought Water Bank EA/FONSI (p.3-88). Do both authorizing agencies, the Bureau and DWR, lack criteria to prioritize water transfers? Are transfers approved on a first-come first-serve basis, as generated by market conditions alone? What is the legal or policy basis to act without providing priority criteria? A lack of criteria fails to encourage regions to develop their own water supplies more efficiently and cost-effectively without damage to resources of other regions. If criteria will be applied, these need to be disclosed and analyzed in the EIS/EIR.

Additional uncertainty caused by the incomplete project description includes:

- How many of the proposed transfers would be one year in duration, multi-year, or permanent. How will the duration of any agreement be determined? The duration of a transfer agreement will have dramatic effects on the water market as well as the environmental impact analysis.

- The EIS/EIR purports to be a 10 year project, but is there an actual sunset date, since it continues serially in multiple years? Could any transfer be approved in the next 10 years that would extend beyond 2024?

- The proposed program provides no way to know what ultimate use transferred water will be put to; nor does the EIS/EIR provide any way to know what activities may occur on idled cropland. The EIS/EIR assumptions on these points are inherently incomplete and fail to support any discrete environmental analysis.

In sum, the proposed program provides no way to know which transfers may or may not occur, individually or cumulatively. The lack of a stable and finite project description undermines the entire EIS/EIR. As discussed further, below, description of the environmental setting, evaluation of potentially significant impacts, and formulation of mitigation measures, among other issues, all are rendered unduly imprecise, deferred, and incomplete, subject to the theoretical transfers taking shape at some, unknown, future time.

Response

As discussed in Section 1.5 of the EIS/EIR, the transfers included in this document are not part of a "program" where Reclamation would determine which transfers should move forward based on a set of criteria. The EIS/EIR analyzes transfers that would be negotiated between buyers and sellers, as described in the project description. Reclamation would not prioritize transfers, but would evaluate if transfers should be approved and facilitate the approved transfers. See Common Response 14 for more information about the annual review process.

The EIS/EIR only covers the period through 2024; transfers extending after this date would require subsequent environmental compliance. During the 2015-2024 period, transfers could be single year or multi-year (as discussed in Section 2.3.2.7). If a buyer and seller negotiate a multi-year transfer, it does not mean that water would be transferred every year of the transferring period. Rather, it indicates that a buyer has a first right of refusal for that water, and the buyer could purchase that water in dry years with transfer demand and available capacity to move the water. Reclamation would still need to approve these transfers each year, as discussed in Common Response 14.

Section 1 discusses that the transferred water would be used to meet existing demands for agricultural and municipal and industrial water supply. Because the buyers and sellers cannot predict in which years transfers may be made and the quantity of water that may be available, the full range of potential transfer actions have been analyzed in the EIS/EIR to capture the potential environmental effects.

Comment NG03-7

Comment
Historic transfer data is excluded:

Absent from the DEIS/EIR are any of the required monitoring reports from previous transfer projects. See, e.g., Citizens for East Shore Parks v. State Lands Commission (2010) 48 Cal.App.4th 549; communities for a Better Environment v. South Coast Air Quality Mgmt. Dist. (2010) 48 Cal.App.4th 310. Without the required monitoring reports, the public is left in the dark regarding this new proposal to sell up to 600,000 AF annually over a 10 year period. No information is provided regarding the impacts to downstream users, wells near production wells, the Sacramento River and its tributaries, refuges, water quality, special status species and the San Francisco Bay Delta Estuary from past CVP transfers or cumulatively including non-CVP water transfers in the area of origin. For example, groundwater substitution transfers and transfers that result in reduced flows in combination with below normal water years are known to have to have the potential for significant impacts on water quality, fish, wildlife and the flows in the Sacramento River and its tributaries. Providing all such documentation of the terms, conditions, effects, and outcomes of prior transfers is integral to understanding the proposed Project.

Response
See response to Comment NG02-31.

Comment NG03-8

Comment
The Proposed Project is in Fact a Proposed Program:

The lack of any stable, discrete, project description, at best, renders the proposed project a “program,” rather than any specific project itself. “[A] program EIR is distinct from a project EIR, which is prepared for a specific project and must examine in detail site-specific considerations.” Center for Sierra Nevada Conservation v. County of El Dorado (2012) 202 Cal.App.4th 1156, 1184. As discussed further, below, this EIS/EIR does not and cannot complete site-specific and project-specific analysis of unknown transfers at unknown times. Buyers and sellers have “expressed interest,” but no specific transfers or combination of transfers are proposed, and we don’t know which may be proposed or ultimately approved.

Put differently, the EIS/EIR project description is not simply inadequate: the EIS/EIR fails to propose or approve any project at all. Instead, the EIS/EIR should be recharacterized and revised as a program EIS/EIR. Indeed, agency documents have referred to this program, as such, for years. (E.g., Federal Register /Vol. 75, No. 248 /Tuesday, December 28, 2010 /Notices Long-Term North to South Water Transfer Program, Sacramento County, CA; Final EA/FONSI for 2010-2011 Water Transfer Program.) And other external sources also support the proposition that this EIS/EIR does not and cannot review and approve specific transfers:

"Each transfer is unique and must be evaluated individually to determine the quantity and timing of real water made available." (BDCP DEIR at 1E-2.)

"Although this document seeks to identify in the best and most complete way possible the information needed for transfer approval, to both expedite that approval and to reduce participant uncertainty, each transfer is unique and must be considered on its individual factual merits, using all the information that is available at the time of transfer approval and execution of the conveyance or letter of agreement with the respective Project Agency in accordance with the applicable legal requirements. This document does not pre-determine those needs or those facts and does not foreclose the requirement and consideration of additional information." (Draft Technical Information for Preparing Water Transfer Proposals ("DTIPWTP") 2014.)

Response

Chapter 2 of the EIS/EIR provides a complete description of each of the action alternatives considered in the EIS/EIR, including the location, scope, elements, and implementation timeframe of each alternative. That project description information provided the basis to complete a comprehensive impacts analysis for the implementation of each alternative. Comments claiming that the project description is too general and that the EIR should be recharacterized as a program EIR are similar to the arguments recently rejected by the California Appellate Court in Citizens for a Sustainable Treasure Island v. City and County of San Francisco, (2014) 227 Cal.App.4th 1036. The Court of Appeal essentially rejected the argument of "project EIR" versus "program EIR" as mere semantics, noting that "many different names have been applied to EIRs" and "[f]or this reason, courts strive to avoid attaching too much significance to titles in ascertaining whether a legally adequate EIR has been prepared for a particular project." The Court pointed out that all EIRs must cover the same general content and that "[t]he level of specificity of an EIR is determined by the nature of the project and the "rule of reason" … rather than any semantic label accorded to the EIR." Relative to the lack of certain details within the project description, the Court found "the EIR cannot be faulted for not providing detail that, due to the nature of the Project, simply does not now exist." Merely because "all hypothetical details" were not resolved and the EIR did "not anticipate every permutation or analyze every possibility" did not render its project description misleading, inaccurate, or vague; rather, the project description chapter within the EIR accurately described the Project and "remained accurate, stable, and finite throughout the EIR process." See Common Response 14.

Comment NG03-9

Comment
Indeed, the Bureau and DWR have known for over a decade that programmatic environmental review was and is necessary for water transfers from the Sacramento Valley. The following examples highlight the Bureau and DWR's deficiencies in complying with NEPA and CEQA.

a. The Sacramento Valley Water Management Agreement was signed in 2002, and the need for a programmatic EIS/EIR was clear at that time it was initiated but never completed.

b. In 2000, the Governor's Advisory Drought Planning Panel report, Critical Water Shortage Contingency Plan promised a program EIR on a drought-response water transfer program, but was never undertaken.

c. Sacramento Valley Integrated Regional Water Management Plan (2006).

d. The Sacramento Valley Water Management Plan (2007).

e. The CVPIA mandates the Bureau contribute to the State of California's long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, among other things. (EIS/EIR 1-10.)

Accordingly, the EIS/EIR should be revised to state that it does not and cannot constitute sufficient environmental review of any particular, as-of-yet-unknown, water transfer proposal; and instead be revised, restructured, and recirculated to provide programmatic policies, criteria, and first-tier environmental review.

Response
The activities analyzed under the Proposed Action are different from the efforts cited in the comments, and reflect a range of potential transfers that are driven by buyers and sellers. These parties have provided information on upper limits for transfers, where the transfer would occur, the method to make water available, and how it would be conveyed to the buyer. See Common Response 14.

Chapter 2 of the EIS/EIR provides a complete description of each of the action alternatives considered in the EIS/EIR, including the location, scope, elements, and implementation timeframe of each alternative. That project description information provided the basis to complete a comprehensive impacts analysis for the implementation of each alternative. Comments claiming that the project description is too general and that the EIR should be recharacterized as a program EIR are similar to the arguments recently rejected by the California Appellate Court in Citizens for a Sustainable Treasure Island v. City and County of San Francisco, (2014) 227 Cal.App.4th 1036 (see response to Comment NG03-8).

Comment NG03-10

Comment

The EIS/EIR Improperly Segments Environmental Review of the Whole of this Program:

As discussed throughout these comments, the proposed Project does not exist in a vacuum, but rather is another transfer program in a series of many that have been termed either "temporary," "short term," "emergency," or "one-time" water transfers, and is cumulative to numerous broad programs or plans to develop regional groundwater resources and a conjunctive use system. The 2015-2024 Water Transfer Program is also only one of several proposed and existing projects that affect the regional aquifers.

For example, the proposed Project is, in fact, just one project piece required to implement the Sacramento Valley Water Management Agreement ("SVWMA"). The Bureau has publically stated the need to prepare programmatic environmental review for the SVWMA for over a decade, and the present EIS/EIR covers a significant portion of the program agreed to under the SVWMA. In 2003, the Bureau published an NOI/NOP for a "Short-term Sacramento Valley Water Management Program EIS/EIR." (68 Federal Register 46218 (Aug 5, 2003).) As summarized on the Bureau's current website:

The Short-term phase of the SVWM Program resolves water quality and water rights issues arising from the need to meet the flow-related water quality objectives of the 1995 Bay-Delta Water Quality Control Plan and the State Water Resources Control Board's Phase 8 Water Rights Hearing process, and would promote better water management in the Sacramento Valley and develop additional water supplies through a cooperative water management partnership. Program participants include Reclamation, DWR, Northern California Water Association, San Luis & Delta-Mendota Water Authority, some Sacramento Valley water users, and Central Valley Project and State Water Project contractors. SVWM Program actions would be locally-proposed projects and actions that include the development of groundwater to substitute for surface water supplies, conjunctive use of groundwater and surface water, refurbish existing groundwater extraction wells, install groundwater monitoring stations, install new groundwater extraction wells, reservoir re-operation, system improvements such as canal lining, tailwater recovery, and improved operations, or surface and groundwater planning studies. These short-term projects and actions would be implemented for a period of 10 years in areas of Shasta, Butte, Sutter, Glenn, Tehama, Colusa, Sacramento, Placer, and Yolo counties (Source: http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=788)

The resounding parallels between the SVWMA NOI/NOP and the presently proposed project are not merely coincidence: they are a piece of the same program. In fact, the SVWMA continues to require the Bureau and SLDMWA to facilitate water transfers through crop idling or groundwater substitution: Management Tools for this Agreement. A key to accomplishing the goals of this Agreement will be the identification and implementation of a "palette" of voluntary water management measures (including cost and yield data) that could be implemented to develop increased water supply, reliability, and operational flexibility. Some of the measures that may be included in the palette are: (v) Transfers and exchanges among Upstream Water Users and with the CVP and SWP water contractors, either for water from specific reservoirs, or by substituting groundwater for surface water . . . (Source:http://www.norcalwater.org/wp-content/uploads/2010/12/sac_valley_water_mgmt_agrmt_new.pdf)

Response
The Proposed Action is not part of the Sacramento Valley Water Management Agreement (SVWMA). At this time, the SVWMA is not moving forward and is not considered in the cumulative analysis.

Comment NG03-11

Comment
It is abundantly clear that the Bureau and SLDMWA are proposing a program through the present draft EIS/EIR to implement this management tool, as required by the SVWMA. But neither CEQA nor NEPA permit this approach of segmenting and piecemealing review of the whole of a project down to its component parts. The water transfers proposed for this project will directly advance SVWMA implementation, and the Bureau and DWR must complete environmental review of the whole of the program, as first proposed in 2003 but since abandoned. For example, the draft EIS/EIR does not reveal that the current Project is part of a much larger set of plans to develop groundwater in the region, to develop a "conjunctive" system for the region, and to integrate northern California's groundwater into the state's water supply.

In this vein the U.S. Department of Interior, 2006. Grant Assistance Agreement, Stony Creek Fan Conjunctive Water Management Program and Regional Integration of the lower Tuscan Groundwater formation laid bare the intentions of the Bureau and its largest Sacramento Valley water district partner, Glenn Colusa Irrigation District, to take over the Tuscan groundwater basin to further the implementation of the SVWMA, stating:

GCID shall define three hypothetical water delivery systems from the State Water Project (Oroville), the Central Valley Project (Shasta) and the Orland Project reservoirs sufficient to provide full and reliable surface water delivery to parties now pumping from the Lower Tuscan Formation. The purpose of this activity is to describe and compare the performance of three alternative ways of furnishing a substitute surface water supply to the current Lower Tuscan Formation groundwater users to eliminate the risks to them of more aggressive pumping from the Formation and to optimize conjunctive management of the Sacramento Valley water resources.

Response
See responses to Comments NG03-8 and NG03-10.

Comment NG03-12

Comment
The Project Description Contains an Inadequate Statement of Objectives, Purpose, and Need.

The lack of a stable project description/proposed alternative, as discussed, above, further obfuscates the need for the Project. Further, without programmatic criteria to prioritize certain transfers, the public is not provided with even a basic understanding of the need for the Project. The importance of this section in a NEPA document can't be overstated. "It establishes why the agency is proposing to spend large amounts of taxpayers' money while at the same time causing significant environmental impacts… As importantly, the project purpose and need drives the process for alternatives consideration, in-depth analysis, and ultimate selection. The Council on Environmental Quality (CEQ) regulations require that the EIS address the "no-action" alternative and "rigorously explore and objectively evaluate all reasonable alternatives." Furthermore, a well-justified purpose and need is vital to meeting the requirements of Section 4(f) (49 U.S.C. 303) and the Executive Orders on Wetlands (E.O. 11990) and Floodplains (E.O. 11988) and the Section 404(b)(1) Guidelines. Without a well-defined, well-established and well-justified purpose and need, it will be difficult to determine which alternatives are reasonable, prudent and practicable, and it may be impossible to dismiss the no-build alternative". (Source: Federal Transportation and Highway Administration, 1990. NEPA and Transportation Decision-making: The Importance of Purpose and Need in Environmental Documents. http://www.environment.fhwa.dot.gov/projdev/tdmneed.asp)

With the importance of a Purpose and Need statement revealed above, the Project's version for purposes of NEPA states that, "The purpose of the Proposed Action is to facilitate and approve voluntary water transfers from willing sellers upstream of the Delta to water users south of the Delta and in the San Francisco Bay Area. Water users have the need for immediately implementable and flexible supplemental water supplies to alleviate shortages," (p. 1-2). Noticeably missing from this section of the EIS/EIR is a statement about the Bureau's purpose and need, not the buyers' purpose and need. The omission of any need on the Bureau's part for this Project highlights the conflicts in the Bureau's mission, deficiencies in planning for both the short and long term, and the inadequacy of the EIS/EIR that should provide the public with the basis for the development of the range of reasonable alternatives and the identification and eventual selection of a preferred alternative. The

Reclamation's NEPA Handbook (2012) stresses that, "The need for an accurate (and adequate) purpose and need statement early in the NEPA process cannot be overstated. This statement gives direction to the entire process and ensures alternatives are designed to address project goals." (p.11-1)

For purposes of CEQA, the Project Objectives (p. 1-2) go on to state that,

SLDMWA has developed the following objectives for long-term water transfers through 2024:

- Develop supplemental water supply for member agencies during times of CVP shortages to meet existing demands.
- Meet the need of member agencies for a water supply that is immediately implementable and flexible and can respond to changes in hydrologic conditions and CVP allocations.

Because shortages are expected due to hydrologic conditions, climatic variability, and regulatory requirements, transfers are needed to meet water demands.

But merely asserting that there are "demands" from their member lacks context, specificity, and rigor. It also fails to mention the need of the non-member buying agencies involved in the Project.

Response
The Lead Agencies establish the purpose and need and project objectives to best describe their underlying reasons for considering an action. Reclamation is not prioritizing transfers because this effort is not a "program" led by Reclamation, but rather a range of potential individual transfers that may be negotiated by the sellers and buyers. Reclamation would not prioritize the transfers, but would review and approve (if appropriate) each proposed transfer on an equal level.

Comment NG03-13

Comment
Some context for the policy failures that lead to the stated need for the Project must be presented. First, the hydrologic conditions described on pages ES-1, 1-1, and 1-2 almost always apply to the entire state, including the region where sellers are sought, not just the areas served by SLDMWA and non-member buyers as presented here. Second, SLDMWA has chronic water shortages due to its contractors' junior position in water rights, risks taken by growers to plant permanent crops, and serious long-term overdraft in its service area. Where is this divulged? Third, SLDMWA or its member agencies have sought to buy and actually procured water in many past water years to make up for poor planning and risky business decisions, which violates CEQA's prohibition against segmenting a project to evade proper environmental review. The habitual

nature of the transfers is acknowledged on pages ES-1 and 1-1 stating, “In the past decades, water entities have been implementing water transfers to supplement available water supplies to serve existing demands, and such transfers have become a common tool in water resource planning.” (See Table 1 for an attempt at documenting transfers since actual numbers are not disclosed in the EIS/EIR).

Response
See response to Comment LA02-3. The Draft EIS/EIR did consider alternatives that would change cropping patterns or retire land in the buyers area (see Table 2-1 and Appendix A), but these alternatives did not move forward because they did not meet most of the purpose and need and project objectives. Table 1-3 shows historic transfers to the buyers in this document; each of these transfers had independent utility and did not rely on other transfers.

Comment NG03-14

Comment
The Bureau and DWR‘s facilitation of so-called “temporary” annual transfers in 12 of the last 14 years is illustrated in Table 1 (2014 transfer totals have not been tallied to date). {See Table 1 in comment letter}.

The Project has become an extension of the so-called “temporary” annual transfers based on the demands of junior water rights holders who expect to receive little contract water during dry years. The low priority of their junior water service contracts within the Central Valley Project leaves their imported surface supplies in question year-to-year. It is the normal and appropriate function of California‘s system of water rights law that makes it so. Yet the efforts of the Bureau and DWR to oversee, approve, and facilitate water sales from the Sacramento, Feather, and Yuba rivers with fallowing and groundwater substation are only intended to benefit the few western San Joaquin Valley farmers whose contractual surface water rights have always been less reliable than most—and whose lands are the most problematic for irrigation. These growers have chosen to harden demand by planting permanent crops, a very questionable business decision, but the Bureau fails to explain why this “tail” in water rights is wagging the dog.

Response
Many of the transfers in Table 1 of the comment letter are not CVP-related and do not involve Reclamation. Table 1-3 includes historic transfers similar to those included in the action alternatives. This EIS/EIR analyzes potential multi-year transfers in addition to single-year transfers. The potential to change cropping patterns in the San Joaquin Valley was considered as an alternative in the EIS/EIR (see Table 2-1 and Appendix A), but was not carried forward for more detailed analysis because it did not meet the purpose and need and project objectives of immediacy and flexibility.

Comment NG03-15

Comment
The Project Description does Not Include all Project Components.

i. Carriage water.

The EIS/EIR's description of and reliance on "carriage water" is completely uncertain, undefined, and provides no meaningful information to the public. The EIS/EIR states that "Outflows would generally increase during the transfer period because carriage water would become additional Delta outflow." (EIS/EIR 3.2-39.) The EIS/EIR also asserts that, "Carriage water (a portion of the transfer that is not diverted in the Delta and becomes Delta outflow) will be used to maintain water quality in the Delta." (EIS/EIR 2-29.) Elsewhere the EIS/EIR references 20% carriage losses for CCWD and SLDMWA in the EIS/EIR (3.2-39, 3.2-57-58, and B-6), while prior documents have used higher estimates:

Historically, approximately 20-30% of the water transferred through the Delta would be necessary to enable the maintenance of water quality standards, which are based largely upon the total amount of water moving through the Bay-Delta system. This water, which is not available for delivery to Buyers, is known as "carriage water." Given historically dry conditions prevailing in 2014, DWR estimates that carriage losses could be higher. (Biggs West Gridley 2014 Water Transfer Neg Dec, p. 4) (Exhibit I). A Bureau spreadsheet that documents the final transfer numbers for 2013 clearly demonstrates that the 30% figure was used for carriage losses (Source: Bureau of Reclamation, 2013-12-17 2013 Total Pumpage (FINAL) nlw.xlsx (Exhibit J)). The spreadsheet further reveals that there are additional water deductions that were made prior to delivery in 2013 for DWR Conveyance Loss (2%) and Warren Act Conveyance Loss (3%). When all the water deductions are tallied for stream depletion, carriage losses, and the two conveyance losses, the actual water available for delivery when groundwater substitution is used is 53%. This is not presented in the EIS/EIR, which allows the Lead Agencies to overestimate the amount of water that is delivered through the Delta to Buyers and therefore the economic benefits of the 2015-2024 Water Transfer Program. What is lacking is any meaningful discussion of the need for, role, availability, and effect of carriage water and conveyance losses in any transfer in the EIS/EIR. Without such information it is not possible to determine the water quality and supply effects of the program.

Response
The description of carriage water in Section 2.3.2.4 has been revised for clarity. Carriage water includes water to maintain water quality in the Delta as well as conveyance losses, as described in the comment. The precise amount of carriage water is calculated during the transfer based on real-time monitoring information in the Delta. As mentioned in the comment, the typical amount for transfers from the Sacramento Valley is about 20 to 30 percent, and the typical

amount for transfers from the San Joaquin Valley is about 10 percent. The comment assumes a percentage for a streamflow depletion factor that is not clear, as a specific number was not included in the Draft EIS/EIR. (Common Response 8 includes updated information on the streamflow depletion factor.) While the exact numbers are not clear until the transfer occurs, the amount a buyer receives from the original transfer is reduced by carriage water losses and the streamflow depletion factor.

Comment NG03-16

Comment
Monitoring and production wells:

The identity and locations of all wells that will be used to monitor groundwater substitution transfer pumping impacts are unknown. The EIS/EIR must include proposed transfer well locations that are sufficiently accurate to allow for determination of distances between the wells and areas of potential impact. These are integral project features that must be disclosed in detail prior to any meaningful effects analysis.

In 2009, GCID installed four production wells to extract 26,530 AF of groundwater as part of its Stony Creek Fan Aquifer Performance Testing Plan. Other districts have also installed production wells, most with public funds, that have been used for past transfers such as Anderson/Cottonwood Irrigation District, Butte Water District, and RD-108. To the extent those wells and any others would be used in this project, they must be considered to be part of the whole of the action, and disclosed and analyzed herein.

Response
The production wells are shown in Figures 3.3-28 through 3.3-33. Monitoring wells may vary in different years as new monitoring facilities become available; the monitoring objectives that must be satisfied are included in Mitigation Measure GW-1. See Common Responses 6 and 7 for additional information. The monitoring wells must be in addition to production wells. The action alternatives do not include installation of new wells; if the sellers want to install additional wells for transfers or other purposes, that effort would require additional environmental compliance.

Comment NG03-17

Comment
“Other” transfers:

The EIS/EIR states that, “Other transfers not included in this EIS/EIR could occur during the same time period, subject to their own environmental review (as necessary).” (EIS/EIR 1-2.) In other words, not only is the EIS/EIR unclear precisely about which transfers are likely to occur and are analyzed in this

EIR/EIR, it also leaves open-ended the prospect of some transfers not being covered by the EIS/EIR. This apparent piecemealing of transfer projects short-circuits comprehensive environmental review.

Response

This EIS/EIR has asked potential buyers and sellers to provide the best available information on future water transfers, and any potential transfers identified were included in the evaluation. The cited text refers to other transfers that may occur at the same time to different buyers; these transfers are included in the cumulative analysis and are analyzed in combination with the action alternatives.

Comment NG03-18

Comment

The Project Description Fails to Include Sufficient Locations, Maps, and Boundaries:

The project description must show the location of the project, its component parts, and the affected environmental features. CEQA Guidelines § 15124(a).

Maps are needed of each seller service area at a scale that allows for reasonably accurate measurement of distances between the groundwater substitution transfer wells and surface water features, other non-participating wells, proposed monitoring wells, fisheries, vegetation and wildlife areas, critical surface structures, and regional economic features. Maps with rates and times of stream depletion by longitudinal channel section are needed to allow for an adequate review of the Draft EIR/EIS conclusion of less than significant and reasonable impacts with no injury. These maps are also needed to evaluate the specific locations for monitoring potential impacts. Thus, detailed maps that show the locations of the monitoring wells and the areas of potential impact along with the rates and seasons of anticipated stream depletion are needed for each seller service area. These maps are also needed to allow for evaluation of the cumulative effects whenever pumping by multiple sellers can impact the same resource. The only maps provided by the Draft EIS/EIR that show the location of the groundwater substitution transfer wells, and the rivers and streams potentially impacted are the simulated drawdown Figures 3.3-26 to 3.3-31, which are at a scale of approximately 1 inch to 18 miles. The lack of maps with sufficient detail to see the relationship between the wells and the surface water features prevents adequate review of the Draft EIS/EIR analysis to determine groundwater and surface water impacts.

Response

Figures have been added to Chapter 2 to show more information about surface water features and participating groundwater wells.

Comment NG03-19

Comment
Furthermore, figure 3.1-1, mapping the project area, is impossible to read and determine where each seller and buyer service area actually lies. Nor does the figure itself actually include many geographic points of reference used throughout the EIS/EIR. The EIS/EIR, for example, states that “Pelger MCW is located on the east side of the Sacramento River near Robbins (Figure 3.1-1.)” (EIS/EIR at 3.1-7.) But Robbins is not on the map, and the Pelger MCW is virtually impossible to locate on Figure 3.1-1. Similarly, the EIS/EIR states that the Sacramento River is impaired from Keswick dam to the Delta, but the EIS/EIR contains no description or map showing where Keswick dam is located, or any map enabling an understanding of the geographic scope of this water quality impairment. This problem repeats for literally dozens of existing environmental features described in the EIS/EIR. And, this problem is compounded by the unstable nature of the project description itself, leaving the EIS/EIR to string together multiple combinations of place names where transfers may or may not be imported or exported, and leaving the reader to continually search out secondary information to attempt to follow the EIS/EIR’s terse and convoluted descriptions. A clear explanation, with visual aids, of the affected environment, including all local creeks and streams, and transfer water routes, is necessary to enable any member of the general public to grasp the potential types and locations of environmental impacts caused by the proposed program.

Response
Figure 3.1-1 has been revised to add points of reference to the map. Figure 2-4 provides a more detailed map of the location of potential sellers. As described in Section 3.17.1.3.1, Keswick Dam is approximately 9 miles downstream of Shasta Dam. Other facilities within the area of analysis are described and shown visually in the applicable resource areas in Chapter 3.

Comment NG03-20

Comment
The EIS/EIR State Lead Agency Should be DWR, Not SLDMWA:

SLDMWA is not the proper Lead Agency for the Project. California Environmental Quality Act (“CEQA”) Guidelines sections 15367 and 15051 require that the California Department of Water Resources (“DWR”), as the operator of the California Aqueduct and who has responsibility to protect the public health and safety and the financial security of bondholders with respect to the aqueduct, is the more appropriate lead agency. In PCL v DWR, the court found that DWR’s attempt to delegate lead agency authority impermissibly insulated the department from “public awareness and possible reaction to the individual members’ environmental and economic values.” {Planning and Conservation League et al. v Department of Water Resources (2000) 83

Cal.App.4th 892, 907, citing Kleist v. City of Glendale (1976) 56 Cal. App. 3d 770, 779.}

Pursuant to CEQA, "lead agency" means the public agency which has the principal responsibility for carrying out or approving a project which may have a significant effect upon the environment." (Public Res. Code § 21067.) As such, the lead agency must have authority to require imposition of alternatives and mitigation measures to reduce or avoid significant project effects, and must have the authority to disapprove of the project altogether. Here, the DWR clearly fits this description. As the EIS/EIR states, "[t]hese transfers require approval from Reclamation and/or Department of Water Resources (DWR)." (EIS/EIR 1-2.) Additionally, the EIS/EIR reveals the obvious and long-standing relationship between the Bureau and DWR in facilitating surface water transfers. The Bureau and DWR have collaborated on each DTIWT publication, which provides specific environmental considerations for transfer proposals; are said to have "sponsored drought-related programs" together; have created the joint EIS/EIR for the Environmental Water Account ("EWA"); and "cooperatively implemented the 2009 Drought Water Bank."

SLDMWA should not serve as the lead agency. The 2015-2024 Water Transfer Program has the potential to impact the long-term water supplies, environment, and economies in many California counties far removed from the SLDMWA geographic boundaries. With SLDMWA designated as the lead agency, and no potential sellers or source counties designated as responsible agencies, the process is unreasonably biased toward the narrow functional interests of SLDMWA and its member agencies. According to the EIS/EIR, the SLDMWA's role is to "[h]elp negotiate transfers in years when the member agencies could experience shortages." (EIS/EIR 1-1.) Helping to negotiate a transfer is a wholly different role than that of a lead agency with approval authority over a project. All of SLDMWA's purposes and powers are centered on providing benefit to member organizations,{Source: SLDMWA JPA, para. 6, pp. 4-7} and do not implement the Sustainable Groundwater Management Act.{Source: St. Amant 2014. Letter to Bureau of Reclamation and SLDMWA re the 2015-2024 Water Transfer Program}. Not only would SLDMWA be advocating on behalf of its members in this process, but nothing provided in the EIS/EIR suggests that it has authority to require mitigation measures or alternatives to reduce or avoid significant project impacts, for example, to groundwater resources in the seller service area, as such limitations would clearly be contrary to the specific interests of the SLDMWA members.

Importantly, DWR not only has jurisdiction over the SLDMWA transfers in ways that SLDMWA does not, but also DWR has review and approval authority over potential transfers outside of the SLDMWA altogether, including, for example, the East Bay Municipal Utilities District, as well as "[o]ther transfers not included in this EIS/EIR [that] could occur during the same time period, subject to their own environmental review (as necessary)." (EIS/EIR 1-2.) Environmental review of transfers should be unified and comprehensive, and cumulative across both geography and over time in a way that DWR and not SLDMWA can provide.

Response
See Common Response 1.

Comment NG03-21

Comment
The EIS/EIR Fails to Completely and Accurately Describe the Affected Environmental Setting and Baseline Conditions.

A complete and accurate description of the existing and affected environmental setting is critical for an adequate evaluation of impacts to it. See e.g. San Joaquin Raptor/Wildlife Rescue Ctr. v. County of Stanislaus (1994) 27 Cal.App.4th 713; Galante Vineyards v. Monterey Peninsula Water Mgmt. Dist. (1997) 60 Cal.App.4th 1109, 1122; County of Amador v. El Dorado County Water Agency (1999) 76 Cal.App.4th 931, 955; Cadiz Land Co. v. Rail Cycle (2000) 83 Cal.App.4th 74, 94.

As discussed, below, and in the expert reports submitted by Custis, EcoNorthwest, Cannon, and Mish on behalf of AquAlliance, the EIS/EIR fails to comport with these standards.

Response
See response to Comment NG02-2.

Comment NG03-22

Comment
The EIS/EIR Fails to Describe Existing Physical Conditions.

i. Groundwater Supply

The EIS/EIR fails to provide a comprehensive assessment of the historic change in groundwater storage in the Sacramento Valley groundwater basin, and other seller sources areas within the proposed 10-year groundwater substitution transfer project. Historic change and current groundwater contour maps are critical to establishing an environmental baseline for the groundwater substitution transfers. The EIS/EIR uses SACFEM2013 simulations of groundwater substitution transfer pumping effects for WY 1970 to WY 2003, but the discussion of the simulation didn't provide specifics on how the model simulated the current conditions of the Sacramento Valley groundwater system or the potential impacts from the 10-year groundwater substitution transfer project based on current conditions. Again, The EIS/EIR relies on only modeling to consider impacts from the Project when it should disclose the results from actual monitoring and reporting for water transfer conducted in 12 of the last 14 years.

The EIS/EIR concludes that the Sacramento Valley basin's groundwater storage has been relatively constant over the long term, decreasing during dry years and increasing during wetter periods, but the EIR/EIS ignores more recent information and study (e.g. Brush 2013a and 2013b, NCWA, 2014a and 2014b). According to the BDCP EIS/EIR:

Some locales show the early signs of persistent drawdown, including the northern Sacramento County area, areas near Chico, and on the far west side of the Sacramento Valley in Glenn County where water demands are met primarily, and in some locales exclusively, by groundwater. These could be early signs that the limits of sustainable groundwater use have been reached in these areas."

Response
See Common Response 4 for documentation of current groundwater conditions and Common Response 5 regarding the model timeframe.

Comment NG03-23

Comment
(BDCP EIS/EIR at 7-13.) The Draft EIS/EIR provides only one groundwater elevation map of the Sacramento Valley groundwater basin, Figure 3.3-4, which shows contours only from selected wells that omit many depths and areas. The Draft EIS/EIR doesn't provide maps showing groundwater elevations, or depth to groundwater, for groundwater substitution transfer seller areas in Sutter, Yolo, Yuba, and Sacramento counties. The DWR provides on a web site a number of additional groundwater level and depth to groundwater maps that the EIS/EIR should use to help complete its description of the affected environment {Source: http://www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/gw_level_monitoring.cfm#Well%20Depth%20Summary%20Maps}

Presented below are tables that illustrate maximum and average groundwater elevation decreases for Butte, Colusa, Glenn, and Tehama counties at three aquifer levels in the Sacramento Valley between the fall of 2004 and 2013. {See Comment letter for fall and spring 2004 and 2014 tables}

The DWR data clearly present a different picture of the condition of the Sacramento Valley groundwater basin over time than what is provided in the EIS/EIR. This must be corrected and considered in the NEPA and CEQA process.

Response
See Common Response 4.

Comment NG03-24

Comment
The EIS/EIR omits other critical information needed to understand the project's impacts to area groundwater, including but not limited to:

1. the distances between the transfer well(s) and surface water features;

2. the number of non-participating wells in the vicinity of the transfer wells that may be impacted by the pumping; and,

3. the distance between the transfer wells and non-participant wells that may be impacted by the transfer pumping, including domestic, public water supply and agricultural wells.

Response
Figures 3.3-28 through 3.3-33 show the location of groundwater substitution wells with respect to surface water features within the Sacramento Valley. These figures also show the potential change in groundwater elevation that might occur under the Proposed Action. The scale of these figures has been increased to make them easier to read.

Mitigation Measure GW-1 described in Section 3.3.4.1 discusses monitoring and mitigation measures adopted during transfers to avoid significant impacts to non-participating wells. Common Response 6 includes information about clarifications to Mitigation Measure GW-1.

Comment NG03-25

Comment
The EIS/EIR assumes that, "The groundwater modeling results indicate that shallow groundwater is typically deeper than 15 feet in most locations under existing conditions, and often substantially deeper." (3.8-32.) However, existing hydrologic condition documents clearly show Depth to Groundwater levels in shallow portions of the aquifer system that are <15' from the surface.

1. The Chart titled Depth to Water by Sub-Inventory Unit (SIU) on 2014_10_Summary_Table.PDF page 2/2 shows the Average Depth to Water (feet) in March through October 2014. 7 of 16 Sub-Inventory Units ("SIUs") in Butte County show average groundwater levels <15' from the surface at some time of the year {Source: https://www.buttecounty.net/wrcdocs/Programs/Monitoring/GWLevels/2014/2014_10_Summary_Table.pdf https://www.buttecounty.net/wrcdocs/Programs/Monitoring/GWLevels/2014/2014_10_Data_Summary_Update.pdf (Exhibit K)}

2. November 2014 Adobe spreadsheets show numerous monitoring wells with water levels closer than 10' to the surface. The wells are located in Butte

County SIUs designated under the county Basin Management Objective ("BMO") program. While some of the SIUs are corresponding to an Irrigation District primarily served by surface water, the Butte Sink, Cherokee, North Yuba, Angel Slough, Llano Seco and M&T SIUs have naturally occurring water levels <10'. All 3 pages show ground surface to water surface (feet) {Source: 2014 Monthly Groundwater Depth to Water-CASGEM: https://www.buttecounty.net/wrcdocs/Programs/Monitoring/GWLevels/2014/2014_10_Data_Summary_Update.pdf (Exhibit K)}

3. The January 2014 BUTTE COUNTY DOMESTIC WELL DEPTH SUMMARY shows the 10' Depth to Groundwater Contour lines in the lower portion of the map.{Source: Butte County shallow Groundwater Contours: www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/WellDepthSummaryMaps/Domestic_BUTTE.pdf (Exhibit L)}

4. The January 2014 COLUSA COUNTY DOMESTIC WELL DEPTH SUMMARY shows the 10' Depth to Groundwater Contour lines in large portions of the county. {Colusa County shallow Groundwater Contours: www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/WellDepthSummaryMaps/Domestic_COLUSA.pdf (Exhibit M)}

5. The January 2014 GLENN COUNTY DOMESTIC WELL DEPTH SUMMARY shows the 10' Depth to Groundwater Contour lines in the lower portion of the map.{ Source: Glenn County shallow Groundwater Contours: www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/WellDepthSummaryMaps/Domestic_GLENN.pdf (Exhibit N)}

Response

The vegetation and wildlife analysis acknowledges that there are groundwater and surface water interactions, but focuses the analysis primarily on surface water where terrestrial ecosystems are most likely to be affected. Water would continue to flow in the creeks and rivers, and water would seep from the creeks and rivers into the ground, thereby providing a source of water for riparian vegetation. Farther from creeks and rivers, the groundwater table is typically much deeper than 15 feet so a change in the water table would have little effect on vegetation; as described in the Assessment/Evaluation Methods, groundwater levels are substantially below the surface in many areas (i.e., typically below 100 feet in depth, see Appendix E). Therefore, groundwater would be well below the depth of most riparian vegetation. See Common Responses 10 and 11 for more information.

Comment NG03-26

Comment

Dan Wendell of The Nature Conservancy, a panelist at a workshop held by the California Natural Resources Agency, the California Department of Food and Agriculture, and California EPA on March 24, 2014, presented a similar picture as the county summaries above, but also raised the alarm about the existing, significant streamflow losses from groundwater pumping and, even more significantly, how long it takes for those losses to appear:

"The Sacramento Valley still has water levels that are fairly shallow," he said. "There are numerous perennial streams and healthy ecosystems, and the basin is largely within a reasonable definition of sustainable groundwater yield. However, since the 1940s, groundwater discharge to streams in this area has decreased by about 600,000 acre-feet per year due to groundwater pumping, and it's going to decrease an additional 600,000 acre-feet in coming years under 2009 status quo conditions due to the time it takes effects of groundwater pumping to reach streams. It takes years to decades, our work is showing."{Source: http://mavensnotebook.com/2014/04/28/groundwater-management-workshop-part-1-sustainable-groundwater-management-panel/ (Exhibit O)}

What areas in the Sellers' region were used to reach the EIS/EIR conclusion that "[i]ndicate that shallow groundwater is typically deeper than 15 feet"? What prevented the analysis from disclosing the many miles of riparian habitat in the Sacramento Valley that indicate that riparian forest vegetation remains healthy with groundwater levels shallower than 15 feet? As we presented above, there are many areas in the Sellers' region that have groundwater higher than 15 feet below ground surface.

Response

See response to Comment NG03-25.

Comment NG03-27

Comment

In addition, the EIS/EIR fails to provide recharge data for the aquifers. Professor Karin Hoover, Assistant Professor of hydrology, hydrogeology, and surficial processes from CSU Chico, found in 2008 that, "Although regional measured groundwater levels are purported to 'recover' during the winter months (Technical Memorandum 3), data from Spangler (2002) indicate that recovery levels are somewhat less than levels of drawdown, suggesting that, in general, water levels are declining." According to Dudley, "Test results indicate that the 'age' of the groundwater samples ranges from less than 100 years to tens of thousands of years. In general, the more shallow wells in the Lower Tuscan Formation along the eastern margin of the valley have the 'youngest' water and the deeper wells in the western and southern portions of the valley have the ‘oldest’ water,” adding that “the youngest groundwater in the Lower Tuscan Formation is probably nearest to recharge areas.” (2005). “This implies that there is currently no active recharge to the Lower Tuscan aquifer system (M.D. Sullivan, personal communication, 2004),” explains Dr. Hoover. “If this is the case, then water in the Lower Tuscan system may constitute fossil water with no known modern recharge mechanism, and, once it is extracted, it is gone as a resource,” (Hoover 2008).{ Source: Spangler, Deborah L. 2002. The Characterization of the Butte Basin Aquifer System, Butte County, California. Thesis submitted to California State University, Chico; Dudley, Toccoy et al. 2005. Seeking an Understanding of the Groundwater Aquifer Systems in the Northern Sacramento Valley: An Update; Hoover, Karin A. 2008. Concerns Regarding the Plan for Aquifer Performance Testing of Geologic Formations Underlying Glenn-Colusa Irrigation District, Orland Artois Water District, and Orland Unit Water Users Association Service Areas, Glenn County, California. White Paper. California State University, Chico.}

Response
Section 3.3.2.4 discusses simulated recovery at water tables and pumping zones at Selected Hydrograph Location 21 (near Sycamore Mutual Water Company), Selected Hydrograph Location 14 (near Cordua ID), and Selected Hydrograph Location 31 (near Sacramento County WA). Additional information has been added to Section 3.3.2.4. See Common Response 4.

As discussed in Common Response 4, only a small amount of groundwater substitution-related pumping would be from the Tuscan Aquifer System.

Comment NG03-28

Comment
The Draft EIS/EIR discusses the potential for impacts to groundwater quality by migration of contaminants as a result of groundwater substitution pumping, but provides only a general description of the current condition of groundwater quality. No maps are provided that show the baseline groundwater quality and known areas of poor or contaminated groundwater, or from all areas where groundwater pumping may occur. Groundwater quality information on the Sacramento Valley area is available from existing reports by the USGS (1984, 2008b, 2010, and 2011) and Northern California Water Association (NCWA, 2014c). Determination of groundwater quality prior to pumping is critical to avoiding significant adverse impacts, both to adjacent groundwater users impacted by migrating contaminants, as well as surface water potentially impaired by contaminated runoff from irrigated agriculture or other uses.

Response
Section 3.3.1.3.2 has been revised to include additional groundwater quality information from SWRCB (GeoTracker Clean Up sites). Impacts to groundwater quality are discussed in Section 3.3.2.4.

Comment NG03-29

Comment
There are numerous hazardous waste plumes in Butte County, which could easily migrate with the potential increased groundwater pumping proposed for the Project. The State Department of Toxics Control and the Regional Water Resources Control Boards have a great deal of information readily available for all counties involved with the proposed Project. Fluctuating domestic wells can lead to serious contamination from heavy metals and non-aqueous fluids. Because the Bureau fails to disclose basic standards for the mitigation and monitoring requirements, it is unknown if hazardous plumes in the areas of origin will be monitored or not. Please note the attached map from the State Water Resources Control Board (2008) that highlights areas vulnerable to groundwater contamination throughout the state. A significant portion of both the areas of origin and the receiving areas are highlighted. When the potential for serious health and safety impacts exists, NEPA and CEQA require that this must be disclosed and analyzed.

Response
See response to Comment NG03-28.

Comment NG03-30

Comment
Surface Water Flows:

The EIS/EIR asserts that, under the no action/no project alternative, “Surface water supplies would not change relative to existing conditions. Water users would continue to experience shortages under certain hydrologic conditions, requiring them to use supplemental water supplies.” (3.1-15.) It would be most helpful if the Lead Agencies would explain the geographic scope of this statement since the shortages could be experienced throughout the areas of origin, transmission, and delivery – as well as the entire State of California. The section continues with, “Under the No Action/No Project Alternative, some agricultural and urban water users may face potential shortages under dry and critical hydrologic conditions.” Again, to what geographic areas is the EIS/EIR referring? The final sentence in the section reads, “Impacts to surface water supplies would be the same as the existing conditions.” Without further elaboration or a reference that would further explain what exactly are the “existing conditions, mentioned” this is merely a conclusory assertion without the benefit of factual data. For example, existing conditions vary wildly in California weather patterns and agency allocations can as well. For example, in 2014 CVP Settlement Contractors were threatened with an unprecedented 40 percent allocation, which later became 75 percent when they cooperated with water transfers. Failing to disclose the wide range of natural and agency decisions that comprise the No Action/No Project alternative must be corrected and re-circulated in another draft EIS/EIR.

Response
The geographic scope of the potential water supply impacts from the alternatives is presented in Section 3.1.1.1, Area of Analysis. Existing water supply conditions of the region are described in Section 3.1.1.3, Existing Conditions.

The model period of analysis includes hydrologic conditions that are representative of likely future conditions. While the next ten years are likely to have a broad range of hydrologic conditions, the historic record used in modeling has also exhibited a broad range of hydrologic conditions. See Common Response 5 for additional information.

Comment NG03-31

Comment
The EIS/EIR states that "[b]ecause of the interaction of surface flows and groundwater flows in riparian systems, including associated wetlands, enables faster recharge of groundwater, these systems are less likely to be impacted by groundwater drawdown as a result of the action alternatives;" therefore, "[t]hese systems are less likely to be impacted by groundwater drawdown as a result of the action alternatives." (EIS/EIR 3.8-32.) This flawed assumption has been readily discredited by USGS:

There is more of an interaction between the water in lakes and rivers and groundwater than most people think. Some, and often a great deal, of the water flowing in rivers comes from seepage of groundwater into the streambed. Groundwater contributes to streams in most physiographic and climatic settings… Groundwater pumping can alter how water moves between an aquifer and a stream, lake, or wetland by either intercepting groundwater flow that discharges into the surface-water body under natural conditions, or by increasing the rate of water movement from the surface-water body into an aquifer. A related effect of groundwater pumping is the lowering of groundwater levels below the depth that streamside or wetland vegetation needs to survive. The overall effect is a loss of riparian vegetation and wildlife habitat. {Source: The USGS Water Science School. http://ga.water.usgs.gov/edu/gwdepletion.html}

Response
See Common Response 11.

Comment NG03-32

Comment
Lastly, the EIR/EIS presents the rivers and streams analyzed for impacts from the Proposed Action alternative with numerous omissions and conclusory remarks that are not supported. (3.8-49 – 3.8-51.) Examples include:

1. Table 3.8.3 Screening Evaluation Results for Smaller Streams in the Sacramento River Watershed for Detailed Vegetation and Wildlife Impact Analysis for the Proposed Action fails to designate the counties of origin except for Deer and Mill creeks. Even readers familiar with the region need this basic information.

2. Creeks with groundwater/surface water connections, but omitted from Tehama and Butte counties in Table 3.8.3 include, but are not limited to: Clear, Cottonwood, Battle, Singer, Pine, Zimmershed, Rock, Mud, and Big Chico.

3. The modeling that is used to omit streams from analysis and to select and analyze other streams is completely inadequate to the task. Page D-3 has information about model resolution. It is normal to have five to ten nodes to resolve a feature of interest, but the nodal spacing is listed as ranging from 125 to 1000 meters, with stream node spacing around 500 meters (EIS/EIR p. D-3). This implies that spatial features smaller than about 2 kilometers cannot be resolved with this model. With the physical response of interest below the threshold of resolution even under the best of circumstances, then you have 100% margin of error, because the model cannot "see" that response.{ Source: Mish, p. 8. (Exhibit C)}

Response
The counties that make up the area of origin are not necessary for the fisheries analysis. All of the waterways in the SACFEM2013 model are shown in Figure 14 in Appendix M. Additionally, Figures 3.3-28 through 3.3-33 in the main body of the EIS/EIR show groundwater modeling results, and the smaller waterways are included in these figures. SACFEM2013 modeled Big Chico Creek, which has been added to the table. The remaining small waterways in item two are not included in the model. See response to Comment NG10-28 for additional discussion.

Comment NG03-33

Comment
Surface Water Quality:

The baseline water quality data presented in the EIS/EIR is insufficient to accomplish any meaningful understanding of existing water quality levels throughout the project area. The EIS/EIR fails to show where each affected water body is, or disclose its existing beneficial uses, or numeric water quality objectives. Data that are presented is scattered, inconsistent, incomplete, often severely out of date, and often misleading. Further, the EIS/EIR fails to explain exactly where much of the presented water quality data comes from – indeed, failing to explain exactly where the affected environment is at all.

Response
The Draft EIS/EIR presents tables summarizing water quality for potentially affected water bodies within the area of analysis. The tables present the minimum, maximum, and average values for selected water quality constituents and provide information regarding the source of the data and the sampling period. The information is sufficient to characterize water quality conditions so the reader can understand the impact analysis.

Figure 3.2-1 shows the area of analysis for water quality and the potentially affected water bodies. The beneficial uses designated for water bodies within the area of analysis are presented in Table 3.2-2 (seller service area) and Table 3.2-3 (buyer service area).

Comment NG03-34

Comment
Many waterways are left out of this section entirely. The biological and vegetation effects of the program are discussed elsewhere in the EIS/EIR, and show that most would be impacted by the proposed program, but these waterways are not discussed in the EIS/EIR water quality section. Diminished flows can affect water quality in a variety of way, for example, causing higher temperatures, lower dissolved oxygen, or high sediment contamination or turbidity. Therefore, these affected waterways should be described and analyzed in the EIS/EIR water quality chapter.

Response
The Draft EIS/EIR presents tables summarizing water quality for potentially affected water bodies within the area of analysis. Impacts to fish and wildlife resulting from changes in water quality are discussed in Sections 3.7 and 3.8, respectively. The information is sufficient to characterize water quality conditions so the reader can understand the impact analysis.

Comment NG03-35

Comment
In addition, the EIS/EIR only names the California Aqueduct, the Delta-Mendota Canal, and the San Luis Reservoir as affected waters within the buyer areas. Later, the EIS/EIR admits that increased irrigation in the buyers’ areas may adversely impact stream water quality, but none of these rivers, streams, creeks, or any other potentially affected waterway of any kind, are described in the buyer project areas. (EIS/EIR 3.2-26.)

Response
This EIS/EIR only evaluates waters that may be impacted by the action alternatives. Within the buyers' area, only San Luis Reservoir may be impacted by the Project. Potential effects to the San Joaquin River or its tributaries are

included as part of the sellers' area because they are upstream from the Delta (and include transfers from Merced ID).

Comment NG03-36

Comment

The EIS/EIR also fails to meaningfully describe the existing water quality in the affected environment. The EIS/EIR repeatedly misleads the public and decision-makers regarding the baseline conditions of waters within the project area by labeling them as "generally high quality." For example, the EIS/EIR states that "certain segments of the Sacramento River contain several constituents of concern, including Chlordane, dichlorodiphenyltrichloroethane, Dieldrin, mercury, polychlorinated biphenyls (PCBs), and unknown toxicity (see Table 3.2-1); however, the water quality in the Sacramento River is generally of high quality." What is the basis for this non-sequitur used here, and repeated throughout the existing environmental descriptions in the EIS/EIR? How do constituents of concern and unknown toxicity translate to generally high quality?

The remaining baseline information presented in the EIS/EIR contains significant gaps that preclude a meaningful understanding of the existing environmental conditions. In order to attempt to characterize the water quality in the affected environmental area, the EIS/EIR lists out beneficial uses, 303(d) impairments, and a variety of water quality monitoring data. The EIS/EIR presents almost no reference to existing numeric water quality objectives, and evaluation of potential breaches of those standards is therefore impossible.

Response

Existing water quality based violations and regulatory compliance issues are discussed in Section 3.7.1.3. Additional discussion of numeric water quality objectives has been added to Section 3.2.

Comment NG03-37

Comment

Table 3.2-1 lists 303(d) impairments within the area of analysis. The table states the approximate mileage or acreage of the portion of each water body that is impaired, but fails to inform the public exactly where these stretches are located. For example, table 3.2-1 states that, within the Delta, approximately 43,614 acres are impaired for unknown toxicity, 20,819 acres are impaired for electrical conductivity, and 8,398 acres are impaired for PCBs; but without knowing which acres within the Delta this table describes, it is impossible to know whether transfer water will affect those particular areas. This problem repeats for all impairments listed in table 3.2-1.

Response
Based on water quality modeling for the Delta region (see Appendix C), it was determined that transfers would not have a significant impact on Delta water quality regardless of current impairment status or specific locations of impairments.

Comment NG03-38

Comment
The baseline environmental condition of the Delta is poorly described. The EIS/EIR states that:

[e]xisting water quality constituents of concern in the Delta can be categorized broadly as metals, pesticides, nutrient enrichment and associated eutrophication, constituents associated with suspended sediments and turbidity, salinity, bromide, and organic carbon. Salinity is a water quality constituent that is of specific concern and is described below. (EIS/EIR at 3.2-21.) The EIS/EIR provides no further information about "metals, pesticides, nutrient enrichment and associated eutrophication, constituents associated with suspended sediments and turbidity." These contaminants are each the focus of intensive regulation and controversy, and could cause significant adverse impacts if contaminated surface waters are transferred, but no meaningful baseline data of existing conditions is provided to facilitate an evaluation of the effects of the incremental changes caused by the proposed program.

Response
The action alternatives would not affect the remaining constituents referenced by the commenter. Contaminated surface water would not be transferred under any alternative.

Comment NG03-39

Comment
The EIS/EIR provides scattered and essentially useless monitoring data to attempt to describe the existing water quality conditions in the program area. First, the EIS/EIR is unclear exactly what year or years it uses to constitute the baseline environmental conditions. Then, Tables 3.2-4 through 3.2-20 provide data from 1980 through 2014. Some tables average data, some use median data, some present isolated data, and none provide a comparison to existing numeric water quality objectives. Of all of the existing environmental baseline data provided, only table 3.2-15 provides any data regarding contamination caused by metals in the water column, and only for Lake Natoma from April to September of 2008. As a result, any contamination relating to any metals in any transfer water is essentially ignored by the EIS/EIR. Moreover, the scattershot data provided in the EIS/EIR does not provide the public with any information about the actual water quality of transfer water that may be used in any future project. Table 3.2

Response
The Draft EIS/EIR presents tables summarizing water quality for potentially affected water bodies within the area of analysis. Wherever possible the most recent data was included in the summary tables. The tables present the minimum, maximum, and average values for selected water quality constituents and provide information regarding the source of the data and the sampling period. No data was excluded from the summary statistics. The information is sufficient to characterize water quality conditions so the reader can understand the impact analysis.

Comment NG03-40

Comment
Table 3.2-21 presents mean data from "selected" monitoring stations throughout the Delta. The EIS/EIR states that "[s]ampling period varies, depending on location and constituent, but generally is between 2006-2012." (EIS/EIR 3.2-22.) EIS/EIR readers simply have no way to know what these data actually represent. Columns are labeled "mean TDS," "mean electrical conductivity," and "mean chloride, dissolved." Are these data averaged for the approximate period of 2006-2012? Were any data excluded? The EIS/EIR lists these monitoring stations, but doesn't explain where each is actually located, which should be mapped for ease of reference. Nor does the EIS/EIR state what the applicable water quality objective is at each monitoring point for each parameter; nor how often these water quality objectives were breached.

Response
See response to Comment NG03-39.

Figure 3.2-1 shows the area of analysis for water quality and the potentially affected water bodies. The beneficial uses designated for water bodies within the area of analysis are presented in Table 3.2-2 (seller service area) and Table 3.2-3 (buyer service area). Salinity (EC) water quality objectives are include for the San Joaquin River at Vernalis.

Comment NG03-41

Comment
Figure 3.2-2 presents the monthly median chloride concentrations at selected monitoring sites, and misleadingly states that these median concentrations do not exceed the secondary MCL for chloride of 250 mg/L; but that comparison is irrelevant as the Bay-Delta Plan sets water quality objectives for chloride at 250 mg/day, not monthly mean.

Response
Figure 3.2-2 presents available information on chloride concentrations at Banks Pumping Plant, the Sacramento River at Hood, and the San Joaquin River near Vernalis. While the figure does represent monthly average concentrations,

these concentrations are all under 100 milligrams per liter (mg/L) of chloride (with most concentrations under 80 mg/L of chloride).

Comment NG03-42

Comment
Figures 3.2-3 through 3.2-5 show average electrical conductivity at selected monitoring stations, but the EIS/EIR fails to state the relevant water quality standard against which to compare these data, and fails to report the frequency and magnitude of exceedances, which are numerous and great. When do exceedances occur, and how can the proposed program avoid transferring water from or into waterways with elevated EC?

Response
A discussion of electrical conductivity (EC) standards has been added to Section 3.2.

Comment NG03-43

Comment
The EIS/EIR fails to provide any discussion or analysis of how SWRCB Decision 1641 would be implemented. The EIS/EIR states that Decision 1641 "requires Response Plans for water quality and water levels to protect diverters in the south Delta that may affect the opportunity to export transfers." (EIS/EIR at 2-32.) Later, the EIS/EIR adds that Decision 1641 "require[s] that the Central Valley Project (CVP) and State Water Project (SWP) be operated to protect water quality, and that DWR and/or Reclamation ensure that the flow dependent water quality objectives are met in the Delta (SWRCB 2000)." (EIS/EIR 3.2-10.) Nowhere does the EIS/EIR actually identify what these requirements entail, nor analyze when they would or would not be met by any portion of the proposed program. D-1641 is among the most critical of water quality regulations controlling the proposed program, and the EIS/EIR must provide significantly more analysis of how it would propose to comply with these State Water Board standards. As discussed, below, compliance with D-1641 standards is far from certain.

Response
The Draft EIS/EIR Appendix C describes Delta conditions as necessary to assist in evaluation of environmental impacts associated with a range of potential transfer activities within the Delta, including D-1641 requirements. The Delta conditions assessment simulates the hydrodynamics and water quality within the Delta when transfer water is made available by various sellers to determine how and where within the Delta the effects are likely to occur under the alternatives. Output from the Delta conditions assessment addresses environmental flows under D-1641 as well as other parameters such as water level (stage), water quality, and the biological opinions, and thus provides a basis for environmental assessment.

Comment NG03-44

Comment
Similarly, the EIS/EIR notes that "DWR has developed acceptance criteria to govern the water quality of non-Project water that may be conveyed through the California Aqueduct. These criteria dictate that a pump-in entity of any non-project water program must demonstrate that the water is of consistent, predictable, and acceptable quality prior to pumping the local groundwater into the SWP." (EIS/EIR at 3.2-10.) Again, however, the EIS/EIR fails to explain what these criteria require, and fails to provide any discussion of whether, when, or how these criteria could be met for each transfer contemplated by the program. This lack of information and analysis is insufficient to support informed public and agency environmental decision-making.

Response
The action alternatives do not propose to add non-Project water to the California Aqueduct. The action alternatives could add non-Project water to the Delta-Mendota Canal, and the potential water quality impacts of this action are analyzed in the water quality section. The discussion of DWR Acceptance Criteria is included for information, and a discussion of the Reclamation water quality standards to add water to the Delta-Mendota Canal has been added.

Comment NG03-45

Comment
The EIS/EIR Fails to Evaluate Inconsistency with Applicable Laws, Plans, and Policies.

a. State Water Policies:

The EIS/EIR should fully disclose the consolidated places of use for DWR and the Bureau, and what criteria might be applied for greater flexibility claimed for the consolidated place of use necessary for any given year's water transfer program, and what project alternatives could avoid this shift. Could the transfers be facilitated through transfer provisions of the Central Valley Project Improvement Act? Would the consolidation be a permanent or temporary request, and would the consolidation be limited to the duration of just the 2015-2024 Water Transfer Program? How would the consolidated places of use permit amendments to the SWP and CVP permits relate to their joint point of diversion? Would simply having the joint point of diversion in place under D-1641 suffice for the purpose of the Project?

Response
A consolidated place of use for Reclamation and DWR may or may not be required, depending on the source of the transfer water. If desired, a consolidated place of use would be secured on an annual basis.

Comment NG03-46

Comment

The EIS/EIR should better describe existing water right claims of sellers, buyers, the Bureau, and DWR. In response to inquiries from the Governor's Delta Vision Task Force, the SWRCB acknowledged that while average runoff in the Delta watershed between 1921 and 2003 was 29 million acre-feet annually, the 6,300 active water right permits issued by the SWRCB is approximately 245 million acre-feet {Source: SWRCB, 2008. Water Rights Within the Bay Delta Watershed (Exhibit P.)} (pp. 2-3). In other words, water rights on paper are 8.4 times greater than the real water in California's Central Valley rivers and streams diverted to supply those rights on an average annual basis. And the SWRCB acknowledges that this 'water bubble' does not even take account of the higher priority rights to divert held by pre-1914 appropriators and riparian water right holders (Id. p. 1). More current research reveals that the average annual unimpaired flow in the Sacramento River basin is 21.6 MAF, but the consumptive use claims are an extraordinary 120.6 MAF – 5.6 times more claims than there is available water. {Source:California Water Impact Network, AquAlliance, and California Sportfishing Protection Alliance 2012. Testimony on Water Availability Analysis for Trinity, Sacramento, and San Joaquin River Basins Tributary to the Bay-Delta Estuary. (Exhibit Q)} Informing the public about water rights claims would necessarily show that buyers and the Agencies clearly possess junior water rights as compared with those of many willing sellers. Full disclosure of these disparate water right claims and their priority is needed to help explain the actions and motivations of buyers and sellers in the 2015-2024 Water Transfer Program. Otherwise the public and decision makers have insufficient information on which to support and make informed choices.

To establish a proper legal context for these water rights, the EIS/EIR should also describe more extensively the applicable California Water Code sections about the treatment of water rights involved in water transfers.

Response

Existing water rights of potential sellers are described in Section 3.1.1.3, Existing Conditions, which was developed in consultation with sellers. Section 1.3 summarizes the federal and state laws that pertain to water transfers.

The EIS/EIR is analyzing the potential environmental effects of the action alternatives compared to existing conditions (under CEQA) and the No Action/No Project Alternative (under NEPA). The EIS/EIR analyzes how the action alternatives could affect water supply, water rights, and water quality. The analysis did not identify significant effects after mitigation. The commenter seems to be concerned that the California water rights system is over-allocated, but this issue is outside the scope of this EIS/EIR because it would not be affected by the action alternatives. The "motivation of the buyers" is delineated in Section 1.1 under the discussion of purpose and need and project objectives.

Comment NG03-47

Comment

Like federal financial regulators failing to regulate the shadow financial sector, subprime mortgages, Ponzi schemes, and toxic assets of our recent economic history, the state of California has been derelict in its management of scarce water resources. As we mentioned above we are supplementing these comments on this matter of wasteful use and diversion of water by incorporating by reference and attaching the 2011 complaint to the State Water Resources Control Board of the California Water Impact Network the California Sportfishing Protection Alliance, and AquAlliance on public trust, waste and unreasonable use and method of diversion as additional evidence of a systemic failure of governance by the State Water Resources Control Board, the Department of Water Resources and the U.S. Bureau of Reclamation, filed with the Board on April 21, 2011. (Exhibit Q)

Response

See response to Comment NG03-46. The commenter's Exhibit Q indicates that this concern has been brought to the State Water Resources Control Board, which is the appropriate venue to resolve the concern.

Comment NG03-48

Comment

b. Public Trust Doctrine.

The State of California has the duty to protect the people's common heritage in streams, lakes, marshlands, and tidelands through the Public Trust Doctrine.[27] The Sacramento, Feather, and Yuba rivers and the Delta are common pool resources. DWR acknowledges this legal reality in its publication, Water Transfer Approval: Assuring Responsible Transfers.[28] The application of the Public Trust Doctrine requires an analysis of the public trust values of competing alternatives, as was directed by the State Water Board in the Mono Lake Case. Its applicability to alternatives for the water transfers planned from the Sacramento, Feather, and Yuba rivers and through the Delta, where species recovery, ecosystem restoration, recreation and navigation are pitted against damage from water exports, is exactly the kind of situation suited to a Public Trust analysis, which should be required by the 2015-2024 Water Transfer Program. The act of appropriating water – whether for a new use or for a new method of diversion or of use – is an acquisition of a property right from the waters of the state, an act that is therefore subject to regulation under the state's public trust responsibilities. Groundwater pumping with adverse effects to public trust surface waters must also be considered.

[27] *National Audubon Society v. Superior Court* (1983) 33 Cal 3d, 419, 441.

[28] California Department of Water Resources, Water Transfer Approval: Assuring Responsible Transfers, July 2012, page 3. Accessible online 16 February 2014 at http://www.water.ca.gov/watertransfers/docs/responsible_water_transfers_2012.pdf. In addition, the Delta Protection Act of 1959 also acknowledges this reality, California Water Code Sections 12200-12205. (Exhibit R)

Response
CDFW is a trustee agency under CEQA because it has "jurisdiction by law over natural resources affected by a project, that are held in trust for the people of the State of California." (CEQA Guidelines Section 21070) CDFW reviewed this EIS/EIR and provided comments, which have been addressed. For more information on the appropriate CEQA lead agency, see Common Response 1.

Comment NG03-49

Comment
c. Local General Plans and Ordinances.

The Draft EIS/EIR discusses only two county ordinances, the Colusa Ordinance No. 615 and Yolo Export Ordinance No. 1617, one agreement, the Water Forum Agreement in Sacramento County, and one conjunctive use program, the American River Basin Regional Conjunctive Use Program. Except for the brief discussion of the two ordinances, one agreement, and one conjunctive use program listed above, the Draft EIS/EIR doesn't describe the requirements of local GMPs, ordinances, and agreements listed in Tables 3.3-1 (page 3.3-8) and Table 3-1 (page 27). Thus, the actual groundwater substitution transfer project permit requirements, restrictions, conditions, or exemptions required for each seller service area by the Bureau, DWR, and one or more County GMP or groundwater ordinance will apparently be determined at a future date.

Additional information is needed on what the local regulations require for exporting groundwater out of each seller's groundwater basin. The Draft EIS/EIR needs to discuss how the local regulations ensure that the project complies with Water Code Sections 1220, 1745.10, 1810. 10750, 10753.7, 10920-10936, and 12924 (for more detailed discussion of these Water Codes see Draft EIS/EIR Section 3.3.1.2.2). Although the Draft EIS/EIR doesn't document, compare or evaluate the requirements of all local agencies that have authority over groundwater substitution transfers in each seller service area, the Draft EIS/EIR concludes that the environmental impacts from groundwater substitution transfer pumping by each of the sellers will either be less than significant and cause no injury, or be mitigated to less than significant through mitigation measures WS-1, and GW-1 with its reliance on compliance with local regulations.

Response
Section 3.3.1.2.3 has been revised to include all pertinent ordinances related to groundwater substitution transfers within the area of analysis (i.e., the area underlying substitution pumping). Transfers must comply with local regulations.

See Common Response 6 regarding clarification of Mitigation Measure GW-1.

Comment NG03-50

Comment
As noted above, this conclusions is derived from information absent from the EIS/EIR and, even if there was information considered by the Lead Agencies, without any apparent analysis. Butte, Glenn, and Shasta counties represent counties with Sellers and all of them have the potential to be heavily impacted by activities in or adjacent to their jurisdictions. AquAlliance has examined their ordinances and found them insufficient to protect other users and the environment (Exhibits U, V, X). Sincere efforts at monitoring for groundwater levels and subsidence become meaningless if the monitoring infrastructure is scant and enforcement absent. The Butte County Department of Water and Resource Conservation also explains that local plans are simply not up to the task of managing a regional resource:

Each of the four counties that overlie the Lower Tuscan aquifer system has their own and separate regulatory structure relating to groundwater management. Tehama County, Colusa, and Butte Counties each have their own version of an export ordinance to protect the citizens from transfer-related third party impacts. Glenn County does not have an export ordinance because it relies on Basin Management Objectives (BMOs) to manage the groundwater resource, and subsequently to protect third parties from transfer related impacts. Recently, Butte County also adopted a BMO type of groundwater management ordinance. Butte County, Tehama County and several irrigation districts in each of the four counties have adopted AB3030 groundwater management plans. All of these groundwater management activities were initiated prior to recognizing that a regional aquifer system exists that extends over more than one county and that certain activities in one county could adversely impact another. Clearly the current ordinances, AB3030 plans, and local BMO activities, which were intended for localized groundwater management, are not well suited for management of a regional groundwater resource like that theorized of the Lower Tuscan aquifer system.29

Response
See Common Response 4 regarding substitution pumping under the Proposed Action being outside the lower Tuscan Aquifer System. No transfer-related pumping is proposed in Butte County.

Mitigation Measure GW-1 takes into account groundwater management activities (BMO and GMP) to avoid or reduce potential impacts to groundwater resources. See Common Responses 6 and 7 for additional information.

Comment NG03-51

Comment

There is a possibility that a seller's groundwater substitution area of impact will occur in multiple local jurisdictions, which should results in project requirements coming from multiple local as well as state and federal agencies. The Draft EIS/EIR doesn't discuss the obstacles from cross jurisdictional impacts that are immense because groundwater basins cross county lines thereby eliminating authority. (Id) One obvious example is found with productions wells placed in Glenn County in the lower end of the Tuscan Aquifer Basin that may affect the up-gradient part of the aquifer in Butte and Tehama counties.

If the Project proceeds, each seller's project analysis should identify what future analyses, ordinances, project conditions, exemptions, monitoring and mitigation measures are required to ensure that each of the seller's project meets or exceed the goals of the Draft EIS/EIR.

Response

The commenter is correct in stating that the potential impact of groundwater substitution pumping may cross political boundaries. Section 3.3.1.2, Regulatory Setting, lists the applicable regulations pertaining to transfers. The local regulatory information provided in Section 3.3.1.2.3 is listed for local jurisdictions where groundwater transfers are anticipated. Mitigation measure GW-1 requires a monitoring and mitigation plan be developed to ensure compliance with performance criteria and to avoid potentially significant impacts of transfer-related pumping. The monitoring program will be established to cover an area where impacts might occur, regardless of political jurisdiction.

Comment NG03-52

Comment

V. The EIS/EIR Fails to Adequately Analyze Numerous Environmental Effects.

The EIS/EIR fails to include numerous required elements to support a meaningful analysis of the project's significant adverse impacts. First, the deficiencies in the incomplete and undefined project description, and incomplete description of existing environmental conditions, render any true impact analysis, or hard look at the project effects, impossible. See, e.g., Santiago County Water Dist. v. County of Orange (1981) 118 Cal.App.3d 818; San Joaquin Raptor Rescue Ctr. v. County of Merced (2007) 149 Cal.App.4th

645. Even the analysis provided, however, employs unsupported and inapplicable standards of significance. (CEQA Guidelines § 15064(b); see, e.g., Oakland Heritage Alliance v. City of Oakland (2011) 195 Cal.App.4th 884, 896; Protect the Historic Amador Waterways v. Amador Water Agency (2004) 116 Cal.App.4th 1099, 1111). The EIS/EIR fails to completely analyze the project's significant adverse impacts, and fails to support its conclusions with substantial evidence, failing to characterize the project effects in the proper context and intensity. (Id.; 40 C.F.R. § 1508.27(a); City of Maywood v. Los Angeles Unified School Dist. (2012) 208 Cal.App.4th 362, 391; Laurel Heights Improvement Association v. Regents of Univ. of Cal. (1988) 47 Cal.3d 376, 393; Madera Oversight Coalition, Inc. v. County of Madera (2011) 199 Cal.App.4th 48, 102 ("whether an EIR is sufficient as an informational document is a question of law subject to independent review by the courts.")

As discussed, below, and in the expert reports submitted by Custis, EcoNorthwest, Cannon, and Mish on behalf of AquAlliance, the EIS/EIR fails to comport with these standards.

Response
This comment does not include any specific requests for additional information to be included to help define the project description. Commenters submitted requests for additional data to be included in the existing conditions sections for several resources, and this information has been added to the Final EIS/EIR where relevant. The additional data helped to clarify environmental conditions, but it did not result in changes that modified the impact analyses.

Comment NG03-53

Comment
a. Surface Water Flows.

The EIS/EIR fails to adequately analyze changes to all surface water flows as a result of the proposed project. While the EIS/EIR presents some level of streamflow drawdown analysis in its vegetation and biological resources section, that analysis is not taken into consideration with respect to affects to other water supply rights. This raises the specter of injury to senior water rights holders, and the EIS/EIR fails to provide sufficient information regarding where such rights are held and in what amounts, and where proposed transfers may interfere.

Response
Streamflow depletion from groundwater substitution has the potential to decrease surface water flows in waterways as the groundwater basin refills. The EIS/EIR estimates these potential effects, including the compounding effects from multiple consecutive years of transfers, using the SACFEM2013 groundwater model, the CalSim model, and the Transfer Operation Model (TOM). The changes in streamflow have the potential to affect multiple

resources; these effects are analyzed in Sections 3.1, Water Supply; 3.7, Fisheries; and 3.8, Vegetation and Wildlife. The water supply section investigates how changes in streamflow could affect water supply, and concludes that the potential effects would be focused on CVP and SWP users that receive water conveyed through the Delta.

Comment NG03-54

Comment
Streamflow depletion in the EIS/EIR is evaluated through modeling, but a closer look at the models employed shows significant omissions. First, because the rate of stream depletion is scaled to pumping rate and because the model documentation doesn't indicate the pumping locations, rates, volumes, times or durations that produced the pumped volumes shown in Figure 3.3-27, or the stream depletions shown in Figures B-5 and B-6 in Appendix B, it appears that the SACFEM2013 modeling did not simulate the maximum rate of stream depletion for the proposed 10-year project.

Response
See response to Comment NG01-16.

Comment NG03-55

Comment
Second, the available Delta export capacity was determined from CalSim II model results using only conditions through WY 2003, which fails to account for current conditions, climate change conditions, and future conditions. (EIS/EIR 3.7-18.) The adequacy of CalSIM II has also been called into question. 30

Response
See Common Response 5 in response to analysis through WY 2003. The comment refers to a peer review completed in 2003 without reference to the response to peer review from DWR and Reclamation (2004) or the significant improvements made to CalSim II since 2003. CalSim II is continually being improved, refined, and enhanced. Reclamation reviewed available modeling tools and selected the best available tool for each portion of the analysis.

Comment NG03-56

Comment
In addition, the Bay-Delta Conservation Plan establishes flow limits for the Delta that the EIS/EIR fails to consider. Instead, the EIS/EIR states that the proposed projects could decrease outflows by 0.3 percent in winter and spring, and provides a bare conclusion that this impact is less than significant. (EIS/EIR 3.2-39.) Just this year the Bureau of Reclamation and DWR requested a Temporary Urgency Change from the SWRCB, a modification to Delta flow

objectives that were not being met, and D-1641 standards, in order to attempt to manage species protection.

Response
The Bay-Delta Conservation Plan (BDCP) schedule indicates the plan would not be in place during the 10-year period analyzed in this EIS/EIR; therefore, the changes in flows from the BDCP were not incorporated in the analysis. Section 3.2, Water Quality analyzes the potential changes to water quality from water transfers. The analysis finds the changes to Delta water quality from existing conditions and from the No Action/No Project Alternative would be less than significant.

Comment NG03-57

Comment
The EIS/EIR attempts to consider changes in available supplies for project participants, but fails to review what other water rights holders may be affected by diminished flows. This is especially important given the EIS/EIR's conclusion that transfers would be most needed in times of critical shortage.

Response
Section 3.1.2.4.1 considers changes to water users in the Sacramento Valley as well as CVP and SWP water users that receive water conveyed through the Delta. The EIS/EIR considers how changes in streamflow could affect water supply, and concludes that the potential effects would be focused on CVP and SWP users that receive water conveyed through the Delta.

Comment NG03-58

Comment
The EIS/EIR also fails to disclose changes in flows as a result of tailwater and ag drainage, which could lead to significant streamflow impacts.

Response
As described in Section 2.3.2.1, water for transfers is made available by a seller who "must take an action to reduce consumptive use or use water in storage." If sellers transfer water through cropland idling or crop shifting, they would decrease their diversions only by the amount of applied water that would have been consumptively used absent the transfer. Without transfers, some of the applied water on each field is consumptively used by the crop (the evapotranspiration of applied water), but some is not used by the crop and becomes percolation to the groundwater or surface runoff. For cropland idling or crop shifting, water that would have been applied to the field but not consumptively used by the crop would continue to be diverted by the seller and would enter the distribution system. Water that would run off fields into drain facilities would continue to flow into these drains; therefore, flows into the drain canals would not be affected.

Comment NG03-59

Comment
b. Water Quality.

i. The EIS/EIR improperly excludes substantial amounts of water from any meaningful impact evaluation.

The EIS/EIR fails to provide any evidence to support its proposition that "if the change in flow is less than ten cubic feet per second (cfs), it is assumed that there would be no water quality impacts as this is within the error margins of the model." (EIS/EIR 3.2-27.) First, the margin of error of the model has no bearing on actual water quality. Second, NPDES permits regularly regulate flows of less than 10 cfs. According to USGS, 10 cfs equals 6.46 million gallons per day (MGD). The EIS/EIR's assumption that a change in reservoir elevation of less than 1,000 acre feet could not possibly have significant impacts to water quality is similarly baseless. (EIS/EIR 3.2-27.) This amounts to approximately 325,800 gallons of water, more than enough to result in a noticeable difference in water quality. The Federal Clean Water Act is a strict liability statute providing no de minimis exceptions. By way of comparison, the City of Galt Wastewater Treatment Plant maintains flows at 4.5 MGD (NPDES Permit No. CA0081434), the City of Colusa Wastewater Treatment Plant maintains flows of approximately 0.7 MGD (NPDES Permit No. CA0078999), and each of these facilities has been assessed penalties for effluent exceedances by the Regional Water Board in recent years. The EIS/EIR's conclusion that flows equivalent to entire municipal wastewater treatment plants have no ability to compromise water quality standards is simply wrong.

Response
This clause has been removed from Section 3.2.2.1.1. The water quality analysis in Section 3.2 presented changes smaller than these thresholds in the effects analysis. However, small changes in flow and reservoir storage would not be comparable to the examples cited in this comment. These examples focus on discharges of water with poorer water quality than the receiving water. The water quality analysis considers whether small changes in flows or reservoir storage could, in and of themselves, affect water quality through changing dilution factors. This potential impact mechanism is very different from effluent discharge from wastewater treatment facilities.

Comment NG03-60

Comment
Similarly, the EIS/EIR provides the bare conclusion that:

CVP and SWP reservoirs within the Seller Service Area would experience only small changes in storage, which would not be of sufficient magnitude and frequency to result in substantive changes to water quality. Any small changes to water quality would not adversely affect designated beneficial uses, violate existing water quality standards, or substantially degrade water quality. Consequently, potential effects on reservoir water quality would be less than significant. (EIS/EIR 3.2-31.) The EIS/EIR simply provides no evidence or analysis in making this conclusion.

Response
The impact statement referred to in the comment considers whether changes in reservoir storage could affect water quality. Some clarifying text has been added to indicate that changes in storage could affect water quality if they substantially affect the water available for dilution; however, the small changes from the action alternatives would be insubstantial and would not result in this type of effect.

Comment NG03-61

Comment
Lastly, the EIS/EIR provides no actual analysis of potential impacts to San Luis Reservoir as a result of lowering water levels in response to transfers. The EIS/EIR admits that “storage under the Proposed Action would be less than the No Action/No Project Alternative for all months of the year,” and asserts that water levels would be lowered between 3%-6% as a result of the Project. (EIS/EIR 3.2-41.) The EIS/EIR then presents the bare conclusion that “These small changes in storage are not sufficient to adversely affect designated beneficial uses, violate existing water quality standards, or substantially degrade water quality.” The EIS/EIR provides no basis for this determination, including no comparison of baseline environmental conditions to changes in contaminated runoff as a result of any particular water transfer.

Response
Additional analysis has been added to Section 3.2 regarding San Luis Reservoir and potential impacts relating to operations.

Comment NG03-62

Comment
ii. The EIS/EIR fails to provide any information with which to evaluate impacts from idled crop fields, or farmlands in buyers’ areas.

The EIS/EIR assumes certain agricultural practices will occur at idle rice fields, when in reality, property owners would be free to re-purpose idled fields in countless and creative ways. (EIS/EIR 3-2.30.) For idled alfalfa, corn, or tomato cropland, the EIS/EIR assumes that property owners will put in place erosion control measures to conserve soil. While this may be a reasonable assumption for some farms, others, who may prefer to purse multi-year water transfers, may not have an interest in investing in soil conservation. In addition, the EIS/EIR fails to provide analysis of the degree of effectiveness of soil conservation measures where no groundcover is in place. (EIS/EIR 3.2-29.) If proven to be effective, the EIS/EIR should require the Lead Agencies to condition water transfers on these necessary mitigation measures, and provide monitoring and reporting to ensure their continued implementation. We recommend that the Bureau and DWR require, at a minimum, that local governments select independent third-party monitors, who are funded by surcharges on Project transfers paid by the buyers, to oversee the monitoring that is proposed in lieu of Bureau and DWR staff, and that peer-reviewed methods for monitoring be required. If this is not done, the Project's proposed monitoring and mitigation outline is insufficient and cannot justify the significant risk of adverse environmental impacts.

Response
The potential for erosion from idled croplands is analyzed in Section 3.4, Geology and Soils and found to be less than significant because the soil types are not prone to erosion. This analysis assumes typical agricultural practices on the properties and does not assume erosion control measures are in place. The impact analysis addresses the reasonably foreseeable potential scenarios and is not required to analyze a hypothetical worst case scenario that could result from the Proposed Action.

Comment NG03-63

Comment
The EIS/EIR also states that increased erosion would not be of concern in Butte, Colusa, Glenn, Solano, Sutter, and Yolo counties, due to the prevalence of clay and clay loam soils. (EIS/EIR 3.2-29.) This bare conclusion does not provide any meaningful evaluation of the proposed program's impacts. Does the EIS/EIR really mean to assert that nowhere across six entire counties does soil erosion adversely impact water quality?

Response
New maps prepared for Section 3.4 as well as revised analysis in that section show soil surface textures in the sellers service area and the location of the water districts, with no material changes to the conclusions of the Draft EIS/EIR. See Section 3.4.2.4 for a discussion of soil textures in the sellers service area and impacts related to erosion.

Comment NG03-64

Comment
The EIS/EIR contradicts itself, stating:

In cases of crop shifting, farmers may alter the application of pesticides and other chemicals which negatively affect water quality if allowed to enter area waterways. Since crop shifting would only affect currently utilized farmland, a significant increase in agricultural constituents of concern is not expected.

(EIS/EIR 3.2-30.) Would applications be altered, or remain the same? The EIS/EIR says both. In truth, due to the programmatic nature of this EIS/EIR, although it is a "project" not a "programmatic" document, one cannot know. This level of impact must be evaluated on a project-by-project basis, yet the Lead Agencies assertion that this is a "project" level EIS/EIR precludes additional CEQA and NEPA review.

Response

Different types of crops may require different use of pesticides and fertilizers. However, crop shifting would only occur on currently utilized farmland, and not on lands converted to agricultural use. Therefore, there will not be a significant change in farming methods such that water quality would be affected.

Comment NG03-65

Comment

The EIS/EIR concludes that water quality impacts in the buyer area would be less than significant, but provides no evidence or assurances whatsoever regarding the ultimate use of the purchased water would be. (EIS/EIR 3.2-41.) The EIS/EIR then considers only impacts resulting from increased crop irrigation, acknowledging that "[i]f this water were used to irrigate drainage impaired lands, increased irrigation could cause water to accumulate in the shallow root zone and could leach pollutants into the groundwater and potentially drain into the neighboring surface water bodies." (EIS/EIR 3.2-41.) The EIS/EIR then dismisses this possibility, assuming that buyers would only use water for "prime or important farmlands." Missing from this section is any analysis of water quality. What does the EIS/EIR consider to be prime or important farm lands? Do all such actual farms exhibit the same water quality in irrigated runoff? The EIS/EIR provides no assurances its assumptions will be met, and moreover, fails to explain what its assumptions actually are.

Response

Section 3.9 of this document addresses agricultural land use. Prime or important farmlands are determined by soil characteristics. The water quality of runoff varies based on these characteristics (among other factors). In general, runoff from prime farmlands is likely to be lower in salinity due to soil characteristics.

Comment NG03-66

Comment

The EIS/EIR then again relies on an improper ratio comparison of the amount of transfer water potentially used in buyer areas, to the total amount of all water used in the buyers' areas. The EIS/EIR adds:

The small incremental supply within the drainage-impaired service areas would not be sufficient to change drainage patterns or existing water quality, particularly given drainage management, water conservation actions and existing regulatory compliance efforts already implemented in that area. (EIS/EIR 3.2-41.) Again, however, any comparison ratio of transferred water to other irrigation simply provides no analysis of what water quality impacts any individual transfer would have after application on any individual farm. Moreover, if indeed a transfer is responding to a shortage, the transfer amount could actually constitute all or a majority of water usage for a particular site. Allusion to "existing regulatory compliance efforts" only suggests that regulatory compliance is not already maintained in each and every potential buyer farmland. There is no reasonable dispute that return flows from irrigated agriculture can often compromise water quality standards, but the EIS/EIR simply brushes this impact aside.

Response
The amount of transfer water that would be provided for irrigation in the buyer's service area is minimal compared to existing applied irrigation in the area. The small incremental supply within the service area would not be substantive enough to change drainage patterns or water quality.

Comment NG03-67

Comment
The EIS/EIR assumes that transfers may only occur during times of shortage (EIS/EIR 3.2-41), yet the proposed project itself is not so narrowly defined, and nothing in the Water Code limits transfers to circumstances where there has been a demonstrated shortfall in the buyer's area. As a result of this open-ended project description, the true water quality impacts in the buyers' areas are completely unknown.

Response
Chapter 2 explains that water transfers could only occur when buyers have demand and capacity is available to convey water to those buyers. Section 2.3.2.5 describes this concept in more detail, and explains that no capacity for transfers existed in 65 percent of the years studied.

Comment NG03-68

Comment
iii. The EIS/EIR ignores numerous potentially significant sources of contamination to surface waters.

The EIS/EIR describes the existing environmental conditions of most of the water bodies within the potential seller areas to be impaired for numerous contaminants; and also provides sampling and monitoring data to show that in-stream exceedances of water quality objectives regularly occur. Yet, the EIS/EIR fails to ever discuss the impact of moving contaminated water from one source to another. For example, where a seller's water is listed as impaired for certain contaminants, any movement of that water to another waterbody will simply spread this impairment. The EIS/EIR provides no information with which to determine the actual water quality of the seller's water for any particular transfer, nor any evaluation or monitoring to determine whether moving these contaminants from one water to another would harm beneficial uses or exceed receiving water limits. The EIS/EIR should provide a more particularized review of potential contaminants and their impacts under the proposed project. For example, the EIS/EIR does not analyze water quality impacts from boron, but the BDCP EIS/EIR states, "large-scale, out-of-basin water transfers have reduced the assimilative capacity of the river, thereby exacerbating the water quality issues associated with boron." (BDCP EIS/EIR at 8-40.) Similarly, dissolved oxygen, among other forms of contamination, pose regular problems pursuant to D-1641. These potentially significant impacts must be disclosed for public and agency review.

What selenium and boron loads in Mud Slough and other tributaries to the San Joaquin River may be expected from application of this water to western San Joaquin Valley lands?

Response
The action alternatives would transfer water through the Delta, that is, from sources that already enter the Delta (the Sacramento, Feather, Yuba, American, and San Joaquin rivers). Additionally, the origins of the transfer water are water bodies that have generally high quality water. Water transfers would result in very small changes to reservoir storage and river flow, but would not change constituents entering these water bodies. For these reasons, water transfers would also not have significant effects on dissolved oxygen in the Delta.

Section 3.2.2.4.2 assesses the potential for transfers to affect water quality in the San Joaquin River through increased agricultural runoff. This assessment includes constituents present in agricultural runoff, including boron. The impact assessment finds that the impacts would be less than significant. The Bay-Delta Conservation Plan (BDCP) text cited refers to a decreased assimilative capacity in the San Joaquin River; the "transfers" discussed refer to moving water from the San Joaquin River out of basin. The action alternatives do not include similar actions.

Comment NG03-69

Comment
The EIS/EIR fails to disclose whether changes in specific conductivity as a result of the program would result in significant impacts to water quality. First, as noted above, the EIS/EIR presents scattered baseline data, much of which appears to show ongoing EC exceedances, but the EIS/EIR fails to disclose what Bay-Delta EC standards are, and the frequency and magnitude of baseline exceedances. Against this backdrop, the EIS/EIR then admits that program

transfers would increase EC by as much as 4.3 percent. (EIS/EIR 3.2-39.) The EIS/EIR fails to disclose whether these regular EC increases would exacerbate baseline violation conditions. In addition, the EIS/EIR only presents analysis for one monitoring location, whereas the Bay-Delta plan contains EC limits for over a dozen monitoring locations.

Response
The Draft EIS/EIR notes on p. 3.2-20 that the San Joaquin River water quality standards include salinity standards at Vernalis, which is just downstream of the confluence with the Stanislaus River. The Draft EIS/EIR notes that the salinity standard (measured as EC) is 700 microsiemen per centimeter (µS/cm) from April 1 to August 31, and 1000 µS/cm for the remainder of the year. The analysis presents the magnitude of average monthly increases based on the year type (e.g., wet, dry, etc.). Water quality at additional sites in the Delta has been added to the Final EIS/EIR.

Comment NG03-70

Comment
The EIS/EIR fails to disclose the extent to which program transfers could harm water quality by moving the “X2” location through the Delta. D-1641 specifies that, from February through June, the location of X2 must be west of Collinsville and additionally must be west of Chipps Island or Port Chicago for a certain number of days each month, depending on the previous month’s Eight River Index. D-1641 specifies that compliance with the X2 standard may occur in one of three ways: (1) the daily average EC at the compliance point is less than or equal to 2.64 millimhos/cm; (2) the 14-day average EC is less than or equal to 2.64 millimhos/cm; or (3) the 3-day average Delta outflow is greater than or equal to the corresponding minimum outflow.

Response
The EIS/EIR considers movement to X2 in Section 3.2.2.4.1, and finds the changes in X2 would remain within water quality standards.

Comment NG03-71

Comment
The EIS/EIR relies on an improper ratio approach to its impact evaluation of increased EC concentrations in the Delta Mendota Canal as a result of San Joaquin River diversions. (EIS/EIR 3.2-40.) The EIS/EIR admits that EC in the canal would increase as a result of these diversions, but fails to disclose by how much, or against what existing environmental conditions. Instead, the EIS/EIR compares the transfer amount, approximately 250 cfs, to the total capacity of the canal, about 4,000 cfs, to conclude that EC changes would not be significant. A comparison of the transfer amount to the total canal capacity simply provides no analysis of or information about EC concentrations.

Response
The assessment of potential impacts to the Delta-Mendota Canal does not rely solely on the flow change into the canal, but also considers the water quality of the potential transferred water. The impact discussion identifies the potential water quality of water captured at Banta Carbona ID (Table 3.2-20) and water quality captured at West Stanislaus ID or Patterson ID (Table 3.2-19). The quality of this water is compared to the quality of water in the Delta-Mendota Canal (Table 3.2-21). The average and maximum EC concentrations at Banta Carbona ID, West Stanislaus ID, and Patterson ID would be higher than the average EC concentration in the Delta-Mendota Canal, but the small amount of water from these sources indicates the overall change to water quality in the Delta-Mendota Canal would be insubstantial.

Comment NG03-72

Comment
The EIS/EIR fails to meaningfully evaluate potentially significant impacts to surface water quality as a result of groundwater substitution. First, the EIS/EIR provides an improper and misleading comparison, stating that the amount of groundwater substituted for surface water under the Proposed Action would be relatively small compared to the amount of surface water used to irrigate agricultural fields in the Seller Service Area. Groundwater would mix with surface water in agricultural drainages prior to irrigation return flow reaching the rivers. Constituents of concern that may be present in the groundwater could enter the surface water as a result of mixing with irrigation return flows. Any constituents of concern, however, would be greatly diluted when mixed with the existing surface waters applied because a much higher volume of surface water is used for irrigation purposes in the Seller Service Area. Additionally, groundwater quality in the area is generally good and sufficient for municipal, agricultural, domestic, and industrial uses. (EIS/EIR at 3.2-21.) The EIS/EIR's threshold of significance asks whether any water quality objective will be violated, and this must be measured at each discharge point. In turn, any farm that substitutes surface water irrigation for groundwater irrigation must be evaluated against this threshold. The EIS/EIR fails to provide any evidence to support its conclusion that the dilution of the groundwater runoff into surface waters would avoid any significant water quality impacts. On one hand the EIS/EIR asserts that groundwater is of good quality, and on the other hand, asserts that the overall quality would improve as it is mixed with surface water irrigation runoff: which source provides the better water quality in this arrangement? It is widely recognized that irrigated agricultural return flows can transport significant contaminants to receiving water bodies. In addition, the EIS/EIR simply assumes that contaminated groundwater would not be pumped and applied to agricultural lands, despite the fact that groundwater extractions may mobilize PCE, TCE, and nitrate plumes under the City of Chico,32 and fails to disclose the existence of all hazardous waste plumes in the area of origin where groundwater substitution may occur. The assertion that "groundwater is generally good" throughout 6-10 counties is insufficient to

provide any meaningful information against which to evaluate any particular transfer.

Response
Groundwater quality is discussed in detail in Section 3.3, Groundwater Resources. The Draft EIS/EIR describes dilution in the context of general on-farm conditions under which a transfer may result in groundwater substitution. Groundwater in combination with surface water would be applied to specific fields. Return flows from these fields would eventually discharge into receiving water. Pollutants, if any, associated with these discharges would be covered under the SWRCB Agricultural Waivers program, and would likely be related to agricultural applications of fertilizers and pesticides which would occur in the absence of water transfers.

Comment NG03-73

Comment
For “non-Project” reservoirs, the EIS/EIR provides one piece of additional information: modeling projections showing various rates of drawdown in table 3.2-24. The EIS/EIR then concludes that because water quality in these reservoirs is generally good, the reductions would not result in any significant water quality impacts. Again, the EIS/EIR provides no evidence or analysis to support this bare conclusion. Nor does the EIS/EIR present the beneficial uses of Collins Lake, nor Dry Creek, downstream of Collins Lake (see Table 3.2-2). The EIS/EIR does note that Lake McClure, Hell Hole Reservoir, and Camp Far West Reservoir maintain beneficial uses for cold water habitat and wildlife habitat, but fails to evaluate whether these beneficial uses would be impacted. Dissolved oxygen rates will decrease with lower water levels, and any sediment-based contaminant concentration, will increase. And the fact that drawdowns increase in already-critical years only heightens the water quality concerns.

Response
Collins Lake and Dry Creek are not listed for beneficial uses in the Basin Plan. According to the 2011 Sacramento River Basin and San Joaquin River Basin Water Quality Control Plan, "It should be noted that it is impractical to list every surface water body in the Region." Potential impacts to water quality based on each alternative are evaluated.

Comment NG03-74

Comment
The EIS/EIR repeatedly relies on dilution as the solution, with no actual analysis or receiving water assimilative capacity, and no regulatory authority. It is well-established law that a discharger may receive a mixing zone of dilution to determine compliance with receiving water objectives if and only if the permittee has conducted a mixing zone study, submitted to a Regional Board or

the State Board for approval. (See, e.g., Waterkeepers N. Cal. v. AG Indus. Mfg., 2005 U.S. Dist. LEXIS 43006 [“A dilution credit is a limited regulatory exception that must be preceded by a site specific mixing zone study”]; Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California, 65 Fed. Reg. 31682 (May 18, 2000), 31701 [“All waters . . . are subject to the criteria promulgated today. Such criteria will need to be attained at the end of the discharge pipe, unless the State authorizes a mixing zone.”]) The EIS/EIR entirely ignores Clean Water Act requirements for obtaining dilution credits, and, with no supporting evidence whatsoever, effectively and illegally grants dilution credits across the board. (See, EIS/EIR 3.2-31, 3.2-35, 3.2-36, 3.2-42, 3.2-59). For each instance in which the EIR/EIS wishes to apply dilution credit to its determination of whether water quality impacts will be significant, it must perform – with the approval of the State or Regional Water Board – a mixing zone study considering the impacted waterbody and the specific types and quantities of the proposed pollutant discharge(s). Short of that, each time the EIS/EIR relies on dilution as the solution, it fails to analyze whether any contaminant in any waterbody in any amount could protect beneficial uses or exceed receiving water standards. The more Project water goes to south-of-Delta agricultural users than to urban users, the higher would be their groundwater levels, the more contaminated the groundwater would be in the western San Joaquin Valley and the more the San Joaquin River would be negatively affected from contaminated seepage and tailwater by operation of the Project.

Response

The Draft EIS/EIR describes dilution in the context of general on-farm conditions under which a transfer may result in groundwater substitution (see pages 3.2-31 and 3.2-42). Groundwater in combination with surface water would be applied to specific fields. Return flows from these fields would eventually discharge into receiving water. These instances would not be considered point source discharges, would not be covered by NPDES discharge permits, and would not require a mixing zone analyses. Pollutants, if any, associated with these discharges may be covered under the SWRCB Agricultural Waivers program, and would likely be related to agricultural applications of fertilizers and pesticides which would occur in the absence of water transfers.

The Draft EIS/EIR describes dilution in the context of transfers resulting in increased reservoir releases and increased river flows (see pages 3.2-25, 3.2-26, and 3.2-59). These releases are not covered by NPDES permits and do not require a mixing zone analysis.

Comment NG03-75

Comment

c. Groundwater Resources.

The modeling efforts presented by the EIS/EIR fail to accurately capture the project’s groundwater impacts. First, the SACFEM2013 simulations didn’t evaluate the impacts of pumping the maximum annual amount proposed for each of the 10 years of the project. Second, because the groundwater modeling effort didn’t include the most recent 11 years record, it appears to have missed simulating the most recent periods of groundwater substitution transfer pumping and other groundwater impacting events, such as recent changes in groundwater elevations and groundwater storage (DWR, 2014b), and the reduced recharge due to the recent periods of drought. Without taking the hydrologic conditions during the recent 11 years into account, the results of the SACFEM2013 model simulation may not accurately depict the current conditions or predict the effects from the proposed groundwater substitution transfer pumping during the next 10 years.

Response
See Common Response 5 and response to Comment NG01-13.

Comment NG03-76

Comment
The Lead Agencies are making gross assumptions about the number, size, and behavior of all the surface water resources in the state, just to be able to coerce those assumptions into data that fits into the SACFEM2013 model. The assumptions are driving the modeling instead of the model (and science) driving accurate results. Appendix D is full of inaccurate statements and clear indications that this model is deficient. For example, it's advertised as a 3D model, but it's actually a collection of linked 2D models, and those are driven not by science, but by assumptions, e.g., the model can't calculate the location of the phreatic surface: it relies on assumptions and observations for that data, and that makes the model incapable of prediction.33

Response
As with any groundwater modeling effort, incorporating parameter and boundary condition assumptions in areas of the domain where field data are not available is a requirement, rather than a choice. The Lead Agencies consider the input assumptions reasonable and appropriate. Further, SACFEM2013 was built using the MicroFEM code, a three-dimensional numerical groundwater flow code that simulates horizontal flow through layers as well as vertical flow between layers to simulate a three-dimensional groundwater flow field. MicroFEM has been reviewed by the National Ground Water Association Ground Water journal in the Software Spotlight Column (Ground Water 38, No. 5, p. 649-650). The assertion that SACFEM2013 is incapable of prediction is without basis, provided that end users of SACFEM2013 recognize that it is not possible to predict aquifer and stream responses with absolute certainty. SACFEM2013 is a powerful tool that, when used carefully, provides useful insights into potential outcomes from proposed groundwater management activities.

Comment NG03-77

Comment
The Draft EIS/EIR should provide the time-drawdown and distance-drawdown hydraulic characteristics for each groundwater substitution transfer well so that non-participant well owners can estimate and evaluate the potential impacts to their well(s) from well interference due to the pumping the groundwater substitution transfer well(s). This analysis is not present in the EIS/EIR.

Response
The project description developed in Section 2 provides the maximum volumes that may be transferred as part of the EIS/EIR (Table 2-4). Table 2-5 further divides the volumes from Table 2-4 into volumes for each transfer method. The data in Table 3.3-3 show the number of wells and range of individual well pumping rates. To provide a conservative assessment of potential impacts, this EIS/EIR simulated the concurrent groundwater substitution pumping of all the wells in Table 3.3-3. Pumping fewer wells and/or pumping wells at lower rates would likely result in lesser impacts than those presented in this EIS/EIR. Appendix E includes figures that show groundwater recovery over time at multiple locations throughout the area of analysis.

Comment NG03-78

Comment
The EIS/EIR wrongly assumes that stream depletion impacts from pumping occur only downstream from the point on the stream closest to the pumping well. Any monitoring of the effects of groundwater substitution pumping on surface or ground water levels, rates and areas of stream depletion, fisheries, vegetation and wildlife impacts, and other critical structures needs to cover a much wider area than what is needed for a direct surface water diversion.

Response
The EIS/EIR does not assume that streamflow depletion occurs downstream from pumping wells. The EIS/EIR includes an extensive modeling effort that considered changes in groundwater levels and groundwater-surface water interaction throughout the Sacramento Valley using the SACFEM2013 groundwater model. The results of this model were used in conjunction with the CalSim system operations model and the Transfer Operations Model (see Appendix D) to estimate the timing, location, and extent of groundwater-surface water interaction on streamflows throughout the groundwater basin area. These results were the basis for the analyses in Sections 3.1, Water Supply; 3.3, Groundwater; 3.7, Fisheries; and 3.8, Vegetation and Wildlife.

Comment NG03-79

Comment
The EIS/EIR doesn't compare the known groundwater quality problem areas with the SACFEM2013 simulated drawdowns to demonstrate that the proposed projects won't draw in or expand the areas of known poor water quality. The EIS/EIR analysis doesn't appear to consider the impacts to private well owners. Pumping done as part of the groundwater substitution transfer may cause water quality impacts from geochemical changes resulting from a lowering the water table below historic elevations, which exposes aquifer material to different redox conditions and can alter the mixing ratio of different quality aquifer zones being pumped. Changes in groundwater level can also alter the direction and/or rate of movement of contaminated groundwater plumes both horizontally and vertically, which may expose non-participating wells to contaminants they would not otherwise encounter.

Response
Section 3.3.2.4 describes potential impacts from the Proposed Action to groundwater quality within the seller service area. Groundwater extraction under the Proposed Action would be limited to short-term withdrawals during the irrigation season. Since inducing migration of groundwater is not likely to be a concern unless groundwater levels and/or flow patterns are substantially altered for a long period of time, effects from the migration of reduced groundwater quality would be less than significant.

Comment NG03-80

Comment
The EIS/EIR fails to evaluate any changes in the rate and direction of inter-basin groundwater flow. Inter-basin groundwater flow may become a hidden long-term impact that increases the time needed for recovery of groundwater levels from groundwater substitution transfer pumping, and can extend the impact from groundwater substitution transfer pumping to areas outside of the groundwater substitution transfer seller's boundary.

Response
The modeling analysis performed utilized a three-dimensional groundwater flow model that incorporates changes in groundwater flow in all directions surrounding the groundwater pumping wells. Groundwater flow in the model is not restricted by jurisdictional boundaries such as the potential seller's boundaries. Figures 3.3-28 through 3.3-33 show the spatial distribution of the change in groundwater levels within the Sacramento Valley.

Comment NG03-81

Comment
Finally, the EIS/EIR should evaluate how Project transfers could add to the already high water table in the western San Joaquin Valley? Impacts from a higher water table could include increased groundwater contamination, lower flood resistance, greater erosion, and loss of suitability of certain parcels to particular land uses.

Response
As stated in the Executive Summary and Chapter 1, transferred water will be used to meet existing demand. Because the water is being used to meet existing demand, a substantial increase in groundwater levels is not expected in the area mentioned.

Comment NG03-82

Comment
d. The SACFEM 2013 and CALSIM II Models are Inadequate.

The comments herein are based largely on the attached work of Dr. Custis (Exhibit A) and Dr. Mish (Exhibit C), and we request specific responses to these attached works. The EIR/EIS fails to accurately estimate environmental effects likely to occur during water transfers. The SACFEM2013 model used to predict groundwater resources is flawed by being based on poor technology that is simply not up to the task of accurate large-scale modeling.

The SACFEM2013 model is only partially predictive, in that key aquifer responses are entered as input data instead of being computed as predictive quantities. The model requires considerable data manipulation to be used, and these manipulations are necessarily subject to interpretation. The model description in the EIR/EIS presents no validation results that can be used to provide basic quality-assurance for the analyses used in the EIR/EIS. The model is not predictive in many important responses (as mentioned above), so its results are a reflection of past data (e.g., streamflows, phreatic surface location, etc.) instead of providing a predictive capability for future events. As described in previous sections, both the model and the input data contain gross over-simplifications that compromise the ability to provide accurate estimates of real-world responses of water resources On page 19 of Appendix B, the reader is promised that model uncertainty will be described in Appendix D, but that promise is never delivered. This lack of any formal measure of uncertainty is not an unimportant detail, as it is impossible to provide accurate estimates of margin of error without some formal treatment of uncertainty. Any physical response asserted by the model's results has a margin of error of 100% if that response involves spatial scales smaller than a kilometer or more.

Response
SACFEM has undergone an extensive independent peer review performed by an independent consultant with extensive experience in the application of groundwater models to evaluate groundwater systems and surface water-groundwater interaction (WRIME 2011). The objective of the peer review was to evaluate the adequacy of the model to estimate the impacts of groundwater substitution water transfer pumping on third party groundwater users as well as impacts to surface water flows. The results of the peer review identified seven primary enhancements to the model that would improve its accuracy in forecasting pumping impacts on water resources in the Sacramento Valley. All seven of these enhancements have been incorporated into SACFEM2013, the most recent version of SACFEM. See response to Comment SA03-7 for additional information.

The SACFEM2013 User's Manual has been included in the Final EIS/EIR as Appendix M, and it includes a discussion of model uncertainty. Additionally, a description of the sensitivity analyses completed as part of the Long-Term Water Transfers EIS/EIR has been included in Appendix D.

Comment NG03-83

Comment
The EIR/EIS makes little connection between groundwater extraction process modeled by SACFEM2013 and the all-too-real potential for surface subsidence, and the attendant irreversible loss of aquifer capacity. The problem is especially important during drought years, when groundwater substitution is most likely to occur. In a drought, the aquifer already entrains less groundwater than normal, so that additional stresses due to pumping are visited upon the aquifer skeleton. This is exactly the conditions required to cause loss of capacity and the risk of subsidence. Yet the EIR/EIS makes scant mention of these all-too-real problems, and no serious modeling effort is presented in the EIR/EIS to assess the risk of such environmental degradation.

Response
Section 3.3.2.4 evaluates land subsidence. See Common Response 7.

Comment NG03-84

Comment
In contrast to the shortcomings of the model, the Bureau/DWR's DTIPWT seeks information on interactions between groundwater pumping and groundwater/surface water supplies at various increments of less than one and two miles. (DTIPWT at Appendix B.) Where the EIS/EIR fails to provide information at a level of detail required by BOR and DWR to determine whether significant impacts to water supplies may occur, the EIS/EIR fails to provide information needed to support a full analysis of groundwater and surface water impacts, and fails to support its conclusions with evidence.

Response

Appendix B of the Draft Technical Information Papers for Water Transfers in 2014 discusses well acceptance criteria. It is not a measure of significant impacts. The well acceptance criteria are not included in the EIS/EIR. The evaluation using SACFEM2013 and TOM was a comprehensive evaluation of groundwater-surface water interaction to support the analysis in the EIS/EIR.

Comment NG03-85

Comment

CalSim II is a highly complex simulation model of a complex system that requires significant expertise to run and understand. Consequently, only a few individuals concentrated in the Department of Water Resources, U.S. Bureau of Reclamation and several consulting firms understand the details and capabilities of the model. State Water Resources Control Board (SWRCB) staff cannot run the model. To the extent CalSim II is relied upon, the EIR/EIS must be transparent and clearly explain and justify all assumptions made in model runs. It must explicitly state when findings are based on post processing and when findings are based on direct model results. And results must include error bars to account for uncertainty and margin of safety.

Response

The assumptions included in the CalSim II simulation are set forth in Appendix B, page B-66. This table is a common method for reporting the assumptions in a CalSim II simulation. Figure B-1, page B-4 illustrates the interconnected modeling process used to develop results in the EIR/EIS and indicates what results come from each of the three models. CalSim II is used to simulate the baseline, without transfers, operation of the CVP and SWP. This baseline operation is also included in TOM, but results for any of the with-project alternatives are from TOM, and TOM uses output from SACFEM2013 for analysis of groundwater substitution transfers.

Comment NG03-86

Comment

As an optimization model, CalSim II is hardwired to assume perfect supply and perfect demand. The notion of perfect supply is predicated on the erroneous assumption that groundwater can always be obtained to augment upstream supply. However, the state and federal projects have no right to groundwater in the unadjudicated Sacramento River basin. Operating under this assumption risks causing impacts to ecosystems dependent upon groundwater basins in the areas of origin. The notion of perfect demand is also problematic, as it cannot account for the myriad of flow, habitat and water quality requirements mandated by state and federal statutes. Perfect demand assumes water deliveries constrained only by environmental constraints included in the code. In other words, CalSim II never truly measures environmental harm beyond simply projecting how to maximize deliveries without violating the incorporated environmental constraints. As a monthly time-step model, CalSim II cannot determine weekly, daily or instantaneous effects; i.e., it cannot accurately simulate actual instantaneous or even weekly flows. It follows that CalSim II cannot identify real-time impacts to objectives or requirements. Indeed, DWR admits, “CalSim II modeling should only be used in ‘comparative mode,’ that is when comparing the results of alternate CalSim II model runs and that ‘great caution should be taken when comparing actual data to modeled data."35

Response
CalSim II is a planning model jointly developed by Reclamation and DWR to simulate operations of the CVP and SWP. CalSim II is the only available model that simulates CVP and SWP operations over a long-term period of historical hydrology. Environmental effects were determined based on review of model results and other data. Model results were used in a comparative sense (i.e., by comparing results of simulations with the transfers to a baseline simulation without the transfers) when determining environmental effects. It is unclear what is meant by "perfect supply and perfect demand." There are limitations in the ability of any model to simulate actual, real-time human decision making. However, these limitations are disclosed in the document and do not invalidate the analysis or the effects determined based on the analysis.

Comment NG03-87

Comment
The Department of Civil Engineering University of California at Davis conducted a comprehensive survey of members of California’s technical and policy-oriented water management community regarding the use and development of CalSim II in California. Detailed interviews were conducted with individuals from California’s water community, including staff from both DWR and USBR (the agencies that created, own, and manage the model) and individuals affiliated with consulting firms, water districts, environmental groups, and universities.

The results of the survey, which was funded by the CalFed Science Program and peer-reviewed, should serve as a cautionary note to those who make decisions based on CalSim II. The report cites that in interviewing DWR and USBR management and modeling technical staff: “Many interviewees acknowledge that using CALSIM II in a predictive manner is risky and/or inappropriate, but without any other agency-supported alternative they have no other option.”

The report continues that: “All users agree that CalSim II needs better documentation of the model, data, inputs, and results. CalSim II is data-driven, and so it requires numerous input files, many of which lack documentation,” and “There is considerable debate about the current and desirable state of CalSim II’s calibration and verification,” and “Its representation of the SWP and CVP includes many simplifications that raise concerns regarding the accuracy of results." "The model's inability to capture within-month variations sometimes results in overestimates of the volume of water the projects can export from the Sacramento- San Joaquin Bay-Delta and makes it seem easier to meet environmental standards than it is in real operations." The study concluded by observing, "CalSim II is being used, and will continue to be used, for many other types of analyses for which it may be ill-suited, including in absolute mode."

In sum, the relied-upon models fail to accurately characterize the existing and future environment, fail to assess project-related impacts at a level of detailed required for the EIS/EIR, and fail to support the EIS/EIR's conclusions regarding significance of impacts.

Response
There are limitations to using CalSim II as described in the comment. However, CalSim II is the best available tool for analysis of effects to the CVP and SWP and is still the industry standard for the type of comparative analysis performed in preparation of the EIS/EIR.

Comment NG03-88

Comment
e. Seismicity.

The EIS/EIR reasoning that because the projects don't involve new construction or modification of existing structures that there are no potential seismic impacts from the activity undertaken during the transfers is incorrect. The project area has numerous existing structures that could be affected by the groundwater substitution transfer pumping, specifically settlement induced by subsidence. Although the seismicity in the Sacramento Valley is lower than many areas of California, it's not insignificant. There is a potential for the groundwater substitution transfer projects to increase the impacts of seismic shaking because of subsidence causing additional stress on existing structures.

Response
Subsidence impacts are addressed in Section 3.3, Groundwater Resources, and are addressed by Mitigation Measure GW-1: Monitoring Program and Mitigation Plans. This mitigation measure has also been refined in response to public comment. See Common Response 7 for additional information.

Comment NG03-89

Comment
The EIS/EIR fails to inform the public through any analysis of the potential effects excessive groundwater pumping in the seller area may have on the numerous known earthquake faults running through and about the north Delta

area, and into other regions of Northern California. As recently detailed in a paper published by a well-respected British scientific journal, “[u]plift and seismicity driven by groundwater depletion in central California,” excessive pumping of groundwater from the Central Valley might be affecting the frequency of earthquakes along the San Andreas Fault, and raising the elevation of local mountain belts. The research posits that removal of groundwater lessens the weight and pressure on the Earth’s upper crust, which allows the crust to move upward, releasing pressure on faults, and rendering them closure to failure. Long-Term Water Transfer Agreements have impacted the volume of groundwater extracted as farmers are able to pump and then forego surface water in exchange for money. The drought has exacerbated the need for water in buyer areas, and depleted the natural regeneration of groundwater supply due to the scarcity of rain.

Detailed analyses of this seismicity and focal mechanisms indicate that active geologic structures include blind thrust and reverse faults and associated folds (e.g., Dunnigan Hills) within the Coast Ranges-Sierran Block (“CRSB”) boundary zone on the western margin of the Sacramento Valley, the Willows and Corning faults in the valley interior, and reactivated portions of the Foothill fault system. Other possibly seismogenic faults include the Chico monocline fault in the Sierran foothills and the Paskenta, Elder Creek and Cold Fork faults on the northwestern margin of the Sacramento Valley.36

Response
The purpose of Mitigation Measure GW-1 is to monitor groundwater levels during transfers to avoid potentially significant effects. See Common Responses 6 and 7 for additional information. In addition, Reclamation’s transfer approval process and groundwater mitigation measures set forth a framework that is designed to avoid and minimize adverse groundwater effects. Reclamation will verify that sellers adopt and implement these measures to minimize the potential for adverse effects related to groundwater extraction. The article "Earthquake Activity in the Central Valley, California and its Implications to Active Geologic Structures and Contemporary Tectonic Stress" referred to in the comment does not mention the role of groundwater pumping on the frequency of earthquakes in central California.

Comment NG03-90

Comment
The gross omissions and errors within the climate change analysis of the EIS/EIR fail to accurately describe the existing climatological conditions into which the project may be approved, fail to accurately describe the diminution of water and natural resources over recent and future years as a result of climate change, fail to integrate these changing circumstances into any future baseline or cumulative conditions, and fail to completely analyze or support the EIS/EIR conclusions regarding the project’s potentially significant impacts.

Response
Section 3.6, Climate Change describes the existing climatological conditions for the study area in Section 3.6.1.3, Existing Conditions. Multiple reports were reviewed in detail to determine the projected climate effects that could occur during project implementation. The climate change analysis in the EIS/EIR was also consistent with the groundwater substitution assumptions modeled using CalSim II, SACFEM2013, and the Transfer Operations Model (TOM); see Appendix B for more information on the use and interaction of these three models. Because these models consider any hydrologic changes that could have occurred in the past, the modeling completed for this analysis would have incorporated any changes to water operations that would be occurring from climate change. Furthermore, the modeling was further refined collaboratively with Reclamation because the baseline study was revised for an existing level of development, requirements, and projects (see page B-5). Appendix B states that "[t]he Project's ten-year period allows simulation of a single level of development under the assumptions that conditions are not likely to change significantly over such a short time horizon" (see page B-19). As a result, no additional analysis is required for climate change.

Comment NG03-91

Comment
i. The EIS/EIR Completely Fails to Incorporate Any Climate Change Information into its Analysis.

The EIS/EIR provides no analysis whatsoever of the extent to which climate change will affect the EIS/EIR assumptions regarding water supply, water quality, groundwater, or fisheries. Despite providing an overview of extant literature and study, all agreeing that California temperatures have been, are, and will continue to be rising, the entire EIS/EIR analysis of climate change interactions with the proposed project states:

As described in the Section 3.6.1.3, changes to annual temperatures, extreme heat, precipitation, sea level rise and storm surge, and snowpack and streamflow are expected to occur in the future because of climate change. Because of the short-term duration of the Proposed Action (10 years), any effects of climate change on this alternative are expected to be minimal. Impacts to the Proposed Action from climate change would be less than significant.

(EIS/EIR 3.6-21 to 3.6-22; similarly, the EIS/EIR Fisheries chapter at 3.7-23 states: “Future climate change is not expected to alter conditions in any reservoir under the No Action/No Project Alternative because there will be limited climate change predicted over the ten year project duration (see Section 3.6, Climate Change/Greenhouse Gas).”)

First, this “analysis” seriously misstates extant science by claiming that climate change impacts “are expected to occur in the future.” The effects of climate change are affecting California's water resources at present, and have been for years. A 2007 DWR fact sheet, for example, states that "[c]limate change is already impacting California's water resources."37 A more recent 2013 report issued by the California Office of Environmental Health Hazard Assessment states that "[m]any indicators reveal already discernible impacts of climate change, highlighting the urgency for the state, local government and others to undertake mitigation and adaptation strategies."38 The report states that:

Climate is a key factor affecting snow, ice and frozen ground, streams, rivers, lakes and the ocean. Regional climate change, particularly warming temperatures, have affected these natural physical systems.

From October to March, snow accumulates in the Sierra Nevada. This snowpack stores much of the year's water supply. Spring warming releases the water as snowmelt runoff. Over the past century, spring runoff to the Sacramento River has decreased by 9 percent. Lower runoff volumes from April to July may indicate: (1) warmer winters, during which precipitation falls as rain instead of snow; and (2) earlier springtime warming.

Glaciers are important indicators of climate change. They respond to the combination of winter snowfall and spring and summer temperatures. Like spring snowmelt, the melting of glaciers supplies water to sustain flora and fauna during the warmer months. Glacier shrinkage results in earlier peak runoff and drier summer conditions—changes with ecological impacts—and contributes to sea level rise.

With warming temperatures over the past century, the surface area of glaciers in the Sierra Nevada has been decreasing. Losses have ranged from 20 to 70 percent.

Over the last century, sea levels have risen by an average of 7 inches along the California coast.

Lake waters have been warming at Lake Tahoe, Lake Almanor, Clear Lake and Mono Lake since the 1990s. Changes in water temperature can alter the chemical, physical and biological characteristics of a lake, leading to changes in the composition and abundance of organisms that inhabit it.

Snow-water content—the amount of water stored in the snowpack—has declined in the northern Sierra Nevada and increased in the southern Sierra Nevada, likely reflecting differences in precipitation patterns.

Reduced runoff means less water to meet the state's domestic, agricultural, hydroelectric power generation, recreation and other needs. Cold water fish habitat, alpine forest growth and wildfire conditions are also impacted.

Response

See Common Response 5 and response to comment LA02-7.

Comment NG03-92

Comment
In addition, climate change threatens to reduce the size of cold water pools in upstream reservoirs and raise temperatures in upstream river reaches for Chinook, and climate change will reduce Delta outflows and cause X2 to migrate further east and upstream. (See, BDCP at 5.B-310, "Delta smelt may occur more frequently in the north Delta diversions area under future climate conditions if sea level rise [and reduced Sacramento River inflow below Freeport] induces movement of the spawning population farther upstream than is currently typical.")

Response
A range of potential transfer activities, including long-term water transfers, within a 10-year timeframe are evaluated in this EIS/EIR. BDCP did not assume any climate change in its 10-year model scenario ("near-term") because predicted changes were within the range of model variation. Climate change likewise was not considered for the modeling evaluation in this EIS/EIR because climate change effects would have been too small to be outside the range of modeling variation.

Comment NG03-93

Comment
And, the EIS/EIR "[f]igure 3.6-1 shows the climate change area of analysis," excluding all of the Sierra Nevadas except those within Placer County, and excluding all of Sacramento County. (EIS/EIR 3.6-2.)

Response
As described in Section 3.6, Climate Change, the "area of analysis for climate change includes counties where cropland idling could occur in the Seller Service Area, counties overlying groundwater basins where groundwater substitution transfers could occur, and counties where transferred water would be used for agricultural purposes in the Buyer Service Area" (page 3.6-2). The exclusion of Sacramento County is an error and Figure 3.6-1 has been revised to include Sacramento County. Areas without cropland idling or groundwater substitution transfers, such as Placer County, are not included in the climate change area of analysis.

Comment NG03-94

Comment
Instead of accounting for these factors in its environmental analysis, the EIS/EIR takes the obtuse approach of relying only on "mid-century" and year 2100 projections to cast climate change as a "long-term" and "future" problem. (See, e.g., EIS/EIR 3.6-10.) First, the U.S. Department of Interior and the California Resources Agency clearly possess better information regarding past,

present, and on-going changes to water supplies as a result of climate change than presented in the EIS/EIR, and such information must be incorporated. Second, even the information presented could be more fully described, and where appropriate, extrapolated, to support any meaningful analysis. Presumably these studies and reports provide more than one or two future data points, and instead show curved projections over time. For example, the EIS/EIR states that "[i]n California, snow water equivalent (the amount of water held in a volume of snow) is projected to decrease by 16 percent by 2035, 34 percent by 2070, and 57 percent by 2099, as compared to measurements between 1971 and 2000." (EIS/EIR 3.6-11.) Are these the only three data points provided by the study? Unless the EIS/EIR assumes that the entire percent decreases will be felt exclusively in years 2035, 2070, and 2099, these data should be extrapolated, as follows, to approximate the snow melt decrease over the project term: {See Comment Letter for Figure}

From this it is apparent that snow melt will decrease over the project term. This provides just one example, but the EIS/EIR itself should include meaningful analysis of climate change effects upon annual temperatures, extreme heat, precipitation, evaporation, sea level rise, storm surge, snowpack, groundwater, stream flow, riparian habitat, fisheries, and local economies over the life of the project.

Nine years ago, in 2005, then California Governor Arnold Schwarzenegger stated "[w]e know the science. We see the threat. And we know the time for action is now."{Source:United Nations World Environment Day Conference, June 1, 2005, San Francisco; see also, Executive Order S-3-05}. Here, in contrast, the EIS/EIR says, let's wait another ten years. This is simply unacceptable.

Response
The additional reports cited in the comment letter do not contradict or undermine the information presented in the EIS/EIR, nor do they materially add to the existing discussion. As such, it is not necessary to revise or supplement the existing discussion. As is demonstrated in Section 3.6.1.3, Existing Conditions, the EIS/EIR acknowledges the ways that climate change impacts California and the project study area. Section 3.6.2, Environmental Consequences/Environmental Impacts describes climate change impacts that would occur during the project implementation and concludes that the impacts would be insubstantial, as demonstrated by the data presented in the analysis.

Comment NG03-95

Comment
The EIS/EIR Completely Ignores Increased GHG Emission in the Buyer Areas.

The EIS/EIR impact evaluation of increased GHG emissions in the buyer areas consists of a series of incomplete characterizations and unsupported conclusion.

First, the EIS/EIR states: “Water transfers to agricultural users . . . could temporarily reduce the amount of land idled relative to the No Action/No Project Alternative.” (EIS/EIR 3.6-22.) This is in part true, but understates the impact, as there is no guarantee that the newly-supported land-uses would either be temporary, or agricultural. Second, the EIS/EIR states that “farmers may also pump less groundwater for irrigation, which would reduce emissions from use of diesel pumps.” This too is entirely speculative, and also contradicts the earlier implication that transfer water would only go to idled cropland. Third, the EIS/EIR summarily concludes that, “[t]he total amount of agricultural activity in the Buyer Service Area relative to GHG emissions would not likely change relative to existing conditions and the impact would be less than significant.” This again contradicts the EIS/EIR earlier statement that a water transfer could result in less idled cropland; and also defies logic and has no support in fact to suggest that increasing provision of a scarce resource would not induce some growth. At a bare minimum, the EIS/EIR should use its own estimated GHG reduction rates achieved as a result of newly idled cropland in the sellers’ service area as means of measuring the estimated GHG emission increases caused by activating idled cropland in the buyers’ service areas.

Response

The information presented in the EIS/EIR is not contradictory, as stated by the commenter, because it presents possible outcomes of water use in the buyers’ service area and does not state that water would "only" be used in certain ways. Because it is not known how the buyers would use transferred water, it is not possible to estimate GHG emissions to the same level of detail as was completed for the sellers' service area. However, Chapter 1 states that "[w]ater transfers would be used only to help meet existing demands and would not serve any new demands in the buyers' service areas" (see page 1-1). As a result, the assertion in the comment that water transfers would be used to support additional growth is unfounded.

Comment NG03-96

Comment

The EIS/EIR Threshold of Significance for GHG Emissions is Inappropriate.

The EIS/EIR reviews nearly a dozen relevant, agency-adopted, thresholds of significant for GHG emissions, and chooses to select the single threshold that sits a full order of magnitude above all others. The chosen threshold is unsupported in fact or law, and creates internal contradiction within the EIS/EIR. The CEQA Guidelines state that:

A lead agency should consider the following factors, among others, when assessing the significance of impacts from greenhouse gas emissions on the environment: . . .

Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project.

The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions.

(CEQA Guidelines § 15064.4.) Numerous Air Districts within the affected area have established GHG thresholds of significance that the EIS/EIR improperly chooses not to apply. The EIS/EIR argues that these Air District thresholds are meant to apply to stationary sources, an exercise that “would be overly onerous and is not recommended.” (EIS/EIR 3.6-18.) This must be rejected. The EIS/EIR fails to provide any reason to believe that Air District regulations would not and should not be applied to activities occurring within each respective Air District. The CEQA Guidelines require the lead agency to use “a threshold of significance that the lead agency determines applies to the project;” here, the lead agency has not determined that the local Air District thresholds do not apply to the project activities; rather, it has determined that this evaluation would be too onerous. So instead, the EIS/EIR chooses to apply the threshold of significance adopted by the Antelope Valley Air District and the Mojave Desert Air District, each of which would clearly have latitude to adopt lax air quality thresholds owing to the lack of use intensity within each district. With (hopefully) no transfer water heading to the Mojave Desert, the lead agency has no basis to determine that the Mojave Desert Air District’s thresholds of significance “applies to the project.” The EIS/EIR also notes that the same threshold has been adopted by USEPA for Clean Air Act, Title V permits. But the Title V standard also applies to stationary sources, which the EIS/EIR says are inapplicable. Does any project element require a Title V permit? In short, the EIS/EIR fails to evaluate the project against any threshold of significance that was adopted either (1) for the benefit of an individual air district in which project activities would occur, or (2) for the benefit of regional or statewide GHG emission goals. The EIS/EIR’s unsupported grab of the most lax standard it could find, with no bearing on the project whatsoever, must be rejected.

Response

As discussed in the EIS/EIR, "[t]he stationary source threshold used by multiple air districts (i.e., 10,000 metric tons per year) is not intended to cover stationary source emissions owned and operated by multiple parties; rather, it is applicable to individual pieces of equipment, or at most, an individual facility, rather than all equipment affected by the action alternatives" (see page 3.6-19). The 100,000 tons per year threshold was not selected because it is "lax" in comparison to the 10,000 metric tons per year threshold, but rather because it is similar to the prevention of significant deterioration permitting threshold, which is intended to prevent the degradation of air quality. The prevention of significant deterioration permitting threshold was considered suitable for determining the impacts from the combined activity of all groundwater pumps operating throughout the region. It should also be noted that the EIS/EIR does not say stationary source thresholds are not applicable to the action alternatives; rather, it says the 10,000 metric tons per year threshold is applicable to individual stationary sources, not to the combined activities from the entire project.

Comment NG03-97

Comment
AquAlliance shares the widely held view that operation of the Delta export pumps is the major factor causing the Pelagic Organism Decline ("POD") and in the deteriorating populations of fall-run Chinook salmon. In 2012, the State Water Resources Control Board received word in early December that the Fall Midwater Trawl surveys for September and October showed horrendous numbers for the target species. The indices for longfin smelt, splittal, and threadfin shad reveal the lowest in history {Source: http://www.dfg.ca.gov/delta/data/fmwt/Indices/index.asp. (Exhibit CC)}. Delta smelt, striped bass, and American shad numbers remain close to their lowest levels (Id). The 2013 indices were even worse and the 2014 indices are also abysmal (Id). Tom Cannon declared in June 2014 that water transfers have been and will remain devastating to Delta smelt during dry years {Cannon 2014. Declaration for Preliminary Injunction in AquAlliance and CSPA v. United State Bureau of Reclamation. (Exhibit DD)}. "In my opinion, the effect of Delta operations this summer [2014] of confining smelt to the Sacramento Deepwater ship channel upstream of Rio Vista due to adverse environmental conditions in the LSZ that will be exacerbated by the Transfers, both with and without relaxed outflow standards, with no evidence that they can emerge from the ship channel in the fall to produce another generation of smelt, is significant new information showing that the Transfers will have significant adverse impacts on Delta smelt." Mr. Cannon's October report observes that "habitat conditions have been very poor and the Delta smelt population is now much closer to extinction with the lowest summer index on record."

As Mr. Cannon's comments highlight, attached and fully incorporated as though stated in their entirety, herein, the EIS/EIR has inaccurately characterized the existing environment, including the assumption that delta smelt are not found in the Delta in the summer transfer season, when in fact during dry and critical years when transfers would occur, most if not all delta smelt are found in the Delta; and fails to fully assess the significant and cumulative effects to listed species in multiyear droughts when listed fish are already under maximum stress, which effects could be avoided by limiting transfers in the second or later years of drought.

The 2015-2024 Water Transfer Program would exacerbate pumping of fresh water from the Delta, which has already suffered from excessive pumping over the last 12 years. Pumped exports cause reverse flows to occur in Old and Middle Rivers and can result in entrainment of fish and other organisms in the pumps. Pumping can shrink the habitat for Delta smelt (Hypomesus transpacificus) as well, since less water flows out past Chipps Island through Suisun Bay, which Delta smelt often prefer.

Response
As described in the in-Delta analysis (pp. 3.7-31 through 3.7-38), the majority of Delta smelt move downstream towards cooler, ocean-influenced water in the bays during the summer because temperatures in the Delta become too warm, out of the influence of Old and Middle River (OMR) reverse flows and the export facilities in the south Delta.

See pages 3.7-31 through 3.7-38 for a full description.

Comment NG03-98

Comment
The EIS/EIR should also evaluate whether Project effects could alter stream flows necessary to maintain compliance with California Fish and Game Code Section 5937. A recent study issued from the University of California, Davis, documents hundreds of dams failing to maintain these required flows {Source: https://watershed.ucdavis.edu/files/biblio/BioScience-2014-Grantham-biosci_biu159.pdf. (Exhibit EE)}. Both the timing and volumes of transfer water must be considered in conjunction with 5937 flows.

Response
The action alternatives do not include changes to the ability of dams to provide streamflows below the dams; therefore, they are in compliance with California Fish and Game Code Section 5937.

Comment NG03-99

Comment
The EIS/EIR reaches faulty conclusion for Project and cumulative impacts.

Section 3.8.5, Potentially Significant Unavoidable Impacts, declares that, “None of the alternatives would result in potentially significant unavoidable impacts on natural communities, wildlife, or special-status species.” Regarding cumulative biological impacts of the proposed Project (Alternative 2), the EIS/EIR concludes, “Long-term water transfers would not be cumulatively considerable with the other projects because each of the projects would have little or no impact flows [sic] in rivers and creeks in the Sacramento River watershed or the vegetation and wildlife resources that depend on them,” (p. 3.8-92). This is a conclusory statement without supporting material to justify it, only modeling that has been demonstrated in our comments as extremely deficient.

The EIS/EIR actually discloses there are very likely many significant impacts from the proposed project on terrestrial and aquatic habitat and species. Examples from Chapter 3.8 include:

- "The lacustrine natural communities in the Seller Service Area that would be potentially impacted by the alternatives include the following reservoirs: Shasta, Oroville, New Bullards Bar, Camp Far West, Collins, Folsom, Hell Hole, French Meadows, and McClure," (p. 3.8-10)

- "The potential impacts of groundwater substitution on natural communities in upland areas was considered potentially significant if it resulted in a consistent, sustained depletion of water levels that were accessible to overlying communities (groundwater depth under existing conditions was 15 feet or less). A sustained depletion would be considered to have occurred if the groundwater basin did not recharge from one year to the next," (p. 3.8-33).

- "In addition to changing groundwater levels, groundwater substitution transfers could affect stream flows. As groundwater storage refills during and after a transfer, it could result in reduced availability of surface water in nearby streams and wetlands," (p. 3.8-33).

Response
The text examples in the comment are from the discussions in each impact statement rather than the conclusions. Each impact analysis starts with an italicized impact statement that describes the potential impact being assessed. These statements describe what "could" occur. The analysis then examines the evidence to determine if that type of impact would occur, and the potential magnitude of the impact. This analysis then leads to a conclusion of whether the impact would occur and whether it could be significant. The text cited appears before the full analysis of each impact, which describes the detailed reasons why the impacts would be less than significant.

Comment NG03-100

Comment
It should also be noted that the 2008 U.S. Fish and Wildlife Service (USFWS) and 2009 National Marine Fisheries Service (NMFS) biological opinions did not evaluate potential impacts to in-stream flow due to water transfers involving groundwater substitution. How these potential impacts may adversely affect biological resources in the areas where groundwater pumping will occur, including listed species and their habitat, were also not included {Source: California Department of Fish and Game. 2013. COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT (2013 DRAFT EA) AND FINDING OF NO SIGNIFICANT IMPACT (FONSI) FOR THE 2013 CENTRAL VALLEY PROJECT (CVP) WATER, p.4. (Exhibit FF)}. To reach the conclusion that the Project "would not be cumulatively considerable with the other projects" based only on modeling fails to provide the public with meaningful analysis of probable impacts.

Response
The impact analysis in Sections 3.7 and 3.8 analyzed the potential impacts to fisheries and vegetation and wildlife from groundwater substitution transfers. Section 7 consultation is being initiated with USFWS for the proposed action. Because Section 3.7 determined that the action alternatives (including groundwater substitution transfers) are not expected to affect federal-listed fish, consultation with NOAA Fisheries is not warranted.

Comment NG03-101

Comment
The 2015-2024 Water Transfer Program has potential adverse impacts for the giant garter snake, a threatened species.

As the Lead and Approving Agencies are well aware, the purpose of the ESA is to conserve the ecosystems on which endangered and threatened species depend and to conserve and recover those species so that they no longer require the protections of the Act. 16 U.S.C. § 1531(b), ESA § 2(b); 16 U.S.C. § 1532(3), ESA §3(3) (defining “conservation” as “the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary”). “[T]he ESA was enacted not merely to forestall the extinction of species (i.e., promote species survival), but to allow a species to recover to the point where it may be delisted.” Gifford Pinchot Task Force v. U.S. Fish & Wildlife Service, 378 F3d 1059, 1069 (9th Cir. 2004). To ensure that the statutory purpose will be carried out, the ESA imposes both substantive and procedural requirements on all federal agencies to carry out programs for the conservation of listed species and to insure that their actions are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. 16 U.S.C. § 1536. See NRDC v. Houston, 146 F.3d 1118, 1127 (9th Cir. 1998) (action agencies have an “affirmative duty” to ensure that their actions do not jeopardize listed species and “independent obligations” to ensure that proposed actions are not likely to adversely affect listed species). To accomplish this goal, agencies must consult with the Fish and Wildlife Service whenever their actions “may affect” a listed species. 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a). Section 7 consultation is required for “any action [that] may affect listed species or critical habitat.” 50 C.F.R. § 402.14. Agency “action” is defined in the ESA’s implementing regulations to “mean all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States.” 50 C.F.R. § 402.02.

Response
Section 7 consultation was initiated with USFWS for the Proposed Action on October 7, 2014. A biological assessment prepared by Reclamation in accordance with Section 7 requirements and in connection with that consultation includes an assessment of potential project effects on giant garter

snake. Reclamation submitted the biological assessment to USFWS on November 4, 2014. A ROD will not be signed and no Federal Action will be taken until the required Section 7 consultation with USFWS is complete.

Comment NG03-102

Comment
The giant garter snake ("GGS") is an endemic species to Central Valley California wetlands. (Draft Recovery Plan for the Giant Garter Snake ("DRP") 1). The giant garter snake, as its name suggests, is the largest of all garter snake species, not to mention one of North America's largest native snakes, reaching a length of up to 64 inches. Female GGS tend to be larger than males. GGS vary in color, especially depending on the region, from brown to olive, with white, yellow, or orange stripes. The GGS can be distinguished from the common garter snake by its lack of red markings and its larger size. GGS feed primarily on aquatic fish and specialize in ambushing small fish underwater, making aquatic habitat essential to their survival. Females give birth to live young from late July to early September, and brood size can vary from 10 to up to 46 young. Some studies have suggested that the GGS is sensitive to habitat change in that it prefers areas that are familiar and will not typically travel far distances.

If fallowing (idling) occurs, there will be potentially significant impacts to GGS and this is acknowledged on page 3.8-69: "Giant garter snakes have the potential to be affected by the Proposed Action through cropland idling/shifting and the effects of groundwater substitution on small streams and associated wetlands." The Lead Agencies use language found in a 1997 Programmatic Biological Opinion (as well as the 1999 Draft Recovery Plan) to explain that GGS depend on more than rice fields in the Sacramento Valley. "The giant garter snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, other waterways and agricultural wetlands such as irrigation and drainage canals and rice fields, and the adjacent uplands. Essential habitat components consist of (1) adequate water during the snake's active period, (early spring through mid-fall) to provide a prey base and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat; (3) upland habitat for basking, cover, and retreat sites; and (4) higher elevation uplands for cover and refuge from flood waters." {Source: Programmatic Consultation with the U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter and Yolo Counties, California}

Even with the explanation above, that clearly illustrates the importance of upland habitat to GGS, the EIS/EIR concludes that idling or shifting upland crops "[a]re not anticipated to affect giant garter snakes, as they do not provide suitable habitat for this species" (p. 3.8-69). The EIS/EIR is internally contradictory and fails to provide any evidence to support its conclusion that GGS will not be impacted by idling or shifting crops in upland areas. In support of the importance of upland acreage to GGS, a Biological Opinion for Gray Lodge found that, "Giant garter snakes also use burrows as refuge from extreme heat during their active period. The Biological Resources Division (BRD) of the USGS (Wylie et al_ 1997) has documented giant garter snakes using burrows in the summer as much as 165 feet (50. meters) away from the marsh edge. Overwintering snakes have been documented using burrows as far as 820 feet (250 meters) from the edge of marsh habitat," (1998) {Source: http://www.usbr.gov/mp/nepa/documentShow.cfm?Doc_ID=15453}

Response

The commenter's description of the life history and habitat information pertaining to giant garter snake and their use of upland habitats is consistent with the data and type assumptions used in the EIS/EIR analysis of potential impacts to the species. Upland cropland provides habitat value for giant garter snake similar to habitat associated with fallowed agricultural lands because these areas would be expected to support small mammal burrows that could be used by giant garter snakes.

Comment NG03-103

Comment

More pertinent background information that is lacking in the EIS/EIR is found in the Bureau's Biological Assessment for the 2009 DWB that disclosed that one GGS study in Colusa County revealed the "longest average movement distances of 0.62 miles, with the longest being 1.7 miles, for sixteen snakes in 2006, and an average of 0.32 miles, with the longest being 0.6 miles for eight snakes in 2007." (BA at p. 16) However, in response to droughts and other changes in water availability, the GGS has been known to travel up to 5 miles in only a few days, and the EIS/EIR should evaluate impacts to GGS survival and reproduction under such extreme conditions.

As the EIS/EIR divulges, flooded rice fields, irrigation canals, streams, and wetlands in the Sacramento Valley can be used by the giant garter snake for foraging, cover and dispersal purposes. The Bureau's 2009 and 2014 Biological Assessments acknowledge the failure of the Bureau and DWR to complete the Conservation Strategy that was a requirement of the 2004 Biological Opinion (BA at p. 19-20). Research was finally initiated "since 2009," but is nowhere near the projected 10-year completion date. The unnecessary delay hasn't daunted the agencies pursuit of transfers that affect GGS despite the absence of the following information that the U.S. Fish and Wildlife Service has explicitly required since the 1990s:

- GGS distribution and abundance.
- Ten years of baseline surveys in the Sacramento Valley

- Five years of rice land idling surveys in the Sacramento Valley Recovery Unit and the Mid-Valley Recovery Unit.

This Project and all North-to-South and North-to-North transfers should be delayed until the Bureau and DWR have completed the Conservation Strategy they have known about for at least a decade and a half.

Response
The Proposed Action is not subject to the requirements of the 2004 BO. Effects associated with the proposed project will be assessed by the USFWS as part of a separate Section 7 consultation that was initiated by Reclamation on October 7, 2014.

Comment NG03-104

Comment
The Bureau and DWR continue to allow an increase in acres fallowed (2013 Draft Technical Information for Preparing Water Transfer Proposals ("DTIPWTP")) since the 2010/2011 Water Transfer Program first proposed to delete or modify other mitigation measures previously adopted as a result of the Environmental Water Account ("EWA") EIR process. The EWA substantially reduced significant impacts for GGS, but without showing that they are infeasible, the Bureau and DWR proposed to delete the 160 acre maximum for "idled block sizes" for rice fields left fallow rather than flooded and to substitute for it a 320 acre maximum. (See 2003 Draft EWA EIS/EIR, p. 10-55; 2004 Final EWA EIS/EIR, Appendix B, p. 18, Conservation Measure # 4.) There was no evidence in 2010 to support this change nor has there been any provided to the present time. In light of the agencies failure to complete the required Conservation Strategy mentioned above and the data gathered in the Colusa County study, how can the EIS/EIR suggest (although it is not presented in the document, but in the agencies Draft Technical Information for Preparing Water Transfer Proposals papers) that doubling the fallowing acreage is in any way biologically defensible? The Lead and Approving Agencies additionally propose to delete the EWA mitigation measure excluding Yolo County east of Highway 113 from the areas where rice fields may be left fallow rather than flooded, except in three specific areas {Source: USBR and DWR, 2013. Draft Technical Information for Preparing Water Transfer Proposals.}. (See 2004 Final EWA EIS/EIR, Appendix B, p. 18, Conservation Measure # 2.) What is the biological justification for this change and where is it documented? What are the impacts from this change?

Deleting these mitigation measures required by the EWA approval would violate NEPA and CEQA's requirements that govern whether, when, and how agencies may eliminate mitigation measures previously adopted under NEPA and CEQA.

Response
The commenter is concerned about mitigation measures contained in an environmental document for a separate project. The range of potential water transfer activities analyzed in this EIS/EIR is not subject to prescribed measures in other CEQA or NEPA project documents. The variance from prior Reclamation projects' environmental commitments related to giant garter snake is further described in Common Response 12.

Comment NG03-105

Comment
Additionally, the 2010/2011 Water Transfer Program failed to include sufficient safeguards to protect the giant garter snake and its habitat. The EA for that two-year project concluded, “The frequency and magnitude of rice land idling would likely increase through implementation of water transfer programs in the future. Increased rice idling transfers could result in chronic adverse effects to giant garter snake and their habitats and may result in long-term degradation to snake populations in the lower Sacramento Valley. In order to avoid potentially significant adverse impacts for the snake, additional surveys should be conducted prior to any alteration in water regime or landscape,” (p. 3-110). To address this significant impact the Bureau proposed relying on the 2009 Drought Water Bank (“DWB”) Biological Opinion, which was a one-year BO. Both the expired 2009 BO and the 2014 BO highlighted the Bureau and DWR’s avoidance of meeting federal and state laws stating, “This office has consulted with Reclamation, both informally and formally, seven times since 2000 on various forbearance agreements and proposed water transfers for which water is made available [“for delivery south of the delta” is omitted in 2014] by fallowing rice (and other crops) or substituting other crops for rice in the Sacramento Valley. Although transfers of this nature were anticipated in our biological opinion on the environmental Water Account, that program expired in 2007 and, to our knowledge, no water was ever made available to EWA from rice fallowing or rice substitution. The need to consult with such frequency on transfers involving water made available from rice fallowing or rice substitution suggests to us a need for programmatic environmental compliance documents, including a programmatic biological opinion that addresses the additive effects on giant garter snakes of repeated fallowing over time, and the long-term effects of potentially large fluctuations and reductions in the amount and distribution of rice habitat upon which giant garter snakes in the Sacramento Valley depend,” (p.1-2). And here we are in late 2014 still without that programmatic environmental compliance that is needed under the Endangered Species Act.

If the Project is or isn’t approved, we propose that the Lead and Approving Agencies commit to the following conservation recommendations from the 2014 Biological Opinion by changing the word “should” to “shall”:

1. Reclamation should [shall] assist the Service in implementing recovery actions identified in the Draft Recovery Plan for the Giant Garter Snake

(U.S. Fish and Wildlife Service 1999) as well as the final plan if issued during the term of the proposed action.

2. Reclamation should [shall] work with the Service, Department of Water Resources, and water contractors to investigate the long-term response of giant garter snake individuals and local populations to annual fluctuations in habitat from fallowing rice fields.

3. Reclamation should [shall] support the research goals of the Giant Garter Snake Monitoring and Research Strategy for the Sacramento Valley proposed in the Project Description of this biological opinion.

4. Reclamation should [shall] work with the Service to create and restore additional stable perennial wetland habitat for giant garter snakes in the Sacramento Valley so that they are less vulnerable to market-driven fluctuations in rice production. The CVPIA (b)(1)other and CVPCP conservation grant programs would be appropriate for such work.

Response

As the commenter notes, in prior consultations for water transfers USFWS suggested it might be prudent to develop a programmatic approach to ESA compliance. Further discussions with USFWS indicated their objective with this consultation was to consider the potentially compounding effects of multi-year transfers in one consultation process. Reclamation has met this need through the Long-Term Water Transfers EIS/EIR and biological assessment, which assess these potential impacts at a project level. Reclamation submitted a biological assessment for Long-Term Water Transfers to USFWS on November 4, 2014. USFWS is currently considering the biological assessment and working on a biological opinion.

Comment NG03-106

Comment

The EIS/EIR fails to accurately describe the uppermost acreage that could impact GGS.

Page 3.8-69 claims that the Proposed Action "[c]ould idle up to a maximum of approximately 51,573 acres of rice fields," but the Lead and Approving Agencies are well aware that past transfers have or could have fallowed much more acreage and that 20 percent is allowed per county under the Draft Technical Information for Preparing Water Transfer Proposals last written in 2013. Factual numbers for proposed water transfers that included fallowing and groundwater substitution in the last 25 years should be disclosed in a revised and re-circulated draft EIS/EIR. The companion data that should also be presented would disclose how much water was actually transferred each year by seller and delineated by acreage of land fallowed and/or groundwater pumped. This information should not only be disclosed in the EIS/EIR, but it should also be readily available on the Bureau's web site. In addition, the EIS/EIR should cease equivocating with usage of "could" and "approximately" and select and analyze a firm maximum acreage of idled land, which would provide the public with the ability to consider the impacts from a most significant impact scenario.

"In 1992, Congress passed the Central Valley Project Improvement Act (Act, or CVPIA), which amended previous authorizations of the California Central Valley Project (CVP) to include fish and wildlife protection, restoration, enhancement, and mitigation as project purposes having equal priority with power generation, and irrigation and domestic water uses." {Source: U.S. Department of Interior. 10 Year of Progress: Central Valley Project Improvement Act 1993-2002.
http://www.waterrights.ca.gov/baydelta/docs/exhibits/SLDM-EXH-03B.pdf (Exhibit GG)}. The 2015-2024 Water Transfer Program fails to take seriously the equal priority for, "[f]ish and wildlife protection, restoration, enhancement, and mitigation."

Response
Table 3.10-22 shows the maximum acreages for cropland idling for the range of potential transfer activities evaluated under the Proposed Action. The proposed acreages are the same under Alternative 4. These are the maximum acreages for idling under the Proposed Action, not 20 percent per county as was included in past documents. The EIS/EIR is analyzing future transfers, so data on past transfers was not needed for the analysis and was not included in the EIS/EIR. The EIS/EIR evaluated effects to all resources, including fish and wildlife, equally among alternatives and provided mitigation measures to reduce significant effects to a less-than-significant level.

Comment NG03-107

Comment
Our comments are based largely upon the EcoNorthwest report produced for AquAlliance, attached and fully incorporated as though stated in their entirety, herein. Once again, the lack of relevant baseline information and discrete project description thwarts any ability to effectively analyze the project, and the lack of any market analysis of water prices, and prices for agricultural commodities, relegates the EIS/EIR to unsupported conclusions about the likely future frequency and amounts of water transfers and their environmental and economic consequences. The EIS/EIR further relies on obsolete data for certain key variables and ignores other relevant data and information. For example, the analysis assumes a price for water that bears no resemblance to the current reality. Growers and water sellers and buyers react to changing prices and market conditions, but the EIS/EIR is silent on these forces and how they would influence water transfers.

Response
See the responses to comment letter NG02 specifically, but not limited to, the following comments: NG02-26, NG02-27, NG02-32, and NG02-33.

Comment NG03-108

Comment
The EIS/EIR underestimates negative impacts on the regional economy in the sellers' area, acknowledging that negative economic impacts would be worse if water transfers happen over consecutive years, but estimating impacts only for single-year transfers, ignoring the data on the frequency of recent consecutive-year transfers.

Response
NEPA does not require a judgment of significance or mitigation measures for economic effects. CEQA does not consider economic or social change resulting from a project as adverse effects on the environment. Still, additional text has been added to Section 3.10 to clarify the economic effects of transfers in consecutive years. See response to Comment NG02-4.

Comment NG03-109

Comment
As discussed, below, the EIS/EIR's inadequate evaluation and avoidance of subsidence will result in additional unaccounted-for economic costs. Injured third parties would bear the costs of bringing to the sellers' attention harm caused by groundwater pumping, and the ability of parties to resolve disputes with compensation is speculative. The EIS/EIR is silent on these and other ripple cost effects of subsidence.

Response
See Common Response 7.

Comment NG03-110

Comment
The EIS/EIR ignores the environmental externalities and economic subsidies that water transfers support. The EIS/EIR lists Westlands Water District as one of the CVP contractors expressing interest in purchasing transfer water. The environmental externalities caused by agricultural production in Westlands WD are well documented, as are the economic subsidies that support this production. To the extent that the water transfers at issue in the EIS/EIR facilitate agricultural production in Westlands WD, they also contribute to the environmental externalities and economic subsidies of that production, but the EIS/EIR is silent on these environmental and economic consequences of the water transfers.

Response
See response to Comment NG02-51.

Comment NG03-111

Comment
The EIS/EIR fails to adequately provide evidence that water transfers, which draw down reservoir surface elevations at Central Valley Project (CVP) and State Water Project (SWP) reservoirs beyond historically low levels, could not potentially adversely affect cultural resources. The EIS/EIR states that the potential of adverse impacts to cultural resources does exist:

3.13.2.4 Alternative 2: Full Range of Transfers (Proposed Action)

Transfers that draw down reservoir surface elevations at CVP and SWP reservoirs beyond historically low levels could affect cultural resources. The Proposed Action would affect reservoir elevation in CVP and SWP reservoirs and reservoirs participating in stored reservoir water transfers. Water transfers have the potential to affect cultural resources, if transfers result in changing operations beyond the No Action/No Project Alternative. Reservoir surface water elevation changes could expose previously inundated cultural resources to vandalism and/or increased wave action and erosion (p. 3.13-15).

This passage states that the Long Range Water Transfers undertaking may have the potential to affect cultural resources if the water transfers lowered reservoir elevations enough to expose cultural resources. The first step for analyzing this would require conducting research for past studies and reports with site specific data for the CVP and SWP reservoirs. The EIS/EIR states:

3.13.1.3 Existing Conditions

This section describes existing conditions for cultural resources within the area of analysis. All data regarding existing conditions were collected through an examination of archival and current literature pertinent to the area of analysis. Because action alternatives associated with the project do not involve physical construction-related impacts to cultural resources, no project specific cultural resource studies were conducted in preparation of this Environmental Impact Statement/Environmental Impact Report (EIS/EIR) (EIS/EIR, p. 3.13-13, emphasis added).

However, there are no references listed for all the data collected which were "pertinent to the area of analysis." Also, the EIS/EIR states on p. 3.13-15 cited above that the lowering of the reservoir water elevations due to water transfers may affect cultural resources. Obviously, such an impact does not need to "[i]nvolve physical construction-related impacts to cultural resources," so this rationale for not conducting specific cultural resource studies contradicts its own assertion.

Response
As demonstrated in Section 3.13.2, Environmental Consequences/ Environmental Impacts, changes in the CVP and SWP reservoir elevations from implementation of the action alternatives would be very similar, and any reservoir fluctuations would be within the historical operating range of the reservoirs.

Comment NG03-112

Comment
Instead of conducting a cultural resources study which locates historic resources and traditional cultural properties (with the use of a contemporary Native American ethnological study), and then assesses the amount of project-related water elevation changes which may affect these resources, the EIS/EIR merely stated that their Transfer Operations Model was used to show that the project's "Impacts to cultural resources at Shasta, Oroville and Folsom reservoirs would be less than significant," (3.13-15, 3.13-16). A chart on page 13.3-15 shows that the proposed project is projected to decrease reservoir elevations at the "critical" level in September by 0.5 ft. at Shasta Reservoir, 2.4 ft. at Lake Oroville, and 1.5 ft. at Folsom Reservoir. (There is no source for this chart, and the reader has to guess that it may be from the Transfer Operations Model. The definitions of the various categories in the chart are also unexplained).

Based upon the findings shown on the chart, it is stated:

The reservoir surface elevation changes under the Proposed Action for these reservoirs would be within the normal operations and would not be expected to expose previously inundated cultural resources to vandalism or increased wave action and wind erosion. Impacts to cultural resources at Shasta, Oroville and Folsom reservoirs would be less than significant (p. 3.13-15).

However, there is no evidence to show that a project-related reservoir drop of 2.4 ft. at Lake Oroville will not uncover cultural resources documented in The Archaeological and Historical Site Inventory at Lake Oroville, Butte County, {Source: Prepared for the California Department of Water Resources by the Archaeological Research Center, Sacramento, and the Anthropological Studies Center, Rohnert Park, 2004. (Exhibit HH)} and expose them "to vandalism or increased wave action and wind erosion," thus adversely affecting these resources. This study states that there are 223 archaeological and/or historic sites recorded in the water level fluctuation zone of Lake Oroville (p. 12). Where is the Cultural Study which shows that lowering Lake Oroville 2.4 ft. due to water transfers will not expose specific archaeological sites or traditional cultural properties?

Without an inventory of the cultural resources which may be uncovered by the project-related drop in reservoir elevation for all the affected reservoirs, the numbers in the chart on page 13.3-15 mean nothing. The numbers in the chart provide no evidence that the project may or may not have an adverse effect on cultural resources. In contrast, substantial documentation of cultural resources in these areas exists.50 The threat of potential project-related impacts to cultural resources triggers a Section 106 analysis of the project under the requirements of the National Historic Preservation Act, which "[r]equires Federal agencies to take into account the effects of their undertakings on historic properties" [36 CFR 800.1(a)].

Response
See response to Comment NG03-111.

Comment NG03-113

Comment
Although the issue here is the raising of the Shasta Reservoir water levels, cultural impacts related to water levels at the Shasta Reservoir has been an ongoing issue for the Winnemem Wintu Tribe. The Winnemem Wintu Tribe and all tribes within the project area (Area of Potential Effects) need to be consulted by federal and state agencies. A project-specific cultural study under CEQA is also required under 15064.5. Determining the Significance of Impacts to Archaeological and Historical Resources. Consultation with federally recognized tribes and California Native American tribes is required for this project.

Response
See response to Comment NG03-111.

Comment NG03-114

Comment
The EIS/EIR fails to analyze the air quality impacts in all these regions, especially with regard to the Buyers Service Area. Moreover, Appendix F – Air Quality Emissions Calculations exclude portions of the Sellers Service Area in Placer and Merced Counties. Conversely, there was not data supplied in Appendix F concerning the air quality impacts from the water transfers that would affect the Bay Area AQMD counties (Alameda, Contra Costa, Santa Clara), a Monterey Bay Unified APCD county (San Benito) and San Joaquin APCD counties (San Joaquin, Stanislaus, Merced, Fresno and Kings). Consequently, air quality impacts in the Buyers and Sellers Service Areas are unanalyzed and the EIS/EIR conclusions are not supported by evidence.

Response
See response to Comment LA12-179.

Comment NG03-115

Comment

The EIS/EIR attempts to classify which engines would be subject to the ATCM based on whether an agricultural engine is in an air district designated in attainment for particulate matter and ozone, and is more than a half mile away from any residential area, school or hospital (aka sensitive receptors). (See p. 3.5-14). The EIS/EIR claims that the engines in Colusa, Glenn, Shasta and Tehama (part of Sellers Service Area) are exempt from the ATCM. However, 17 CCCR 93115.3 exempts in-use stationary diesel agricultural emissions not only based on the engines being remote, but all also "provided owners or operators of such engines comply with the registration requirements of section 93115.8, subdivisions (c) and (d), and the applicable recordkeeping and reporting requirement of section 93115.10," which the EIS/EIR ignores. Furthermore, the EIS/EIR fails to present any data about the "tier" the subject agricultural diesel engines fall into. While the EIS/EIR identifies the tiers and concomitant requirements for replacement or repowering, it fails to provide any analysis or evidence evaluating whether the engines being used to pump water are operating within the permissible timeframes, depending on the tier designation.

Response

All engines operated by the water agencies would operate in compliance with the Airborne Toxic Control Measure (ATCM), including any necessary retrofits or repowering. The EIS/EIR has been updated to document that all engines operate in compliance with the emission reduction phase-in requirements described in Section 3.5, Air Quality, including any necessary registrations. Appendix F, Air Quality Emission Calculations, documents the emission tier assumed for each engine included in the analysis.

Comment NG03-116

Comment

The EIS/EIR analyzes the assessment methods based on existing emissions models from the regulation, diesel emissions factors from USEPA Compilation of Air Pollutant Emission Factors (for Natural gas fired reciprocating engines and gasoline/diesel industrial engines) and CARB Emission Inventory Documentation (for land preparation, harvest operations and windblown dust); and CARB size fractions for particulate matter. None of these references is directly on point to diesel powered water pumps and the emissions caused thereby. Moreover, the EIS/EIR provides absolutely no information as to why these models are appropriate to serve as the basis for thresholds of significance.

Response

The pumps used by the water agencies are driven by natural gas, diesel, and electric-powered engines. Therefore, the emission factors used in the analysis are appropriate because they are published for engines. It is also important to understand that the analysis assumed compliance with California Air Resource Board (CARB)'s Airborne Toxic Control Measure for Stationary Compression Ignition Engines (17 CCR 93115 et seq) and AP-42 was only used to estimate emissions from pollutants or fuels not regulated by the ATCM. Furthermore, the CARB Emission Inventory Documentation is unrelated to the fuel-driven pumps and is not appropriately discussed in this comment. Because the emission factors are published by reputable sources following extensive research (e.g., CARB and USEPA) and are applicable to the emission sources considered in this analysis, the emission factors are appropriate to serve as the basis for the thresholds of significance.

Comment NG03-117

Comment

The analysis provided in the EIS/EIR is less than complete. Here the “Significance Criteria” were only established and considered for the “sellers in the area of analysis where potential air quality impacts from groundwater substitution and crop idling transfers could occur.” (See p. 3.5-25) But that is only half the equation. The unconsidered air quality impacts include what and how increased crop production and vehicle usage would affect the air quality in the Buyers Service Area. Data and evidence of those impacts were not even considered.

In establishing the significance criteria, the EIS/EIR utilized known thresholds of significance from the air districts in the Sellers Service Area that had published them. For the other districts in the Sellers Service Area, the EIS/EIR made the assumption that “[t]he threshold used to define a ‘major source’ in the [Clean Air Act] CAA (100 tons per year [tpy])” could be “used to evaluate significance.” (See p. 3.5-26). There are several flaws with this over broad application of the “major source” threshold. First, agricultural pumps and associated agricultural activity are not typically considered “major sources,” especially when compared to major industrial sources. Second, the application of the major source threshold runs counter to the legal requirement that “[u]pwind APCDs are required to establish and implement emission control programs commensurate with the extent of pollutant transport to downwind districts,” as announced as a requirement of the California Clean Air Act. (See p. 3.5-11). Finally, the 100 tpy threshold is wildly disproportionate to the limits set in nearby or adjoining air district and covering the same air basin. For example, the Butte AQMD considers significance thresholds for NOx, ROGs/VOCs and PM10 to be 137lbs/day (25 tpy); Feather River AQMD considers significance thresholds for NOx and VOCs to be 25lbs/day (4.5 tpy) and 80 lbs/day (14.6 tpy) for PM10; Tehama APCD considers significance thresholds for NOx, ROGs/VOCs and PM10 to be 137 lbs/day (25 tpy); Shasta AQMD considers significance thresholds for NOx, ROGs/VOCs and PM10 on two levels – Level “B” is 137 lbs/day (25 tpy) and Level “A” is 25lbs/day (4.5 tpy) and 80 lbs/day (14.6 tpy) for PM10; and Yolo AQMD considers significance thresholds for ROGs/VOCs and NOx to be 54.8 lbs/day (10 tpy) and 80 lbs/day (14.6 tpy) for PM10. Clearly, there is a proportional relationship between these thresholds of significance. In contrast, the EIS/EIR, with substantial evidence to the contrary, assumes that the threshold of significance for those air districts who have not published a CEQA Handbook should be 100 tpy, or an increase by magnitudes of 4 to 20 times more than similarly situated Central Valley air districts.

“When considering a project’s impact on air quality, a lead agency should provide substantial evidence that supports its conclusion in an explicit, quantitative analysis whenever possible.” (See Guide to Air Quality Assessment in Sacramento County, Sacramento Metropolitan Air Quality Management District, 2009, Ch. 2, p. 2-6). Importantly, the EIS/EIR provides no basis, other than an assumption, as to why the major source threshold of significance from the CAA should be used or is appropriate for assessing the significance of the project impacts under CEQA or NEPA. The use of the CAA’s threshold of significance for major sources is erroneous as a matter of law. (See Endangered Habitats League v. County of Orange (2005) 131 Cal.App.4th 777, 793 (“The use of an erroneous legal standard [for the threshold of significance in an EIR] is a failure to proceed in the manner required by law that requires reversal.”)) Lead agencies must conduct their own fact-based analysis of the project impacts, regardless of whether the project complies with other regulatory standards. Here, the EIR/EIS uses the CAA threshold without any factual analysis on its own, in violation of CEQA. (Protect the Historic Amador Waterways v. Amador Water Agency (2004) 116 Cal.App.4th 1099, 1109; citing CBE v. California Resources Agency (2002) 103 Cal.App.4th 98, 114; accord Mejia v. City of Los Angeles (2005 130 Cal.App.4th 322, 342 [“A threshold of significance is not conclusive . . . and does not relieve a public agency of the duty to consider the evidence under the fair argument standard.”].) This uncritical application of the CAA’s major source threshold of significance, especially in light of the similarly situated air district lower standards, represents a failure in the exercise of independent judgment in preparing the EIS/EIR.

Response
See response to Comment LA12-179.

As shown in Table 3.5-7 (Federal Attainment Status for the Area of Analysis), Colusa, Glenn, and Shasta Counties are located in areas designated attainment for ozone and particulate matter (PM10 and PM2.5). As such, even though these counties are located in the same air basin (Sacramento Valley) as counties with lower significance thresholds, it is not appropriate to use the same significance thresholds because the air quality issues in the different regions are not the same. It must also be stated that if a lower threshold were to be used, the threshold for Shasta County (137 pounds per day, or approximately 25 tons per year) would be most applicable to the air quality conditions are most similar in these three counties. Even if this lower threshold were used, air quality impacts would remain less than significant because emissions in both counties are less than 25 tons per year for NOx, VOCs, and PM10. In addition, the "major source" threshold used in the Clean Air Act is intended to prevent degradation of air quality and is appropriate to be used in areas designated attainment for a given criteria pollutant because it would be protective of air quality. The EIS/EIR is not applying this standard to a single well, as stated in the comment, but rather all emissions from a participating selling entity.

Comment NG03-118

Comment
The EIS/EIR Fails to Adequately Analyze Numerous Cumulative Impacts.

The Ninth Circuit Court makes clear that NEPA mandates "a useful analysis of the cumulative impacts of past, present and future projects." Muckleshoot Indian Tribe v. U.S. Forest Service, 177 F.3d 800, 810 (9th Cir. 1999). "Detail is required in describing the cumulative effects of a proposed action with other proposed actions." Id. CEQA further states that assessment of the project's incremental effects must be "viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects." (CEQA Guidelines § 15065(a)(3).) "[A] cumulative impact consists of an impact which is created as a result of the combination of the project evaluated in the EIR together with other projects causing related impacts." (CEQA Guidelines § 15065(a)(3).)

An EIR must discuss significant cumulative impacts. CEQA Guidelines §15130(a). Cumulative impacts are defined as two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. CEQA Guidelines § 15355(a). "[I]ndividual effects may be changes resulting from a single project or a number of separate projects. CEQA Guidelines § 15355(a). A legally adequate cumulative impacts analysis views a particular project over time and in conjunction with other related past, present, and reasonably foreseeable future projects whose impacts might compound or interrelate with those of the project at hand. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time. CEQA Guidelines § 15355(b). The cumulative impacts concept recognizes that "[t]he full environmental impact of a proposed . . . action cannot be gauged in a vacuum." Whitman v. Board of Supervisors (1979) 88 Cal. App. 3d 397, 408 (internal quotation omitted).

In assessing the significance of a project's impact, the Bureau must consider "[c]umulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement." 40 C.F.R. §1508.25(a)(2). A "cumulative impact" includes "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." Id. §1508.7. The regulations warn that "[s]ignificance cannot be avoided by terming an action temporary or by breaking it down into small component parts." Id. §1508.27(b)(7).

An environmental impact statement should also consider "[c]onnected actions." Id. §1508.25(a)(1). Actions are connected where they "[a]re interdependent parts of a larger action and depend on the larger action for their justification." Id. §1508.25(a)(1)(iii). Further, an environmental impact statement should consider "[s]imilar actions, which when viewed together with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography." Id. §1508.25(a)(3) (emphasis added).

As discussed, below, and in the expert reports submitted by Custis, EcoNorthwest, Cannon, and Mish on behalf of AquAlliance, the EIS/EIR fails to comport with these standards for cumulative impacts upon surface and groundwater supplies, vegetation, and biological resources; and, the baseline and modeling data relied upon by the EIS/EIR that does not account for related transfer projects in the last 11 years.

Response
Cumulative effects are evaluated in Chapter 3 for each environmental resource including water supply, groundwater resources, vegetation and wildlife, and fisheries. See Common Response 5. Additional responses on the cumulative analyses have been provided in responses to specific comments.

Comment NG03-119

Comment
Recent Past Transfers.

Because the groundwater modeling effort didn't include the most recent 11 years record (1970-2003), it appears to have missed simulating the most recent periods of groundwater substitution transfer pumping and other groundwater impacting events, such as recent changes in groundwater elevations and groundwater storage (DWR, 2014b), and the reduced recharge due to the recent periods of drought. Without taking the hydrologic conditions during the recent 11 years into account, the results of the SACFEM2013 model simulation may not accurately depict the current conditions or predict the effects from the proposed groundwater substitution transfer pumping during the next 10 years.

f. In 2009, the Bureau approved a 1 year water transfer program under which a number of transfers were made. Regarding NEPA, the Bureau issued a FONSI based on an EA.

g. In 2010, the Bureau approved a 2 year water transfer program (for 2010 and 2011). No actual transfers were made under this approval. Regarding NEPA, the Bureau again issued a FONSI based on an EA.

h. The Bureau planned 2012 water transfers of 76,000 AF of CVP water all through groundwater substitution.51

i. In 2013, the Bureau approved a 1 year water transfer program, again issuing a FONSI based on an EA. The EA incorporated by reference the environmental analysis in the 2010-2011 EA.

j. The Bureau and SLDMWA's 2014 Water Transfer Program proposed transferring up to 91,313 AF under current hydrologic conditions and up to 195,126 under improved conditions. This was straight forward, however, when attempting to determine how much water may come from fallowing or groundwater substitution during two different time periods, April-June and July-September, the reader was left to guess.{Source: The 2014 Water Transfer Program's EA/MND was deficient in presenting accurate transfer numbers and types of transfers. The numbers in the "totals" row of Table 2-2 presumably should add up to 91,313. Instead, they add up to 110, 789. The numbers in the "totals" row of Table 2-3 presumably should add up to 195,126. Instead, they add up to 249,997. Both Tables 2-2 and 2-3 have a footnote stating: "These totals cannot be added together. Agencies could make water available through groundwater substitution, cropland idling, or a combination of the two; however, they will not make the full quantity available through both methods. Table 2-1 reflects the total upper limit for each agency."}

These closely related projects impact the same resources, are not accounted for in the environmental baseline, and must be considered as cumulative impacts.

Response
See Common Response 5.

Comment NG03-120

Comment
Yuba Accord:

The relationship between the Lead Agencies is not found in the EIS/EIR, but is illuminated in a 2013 Environmental Assessment. "The Lower Yuba River Accord (Yuba Accord) provides supplemental dry year water supplies to state and Federal water contractors under a Water Purchase Agreement between the Yuba County Water Agency and the California Department of Water Resources (DWR). Subsequent to the execution of the Yuba Accord Water Purchase Agreement, DWR and The San Luis & Delta- Mendota Water Authority (Authority) entered into an agreement for the supply and conveyance of Yuba

Accord water, to benefit nine of the Authority's member districts (Member Districts) that are SOD [south of Delta] CVP water service contractors." {Source: Bureau of Reclamation, 2013. Storage, Conveyance, or Exchange of Yuba Accord Water in Federal Facilities for South of Delta Central Valley Project Contractors.}

In a Fact Sheet produced by the Bureau, it provides some numerical context and more of DWR's involvement by stating, "Under the Lower Yuba River Accord, up to 70,000 acre-feet can be purchased by SLDMWA members annually from DWR. This water must be conveyed through the federal and/or state pumping plants in coordination with Reclamation and DWR. Because of conveyance losses, the amount of Yuba Accord water delivered to SLDMWA members is reduced by approximately 25 percent to approximately 52,500 acre-feet. Although Reclamation is not a signatory to the Yuba Accord, water conveyed to CVP contractors is treated as if it were Project water."{Source: Bureau of Reclamation, 2013. Central Valley Project (CVP) Water Transfer Program Fact Sheet.} However, the Yuba County Water Agency ("YCWA") may transfer up to 200,000 under Corrected Order WR 2008-0014 for Long-Term Transfer and, "In any year, up to 120,000 af of the potential 200,000 af transfer total may consist of groundwater substitution. (YCWA-1, Appendix B, p. B-97.)." {Source: State Water Resources Control Board, 2008. ORDER WR 2008 - 0025}

Potential cumulative impacts from the Project and the YCWA Long-Term Transfer Program from 2008 - 2025 are not disclosed or analyzed in the EIS/EIR. The 2015-2024 Water Transfer Program could transfer up to 600,000 AF per year through the same period that the YCWA Long-Term Transfers are potentially sending 200,000 AF into and south of the Delta. How these two projects operate simultaneously could have a very significant impact on the environment and economy of the Feather River and Yuba River's watersheds and counties as well as the Delta. The involvement of Browns Valley Irrigation District and Cordua Irrigation District in both long-term programs must also be considered. This must be analyzed and presented to the public in a revised draft EIS/EIR.

Response
Yuba River Water Accord (Accord) is evaluated in the cumulative analysis, as described in Chapter 4. SLDMWA purchases water each year from the Accord if it is available. In general, SLDMWA would purchase Accord water prior to the potential transfer activities evaluated in this EIS/EIR. Reclamation does not approve water transfers above CVP contract quantities. Chapter 3 evaluates the cumulative effects of the Yuba River Water Accord in combination with the range of potential transfer activities under the Proposed Action, including from Browns Valley Irrigation District and Cordua Irrigation District, to each environmental resource.

Comment NG03-121

Comment
Also not available in the EIS/EIR is disclosure of any issues associated with the YCWA transfers that have usually been touted as a model of success. The YCWA transfers have encountered troubling trends for over a decade that, according to the draft Environmental Water Account ("EWA") EIS/EIR, are mitigated by deepening domestic wells (2003 p. 6-81). While digging deeper wells is at least a response to an impact, it hardly serves as a proactive measure to avoid impacts. Additional information finds that it may take 3-4 years to recover from groundwater substitution in the south sub-basin {Source: 2012. The Yuba Accord, GW Substitutions and the Yuba Basin. Presentation to the Accord Technical Committee. (pp. 21, 22).} although YCWA's own analysis fails to determine how much river water is sacrificed to achieve the multi-year recharge rate. None of this is found in the EIS/EIR. What is found in the EIS/EIR is that even the inadequate SACFEM2013 modeling reveals that it could take more than six years in the Cordua ID area to recover from multi-year transfer events, although recovery is not defined (pp, 3.3-69 to 3.3-70). This is a very significant impact that isn't addressed individually or cumulatively.

Response
The Yuba River Water Accord is included in the cumulative analysis. This EIS/EIR does not evaluate the individual effects of the Yuba River Water Accord. Section 3.3 concludes that the Proposed Action effects and cumulative effects to groundwater levels are potentially significant and require mitigation to avoid significant effects.

Comment NG03-122

Comment
The EIS/EIR fails to include the Bay Delta Conservation Plan ("BDCP") in the Cumulative Impacts section and in any analysis of the 2015-2024 Water Transfer Program. Although we acknowledge that BDCP could not possibly be built during the 10-Year Water Transfer Program's operation, the EIS/EIR misses the point that the 2015-2024 Water Transfer Program is a prelude to what comes later with BDCP. This connection is entirely absent. If the Twin Tunnels (the facilities identified in "Conservation Measure 1") are built as planned with the capacity to take 15,000 cubic feet per second ("cfs") from the Sacramento River, they will have the capacity to drain almost two-thirds of the Sacramento River's average annual flow of 23,490 cfs at Freeport {Source:USGS 2009. http://wdr.water.usgs.gov/wy2009/pdfs/11447650.2009.pdf Exhibit KK)} (north of the planned Twin Tunnels). As proposed, the Twin Tunnels will also increase water transfers when the infrastructure for the Project has capacity. This will occur during dry years when State Water Project ("SWP") contractor allocations drop to 50 percent of Table A amounts or below or when Central Valley Project ("CVP") agricultural allocations are 40 percent or below, or

when both projects' allocations are at or below these levels (EIS/EIR Chapter 5). With BDCP, North to South water transfers would be in demand and feasible.

Communication regarding assurances for BDCP indicates that the purchase of approximately 1.3 million acre-feet of water is being planned as a mechanism to move water into the Delta to make up for flows that would be removed from the Sacramento River by the BDCP tunnels {Source: Belin, Lety, 2013. E-mail regarding Summary of Assurances. February 25 (Department of Interior). (Exhibit LL)} . There is only one place that this water can come from: the Sacramento Valley's watersheds. It is well know that the San Joaquin River is so depleted that it will not have any capacity to contribute meaningfully to Delta flows. Additionally, the San Joaquin River doesn't flow past the proposed north Delta diversions and neither does the Mokelumne River.

Response
See response to Comment LA13-9. Long-term water transfers are not a "prelude" to the BDCP, but a project with independent utility during a different time period. Transfers after 2024 (during the period of implementation of the proposed BDCP) would require subsequent environmental documentation.

Comment NG03-123

Comment
As discussed above, the EIS/EIR also fails to reveal that the 2015-2024 Water Transfer Program is part of many more programs, plans and projects to develop water transfers in the Sacramento Valley, to develop a "conjunctive" system for the region, and to place water districts in a position to integrate the groundwater into the state water supply. BDCP is one of those plans that the federal agencies, together with DWR, SLDMWA, water districts, and others have been pursuing and developing for many years.

Response
Reclamation and DWR have been pursuing many water resources projects throughout California to improve water supplies and management, including groundwater and surface water projects. Water transfers are one of several management actions favored under state and federal law. Potential long-term water transfers are distinct activities, independent of other state and federal water management projects or programs. See Common Response 14.

Comment NG03-124

Comment
The Biggs-West Gridley Water District Gray Lodge Wildlife Area Water Supply Project, a Bureau project, is not mentioned anywhere in the Vegetation and Wildlife or Cumulative Impacts sections {Source: http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=15381}.This

water supply project is located in southern Butte County where Western Canal WD, Richvale ID, Biggs-West Gridley WD, and Butte Water District actively sell water on a regular basis, yet impacts to GGS from this project are not disclosed. This is a serious omission that must be remedied in a recirculated draft EIS/EIR.

Response
The project referenced by the commenter is not within the seller's service area. Impacts to giant garter snake from the range of potential water transfer activities analyzed in this EIS/EIR are insubstantial and are so small they would not be cumulatively considerable. The Biggs-West Gridley Water District water supply project is expected to result in a permanent loss of only 1.32 acre of aquatic habitat for giant garter snake and a short-term temporary disturbance of a total of 24 acres of upland and 24 acres of aquatic habitat during activities at 69 separate locations.

Comment NG03-125

Comment
Other Projects

Court settlement discussions between the Bureau and Westlands Water District over provisions of drainage service. Case # CV-F-88-634-LJO/DLB will further strain the already over allocated Central Valley Project with the following conditions:

k. A permanent CVP contract for 890,000 acre-feet of water a year exempt from acreage limitations.

l. Minimal land retirement consisting of 100,000 acres; the amount of land Westlands claims it has already retired (115,000 acres) will be credited to this final figure. Worse, the Obama administration has stated it will be satisfied with 100,000 acres of “permanent” land retirement.

m. Forgiveness of nearly $400 million owed by Westlands to the federal government for capital repayment of Central Valley Project debt.

n. Five-Year Warren Act Contracts for Conveyance of Groundwater in the Tehama-Colusa and Corning Canals – Contract Years 2013 through 2017 (March 1, 2013, through February 28, 2018).

Response
Pursuant to CVPIA Section 3404(c), Reclamation is in negotiations with Westlands Water District for long-term renewal of its CVP contract. Westlands Water District is currently operating under an interim renewal contract. Contract renewal would not provide additional water supplies to Westlands Water District and use of contract water for agriculture and/or municipal and industrial uses would not change from the purpose of use specified in the

existing contracts. A long-term contract would not change CVP water deliveries to Westlands Water District or change water supply reliability. Long-term contract renewal would not have cumulative impacts, and this effort would require NEPA compliance (separate from the Long-Term Water Transfers EIS/EIR) to assess potential impacts of the project. Land has been retired in Westlands Water District, but this does not change the need for water supplies to existing croplands. Land retirement would not have a cumulative effect. A change in Westlands debt would not have cumulative effects related to the potential transfer activities evaluated in this EIS/EIR. Transfers to the Tehama Colusa Canal would not move through the Delta, but the water would stay in the Sacramento Valley. See responses to Comments NG03-141 and NG10-43 for additional information.

Comment NG03-126

Comment

Additional projects with cumulative impacts upon groundwater and surface water resources affected by the proposed project:

a. The DWR Dry Year Purchase Agreement for Yuba County Water Agency water transfers from 2015-2025 to SLDMWA.{Source: SLDMWA Resolution # 2014 386
http://www.sldmwa.org/OHTDocs/pdf_documents/Meetings/Board/Prepacket/2014_1106_Board_PrePacket.pdf}

b. GCID's Stony Creek Fan Aquifer Performance Testing Plan to install seven production wells in 2009 to extract 26,530 AF of groundwater as an experiment that was subject to litigation due to GCID's use of CEQAs exemption for research.

c. Installation of numerous production wells by the Sellers in this Project many with the use of public funds such as Butte Water District,{Source: Prop 13. Ground water storage program: 2003-2004 Develop two production wells and a monitoring program to track changes in ground.} GCID, Anderson Cottonwood Irrigation District,{Source: "The ACID Groundwater Production Element Project includes the installation of two groundwater wells to supplement existing district surface water and groundwater supplies."} and Yuba County Water Authority {Source: Prop 13. Ground water storage program 2000-2001: Install eight wells in the Yuba-South Basin to improve water supply reliability for in-basin needs and provide greater flexibility in the operation of the surface water management facilities. $1,500,00} among others.

Response

The Lower Yuba River Accord project is currently considered (see Chapter 4). Glenn-Colusa Irrigation District's Stony Creek Fan Aquifer Performance Testing (SCFAPT) program concluded with their final report (issued December 2012). The SCFAPT program was a short duration (two irrigation seasons) research program. The two Butte Water District wells have been completed and are part of the existing conditions of the Sacramento Valley (Section 3.3.1). The Anderson Cottonwood ID Groundwater Production Element Project installed two groundwater wells to improve the flexibility and reliability of Anderson Cottonwood ID's water supply. These wells have been installed and are part of the existing conditions of the Redding Basin. The eight new groundwater wells proposed as part of the Yuba County Water Agency's Proposition 13 grant have also already been installed. These wells would be part of the existing conditions in the Sacramento Valley.

Comment NG03-127

Comment
The EIS/EIR Fails to Develop Legally Adequate Mitigation Measures.

CEQA requires that the lead agency consider and adopt feasible mitigation measures that could reduce a project’s adverse impacts to less than significant levels. Pub. Resources Code §§ 21002, 21002.1(a), 21100(b)(3), 21151, 22081(a). An adequate environmental analysis in the EIS/EIR itself is a prerequisite to evaluating proper mitigation measures: this analysis cannot be deferred to the mitigation measure itself. See, e.g., Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova (2007) 40 Cal.4th 412. Moreover, mitigation measures must A mitigation measure is inadequate if it allows significant impacts to occur before the mitigation measure takes effect. POET, LLC v. State Air Resources Board (2013) 218 Cal.App.4th 681, 740. An agency may not propose a list of measures that are “nonexclusive, undefined, untested and of unknown efficacy.” Communities for a Better Environment v. City of Richmond (2010) 184 Cal.App.4th 70, 95. Formulation of mitigation measure should generally not be deferred. CEQA Guidelines § 15126.4(a)(1)(B). If deferred, however, mitigation measure must offer precise measures, criteria, and performance standards for mitigation measures that have been evaluated as feasible in the EIR, and which can be compared to established thresholds of significance. E.g., POET, LLC v. State Air Resources Board (2013) 218 Cal.App.4th 681; Preserve Wild Santee v. City of Santee (2012) 210 Cal.App.4th 260; Sacramento Old City Association v. City Council (1991) 229 Cal.App.3d 1011; CEQA Guidelines § 15126.4(a)(1)(B); Defend the Bay v. City of Irvine (2004) 119 Cal.App.4th 1261, 1275. Economic compensation alone does not mitigate a significant environmental impact. See CEQA Guidelines § 15370; Gray v. County of Madera (2008) 167 Cal.App.4th 1099, 1122. Where the effectiveness of a mitigation measure is uncertain, the lead agency must conclude the impact will be significant. Citizens for Open Govt. v. City of Lodi (2012) 70 Cal.App.4th 296, 322; Fairview Neighbors v. County of Ventura (1999) 70 Cal.App.4th 238, 242. An EIR must not only mitigate direct effects, but also must mitigate cumulative impacts. CEQA Guidelines § 15130(b)(3).

Under NEPA, “all relevant, reasonable mitigation measures that could improve the project are to be identified,” including those outside the agency’s jurisdiction,{Source: http://ceq.hss.doe.gov/nepa/regs/40/40p3.htm} and including those for adverse impacts determined to be less-than-significant (40 C.F.R. § 1502.16(h)).

As discussed, below, and in the expert reports submitted by Custis, EcoNorthwest, Cannon, and Mish on behalf of AquAlliance, the EIS/EIR fails to comport with these standards.

The EIS/EIR illegally defers the development of and commitment to feasible mitigation measures to reduce or avoid a whole host of potentially significant project impacts. The EIS/EIR relies on mitigation measures WS-1 and GW-1 to reduce or avoid significant project effects through the entire environmental review document, not just for surface and ground water supplies, but also for impacts to vegetation, subsidence, regional economics. (3.7-26, 3.7-56, 3.10-37, 3.10-51.) Unfortunately, these mitigation measures fail all standards for CEQA compliance, deferring analysis of the impact in question to a future time, including no criteria or performance standards by which to evaluate success, and failing to demonstrate that the measures are feasible or sufficient.

But the precise relationship of these mitigation measures is unclear. For example, the EIS/EIR relies on GW-1 to mitigate impacts to vegetation and wildlife as a result of stream flow loss; why doesn’t the EIS/EIR consider the streamflow mitigation measure for this impact?

Response
Several comments offered suggestions to strengthen the mitigation measures, and Mitigation Measures WS-1, GW-1, AQ-1, and AQ-2 have been revised for clarity. Edits included efforts to help clarify performance standards. The mitigation measures are legally adequate under CEQA and NEPA. See Common Responses 6, 7, and 10 for more information about changes in Mitigation Measure GW-1.

Comment NG03-128

Comment
WS-1 requires that a portion of transfer water be held back to offset streamflow depletion caused by groundwater substitution pumping, but fails to include critical information to ensure that any such mitigation measure could work. First, it is not clear that any transfer release and the groundwater substitution pumping would simultaneously occur, in real time. If groundwater pumping causes streamflow depletion at any time other than exactly when the transfer is made, then the transfer deduction amount will not avoid streamflow drawdown. And, indeed, it is well known that streamflow depletion can continue, directly and cumulatively, after the transfer activity ends. (E.g., figures B-4, B-5 and B-6 in Draft EIS/EIR Appendix B).

Response
See Common Response 8.

Comment NG03-129

Comment
Next, the EIS/EIR fails to include any meaningful information to determine whether the applicable "streamflow depletion factor" to be applied to any single transfer project will mitigate significant impacts.

The EIS/EIR provides that "The exact percentage of the streamflow depletion factor will be assessed and determined on a regular basis by Reclamation and DWR, in consultation with buyers and sellers, based on the best technical information available at that time." (EIS/EIR at 3.1-21.) More information is required. It is unclear whether WS-1 considers the cumulative volume of water pumped for each groundwater substitution transfers, or the instantaneous rate of stream depletion caused by the pumping. Any factor must be the outcome of numerous measured variables, such as the availability of water to capture, the rate and duration of recharge, the streambed sediment permeability, the duration of pumping, the distance between the well and stream, and others; but the EIS/EIR fails to provide any means of evaluating these various factors. How good must the "best technical information available at that time" be? What is the likelihood it will be available, what constraints does this face, and what requirements are in place to ensure that sufficient information is obtained? Why hasn't this information been analyzed in the EIS/EIR? What roles do the buyers and sellers have in reaching this determination?

Moreover, the EIS/EIR fails to identify the threshold of significance below which significant impacts would not occur. WS-1 purports to avoid "legal injury," but fails to define any threshold or criteria that will be applied in the performance of WS-1 to clearly determine when legal injury would ever occur.

Response
See Common Response 8.

Comment NG03-130

Comment
Groundwater Overdraft:

The EIS/EIR illegally defers formulation and evaluation of mitigation measure GW-1 in much the same way as WS-1. In reliance on GW-1, the EIS/EIR goes so far as to defer the environmental impact analysis that should be provided now, as part of the EIS/EIR itself. Moreover, GW-1 fails to include clear performance standards, criteria, thresholds of significance, evaluation of feasibility, analysis of likelihood of success, and even facially permits significant impacts to occur. And importantly, GW-1 does not, in fact, reduce potentially significant impacts to less-than-significant levels, but rather, attempts to monitor for when significant effects occur, then purports to provide measures to slow the impact from worsening.

Response
Reclamation and SLDMWA have committed themselves to mitigating potential impacts and have established performance standards. The text of Mitigation Measure GW-1 has been clarified based on public comments. See Common Responses 6, 7, and 10 for additional information.

Comment NG03-131

Comment
GW-1 begins by referencing the DRAFT Technical Information for Preparing Water Transfer Proposals (“DTIPWTP”)(Reclamation and DWR 2013) and Addendum (Reclamation and DWR 2014). First, it is worth noting that this document is in DRAFT form, as have all such previous iterations of the Technical Information for Preparing Water Transfer Proposals, leaving any guidance for a final mitigation measure uncertain. Second, the DTIPWTP itself requires a project-specific evaluation of then-existing groundwater and surface water conditions to determine potentially significant impacts to water supplies; but this is exactly the type of impact analysis that must occur now in the self-described project EIS/EIR before any consideration of mitigation measures is possible. Even still, the exact scope of future environmental review is unclear as well. “Potential sellers will be required to submit well data,” but the EIS/EIR does not explain what data or why. (EIS/EIR at 3.3-88.)

Response
Reclamation and DWR continue to update the DRAFT Technical Information for Preparing Water Transfer Proposals document as warranted, and the latest version (for 2015) has been added as a citation to the EIS/EIR. The technical information was cited as a resource used during mitigation measure development. See Common Responses 6, 7, and 10 for additional information.

Comment NG03-132

Comment
GW-1 next requires potential sellers “to complete and implement a monitoring program,” but a monitoring program itself cannot prevent significant impacts from occurring. “ The monitoring program will incorporate a sufficient number of monitoring wells to accurately characterize groundwater levels and response in the area before, during, and after transfer pumping takes place.’ (EIS/EIR 3.3-88.) Again, this should be done now, for public review, to determine the significance of project impacts before the project is approved. Moreover, the EIS/EIR fails to provide any guidance on what constitutes “a sufficient number of monitoring wells.” GW-1 then requires monitoring data no less than on a monthly basis, but common sense suggests that significant groundwater

pumping could occur in less than a month's time. GW-1 requires that "Groundwater level monitoring will include measurements before, during and after transfer-related pumping," but monitoring after transfer-related pumping can only show whether significant impacts have occurred; it cannot prevent them. Yet this is exactly what the EIS/EIR proposes: "The purpose of Mitigation Measure GW-1 is to monitor groundwater levels during transfers to avoid potential effects. If any effects occur despite the monitoring efforts, the mitigation plan will describe how to address those effects." (EIS/EIR 3.3-91.) Hence, GW-1 only requires elements of the mitigation plan to kick in after monitoring shows significant impacts, which are extremely likely to occur given the fact that monitoring alone amounts to no mitigation or avoidance measure.

Response
The monitoring and mitigation plans required as part of Mitigation Measure GW-1 will be developed by the seller as part of the proposal to initiate a water transfer. The plans will be specific to the seller's situation, including the volume and location of transfers (within the Project Description of this EIS/EIR). Because the plans will need to be developed based on current conditions at the time of transfer, it is not possible to develop the plans at this point. See Common Responses 6, 7, and 14 for additional information.

Comment NG03-133

Comment
Even still, the proposed mitigation plans don't mitigate significant impacts. The mitigation plan includes the following requirements: "Curtailment of pumping until natural recharge corrects the issue." This, of course, could take years and is acknowledged in the EIS/EIR (p. 3.1-17 and 18), and really amounts to no mitigation of the significant impact at all. "Reimbursement for significant increases in pumping costs due to the additional groundwater pumping to support the transfer." In what amount, at what time, as decided by who? Monetary compensation is not always sufficient to cover damages to business operations. "Curtailment of pumping until water levels raise above historic lows if non-reversible subsidence is detected (based on local data to identify elastic versus inelastic subsidence)." It does not follow that any water level above the historic lows avoids or offsets damage from non-reversible subsidence. -only admits that irreversible subsidence may occur. Finally, "[o]ther actions as appropriate" is so vague as to be meaningless. (EIS/EIR 3.3-90.)

The wholesale deferral of these mitigation measures is particularly confusing since the Lead Agencies should already have monitoring and mitigation plans and evaluation reports based on the requirements of the DTIPWTP for past groundwater substitution transfers, which likely were undertaken by some of the same sellers as the proposed 10-year transfer project. The Draft EIS/EIR should provide these existing Bureau approved monitoring programs and mitigation plans as examples of what level of technical specificity is required to meet the objectives of GW-1.

Response
As acknowledged by the commenter, curtailment of pumping is a viable option to reduce impacts if they are deemed significant. The curtailment of pumping does not have a time period associated with it. Therefore, the curtailment of pumping could continue as long as the impacts were still observed.

Section 3.3.4.1.3, Mitigation Plan describes the objectives of the mitigation plan. The mitigation plan will include elements related to a seller receiving reports of purported environmental or other effects to non-transferring parties; the procedure for investigating any reported effect; the development of mitigation options, in cooperation with the affected parties, for legitimate significant effects; and assurances that adequate financial resources are available to cover reasonably anticipated mitigation needs.

Each monitoring and mitigation plan will be customized for the local conditions surrounding the potential seller. Local conditions make it difficult to pre-define the required monitoring and mitigation efforts specific to each seller. In general, changes to groundwater levels will need to be in agreement with existing BMOs. In other areas, impacts to third parties will be determined through coordination and feedback with third parties. Common Response 7 also provides additional information regarding subsidence monitoring and mitigation.

Comment NG03-134

Comment
The DTIPWRP doesn’t add any additional monitoring or mitigation requirements for subsidence, stating that areas that are susceptible to land subsidence may require land surface elevation surveys, and that the Project Agencies will work with the water transfer proponent to develop a mutually agreed upon subsidence monitoring program. The monitoring locations in “strategic” locations are similarly deferred with no guiding criteria.

Response
Because of the site-specific nature of each potential seller's location, the details of the monitoring and mitigation plans required under Mitigation Measure GW-1 will be developed when the transfer is proposed. Local subsidence concerns will be incorporated into the plan. Reclamation will have the authority to approve or deny the monitoring and mitigation plan based on its technical understanding of conditions in the seller's area. Common Response 7 provides additional details related to subsidence monitoring and mitigation.

Comment NG03-135

Comment
Lastly, groundwater quality monitoring only appears to be required after a transfer has begun, which again is too late to prevent any significant impact from occurring. (EIS/EIR 3.3-89.)

Response
Section 3.3.4.1.2 states, "samples shall be collected when the seller first initiates pumping, monthly during the transfer period, and at the termination of transfer pumping."

Comment NG03-136

Comment
Mitigation measure GW-1 calls for stopping pumping after significant impacts are detected and then waiting for natural recovery of the water table. This might not be in time for groundwater dependent farms or riparian trees (cottonwoods & willows) to recover from the impact or could greatly extend the time to recovery. In the meantime, riparian-dependent wildlife including Swainson’s hawks would be without nesting habitat, migration corridors, and foraging areas. The mitigation measure should require active restoration of important habitat such as riparian and wetland, not natural recovery. Recovery to an arbitrary water level is not necessarily the same as recovery of wildlife habitat and populations of sensitive species.

Response
See Common Responses 10 and 11.

Comment NG03-137

Comment
The water level monitoring in the mitigation measure should give explicit quantitative criteria for significant impact. Stating that a reduction in flow or GW level is “within natural variation” and therefore not significant is deceptive. The natural variation includes extreme cases and the project should not be allowed to add an additional increment to an already extreme condition. The extremes are supposed to be rare, not long-term and chronic. For example, Little Chico Creek may be essentially dry at times but it is not totally dry and that may be all that allows plants and animals to persist until wetter conditions return. If everything dies because the creek becomes totally dry due to the project, then it may never recover.

Response
See response to Comment LA08-4.

Comment NG03-138

Comment

The EIS/EIR is required to evaluate and implement feasible project alternatives that would lessen or avoid the project's potentially significant impacts. Pub. Resources Code §§ 21002, 21002.1(a), 21100(b)(4), 21150; Citizens of Goleta Valley v. Board of Supervisors (1990) 52 Cal.3d 553, 564. This is true even if the EIS/EIR purports to reduce or avoid any or all environmental impacts to less than significant levels. Laurel Heights Improvement Assn. v. Regents of Univ. of Cal. (1988) 47 Cal.3d 376. Alternatives that lessen the project's environmental impacts must be considered even if they do not meet all project objectives. CEQA Guidelines § 15126.6(a)-(b); Habitat & Watershed Caretakers v City of Santa Cruz (2013) 213 Cal.App.4th 1277, 1302; Center for Biological Diversity v. County of San Bernardino (2010) 185 Cal.App.4th 866. Further, the EIS/EIR must contain an accurate no-project alternative against which to consider the project's impacts. CEQA Guidelines § 15126.6(e)(1); Mira Mar Mobile Community v. City of Oceanside (2004) 119 Cal.App.4th 477.

Under NEPA, the alternatives analysis constitutes "the heart of the environmental impact statement" (40 C.F.R. § 1502.14). The agency must "rigorously explore and objectively evaluate all reasonable alternatives" (40 C.F.R. § 1502.14(a), 40 C.F.R. § 1502.14(b)), and to identify the preferred alternative (40 C.F.R. § 1502.14(e)). The agency must consider the no action alternative, other reasonable courses of action, and mitigation measures that are not an element of the proposed action (40 C.F.R. § 1508.25(b)(1)-(3)).

Response

The EIS/EIR considered a wide range of alternatives, as identified in Appendix A. As described in Section 2.2.2, alternatives were identified to move forward because they "best meet the NEPA purpose and need and CEQA objectives, minimize negative effects, are potentially feasible, and represent a range of reasonable alternatives." The Lead Agencies did consider whether other measures could reduce environmental effects when evaluating alternatives.

The EIS/EIR also includes a No Action/No Project Alternative, as required by NEPA and CEQA. This alternative is described in Section 2.3.1. Each resource area analyzes the impacts of this alternative, and it serves as the basis of comparison under NEPA for the evaluation of the action alternatives.

Comment NG03-139

Comment

The EIS/EIR fails to follow the law and significantly misleads the public and agency decision-makers in declaring that none of the proposed alternatives are environmentally superior. (EIS/EIR 2-39.) First, neither CEQA nor NEPA provide the Lead Agencies with discretion to sidestep this determination. As the Council on Environmental Quality (CEQ) has explained, "[t]hrough the identification of the environmentally preferable alternative, the decision maker is clearly faced with a choice between that alternative and the others, and must consider whether the decision accords with the Congressionally declared polices of the Act."65 CEQA provides that "[i]f the environmentally superior alternative is the "no project" alternative, the EIR shall also identify an environmentally superior alternative among the other alternatives." (CEQA Guidelines § 15126.6(e)(2).)

First, the EIS/EIR fails to identify whether the "no project" alternative is environmentally superior to each other alternative. If that is the case, the EIS/EIR must then identify the next most environmentally protective or beneficial alternative. Here, the EIS/EIR presents evidence that Alternative 3 and Alternative 4 each would lessen the environmental impacts of the proposed project. The EIS/EIR however then shirks its responsibility to identify the environmentally superior alternative by casting the benefits of Alternatives 3 and 4 as mere "trade-offs." This gross mischaracterization misleads the public and agency decision-makers, as the only "trade-off" between the proposed alternative and Alternatives 3 or 4 would be more or less adverse environmental effect.

Response
Chapter 2 of the Draft EIS/EIR complies with CEQA by assessing the environmental advantages and disadvantages associated with the Proposed Action and the alternatives evaluated in the environmental analysis. CEQA calls for identification of an environmentally superior alternative, but does not provide specific direction regarding the methodology for comparing alternatives. Alternatives to be considered in the environmental analysis are those that can avoid or substantially lessen one or more of the significant environmental effects of the proposed action. Accordingly, the alternatives comparison typically begins with a summary of the project's significant impacts that cannot be mitigated to insignificance. Highlighting the areas of significant unavoidable impact identifies which alternative would be capable of eliminating or substantially reducing significant adverse environmental effects. Fundamentally, the scope and nature of the alternatives analysis is shaped by the scope and nature of the proposed activities under consideration. Here, the EIS/EIR notes that the range of transfer activities evaluated under the Proposed Action will not result in any significant impacts that cannot be mitigated to a less-than-significant level, while recognizing that an analysis of alternatives also assists in evaluating options that otherwise may be beneficial, or may reduce or avoid impacts that may not be significant. As summarized in Tables 2-9 and 2-10 and Sections 2.4 and 2.5, the Draft EIS/EIR identifies and compares several alternatives to evaluate whether they would result in greater, similar, or lesser impacts. Consistent with the CEQA Guidelines, the impacts and comparative environmental merits of each alternative are discussed. Where, as in this case, no adverse impacts of the Proposed Action or the alternatives are considered significant and unavoidable, the environmental distinctions among them may be

relatively insubstantial. The Draft EIS/EIR thus concludes that, on balance, none of the alternatives is clearly environmentally superior, while explaining the environmental advantages and disadvantages of each alternative in comparison with the Proposed Action.

Section 2.4 explains that the No Action/No Project Alternative would maintain the status quo of existing conditions and therefore would not result in any of the adverse environmental impacts of the Proposed Action or other alternatives. Section 2.5 explains that Alternatives 3 and 4 each would have lesser impacts than the Proposed Action on some resources but could have greater impacts on other resources. In particular, Alternative 3 involves no cropland modifications and would reduce the environmental effects associated with cropland idling. Alternative 3 would not have the potential to affect terrestrial resources, particularly the giant garter snake, by idling rice fields and reducing habitat. It would also reduce effects to agricultural land use and economic effects to non-transferring parties. However, because there are fewer options for transfers, more transfers would likely involve groundwater substitution actions, so the effects on groundwater could be slightly greater than Alternative 2. Alternative 4 involves no groundwater substitution and would reduce the environmental effects associated with groundwater substitution transfers. Alternative 4 would reduce effects to groundwater levels, quality, and land subsidence. It would also reduce effects associated with streamflow depletion, including potential effects to aquatic resources, terrestrial resources, and water supply. Because Alternative 4 includes fewer options for transfers, it could involve more cropland idling transfers than Alternative 2 and could increase potential impacts to terrestrial resources and agricultural land use.

The Draft EIS/EIR's discussions comport with CEQA's goal of providing sufficient information to the public and decision makers to assess the comparative merits of the Proposed Action and alternatives. The commenter's opinion that Alternatives 3 and 4 are environmentally superior is noted and will be conveyed to the decision makers for their consideration.

Comment NG03-140

Comment

The EIS/EIR argument that its conclusion that no project impacts are significant and unavoidable misses the point. Just as an EIS/EIR may not simply omit any alternatives analysis when there is purported to be no significant and unavoidable impact, neither can the agencies decline to identify the environmentally superior alternative. In fact, the proposed project would cause numerous significant and adverse environmental effects, and the EIS/EIR relies on wholly deferred and inadequate mitigation measures to lessen those effects, even allowing some level of significant impacts to occur before kicking in. But mitigation measures alone are not the only way to lessen or avoid significant project effects: the alternatives analysis performs the same function, and should be considered irrespective of the mitigation measures proposed.

Response
Refer to response to Comment NG03-139 for discussion of the environmentally superior alternative.

Comment NG03-141

Comment
Feasible Alternatives to Lessen Project Impacts are Excluded.

In light of the oversubscribed water rights system of allocation in California, changing climate conditions, and severely imperiled ecological conditions throughout the Delta, the EIS/EIR should consider additional project alternatives to lessen the strain on water resources. Alternatives not considered in the EIS/EIR that promote improved water usage and conservation include:

Fallowing in the area of demand. The EIS/EIR proposes fallowing in the area of origin to supply water for the transfers yet fails to present the obvious alternative that would fallow land south of the Delta that holds junior, not senior, water rights. This would qualify as an, "immediately implementable and flexible" alternative that is part of the Purpose and Need section (p.1-2). Whether or not this is a preference for the buyers, this is a pragmatic alternative that should be fully explored in a recirculated EIS/EIR.

Crop shifting in the area of demand. The EIS/EIR proposes crop shifting in the area of origin to supply water for the transfers yet fails to present the obvious alternative that would shift crops south of the Delta for land that holds junior, not senior, water rights. Hardening demand by planting perennial crops (or houses) must be viewed as a business decision with its inherent risks, not a reason to dewater already stressed hydrologic systems in the Sacramento Valley. This would qualify as an, "immediately implementable and flexible" alternative that is part of the Purpose and Need section (p.1-2). Whether or not this is a preference for the buyers, this is a pragmatic alternative that should be fully explored in a recirculated EIS/EIR.

Mandatory conservation in urban areas. In the third year of a drought, an example of urban areas failing to require serious conservation is EBMUD's flyer from October's bills that reflects the weak mandates from the SWRCB.

- Limit watering of outdoor landscapes to two times per week maximum and prevent excess runoff.
- Use only hoses with shutoff nozzles to wash vehicles.
- Use a broom or air blower, not water, to clean hard surfaces such as driveways and sidewalks, except as needed for health and safety purposes.

- Turn off any fountain or decorative water feature unless the water is recirculated.

While it is laudable that EBMUD customers have cut water use by 20 percent over the last decade, before additional water is ever transferred from the Sacramento River watershed to urban areas, mandatory usage cuts must be enacted during statewide droughts. This would qualify as an, “immediately implementable and flexible” alternative that is part of the Purpose and Need section (p.1-2). This alternative should be fully vetted in a recirculated EIS/EIR.

Land retirement in the area of demand. Compounding the insanity of growing perennial crops in a desert is the resulting excess contamination of 1 million acres of irrigated land in the San Joaquin Valley and the Tulare Lake Basin that are tainted with salts and trace metals like selenium, boron, arsenic, and mercury. This water drains back—after leaching from these soils the salts and trace metals—into sloughs and wetlands and the San Joaquin River, carrying along these pollutants. Retirement of these lands from irrigation usage would stop wasteful use of precious fresh water resources and help stem further bioaccumulation of these toxins that have settled in the sediments of these water bodies. The Lead and Approving Agencies have known about this massive pollution of soil and water in the area of demand for over three decades. Accelerating land retirement could diminish south of Delta exports and provide water for non-polluting buyers. Whether or not this is a preference for all of the buyers, this is a pragmatic alternative that should be fully explored in a recirculated EIS/EIR.

Adherence to California’s water rights. As mentioned above, the claims to water in the Central Valley far exceed hydrologic realty by more than five times. Unless senior water rights holders wish to abandon or sell their rights, junior claimants must live within the hydrologic systems of their watersheds. This would qualify as an, “immediately implementable and flexible” alternative that is part of the Purpose and Need section (p.1-2). Whether or not this is a preference for the buyers, this is a pragmatic alternative that should be fully explored in a recirculated EIS/EIR.

Response

The alternatives suggested in this comment are considered in the Draft EIS/EIR, as summarized in Section 2.2 and detailed further in Appendix A:

"Fallowing in the area of demand" is part of the No Action/No Project Alternative (see Section 2.3.1) and describes a key action that water users would take in response to shortages. Transfers using cropland idling in the buyers service area are considered in the "Transfers within Buyer Service Area" alternative, which was not carried forward for additional analysis because it would not provide additional water to address shortages.

"Crop shifting in the area of demand" is included in the "Change cropping patterns in San Joaquin Valley" alternative. This alternative was not carried forward because it would not provide additional water to address shortages.

"Mandatory conservation in urban areas" is considered in the "Conservation - municipal and industrial" alternative. This conservation alternative explains that reducing water demands in these areas would need to occur in addition to existing and planned water conservation, which would include measures that are more difficult to implement and would involve construction of additional infrastructure. This alternative was not carried forward because it would not provide additional water to address shortages.

"Land retirement in the area of demand" is included in the "Land retirement in the San Joaquin Valley" alternative. This alternative was not carried forward for more detailed evaluation because it would not meet any of the evaluation criteria. The commenter also describes the concept of retiring drainage-impaired lands; Reclamation is considering this concept through a different effort with different objectives (the San Luis Drainage Feature Re-Evaluation).

"Adherence to California's water rights" is included in the "Enforce seniority system to manage deliveries" alternative. This alternative was not carried forward for more detailed evaluation because it would not meet any of the evaluation criteria.

Comment NG03-142

Comment
The EIS/EIR Fails to Disclose Irreversible and Irretrievable Commitment of Resources, and Significant and Unavoidable Impacts.

Under NEPA, impacts should be addressed in proportion to their significance (40 C.F.R. § 1502.2(b)), and all irreversible or irretrievable commitment of resources must be identified (40 C.F.R. § 1502.16). And CEQA requires disclosure of any significant impact that will not be avoided by required mitigation measures or alternatives. CEQA Guidelines § 15093. Here, the EIS/EIR does neither, relegating significant impacts to groundwater depletion, land subsidence, and hardened demand for California’s already-oversubscribed water resources, to future study pursuant to inadequately described mitigation measures, if discussed at all.

a. Groundwater Depletion.

As discussed, above, the EIS/EIR groundwater supply mitigation measures rely heavily on monitoring and analysis proposed to occur after groundwater substitution pumping has begun, perhaps for a month or more. Only after groundwater interference, injury, overdraft, or other harms (none of which are assigned a definition or significance threshold) occur, would the EIS/EIR require sellers to propose mitigation measures, which are as of yet undefined. As a result, significant and irretrievable impacts to groundwater are fully permitted by the proposed project.

Response
See response to Comment NG03-143 and Common Responses 6, 7, and 10.

Comment NG03-143

Comment
Subsidence:

Here, again, the EIS/EIR suffers the same flaw of only catching and proposing to mitigate subsidence after it occurs. But damages caused by subsidence can be severe, permanent, and complicated. The EIS/EIR does not purport to avoid these impacts, nor possibly mitigate them to less than significant levels. Instead, the EIS/EIR provides for "Reimbursement for modifications to infrastructure that may be affected by non-reversible subsidence." This unequivocally provides for significant and irreversible impacts to occur.

Response
Reclamation acknowledges that subsidence is a complicated issue. Mitigation Measure GW-1 was developed based on guidance provided in the DRAFT Technical Information for Preparing Water Transfer Proposals and requires the development of a monitoring and mitigation plan to address potentially significant impacts from groundwater substitution pumping. Common Response 7 provides additional information related to subsidence monitoring. See Common Response 14 for additional information regarding interagency review and approval (or denial) of submitted plans.

Comment NG03-144

Comment
Transfer Water Dependency:

The EIS/EIR fails to account for long-term impacts of supporting agriculture and urban demands and growth with transfer water. Agriculture hardens demand by expansion and crop type and urban users harden demand by expansion. Both sectors may fail to pursue aggressive conservation and grapple with long-term hydrologic constraints with the delivery of more northern California river water that has been made available by groundwater mining and fallowing. Since California has high variability in precipitation year-to-year (http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST) (Exhibit Y), and how will purchased water be used and conserved? Should agricultural water users be able to buy Project water, how will DWR and the Bureau assure that transferred water for irrigation is used efficiently? Could purchased water be used for any kind of crop or landscaping, rather than clearly domestic purposes or strictly for drought-tolerant landscaping?

Without a hierarchy of priority uses among agricultural or urban users for purchasing CVP and non-CVP water, the EIS/EIR fails to ensure that California water resources will not go to waste, and will not be used to harden unsustainable demands.

Response
As described in Chapter 1, transfers would help address shortages related to existing demands and "would not serve any new demands in the buyers' service areas." Transfers would not be used for expansion of either agricultural or urban uses.

Reclamation requires CVP contractors to implement cost-effective BMPs to manage water use. The CVPIA of 1992 and Section 210(b) of the Reclamation Reform Act of 1982 require the preparation and submittal of a water management plan from certain entities that enter into a repayment contract or water service contract with the Reclamation. Each plan is required to be updated every five years. Reclamation develops criteria to evaluate plans prepared by CVP contractors to meet the water conservation requirements. Criteria require contractors to identify BMPs for efficient water use and develop an implementation plan.

Comment NG03-145

Comment
The EIS/EIR Fails to Adequately Evaluate Growth-Inducing Impacts.

The EIS/EIR gives short shrift to the growth inducing impact analyses required under both CEQA and NEPA by absolutely failing to realize or by obfuscating the obvious: these types of Long-Term Water Transfers inherently lead to economic and population growth. Not only are the amount of water sales and types of water sales unknown to the Lead Agencies and the public, but once water is sold and transferred to the buyer agency, there are no use limitations or priority-criteria imposed on the buyer. Whether agricultural support or municipal supply, hydraulic fracturing, industrial use, or onward transfer, the potential growth inducing impacts, both economically and physically are limitless. And once agencies and communities are hooked on buying water to sustain economic conditions or to support development and population growth, while drought conditions continue or are exacerbated, unwinding the clock may prove impossible.

Growth inducing impacts are addressed in Section 15126.2(d) of the CEQA Guidelines, and the Council on Environmental Quality NEPA Sections 1502.16(b) and 1508.8(b). CEQA Section 15126.2(b) requires an analysis of a project’s influence on economic or population growth, or increased housing construction and the future developments' associated environmental impacts. The CEQA Guidelines define growth inducing impacts as "…the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment." Under NEPA, indirect effects as declared in Section 1508.8(b) include reasonably foreseeable growth inducing effects from changes caused by a project.

Response
See response to Comment NG03-146.

Comment NG03-146

Comment
A project may have characteristics that encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively. CEQA Guidelines section 15126.2(d) admonishes the planner not to assume that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment. Included here are projects that would remove physical obstacles to growth, such as provision of new water supply achieved through Long Term Water Transfers. Removal of a barrier such as water shortages may lead to the cultivation of crops with higher-level water dependency and higher profit margins at market, or may supplement perceived and actual advantages of living in population-dense locales, leading to increased population growth.

The EIS/EIR states that direct growth-inducing impacts are typically associated with the construction of new infrastructure while projects promoting growth, like increased water supply in dry years, could have indirect growth inducing effects. Claiming that growth inducing impacts would only be considered significant if the ability to provide needed public services is hindered, or the potential for growth adversely affects the environment, the EIS/EIR then incorrectly concludes that the proposed water transfer from willing sellers to buyers, to meet existing demands, would not directly or indirectly affect growth beyond what is already planned. But the EIS/EIR does not describe "what is already planned," nor how binding such plans would be.

Similar to the drought period in the late 1980's and early 1990's, urban agencies demand was approximately 40 percent of the transfer market. During that drought period, dry-year purchases were short term deals, intended to offset lower deliveries. However, this time around most of the transfer water is available to support longer-term growth, not solely to make up for shortfalls during droughts. Under current law, urban water agencies must establish long-term water supply to support new development, and long term transfers can provide this necessary evidence.{Source: California Senate Bills 221 and 610, entered into law, 2001: requires agencies with over 5000 service connections and those with under 5000 service connections to demonstrate at least 20 years of available water supply respectively, for projects in excess of 500 residential units, or equivalent in combined residential and other demand (large service agencies), or for projects demanding least 10 percent growth in local water needs (small service agencies).}

Adding to these concerns is the increase in fracking interests throughout the state, requiring large-scale water demand to extract oil and gas, run by companies with the financial ability to influence water rights through payment. While one county directly south of the boundary involving this proposed transfer agreement recently banned fracking, other counties in California are either involved in the practice of fracking, have yet to ban the practice, or have no interest in a fracking ban. Notably, the Monterey Shale Formation that stretches south through central California is in the buyer-area of the water districts served by this potential Long-Term Water Transfer Agreement. Without use limitations upon water transfers proposed within this agreement, water transferred under this plan may well be used for fracking

The EIS/EIR inappropriately fails to evaluate or disclose these reasonably foreseeable growth-inducing impacts.

Response
The third paragraph under Section 5.3, Growth Inducing Impacts has been revised.

The proposed action would supply water primarily for agricultural purposes and very little for urban uses. As stated by the commenter, urban water agencies must establish 20 years of available water supply to support new development. Water transferred under the proposed action is not a reliable source of water. Furthermore, the proposed action would occur over a 10-year period instead of a 20-year period, further limiting the ability of water agencies to rely on this water supply for growth.

It is highly unlikely that water transferred under the proposed action would be used for industrial purposes or for fracking as the proposed buyers supply water primarily for agricultural purposes. Transfers would not be used for expansion of either agricultural or urban purposes.

Comment NG03-147

Comment
Conclusion:

Taken together, the Bureau, SLDMWA, and DWR treat these serious issues carelessly in the EIS/EIR, the Draft Technical Information for Water Transfers in 2013, and in DWR's specious avoidance of CEQA review. In so doing, the Lead and Approving Agencies deprive decision makers and the public of their ability to evaluate the potential environmental effects of this Project and violate the full-disclosure purposes and methods of both the National Environmental Policy Act and the California Environmental Quality Act. For each of the foregoing reasons, we urge that the environmental review document for this project be substantially revised and recirculated for public and agency review and comment before any subject project is permitted to proceed.

Response
See response to Comment LA14-5.

Comment Letter NG04, Kyran Mish, AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group

Comment NG04-1

Comment
The Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report Public Draft (henceforth referred to as the "EIR/EIS") articulates an ambitious plan to transfer water within the state of California. But this ambition is not matched by a similar degree of technical merit, as the modeling components of the EIR/EIS are potentially inadequate, inaccurate, and insufficient to the task. Because of this shortcoming, the EIR/EIS fails to demonstrate that environmental impacts of these transfers will be acceptably small. In particular, the groundwater substitution components of the proposed water transfers are based on modeling assumptions that likely limit their practical accuracy, and on computational simulation techniques that cannot be trusted for their intended use without additional work.

The EIR/EIS as written fails to make a technically-persuasive case for these water transfers, and therefore the proposed transfers should be rejected until the various water transfer stakeholders can advocate more effectively for these transfers by using sound scientific principles instead of mere assertions of negligible impact on the environment.

Response
The purpose of the Draft EIS/EIR is not to make a technically-persuasive case for water transfers, but rather to provide an analysis of the no action and action alternatives to help decision-makers understand the potential environmental impacts of each alternative. The analysis uses the best available tools to assess potential impacts to groundwater and surface water from groundwater substitution transfers, as described in Appendices B, C, and D. See responses to Comments LA15-44, LA15-61, and LA15-63 for additional information.

Comment NG04-2

Comment
This critique concentrates on the groundwater modeling portions of the EIR/EIS, as those portions of the EIR/EIS provide the least technical

information relative to the importance of this particular part of the transfer plans. Groundwater resources are seldom seen directly, but their influence is present throughout the hydrological cycle. When the water table sinks, streams dry up and fish die. And when that phreatic surface drops below the level available to domestic water-supply wells, families lose their water supply. Groundwater mining is an all-too-common source of environmental woes, including irreversible loss of aquifer capacity and subsidence observable at the surface of the ground. So accurate groundwater modeling is an essential component of any trustworthy assessment of potential negative environmental effects.

Response
Impacts to groundwater resources are described in Section 3.3. Section 3.7 describes potential impacts to fisheries and Section 3.8 provides information related to vegetation and wildlife resources. The modeling analysis used in this EIS/EIR is technically robust and accurate, given the available data. See response to Comment LA15-44 for additional information.

Comment NG04-3

Comment
This critique focuses on four particular aspects of the groundwater modeling efforts outlined in the EIR/EIS, namely:

- the lack of a defensible technical basis for the use of the SacFEM2013 groundwater model in assessing man-made hazards due to groundwater substitution activities,
- the inherent assumptions and potential inaccuracies present in the SacFEM2013 model, including an exposition of how better groundwater modeling techniques could have been deployed to engender more trust in the computed results,
- the lack of any formal characterization of uncertainty in the model that might be used to assess the impact of those SacFEM2013 model inaccuracies, and
- some general comments on the EIR/EIS's all-too-often inadequate technical treatment of aquifer mechanics.

Sins of omission and commission are thus found in the EIR/EIS, and this critique will attempt to guide the reader through a discussion of each, towards the goal of more accurate and technically defensible modeling that would be required to support the proposed water transfers.

Response
See responses to Comments NG04-4, NG04-5, NG04-6, and NG01-37.

Comment NG04-4

Comment
This review focuses primarily on the groundwater substitution aspects of the EIR/EIS, because those aspects are where my own expertise is deepest. The groundwater model utilized in the EIR/EIS has enough shortcomings to call into question the trustworthiness of the entire EIR/EIS, and until these shortcomings are remedied, such groundwater transfers should not be permitted. Some representative problems with the SACFEM2013 model are presented below.

Fundamental Technical Problems with the SacFEM2013 Model

In simplest terms, the EIR/EIS fails to make a compelling case for the use of the SacFEM2013 groundwater model in assessing man-made hazards due to groundwater substitution activities. For example Appendix D of the EIR is provided to document the SacFEM2013 model, but this section of the EIR/EIS raises more questions than answers about the suitability of the model. Some of the assertions made in Appendix D are incorrect, while others are irrelevant to the purpose of the EIR/EIS. And the most fundamental problem with the information presented on the SacFEM2013 model is that Appendix D fails to provide enough technical context to justify the use of SacFEM2013. A technically-informed citizen interested in providing accurate public commentary on the EIR/EIS must search the literature and other open-source documents to find relevant information about the suitability of the SacFEM2013 model. Unfortunately, these searches prove fruitless, because there simply is not enough information provided in the EIR/EIS to perform a technically-defensible characterization of the suitability of SacFEM2013. Because of this, some of the my comments include qualifiers such as “appears to be” or “apparently”. These qualifiers do not imply any insufficiency in my own understanding: they are explicit reminders that the EIR/EIS fails to provide an adequate technical basis for use of SacFEM2013.

Response
In the early stages of developing this EIS/EIR, Reclamation determined that the modeling of groundwater substitution pumping impacts was critical. Reclamation conducted a model selection process that reviewed the existing available groundwater models. This document selected SACFEM for use in this analysis. Text has been added to Appendix D to describe the model selection process. To provide more detailed about the SACFEM2013 model, the User's Manual has been included in the EIS/EIR as Appendix M.

Comment NG04-5

Comment
One example of incorrect modeling assertions in the EIR/EIS is the characterization1 of SacFEM2013 and its parent code MicroFEM as “three-dimensional” and “high-resolution”. In fact, the SacFEM2013 model provides

only a linked set of two-dimensional analyses2, and would more charitably be described as “two-and-a-half dimensional” instead of possessing a fully-3D modeling capability. This limitation is not an unimportant detail, as a general-purpose 3D groundwater model could be used to predict many important physical responses, e.g., the location of the phreatic surface within an unconfined aquifer. For the SacFEM2013 model, this prediction is part of the data instead of part of the computed solution, and hence SacFEM2013 apparently has no predictive capability for this all-important aquifer response. Here is the relevant EIR/EIS content on this topic(3):

The uppermost boundary of the SACFEM2013 model is defined at the water table. To develop a total saturated aquifer thickness distribution and, therefore, a total model thickness distribution, it was necessary to construct a groundwater elevation contour map and then subtract the depth to the base of freshwater from that groundwater elevation contour map. Average calendar year groundwater elevation measurements were obtained from the DWR Water Data Library. These measurements were primarily collected biannually, during the spring and fall periods; and these values were averaged at each well location to compute an average water level for each location. These values were then contoured, considering streambed elevations for the gaining reaches of the major streams included in the model, to develop a target groundwater elevation contour map for the year 2000.

Note that, in order to begin a SacFEM2013 analysis, the phreatic surface must be specified instead of predicted, and that this specification is based on past records of water table location instead of on verifiable accurate predictions of future groundwater resources. Since California is currently in an unprecedented drought, and because the assessment of similarly-unprecedented future large-scale groundwater transfers is the whole point of the EIR/EIS, it is technically inappropriate to use an averaged historical basis to locate the water table surface simply because the SacFEM2013 is unable to predict that important parameter from first principles!

(3) EIR/EIS, Appendix D, Page 4

Response
MicroFEM's website provides technical details on the code and its capabilities. The Fact Sheet posted at http://microfem.com/download/microfem.pdf lists several features of MicroFEM that are relevant and critical to the EIS/EIR analysis, including the simulation of "saturated single-density flow; multiple aquifer systems and stratified aquifers; confined, leaky and unconfined conditions; heterogeneous aquifers and aquitards; steady-state and transient flow, partially varying anisotropic aquifers; spatially and temporally varying wells and boundary conditions; and precipitation, evaporation, drain, river and wadi top systems."

All numerical groundwater model simulations require the specification of some type of fixed boundary condition in order to begin the simulation. It is typical for the water table to be specified at the beginning of the simulation period. However, after the initial specification of the water table elevation, the water table is allowed to move up or down as the numerical model solves the groundwater flow equations. There are no other time periods in the SACFEM2013 simulation where the phreatic groundwater table is manually specified. Therefore, for the model simulation period starting in 1970, the water table elevation is calculated by the model, and not specified.

Comment NG04-6

Comment
A good example of an irrelevant assertion in the EIR/EIS is the list of reasons given(4) why MicroFEM was chosen as the modeling platform. The first reason is true of any finite-element code used to model groundwater response, and the second and third arise from the existence of a graphical user interface for the model input and output data. Any modern computational tool (e.g., the word-processing application I'm using to write this critique) possesses such a user interface, so all three reasons apply equally well to any well-designed finite element application, yet they are used to motivate the choice of only one such application. Why this specific choice of MicroFEM was made is never developed in the EIR/EIS, but it should be, as with the choice of computational model comes a set of model constraints that can limit the model's utility.

Technical sidebar: finite element models are particularly easy to develop and deploy graphical user interfaces for, because the interpolation scheme used to generate the finite element results provides uniquely-defined and easy-to-compute results for every point in the spatial domain. In addition to this readily-accessible supply of spatial data available for visual interpretation of results, these models also can produce results at regular time intervals (e.g., monthly) that make it easy to generate animations of the spatial data. So the presence of a graphical user interface is a poor reason to choose a particular finite element application, as custom visualization tools are readily developed at low cost to support the use of the model, or public-domain visualization tools can be utilized instead.

(4): EIR/EIS, Appendix D, Page 1

Response
See response to Comment NG04-4.

Comment NG04-7

Comment
Unfortunately for the results presented in the EIR/EIS, MicroFEM is a poor choice for such large-scale modeling. It is an old code that apparently utilizes

only the simplest (and least accurate) techniques for finite-element modeling of aquifer mechanics, and MicroFEM (and hence SacFEM2013) embed serious limitations into the model that compromise the accuracy of the computed results. These limitations include, but are not limited to, the following:

• The model places a remarkably-low upper limit on problem resolution, i.e., 250,000 surface nodes are available to the modeler, but no more. This limit would appear to the technically-oriented reader to indicate that the advanced age of the MicroFEM program has constrained its software architecture so that high-resolution and high-fidelity models are beyond its capabilities. In particular, its MS/DOS origins might indicate an inability to address sufficient computer memory to support a higher-resolution model, or that its solver routines do not scale to support the multiple-processor capabilities available on virtually all current computers. If this is the case, then this problem should be explicitly noted in the EIR/EIS as a model limitation. If it is not the case, then some justification for this upper limit should be provided to aid in the impartial evaluation of the SacFEM2013 model.

Response
The current version of the MicroFEM code can handle up to 250,000 nodes per layer with up to 20 layers. SACFEM2013 provides a nodal resolution of less than 125 meters in areas representing projects. This nodal spacing of 125 meters provides substantially greater resolution than is provided by CVHM and C2VSIM, the other readily-available regional groundwater flow models of the Sacramento Valley. The nodal resolution in SACFEM2013 is considered adequate to help inform decision-making.

Comment NG04-8

Comment
As mentioned above, the SacFEM2013 model is only partially predictive, in that some aquifer responses are entered as input data instead of being computed as predictive quantities. The most serious of these is the lack of ability to predict the location of the phreatic surface in the aquifer. This location is a natural candidate as the single the most important predicted quantity available for understanding near-surface environmental effects of groundwater motion, yet it is apparently not computed by SacFEM2013, which instead relies on its location via the a priori data-entry process quoted above.

Response
SACFEM2013 is parameterized like other regional models groundwater flow models available for the Valley. Aquifer responses are not "entered as input data." Groundwater levels are computed based on modeled aquifer parameter values and boundary conditions.

Comment NG04-9

Comment
As mentioned earlier, the model is not a three-dimensional model, but instead estimates groundwater response via approximations involving a suite of two-dimensional layers with uniform horizontal permeabilities coupled via estimated leakage parameters that represent the actual three-dimensional flow fields of groundwater resources. The limitations of this self-induced model constraint are outlined in more detail below, but the summary is simple enough: the real-world complexities of California's groundwater aquifers are over-simplified by the SacFEM2013 model into no more than 25 available two-dimensional layers of uniform composition, and hence the model results are at best computational simplifications not necessarily representative of actual groundwater responses to pumping.

Response
MicroFEM is a three dimensional groundwater flow code that simulates horizontal flow through layers as well as vertical flow between layers to simulate a three dimensional groundwater flow field. A review of the MicroFEM code in the journal Ground Water describes the code as follows: "MicroFEM can simulate steady-state or transient three-dimensional flow of a constant-density fluid in confined, unconfined, and leaky aquifers. Material properties are assigned to elemental nodes. Aquifers and aquitards can be heterogeneous, and aquifers can have spatially-varying anisotropy." (Ground Water 38, No. 5, p. 649-650). SACFEM2013 does not have uniform horizontal permeabilities as indicated by the commenter.

Comment NG04-10

Comment
In addition to the model not being a true 3D model of the actual geometric nature of the state's groundwater resources, some other problems with the model include the following:

- The model requires considerable data manipulation to be used, and these manipulations are necessarily subject to interpretation. This fact implies that the model results depend on the choices made by the analyst, and are hence not necessarily reproducible. In other words, adjusting of the results (by accident or by design) is an inherent characteristic of the model, and that characteristic alone erodes trust in the model. There are technically-defensible ways to provide accurate assessments of how such adjustments might affect output results used in decision-making (e.g., sensitivity analyses for these parameters), but these means for evaluating trust in the model are not mentioned in the EIR/EIS, and one can only conclude that they have never been performed.

Response
The Lead Agencies acknowledge that some modeling results depend on choices made by the analyst; this is not unique to SACFEM2013. The assertion that adjusting results is an inherent characteristic of the model is not accurate. The results (i.e., groundwater levels and fluxes) are computed by the model based on the modeled input parameter values and boundary conditions. Information on sensitivity studies completed as part of the modeling effort has been added to Appendix D.

Comment NG04-11

Comment
The model description in the EIR/EIS presents no validation results that can be used to provide basic quality-assurance for the analyses used in the EIR/EIS. The reader can seek information on the parent code MicroFEM, but precious little data is available on that code's capabilities, so the question of "can the results of this model be trusted?" is not answered by the EIR/EIS. An expert reviewing the EIR/EIS might seek to examine the MicroFEM code directly, but the underlying source code is not available, and the MicroFEM tool can only be purchased for a substantial fee ($1500), so it is infeasible to gain informed public comment on the suitability of MicroFEM or SacFEM2013 without paying a substantial price.

Response
SACFEM2013 was calibrated by computing 40 years of monthly groundwater levels and comparing them with historical groundwater levels available over that same time period. These historical groundwater levels were measured in more than 200 wells during periods exhibiting very dry to very wet climatic conditions. The SACFEM 2013 User's Manual has been added to the EIS/EIR as Appendix M.

MicroFEM has been available for more than 20 years and has been reviewed by the National Ground Water Association Ground Water journal in the Software Spotlight Column (Ground Water 38, No. 5, p. 649-650).

Comment NG04-12

Comment
The model is not predictive in some aquifer responses (as mentioned above), so its results are a reflection of past data (e.g., streamflows, phreatic surface location, etc.) instead of providing a predictive capability for future events. Since accurate prediction of future environmental effects is the whole point of the EIR/EIS, the SacFEM2013 model is arguably not even suitable for use in the EIR/EIS, much less in real-world hydrological practice.

Response
It is not clear which aquifer responses the commenter is referring to when stating that the model does not predict some aquifer responses. SACFEM2013 computes monthly groundwater levels and fluxes at each model node located in each model layer. MicroFEM and custom SACFEM2013 post processing tools compute the forecast impacts to streams using the three dimensional distribution of simulated groundwater levels and fluxes and the stream stages associated with the boundary-condition nodes representing streams.

Comment NG04-13

Comment
The problem of data manipulation mentioned in the first bullet above represents a serious limitation of the SacFEM2013 model. Model quality can be measured by standard quality-assurance processes utilized for software development, such as the CMM model(5) widely used in software practice. The five stages of increasing quality in the CMM model are termed ad hoc (or chaotic), repeatable, defined, managed, and optimized, and the repeatable stage is generally accepted as the minimal level of quality appropriate for any critical analysis methodology. Since analyst intervention in data preparation creates an obvious risk of analyst dependencies in the output data used to set policy, the current SacFEM2013 workflow is likely only at the “ad hoc/chaotic” state of quality assurance for a model. This is simply not appropriate for critical analyses that are used in decision-making on such important resources as water in California.

A typical example of analyst intervention in data preparation can be found in Appendix D of the EIR/EIS(6):

After a transmissivity estimate was computed for each location, the transmissivity value was then divided by the screen length of the production well to yield an estimate of the aquifer horizontal hydraulic conductivity (Kh). The final step in the process was to smooth the Kh field to provide regional-scale information. Individual well tests produce aquifer productivity estimates that are local in nature, and might reflect small-scale aquifer heterogeneity that is not necessarily representative of the basin as a whole. To average these smaller scale variations present in the data set, a FORTRAN program was developed that evaluated each independent Kh estimate in terms of the available surrounding estimates. When this program is executed, each Kh value is considered in conjunction with all others present within a user-specified critical radius, and the geometric mean of the available Kh values is calculated. This geometric mean value is then assigned as the representative regional hydraulic conductivity value for that location. The critical radius used in this analysis was 10,000 meters, or about six miles. The point values obtained by this process were then gridded using the kriging algorithm to develop a Kh distribution across the model domain. The aquifer transmissivity at each model node within each model layer was then computed using the geometric mean Kh values at that node times the thickness of the model layer. Insufficient data were available to attempt to subdivide the data set into depth-varying Kh distributions, and it was, therefore, assumed that the computed mean Kh values were representative of the major aquifer units in all model layers. The distribution of K used throughout most of the SACFEM2013 model layers is shown in Figure D-4. During model calibration, minor adjustments were made to the Kh of model layer one east of Dunnigan Hills and in model layers six and seven in the northern Sacramento Valley based on qualitative assessment of Lower Tuscan aquifer test data in this area.

Note the presence of terms such as “adjustments”, “assumed”, “insufficient data”, and “representative”. What is being described in this paragraph is a potentially non-repeatable process that converts the three-dimensional permeability tensor into a homogenized number Kh that is then used to estimate conductivity in a plane parallel to the ground surface. Permeability is a local tensorial property of the aquifer (i.e., it varies from point to point in the 3D subsurface domain), but the resulting Kh is smeared across the domain to convert this tensor with six independent spatially-dependent components into a single number that is applied over a huge geographical area instead. And this conversion is subject to the judgment of each analyst, so the results depend on the skill (or lack thereof) of the particular analyst doing the modeling.

Technical sidebar: it is remarkably straightforward to perform accurate and technically-defensible computational analyses to assess the ultimate effect of these data adjustments. One of the most easily-deployed of these techniques is the use of a sensitivity analysis that measures how computed output results depend on adjustments to input parameters. Sensitivity analyses are readily grafted onto nearly any computational model, and while these computations require more effort than not using them, most of the additional effort can readily be offloaded to the computer, so that undue levels of human efforts are not required for their application. Formal sensitivity analyses can also be used to aid in the assessment of model uncertainty (see discussion below), so their omission in the EIR/EIS is a mystery to the technically-informed impartial reviewer of the EIR/EIS.

(5) M.C. Paulk, C.V. Weber, B. Curtis, M.B. Chrissis, "Capability Maturity Model for Software (Version 1.1)". Technical Report, Software Engineering Institute, Carnegie Mellon University, 1993

(6) EIR/EIS, Appendix D, Page 13

Response

Applying capability maturity modeling methodology used for software development to environmental modeling is not appropriate. Environmental modeling requires the user to apply professional judgment. The example of "analyst intervention" referred to by the commenter is actually the application of professional judgment to estimate aquifer parameter values from existing hydrologic data sets. The methodology described simply uses available specific capacity data for numerous wells across the model domain to estimate the spatial variability in aquifer transmissivity within the Sacramento Valley aquifer system. Data evaluation and analysis is a routine practice in the development of aquifer parameter distributions for use in groundwater model applications such as SACFEM2013. It is not possible to develop numerical groundwater flow models like SACFEM2013, CVHM, and C2VSIM without "analyst intervention in data preparation."

The model development team applied a method to distribute aquifer parameter values throughout the domain. That method resulted in a nonuniform distribution of Kh through a given model layer using available specific capacity data. The model underwent calibration to demonstrate its ability to replicate historical monthly groundwater levels over a 40-year period that included a variety of climatic conditions. Although a perfect match between available historical groundwater levels and modeled groundwater levels was not achieved or anticipated, SACFEM2013 has been adequately calibrated to help inform decision-making associated with groundwater management alternatives. Applying professional judgment during the model development process is a requirement with this type of environmental modeling because field data are not available at all locations, depths, and times of interest. Information on sensitivity studies completed as part of the modeling effort has been added to Appendix D.

Comment NG04-14

Comment

And that's only the tip of the larger iceberg of problems with these ad hoc techniques. It is actually quite easy to avoid all these adjustments and oversimplifications entirely, and treat the aquifer as it is, namely as a true three-dimensional physical body of large extent, with a time-varying location of the water table, and with accurate treatment of the complex hydraulic conductivity inherent to the subsurface conditions of California. It's also remarkably simple to include poromechanical effects (see discussion below) in such a 3D model so that accurate local and regional estimates of environmental impacts such as subsidence and loss of aquifer capacity can be predicted and validated. All of this technology has been available for decades, but it is not utilized in the SacFEM2013 model. The citizens of California clearly deserve a better model for decision-making involving one of their most precious resources!

Response

SACFEM has undergone an extensive independent peer review performed by an independent consultant with extensive experience in the application of groundwater models to evaluate groundwater systems and surface water-groundwater interaction (WRIME 2011). The objective of the peer review was to evaluate the adequacy of the model to estimate the impacts of groundwater substitution water transfer pumping on third party groundwater users as well as impacts to surface water flows. The results of the peer review identified seven primary enhancements to the model that would improve its accuracy in forecasting pumping impacts on water resources in the Sacramento Valley. All seven of these enhancements have been incorporated into SACFEM2013, the most recent version of SACFEM.

Comment NG04-15

Comment
Regarding The Need to Characterize Uncertainty in Engineered and Natural Systems:

Some discussion is warranted at this point on the difference between a natural and an engineered system, towards the goal of appreciating why characterizing uncertainty in any proposed water transfer strategy is an essential goal of a well-considered EIR/EIS. An engineered system is designed entirely by humans, so each component of that system is reasonably well-understood a priori, and the uncertainties that are inherent in any system (natural or man-made) are limited to defined uncertainties such as materials chosen, geometric specifications, and conditions of construction and use. So an engineered system such as an automobile (or a groundwater-pumping facility) is uncertain in many aspects, but that uncertainty can in theory be constrained by quality-control efforts or similar means of repeatability. Constraining these uncertainties comes at a price, of course: that is a large part of what we mean when we refer to quality in an engineered system such as in cars or consumer electronics.

A natural system has a much higher threshold for uncertainty, as we often do not even know of all the components of the system, much less their precise characterization (e.g., in a water-bearing aquifer, the materials that entrain the water are by definition unavailable for characterization, and the mere act of digging some of them up for laboratory inspection often changes their physical behaviors so that the tests we perform in the laboratory may not be entirely relevant to the response of the actual subsurface system). So when studying a natural system, a scientist or engineer must exercise due diligence in the examination and characterization of the system's response to stresses of operational use, and must consistently provide means to determine the presence and effect of these inherent uncertainties. To do otherwise is to risk visitation by Murphy's Law, i.e., "anything that can happen, will happen." Thus one of the most obvious metrics for evaluating the quality of any environmental plan is to examine the plan's use of terms such as "uncertainty", as well its technical relatives that include "validation" (testing of models via physical processes such as laboratory experiments), "verification" (testing of models via comparison with other generally-accepted models), and "calibration" (tuning a model using a given set of physical data that will be used as initial conditions for subsequent verification, validation, and uncertainty characterization). These basic operations are fundamental characteristics of any computational model, and are used in everyday life for everything from weather prediction (where uncertainty dominates and limits the best efforts at forecasting) to the simple requirement that important components of infrastructure such as highway bridges be modeled using multiple independent analyses to provide verification of design quality before construction can begin.

Unfortunately, the EIR/EIS does not contain a formal characterization of model uncertainty, either for the SacFEM2013 application itself, or for the underlying data gathered to support the SacFEM2013 analyses. As described in previous sections, both the model and the input data contain simplifications that potentially compromise the model's ability to provide accurate estimates of real-world responses of water resources, and these idealizations create more need for uncertainty characterization, not less. And the all-important technical terms “validation” and “verification” do not appear the EIR/EIS. The term “calibration” occurs twice7 with regard to groundwater models, but only in the context of ad-hoc “adjustments” of the model data.

Response
Terms like "validation" and "verification" are often linked with modeling efforts; however, these terms should be avoided with environmental modeling because they are misleading and set inappropriate expectations (see Oreskes et al., 1994. "Verification, Validation, and Confirmation of Numerical Models in the Earth Sciences," Science, v263, pp. 641-646.). It is preferable to describe whether the model is adequately "calibrated" rather than "validated" or "verified". Model calibration can always be improved, since knowledge of the modeled system evolves as additional data and funding become available to update the model. The preparers of the EIS/EIR, on the basis of their experience and professional judgment, conclude that SACFEM2013 has been adequately calibrated to achieve the current modeling objectives.

Comment NG04-16

Comment
Lack of Trust in the SacFEM2013 Model:

In addition to generally-poor modeling assumptions inherent in the SacFEM2013 model, the all important task of characterizing uncertainty in the model's implementation and data is neglected in the EIR/EIS. On page 19 of Appendix B, the reader is promised that model uncertainty will be described in Appendix D, but that promise is never delivered: the only mention of this essential modeling component occurs merely as an adjunct to discussion of deep percolation uncertainty.

This lack of any formal measure of uncertainty is not an unimportant detail, as it is impossible to provide accurate estimates of margin of error without some formal treatment of uncertainty. Many such formal approaches exist, but apparently none were deployed for the EIR/EIS modeling efforts. In simple terms, this lack of uncertainty characterization removes the basis for trust in the model results, and hence the entire groundwater substitution analysis presented in the EIR/EIS is not technically defensible. Until this omission is remedied, the EIR/EIS simply proposes that water interests in California trust a model that is arguably not worthy of their trust.

Response
The SACFEM2013 user's manual has been incorporated into the EIS/EIR as an appendix. Section 4.3 of this document includes potential sources of error in the model, which helps address model uncertainty. Additionally, a discussion of sensitivity studies completed during development of the EIS/EIR has been included in Appendix D.

Comment NG04-17

Comment
And it's even worse than this, as while the model is asserted to be "high-resolution", in fact the SacFEM2013 model is quite the opposite. The actual spatial resolution of the model is given in Appendix D as ranging from 125 meters for regions of interest, up to 1000 meters for areas remote from the transfer effects. Nodal spacing along flood bypasses and streams is given as 500 meters. No mention is made in the EIR/EIS of exactly what this means in terms of trust in the model, but in accepted computational modeling practice, this is not a particularly high resolution.

In fact, there are formal methods for characterizing the ability of a discretized model such as SacFEM2013 to resolve physical responses of interest. These methods are based on elementary aspects of information theory (e.g., the Nyquist-Shannon sampling theorem), and their practical result is that a discrete analog (i.e., a computer model) of a continuous system (i.e., the actual subsurface geological deposits that entrain the groundwater) cannot resolve any feature that is less than a multiple of the size of the discretization spacing. For regular periodic features (e.g., the waveforms that make radio transmission possible), that multiple can be a small as two, but for transient phenomena (e.g., the response of an aquifer), established practice in computational simulation has demonstrated that a factor of five or ten is the practical limit on resolution.

Thus the practical limit of the SacFEM2013 model to "see" (i.e., to resolve) any physical response is measured in kilometers! The model can compute results smaller than this scale, but those results cannot be implicitly trusted: they are potentially the computational equivalent of in optical illusion. For this reason alone, the SacFEM2013 model cannot be trusted without substantial follow-on work that the EIR/EIS gives no indication of ever having been performed. And thus any physical response asserted by the model's results has a margin of error of 100% if that response involves spatial scales smaller than a kilometer or more, i.e., there is little or no predictive power in the model for those length scales.

The additional verification effort required to gain some measure of trust in the model (i.e., refining the nodal spacing by a factor of two and four to create more refined models, and then comparing these higher-resolution results to gain assurance that no computational artifacts exist in the original model, i.e., no optical illusions are being used to set water transfer policy) is quite straightforward and is also standard practice in verifying the utility of a computational model. It is something of a mystery why this standard modeling quality-assurance technique is not presented in the EIR/EIS, but this omission provides yet-another sound technical reason to reject the results of the EIR/EIS until better modeling efforts are provided.

Technical sidebar: one important side benefit of performing verification studies by refining the finite element mesh in the spatial and temporal domains is that this extra effort provides important information as to whether the resolution of the model is sufficient. In practice, improving the resolution of a computer model is only a means to the desired end of gaining higher fidelity, i.e., a closer approximation to reality. So what we really desire from a computer model is not resolution, but fidelity, and while it is notoriously difficult to assess measures of fidelity, verification techniques based on refining the finite element mesh do provide some measure of trust in model results. One particularly simple verification measure involves plotting the computed results for a quantity of interest (e.g., groundwater flux at some point in the aquifer) as a function of model resolution (e.g., a metric indicating the number of the elements in the model, or a representative spatial scale used) for successive refinements of the finite-element mesh. Such plots help the analyst estimate whether the results at any given resolution yield an asymptotically-accurate estimate of the best results the model can provide given its inherent modeling assumptions. When combined with validation data (e.g., model predictions compared to real-world measured data), these verification-and-validation techniques provide a more sound basis for trust in the model than the minimal motivations found in the EIR/EIS.

It is likely that the SacFEM2013 model may be incapable of performing these more refined higher-resolution analyses because of its underlying assumptions (e.g., idealizing the three-dimensional subsurface domain as a set of coupled two-dimensional layers), and if that is the case, then the underlying groundwater model is simply not up to the requirements of accurate regional water transfer modeling. The underlying MicroFEM model is an old simulation tool, originally written for the MS/DOS platform, and it appears to be near the practical limit of its resolution at the stated size8 of 153,812 nodes (compared to the maximum nodal resolution in MicroFEM of 250,000 nodes cited above). But the current generation of desktop computers can easily handle many millions of nodes for such simulations, and enterprise computers well within the budgets of government agencies are routinely utilized to model systems with hundreds of millions of nodes, so if the SacFEM2013 model is already at its limit of resolution, then it’s clear that a newer, better computational model should be used to replace it.

Response
The resolution of SACFEM2013 substantially exceeds the resolution provided by the other regional groundwater flow models developed for the Sacramento Valley by the USGS and the Department of Water Resources. In addition, SACFEM has undergone an extensive independent peer review performed by an independent consultant with extensive experience in the application of groundwater models to evaluate groundwater systems and surface water-groundwater interaction (WRIME 2011). The objective of the peer review was to evaluate the adequacy of the model to estimate the impacts of groundwater substitution water transfer pumping on third party groundwater users as well as impacts to surface water flows. The results of the peer review identified seven primary enhancements to the model that would improve its accuracy in forecasting pumping impacts on water resources in the Sacramento Valley. All seven of these enhancements have been performed and are reflected in SACFEM2013, the most recent version of SACFEM.

On average, SACFEM2013 computes monthly groundwater levels in nodes representing calibration-target wells located throughout the Valley over a 40-year simulation period more accurately than is suggested by the commenter.

See response to Comment NG04-15 for additional information.

Comment NG04-18

Comment
Inadequacy of Basic Aquifer Mechanics Principles in the EIR/EIS:

In addition to all the fundamental problems inherent in the SacFEM2013 model, the EIR/EIS presents a biased view of basic principles of aquifer mechanics, and this bias serves to understate the risks of serious environmental problems that have long been a bane of water policy in California. In particular, the EIR/EIS simply understates the risk of these environmental effects, beginning with its executive summary and continuing throughout the rest of the document. Here's a representative sample of the problem at its first occurrence(9):

Groundwater substitution would temporarily decrease levels in groundwater basins near the participating wells. Water produced from wells initially comes from groundwater storage. Groundwater storage would refill (or "recharge") over time, which affects surface water sources. Groundwater pumping captures some groundwater that would otherwise discharge to streams as baseflow and can also induce recharge from streams. Once pumping ceases, this stream depletion continues, replacing the pumped groundwater slowly over time until the depleted storage fully recharges.

The use of the adverb "fully" implies that the original storage is entirely recovered, but this is not necessarily the case. The science of poromechanics demonstrates that irreversible loss of aquifer capacity can occur with groundwater extraction, and while this physical phenomenon is explained elsewhere in the EIS/EIR, it is apparently ignored by the SacFEM2013 model, and hence it is not predicted with any degree of accuracy for use in estimating this important environmental effect. California has seen many examples of the accumulation of this environmental risk, as the readily-observable phenomenon known as subsidence is the surface expression of this loss of aquifer capacity. The small strains induced in the aquifer skeleton by groundwater extraction accumulate over the depth of the aquifer, and are expressed by the slow downward movement of the ground surface. The EIR/EIS makes little connection between groundwater extraction process modeled by SacFEM2013 and the all-too-real potential for surface subsidence, and the attendant irreversible loss of aquifer capacity. It is remarkably simple to model these coupled fluid- and solid-mechanical effects using modern computers, and it is thus a fatal shortcoming of the EIR/EIS that such a rational science-based approach to estimating these environmental risks has not been undertaken.

The problem is especially important during drought years, when groundwater substitution is most likely to occur. In a drought, the aquifer already entrains less groundwater than normal, so that additional stresses due to pumping are visited upon the aquifer skeleton. This is exactly the conditions required to cause loss of capacity and the risk of subsidence. Yet the EIR/EIS makes scant mention of these all-too-real problems, and no serious modeling effort is presented in the EIR/EIS to assess the risk of such environmental degradation.

Response
The exact location of the text cited by the commenter is uncertain based on this comment. However, the existing subsidence conditions experienced in the Sacramento and San Joaquin Valleys are discussed in Section 3.3.1.3, Affected Environment. The potential for subsidence is addressed in Section 3.3.2.4. See Common Responses 6 and 7 for additional information.

Comment NG04-19

Comment
Taken together with the other problems catalogued above, it is clear that the EIR/EIS does not accurately estimate potential environmental risks due to groundwater extraction. And since this component of the water transfer process is only one aspect of how water might be moved within the state, the interested reader of the EIR/EIS can only wonder what other important environmental effects have not been accurately assessed in the EIR/EIS.

Response
The EIS/EIR has been developed to analyze all resources potentially affected by the action alternatives, as described in Chapter 2.

Comment NG04-20

Comment
The current draft version of the EIR/EIS fails to accurately estimate environmental effects likely to occur during water transfers. The model used to predict groundwater resources is flawed by being based on old technology that is apparently not up to the task of accurate large-scale modeling as combined with requisite validation measures and uncertainty characterization efforts needed to justify the use of the model. The reasons given for the use of this model do not stand up even to the most rudimentary examination, and the model neglects important environmental effects that have long been observed in California. The proposed transfers should be rejected until a more sound scientific basis can be established for prediction of all substantial environmental effects, and established practices in the use of computational models are developed and deployed in all aspects of computational prediction of those effects.

Response
See responses to Comments NG01-37 and NG04-4.

Comment Letter NG05, Tom Cannon, AquAlliance, California Sportfishing Protection Alliance, Aqua Terra Aeris Law Group

Comment NG05-1

Comment
Long term transfers represent Reclamation and San Luis Delta Mendota Water Authority's ability to move water from north of the Delta to south of the Delta using its Central Valley Project storage, conveyance, and export facilities, and associated authorities. The EIS/EIR describes the details and effects of Reclamation's actions to carry out such transfers. Water for transfers would come from stored and saved water north of the Delta that would be delivered in summer south of the Delta. The amount of water proposed for transfer by Reclamation could be up to 600,000 af (Federal Register and EIS/EIR at p. 1-5), but is likely to be over 200 thousand acre-ft. Reclamation's EIS/EIR covers myriad proposed transfers. Some additional proposed State transfers are addressed in the EIS/EIR cumulative impacts assessment.

CSPA has undertaken a review of transfers and the EIS/EIR effects analysis on special status fish species. The species addressed include Chinook salmon, Steelhead, Green and White sturgeon, and Longfin and Delta smelt. These fish all depend on Central Valley river and Delta flows and habitats for portions of their life cycles. A summary of this review is presented in this report.

Response
The comment cites the upper limit of 600,000 acre-feet for transfers, but that upper limit is related to transfer quantities addressed in the Biological Opinions

on the Coordinated Operations of the CVP and SWP (see Section 1.3.1.2). These quantities reflect the transfer amounts that are addressed in the current biological opinions on CVP and SWP operations in the Delta; the action alternatives in this EIS/EIR are not proposing to transfer this entire quantity. The maximum quantity proposed for transfer under the action alternatives in any year would be about 511,000 acre-feet, and in most years when transfers occur substantially less water would be transferred (see Section 2.3.2.2). An analysis of potential effects to special status fish species is included in Section 3.7.

Comment NG05-2

Comment

1. Change in timing and amount of river flows

Table C2 shows that summer Delta inflows from the Sacramento River in dry and critical water years may increase by several thousand cfs to accommodate transfer Delta exports. With non-CVP transfers the total change is not inconsequential. With minimum river flows of 3000-5000 cfs, transfers can double river flow and Delta inflow in summer of drier years when reservoir levels are low and water deliveries are cut back. Holding Delta outflow near minimum and nearly doubling inflow and exports warms the Delta, increases loss of Delta fishes to export pumps, and degrades freshwater and low salinity zone habitat. For more discussion of this effect see Attachments A and B.

Response

Contrary to the assertion suggested in the comment, reservoir releases and river flows appear to have a minimal influence on in-Delta water temperature. Atmospheric conditions are the primary influencing factor on in-Delta water temperatures (Wagner et al. 2011; see also page 3.7-19 of the EIR/EIS).

Comment NG05-3

Comment

River flows in winter can be lower by 10-20% in dry years as previous year’s transfer releases are made up by reservoir water retention. Rivers flows may be reduced by over 1000 cfs although usually in higher precipitation months. The refill of reservoirs the year after summer transfers reduces winter river flows and Delta inflow. The effect is greatest in drier years when river flows and reservoir releases are at a minimum. These indirect winter effects though not as dramatic as direct summer transfer effects have consequences to drier year winter river rearing and migration habitat of salmon and smelt.

Overall effects from flow changes:

- Significant negative effect on winter run salmon: (1) young rearing in lower Sacramento River in summer, (2) smolt migration in winter, (3) adult upstream migration in winter.

- Significant negative effect on delta smelt: (1) young rearing in the Delta in summer of drier years, (2) adults migrating upstream into Delta during winter.

Response
Based on a thorough review of year-round instream flow modeling outputs in the Sacramento River and Delta in each water year type, the effects stated in the comment are unsubstantiated and are therefore not incorporated in the EIS/EIR analysis (see Section 3.7.2.4.1 for details). Mean changes in flows in the Sacramento River are less than 10 percent throughout the year, regardless of water year type.

Comment NG05-4

Comment
Tables C8 and C9 show expected increases in drier year summer exports in the range of 20-60% from CVP transfers. With non-CVP transfer exports of similar magnitude, total drier year exports are near double or even more in critical years like 2014. Higher exports increase entrainment and salvage losses of fish and degrade Delta rearing habitat (higher water temperatures, lower turbidity, and lower primary and secondary production).

Overall effects from export increases in summer:

- Significant negative effect on delta smelt: (1) from increased entrainment of young rearing in the Delta in summer of drier years, (2) from degradation of rearing habitat of young.

Response
As described in Section 3.7.2.6.1, the changes in Delta exports would not have significant effects on aquatic species; refer to this section for additional detail and justification. The combined effects of Long-Term Water Transfers and other water transfers project were evaluated under Cumulative Effects and would be less than significant.

Comment NG05-5

Comment
Water released from reservoirs for transfers in summer is not the same water exported from the Delta. Exports from the South Delta in summer of drier years typically take the cooler, slightly brackish, productive upper low salinity zone that has been in residence in the Delta for some time. The exported water includes nearly all the higher productivity water of the San Joaquin River that

enters the Delta. Exported water is replaced by reservoir water including that released for transfers. The added reservoir water in higher Delta inflows degrades Delta habitat with fresher, warmer, clearer water.

Overall effects from changes:

- Significant negative effect on delta smelt from degradation of rearing habitat of young in north, south, and west Delta, and eastern Suisun Bay.

Response
Tidal excursion is 7-13 kilometers per tide, twice a day (Walters et al 1985). As a result, fish living in the western Delta experience a wide range of habitat conditions. Water in the Delta during summer months is not warm due to the reservoirs. Water from the reservoirs is among the coldest water in the system, particularly water from the bottom of the reservoirs. Water conveyed through the Delta is warm, particularly if it "has been in residence in the Delta for some time" as indicated by the commenter. Therefore, the Proposed Action would not degrade rearing habitat for delta smelt.

Comment NG05-6

Comment
As it may take several years or more to replace reservoir water released for transfers, reservoir storage is depleted by transfers in multiyear droughts. Reservoir depletion over several years may reach 500,000 ac-ft or more total. Long term droughts already deplete reservoirs to the point of affecting cold water pools and winter-spring releases that benefit fish especially in droughts. Storage releases in the summer of 2014 were in fact higher than planned or believed needed to sustain transfers, other water demands, and outflow and water quality requirements. Thus the true effect of transfers on reservoir storage is unknown.

Reductions in cold water pools can lead to (1) adult salmon being susceptible to diseases from warm water, (2) delays in salmon spawning, (3) reduced survival of eggs and embryos, (4) lower young survival during rearing, and (5) and delays and lower survival of smolts during emigration.

Overall effects from reservoir storage reductions:

- Significant negative effect on winter run salmon in multiyear droughts: (1) young rearing in lower Sacramento River in summer, (2) migrating smolts in winter, (3) eggs and embryos in summer, and (4) adults from lower winter attraction flows in multiyear droughts.

Response
Model outputs indicate that effects to instream flows below reservoirs would be insubstantial and minimal. Therefore, none of the effects listed in the comment would be significant to aquatic resources. For more information, please see Section 3.7.2.4.1.

Comment NG05-7

Comment
We believe the addition of water transfers places significant added burden on the special status fish species over that already imposed by climate change, drought, increasing water supply use, record-high Delta diversions, increasing demands on surface and groundwater, as well as increased demand forecasted under the BDCP. The EIS fails to address these factors, although it does mention the potential of added effects from other Central Valley transfers through the Delta (i.e., by State Water Project and non-project water) not covered by the EIS. The EIS acknowledges these effects, but simply states that the added and cumulative effects are insignificant without any analyses as to whether the severely depressed populations and habitats of special status species are potentially affected by the added stress. Based on our assessment of cumulative effects, significant added stresses would occur on the fish and their habitats

Response
Section 3.7 discusses direct, indirect, and cumulative impacts to fisheries. More detailed information on the fisheries analysis and the science behind it is provided in response to specific comments.

Comment NG05-8

Comment
Winter Run Salmon:

The cumulative effects of the above stresses with addition of water transfers will put winter-run in continuing jeopardy and inhibit their recovery. Transfers reduce reservoir storage in multiyear droughts as transfer storage releases cannot be made up until wet years again occur. Low storage limits the amount of Shasta Reservoir cold water pool to sustain winter run through summer spawning, incubation, and rearing. Continuing low fall releases limits the extent of rearing habitat and early emigration cues. Higher August and September flows from reservoir transfer releases may improve early rearing habitat in the upper Sacramento River near Redding, but may also deplete the cold-water pool and send emigration cues that may push young into warmer portions of the lower Sacramento River. Low storage levels in multiyear droughts limit the available water for storage releases in winter to sustain young emigration and upstream adult migration through the Delta and Bay to and from the Pacific Ocean.

Response
As indicated in the above responses to Comments NGO 5-2 through NGO 5-7, the nature and extent of "stresses" that this comment references as the basis for cumulative effects are unsubstantiated. Based on substantial evidence presented in the EIS/EIR, cumulative effects on aquatic resources would be less than significant. Refer to Section 3.7.6 for details.

Comment NG05-9

Comment
Spring and Fall Run Salmon:

Lower river flows in winter and spring in drier years would effect downstream emigration success of fry to the Delta. Poor dry year Delta rearing habitat would be further degraded by lower Delta inflows. High late summer transfers would encourage early migrations and maturation of adult fall run only to subsequently be subjected to lower fall flows and higher water temperatures.

Response
It is unknown to which river(s) the commenter is referring. However, mean monthly flows in each of the major rivers except the Bear River (Sacramento, Feather, Yuba, American, San Joaquin, and Merced) would not be reduced by more than 10 percent in any month or water year type. The Bear River would experience an 18 percent reduction in critical years during the month of February. This infrequent reduction is not expected to affect aquatic species, particularly because it occurs during February when temperatures are not high enough to cause concern. Therefore, there would be a less than significant effect.

Comment NG05-10

Comment
Delta Smelt and Longfin Smelt

Adult migration and spawning success would be negatively affected by lower Delta winter and spring inflows in multiyear droughts. Lower Delta inflow in late winter and springs of multiyear droughts will reduce survival of young smelt. Higher summer Delta inflows will reduce survival of rearing pre-adult smelt in the Delta from degradation of the low salinity zone and direct and indirect losses to higher Delta exports.

Response
There would be no substantive change in flows in any river during any month or water year type except in the Bear River in critical years during the month of February, when an 18 percent reduction would occur; therefore Delta inflows would not be affected. As a result, delta smelt will not be affected by the project. See Section 3.7.2.4.1 for details.

Comment NG05-11

Comment

Reclamation argues that the effects of transfers are not “unreasonable”. Their main argument is that the BOs state that planned summer transfers up to 600,000 ac-ft would not constitute jeopardy, and that NMFS and USFWS have “OK’d” individual transfers in summer 2014 and past years. The facts are that winter-run salmon and delta smelt populations have further declined significantly since the BOs were prepared. Based on the present situation after two recent periods of drought (6 of last 8 years being dry or critical) we believe the predicted added stress of the whole array of planned transfers is an unreasonable threat to listed salmon and smelt.

Response

A review of Grandtab winter-run escapement data does not reveal a "further significant decline" in the winter-run population since the 2009 NMFS Biological Opinion as suggested by the commenter. Also, a review of the fall midwater trawl delta smelt index does not reveal a "further significant decline" in the delta smelt population since the 2008 USFWS Biological Opinion. Therefore, water transfers that were allowed in these biological opinions, along with all the other physical, biological, and regulatory factors occurring during the period, do not appear to have added further stress on the populations.

Substantial evidence provided in the analysis supports the conclusion that there would be no significant, unavoidable adverse impacts. All potentially significant impacts would be mitigated to result in less than significant impacts and no additional avoidance measures are necessary.

Comment NG05-12

Comment

As shown in Tables 2-9 and 2-10, the Proposed Action in Reclamation’s opinion would not have any significant, unavoidable adverse impacts. From our review the proposed transfers have significant potential effects that are avoidable. Our review shows that potential effects are greatest in multiyear droughts when listed fish are already under maximum stress. Many of the most significant effects can be avoided by limiting transfers in the second or later years of drought. A more detailed review might yield specific criteria or rules that would allow some transfers to occur under certain circumstances. If transfers cannot be avoided, then other types of restrictions on water supply storage or deliveries could be considered to reduce effects of transfers and risks to the listed species.

Response

See response to Comment NG05-11.

Comment NG05-13

Comment
Major flaws in Reclamation's assessment are as follows:

1) Reclamation assumes delta smelt are not found in the Delta in the summer transfer season, when in fact during dry and critical years when transfers would occur most if not all delta smelt are found in the Delta (see Attachments A and B).

Response
The EIS/EIR indicates that delta smelt are typically not found in the area of influence of the export facilities (this does not include the Cache Slough complex) during this time of year because of elevated water temperatures. Water temperature appears to play a key role in this, as suggested by CDFW data described on Page 3.7-32 through Page 3.7-34.

Comment NG05-14

Comment
Reclamation downplays the potential total amount of all transfers, when in fact the capacity exists for transfer amounts up to 600,000 ac-ft (see EIS/EIR CHART BELOW). "The "up to" amount of transfer water that could be made available in any year is approximately 473,000 acre-feet. However, it is unlikely that this amount of water could be transferred in any year due to Delta regulatory and other constraints." (Source: http://www.usbr.gov/mp/PA/water/docs/2014_water_plan_v10.pdf)

Response
Section 2.3.2.5 explains that the maximum quantities associated with the range of potential transfers is "a total of a little over 500,000 AF," specifically 511,094 AF as shown in Table 2-4. The potential transfer quantities used in the analysis were determined through extensive coordination with all potential selling agencies. The Lead Agencies are not "downplaying" the amount of total transfers that could occur each year. The Lead Agencies relied on sophisticated modeling tools to determine Delta capacity to convey water transfers during the transfer period.

Comment NG05-15

Comment
Reclamation has not assessed the effect on Delta habitat in terms of water temperature, turbidity, and location of the Low Salinity Zone.

Response
The Lead Agencies have assessed the effect on water temperature and have determined that, because instream flows do not influence water temperatures in the Delta, there would be no effects associated with the range of potential

transfer activities under the Proposed Action. The effect on the location of the low salinity zone was analyzed, and was determined to be beneficial (X2 location moves farther downstream). No change to either Delta outflow or the low salinity zone location would result in no change in water quality, including turbidity.

Comment NG05-16

Comment
Reclamation has failed to address population level effects on listed fish.

Response
Each impact conclusion is an assessment of population level effects, all of which are less than significant.

Comment NG05-17

Comment
Reclamation has failed to follow the State Board's recommendation: ""The key is to follow the water, not the agreements. Focus on the source of the actual water moving to the transferee. This is the water being transferred and will guide the types of changes in water rights that may be needed." (p 10-3 of SWRCB Guide to Water Transfers.). Reclamation has failed to identify that the water they divert for transfer in the Delta is not the water released upstream for transfer.

Response
TOM, as described in Appendix B, was used to model surface water flows for potential proposed transfers and does not model "agreements." Appendix B lists assumptions made in TOM to model potential water transfers, including how transfer water co-mingles with other water in the system. TOM was developed through extensive coordination with Reclamation, including the Central Valley Operations office.

Comment NG05-18

Comment
Reclamation has failed to assess the cumulative effects on listed fish in multi-year droughts and the consequences of adding transfers on top of emergency drought actions designed to save storage by reducing water demands, exports, and relaxing water quality standards. Reclamation failed to mention its own requests to the State Board for Temporary Urgency Changes in 2013 and 2014 including provisions to exempt transfers from the TUCs that allowed lower Delta outflow and higher salinities in the Delta in summer 2014. Neither BO allowed for transfers under these conditions.

Response

Section 3.7.6 evaluates cumulative effects to fisheries. The period of analysis used in modeling for this analysis includes critical and dry periods as well as multi-year drought periods. Tables in Section 3.2, Water Quality provide expected conditions as a result of each alternative for dry and critical water years. While exceedances of water quality standards have occurred, especially during recent drought years, the changes in operations associated with the range of potential water transfer activities analyzed in this EIS/EIR are not expected to significantly affect water quality or exceedances. See Common Response 5 for additional information regarding the modeled period hydrology.

Comment NG05-19

Comment

- Transfer may not cause significant adverse effects on Reclamation's ability to deliver CVP water to its contractors. In 2014 Reclamation had to release more water than expected to meet export demands including transfers. The unplanned release of "extra" Shasta and Folsom storage water adversely affects Reclamation's ability to meet its contractual demands and permit requirements. For example, North-of-Delta contractors were initially threatened with a 40 percent allocation that was later changed to 75 percent delivery.

Response

Conditions in 2014 were not typical because of the extreme dry conditions. The 40 percent allocation was not related to releases for transfers; this allocation was made early in the season before any transfers were contemplated. The allocation was low because of the lack of precipitation. It was changed because of increased precipitation and intense cooperation with fisheries resource agencies to protect sensitive species.

Comment NG05-20

Comment

- Transfer will be limited to water that would be consumptively used or irretrievably lost to beneficial use. Water diverted from the Delta is not water that would be consumptively used; it is water that would have eventually move to San Francisco Bay.

Response

This citation from the EIS/EIR relates to how water would be made available for transfers in the sellers' area. Transferred water would increase the water entering the Delta compared to what would enter the Delta without transfers, and a portion of this additional water could be diverted at the Delta conveyance facilities.

Comment NG05-21

Comment

- Transfer will not adversely affect water supplies for fish and wildlife purposes. Transfers results in storage levels lower than predicted, which limit cold-water pools and the ability to maintain downstream “fish flows”.

Response

The model outputs indicate there would be no change greater than 10 percent in instream flows in any river evaluated, except in the Bear River during the month of February in critical water years. Therefore, there would be no effect on cold-water pool storage or "fish flows."

Comment NG05-22

Comment

- Transfers cannot exceed the average annual quantity of water under contract actually delivered.

The amount of CVP storage necessary to meet transfer export demands may be double the contracted amount.

Response

Section 3405(a)(1)(A) of the CVPIA refers to how much water can be transferred from willing sellers. Willing sellers cannot sell more water than they have received from the CVP (as an average annual quantity) during the past three years. This description of the CVPIA requirements has been edited for clarity. This clause does not refer to CVP storage, but transfers would only be able to use available storage.

Comment NG05-23

Comment

“Water supplies on the rivers downstream of reservoirs could decrease following stored reservoir water transfers, but would be limited by the refill agreements”. The whole subject of “refill agreements” is not adequately covered by Reclamation. The fact that it may take several years or more to refill is a significant effect not addressed.

Response

On page 2-11 of the EIS/EIR, the description of reservoir release includes the following text: "Refill of the storage vacated for a transfer may take more than one season to refill if the above conditions are not met in the wet season following the transfer."

Comment NG05-24

Comment
"Water transfers could change reservoir storage in CVP and SWP reservoirs and could result in water quality impacts." No information as to the specific effects on Shasta, Trinity, or Folsom reservoir storage or downstream tailwater flows was provided.

Response
This impact statement in Section 3.2, Water Quality summarizes the analysis that occurs below each statement (see, for example, page 3.2-31 of the Draft EIS/EIR). This impact statement is related to water quality, and the subsequent analysis includes a table of specific changes to reservoir storage in these reservoirs. Changes in flows downstream of the reservoirs are included as part of subsequent impact statements, and the flow changes are shown in Tables 3.2-25, 3.2-29, and 3.2-32.

Comment NG05-25

Comment
"Water transfers could change reservoir storage non-Project reservoirs participating in reservoir release transfers, which could result in water quality impacts." The effect on reservoir and tailwater water quality in non-refill years of multiyear droughts was not addressed.

Response
The model used in this analysis includes a period of record which contains multi-year droughts. The model results reflect conditions during and after transfers.

Comment NG05-26

Comment
"Water transfers could change river flow rates in the Seller Service Area and could affect water quality." Effects on specific rivers and reaches were not addressed.

Response
The Draft EIS/EIR presents tables summarizing changes in water flows and associated water quality changes for potentially affected water bodies within the area of analysis (see Table 3.2-25).

Comment NG05-27

Comment
"Water transfers could change Delta outflows and could result in water quality impacts." "Water transfers could change Delta salinity and could result in water

quality impacts." Specific effects on Delta water temperature, salinity, and turbidity in drought years like 2014 were not addressed.

Response
See Common Response 5.

Comment NG05-28

Comment
"Transfer actions could alter hydrologic conditions in the Delta, altering associated habitat availability and suitability" Specific effects of transfers on Delta hydrology in drought years like 2014 were not addressed.

Response
Section 3.7 evaluates impacts to habitat in the Delta. See response to Comment NG05-18 for additional information, and Common Response 5 regarding model timeframe.

Comment NG05-29

Comment
"The cumulative analysis evaluates potential SWP transfers, but they are not part of the action alternatives for this EIS/EIR." Given the difficulty of separating these actions and there effects, and that other environmental assessments and biological opinions address joint actions, we see no reason to not address the joint action of transfers through the Delta in this EIR/EIS, especially given the following EIR/EIS statement: "Most of the pumping capacity available would be at the Banks Pumping Plant except for very dry years. Banks is an SWP facility, so SWP-related transfers would have priority. Agreements with DWR would be required for any transfers using SWP facilities. "

Note: In 2013, DWR facilitated about 265 thousand acre-feet of water transfers through State Water Project facilities, nearly double the amount anticipated for CVP transfers.
(http://www.water.ca.gov/watertransfers/docs/2014/Transfer_Activities_v11.pdf)

Response
State Water Project transfers are not part of the Proposed Action evaluated in this EIS/EIR. Reclamation does not approve or facilitate SWP transfers and SLDMWA is not engaged in transfers between SWP contractors. Because the Lead Agencies are not involved in these transfers, it is appropriate to include SWP transfers in the cumulative analysis and not the proposed alternatives.

Comment NG05-30

Comment
“Water transfers, which would occur from July through September, would coincide with the spawning period of winter-run Chinook salmon. However, spawning occurs upstream of the areas potentially affected by the transfers. Due in part to elevated water temperatures in these downstream areas during this period, emigration would be complete before water transfers commence in July.“ P3.7-12

Water transfers also come from Shasta storage releases. Downstream emigration of fry from spawning reaches near Redding commences in July and continues through September.

Response
The last sentence in the referenced text was changed to read: "Due in part to elevated water temperatures in these downstream areas during this period, spawning and egg incubation would be complete before water transfers commence in July" (see page 3.7-13). This revision would not result in a material change to the analysis or conclusions.

Comment NG05-31

Comment
“Summer rearing of CV steelhead would overlap with water transfers occurring in the Seller Service Area (July-September), both in the Sacramento and San Joaquin River and their tributaries (see specific tributaries listed above). Thus water transfers have the potential to affect steelhead. The majority of rearing, however, would occur in the cooler sections of rivers and creeks above the influence for the water transfers.” P3.7-14. The “majority” of rearing occurs in tailwaters, which would be affected by transfers (e.g., the lower American River tailwater below Folsom Reservoir).

Response
The last sentence in the referenced text was changed to read: "The majority of rearing, however, would occur in the cooler sections of rivers and creeks (McEwan 2001)" (see page 3.7-16). This revision would not result in a material change to the analysis or conclusions.

Comment NG05-32

Comment
“ (Delta smelt) Larvae and juveniles are generally present in the Delta from March through June. Delta smelt have typically moved downstream towards Suisun Bay by July because elevated water temperatures and low turbidity conditions in the Delta are less suitable than those downstream (Nobriga et al. 2008). Some delta smelt reside year-round in and around Cache Slough

(Sommer et al. 2011). Delta smelt in Suisun Bay and Cache Slough would be outside of the influence of the export facilities." P3-7-16. In dry and critical years, delta smelt reside primarily in the Delta in summer in the direct path of water moving across the Delta to South Delta export pumps (see Attachments A and B for details).

Response
See response to Comment NG05-13.

Comment NG05-33

Comment
Consistency of Section 3.7 with the provisions of the California Environmental Quality Act (CEQA) and the CEQA Guidelines. Section 3.7 concludes that all effects are less than significant (e.g., p37-37). Using CEQA criteria - An alternative would have a significant impact on fisheries resources if it would:

a. Cause a substantial reduction in the amount or quality of habitat for target species. YES

Response
The evaluation of potential reductions in the amount and quality of habitat for fisheries resources was discussed throughout Section 3.7.2.4 and consistently found less than significant impacts. Very few small reductions to flow rates exist, and these, in total, would not rise to the level of significant impacts on habitat.

Comment NG05-34

Comment
Have a substantial adverse effect, such as a reduction in area or geographic range, on any riverine, riparian, or wetland habitats, or other sensitive aquatic natural community, or significant natural areas identified in local or regional plans, policies, regulations, or by CDFW, NOAA Fisheries, or USFWS that may affect fisheries resources. YES

Response
The evaluation of potential reductions in the area or geographic range of fisheries resources was discussed throughout Section 3.7.2.4 and consistently found less than significant impacts. Very few small reductions to flow rates exist, and these, in total, would not rise to the level of significant impacts on habitat area or geographic range.

Comment NG05-35

Comment
Conflict with the provisions of an adopted HCP, NCCP, or other approved local, regional, or state habitat conservation plan. YES (Delta Water Quality Control Plan)

Response
The Proposed Action does not conflict with any habitat conservation plans or natural community conservation plans because there would be less than significant impacts after mitigation measures are implemented. See Sections 3.7.2.4 and 3.8.2.4 for more detailed explanations.

Comment NG05-36

Comment
Cause a substantial adverse effect to any special-status species, − Have a substantial adverse effect, either directly or through habitat modifications, on any endangered, rare, or threatened species, as listed in Title 14 of the California Code of Regulations (sections 670.2 or 670.5) or in Title 50, Code of Federal Regulations. A significant impact is one that affects the population of a species as a whole, not individual members. YES (WINTER RUN, DELTA SMELT)

Response
Sections 3.7.2.4 and 3.8.4 explain there would be no substantial adverse effects to any endangered, rare, or threatened species or natural community as a result of the action alternatives.

Comment NG05-37

Comment
Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by CDFW, NOAA Fisheries, or USFWS, including substantially reducing the number or restricting the range of an endangered, rare, or threatened species. YES (WINTER RUN, DELTA SMELT)

Response
The evaluation of potential substantial adverse effects on fisheries resources was discussed throughout Section 3.7.2.4 and consistently found less than significant impacts. Very few small reductions to flow rates exist, and these, in total, would not rise to the level of significant impacts on these species.

Comment NG05-38

Comment
Cause a substantial reduction in the area or habitat value of critical habitat areas designated under the federal ESA or essential fish habitat as designated under the Magnusson Stevens Fisheries Act. YES (WINTER, SPRING, FALL, LATE FALL RUN; STEELHEAD, GREEN AND WHITE STURGEON, DELTA AND LONGFIN SMELT)

Response
The evaluation of potential reductions in the amount and quality of habitat for fisheries resources was discussed throughout Section 3.7.2.4 and consistently found less than significant impacts. Therefore, there would be no reduction in designated critical habitat or essential fish habitat.

Comment NG05-39

Comment
Conflict substantially with goals set forth in an approved recovery plan for a federally listed species, or with goals set forth in an approved State Recovery Strategy (Fish & Game Code Section 2112) for a state listed species. YES, RECOVERY PLANS FOR CV SALMON, DELTA SMELT, AND LONGFIN SMELT.

Response
The evaluation of potential significant impacts on fisheries resources was discussed throughout Section 3.7.2.4 and consistently found less than significant impacts. Because the action alternatives would not have significant effects on fisheries, they would not conflict with recovery plans for Central Valley salmonids and smelt. The recovery plans also include plans to recovery these species, but the recovery objectives are not part of the purpose and need/project objectives for this project and are being met through other efforts.

Comment NG05-40

Comment
Summer 2014 Water Transfers:

Transfers were conducted in the summer of 2014 under a Finding of No Significant Impact NEPA document. Our review of the proposed 2014 transfers is presented in Attachment A.

Summer 2014

As background on the overall effect of summer transfers, we present an assessment of the overall effect on Delta Smelt in summer 2014 in Attachment B.

Response
See responses to Comments NG05-41 through NG05-78.

Comment NG05-41

Comment

8. Delta smelt occupy the area of the Delta known as the "low-salinity zone" ("LSZ"). The LSZ is located where fresh water flowing toward San Francisco Bay mixes with salt or brackish water. The LSZ is generally centered around the areas where salinity values equal 2 parts per thousand, a value known as X2. In the summer months in normal or wet water years, normal Delta outflows keep the LSZ, and the Delta smelt population that lives in the LSZ, in the Western Delta, where water temperatures are suitable for Delta smelt and where they are far from the water export pumps located in the South Delta.

9. In my 2013 analysis (Exhibit 2), I conclude that (1) low Delta outflows caused the LSZ (and its population of Delta smelt) to move upstream into the Central and Southern Delta, where water temperatures are significantly higher than the Western Delta; (2) releases of warm water from reservoirs upstream of the Delta (primarily Lake Shasta) in late June caused water temperatures in July in the LSZ to reach temperatures lethal to smelt; and (3) as a result, Delta smelt suffered significant mortality.

10. In my May 2014 analysis (Exhibit 3), I conclude that the 2014 Transfers, in combination with the SWRCB's May 2, 2014 relaxation of standards that govern Delta flow and water quality will exacerbate a similar increase in Delta smelt mortality because, once again: (1) low Delta outflows will cause the LSZ (and its population of Delta smelt) to move upstream into the Central and Southern Delta, where water temperatures are significantly higher than the Western Delta, and where they are more vulnerable to entrainment in the export pumps; (2) releases of warm water for the Transfers from reservoirs upstream of the Delta (primarily Lake Shasta) in the transfer period (July through September) will cause water temperatures in the transfer period in the LSZ to reach temperatures lethal to smelt; (3) will cause or increase reverse OMR flows making it more likely that any surviving smelt will be entrained in the export pumps; and (4) as a result, Delta smelt will suffer significant mortality.

Response
See pages 3.7-33 through 3.7-38 for details of the EIS/EIR analysis. The analysis indicates that delta smelt would be in the Delta during dry periods only when temperatures allow. If temperatures are too high, the delta smelt will migrate downstream to cooler water despite the higher salinity. The periods of higher water temperatures do not coincide with periods of increased pumping. Therefore, there would be no increased risk of entrainment.

Releases from reservoirs do not drive temperatures in the Delta. Temperatures in water from reservoirs are much cooler than temperatures in the Delta (CDEC data, 6/20/14-6/30/14: Shasta Dam mean daily water temperature = 52.6 F, Sacramento River at Delta mean daily water temperature = 67.4 F), and even much cooler than water in San Francisco Bay at this time of year, even during the severe drought (tidesandcurrents.noaa.gov data, 6/20/14-6/30/14: San Francisco, CA mean daily water temperature = 59.6 F). There is minimal correlation between upstream flows and in-Delta water temperatures (Wagner et al. 2011).

Most important, modeling results indicate there is no decrease in Delta outflow for the range of potential transfer activities evaluated under the Proposed Action during summer months; in fact, there would be a 12.2 percent increase in Delta outflow which, using the logic of the commenter, would provide a benefit to delta smelt.

Comment NG05-42

Comment
In my June 9, 2014, letter (Exhibit 4), I conclude that Delta outflows this summer will be much lower than expected or considered in the Bureau's environmental assessment for the 2014 Transfers because the standard governing Delta outflows (i.e., minimum 3,000 cfs Net Delta Outflow Index ("NDOI") for the transfer period) grossly overestimates actual Delta net outflow. As a result, actual outflows will be close to zero or even negative. This has severe consequences for Delta smelt, because such low outflows exacerbate the conditions that make the standard of 3,000 cfs harmful.

Response
See response to Comment NG05-41.

Comment NG05-43

Comment

12. The Bureau of Reclamation responded to my May 2014 analysis by letter dated May 30, 2014, which included comments provided from Ms. Frances Brewster, a hydrologist, and Dr. Erwin Van Nieuwenhuyse, a biologist. (A true and correct copy of this letter is attached hereto as Exhibit 5.)

13. These reviewers fail to address my main points: that transfers under relaxed standards increase the already high risk from low outflow and exports in summer of critical years when "all" smelt are in the Delta. The main risk is degrading critical habitat by increasing already high water temperatures. My analysis shows that already-critical water temperature will increase in critical habitat habitats of smelt with transfers. All locations in the LSZ will increase in water temperature to near or above critical levels. Thus, while the temperature increases may be small in relative terms, they are critical

because temperatures will be near or at lethal levels even without the transfers and relaxation of standards.

Response
See response to Comment NG05-41.

Comment NG05-44

Comment

14. The analysis of impacts of Delta water management operations on Delta smelt involves a number of causes of impacts that must be assessed in combination with each other, not in isolation, including reduced outflow and higher flow through the Delta from transfers. There are also a number of impacts on smelt habitat from these causes, all of which interact with each other. These include higher water temperature, reverse OMR flows, more upstream location of the LSZ, and reduced food availability. My analysis includes all of these variables.

15. Ms. Brewster, in contrast, selects four values that are not germane to my analysis, and discusses each one in isolation, rather than in combination. Therefore, her conclusions are nonresponsive.

Response
See response to Comment NG05-41. Because temperatures are high in the Delta during this time of year, delta smelt are typically downstream of any risk to entrainment. The effects of potential transfer activities on the foodweb are not easy to discern due to the complexity of the Delta foodweb and an overall lack of understanding about how it works. The explanation provided by Ms. Brewster and Dr. Nieuwenhuyse in the document cited in this comment offers a reasonable explanation for why foodweb effects would be minimal.

For these reasons, there would be no increase in entrainment risk for delta smelt for the range of potential transfer activities evaluated under the Proposed Action.

Comment NG05-45

Comment
Temperature. Ms. Brewster presents data showing that average temperature in the entire three-month transfer period is .5 degrees F higher in the Sacramento River at Rio Vista than at Emmaton. This is the wrong metric for purposes of analyzing the Transfers' impact on Delta smelt. The issue is not whether the transfers under relaxed outflow standards will cause a large average difference, over a 3 month time period, between temperatures at Emmaton and Rio Vista. The issue is whether the transfers under relaxed outflow standards will cause a large enough difference in temperature to kill smelt at any time as compared to either not doing the transfers or doing them under normal outflow standards.

Response
See response to Comment NG05-41. Delta temperatures would not increase and there would be no increase in mortality of delta smelt for the range of potential transfer activities evaluated under the Proposed Action.

Comment NG05-46

Comment
The U.S. Fish and Wildlife Service determination that Delta smelt warrant designation as “endangered” states: “Delta smelt tolerate temperatures ranging from 7.5 C to 25.4 C (45 to 78 F) in the laboratory (Swanson et al. 2000, p. 386, Table 1) ....” (Federal Register, Vol 75, No. 66., p. 17668.) Bennet’s peer reviewed study states: “Water temperatures over about 25°C [77°F] are also lethal, and can constrain delta smelt habitat especially during summer and early fall (Swanson and others 2000). Overall, the majority of juveniles and adults in the TNS and MWT have been caught at water temperatures less than 22°C [71.6°F] (Figure 5).” (“Critical assessment of the delta smelt population in the San Francisco Estuary, California” (2005), William A. Bennet, John Muir Institute of the Environment, Bodega Marine Laboratory, University of California, Davis.) Among biologists, seventy-seven (77) degrees F is a commonly accepted lethal temperature for smelt. In my opinion, prolonged exposure to temperatures above seventy-five (75) degrees F is stressful to smelt.

Response
The comment does not pose any questions or concerns regarding the EIS/EIR; no specific response is needed.

Comment NG05-47

Comment
In my 2013 analysis, I reported that temperatures in late June and July of 2013 reached lethal levels around July 5 in some locations and near-lethal temperatures for a prolonged period of time in many locations. The following table summarizes the data I presented in my 2013 report.

<See Table in original comment>

This data shows that a half-degree increase in temperature is potentially very significant because temperatures are likely to be in the near-lethal to lethal ranges in the LSZ even without transfers and/or relaxed standards. This data also shows that using the small (but potentially significant) difference in the three month average temperature at Emmaton and Rio Vista as a metric for the Transfers’ harm to smelt is not useful for predicting impacts on smelt.

Response
See response to Comments NG05-41 and NG05-45.

Comment NG05-48

Comment
Entrainment. Ms. Brewster argues that the 2008 Smelt BO does not have OMR reverse flow limits in the transfer period and that reverse OMR flows can be as high as -8000 cfs in a “typical year.” These facts are irrelevant to what is happening in the summer months of dry and critically dry years (i.e., 2013 and 2014) because, in a typical year, the LSZ is in the Western Delta, where water temperatures are suitable for Delta smelt and where they are far from the water export pumps located in the South Delta. One of my key points is that the 2008 Smelt BO fails to address what is happening in the summer months of dry and critically dry years, especially under relaxed D-1641 outflow conditions. Indeed, the USFWS has conceded this point.

Response
See response to Comment NG05-44.

Comment NG05-49

Comment
Smelt Food. Ms. Brewster does not disagree with my opinion that “transfer flows will displace plankton rich, higher turbidity water with plankton poor, low turbidity water.” Instead, she asks how this phenomenon differs from normal Delta operations. The USFWS has found that “normal” Delta operations are a significant reason Delta smelt are a “threatened” species and that the “endangered” designation is warranted.3 Ms. Brewster looks at this variable in isolation, rather than in combination with other effects of the transfers under relaxed D-1641 standards. Specifically, doing the transfers under relaxed outflow standards will cause the LSZ where smelt live to be closer to the pumps than they would be in a “normal” year.

Response
See response to Comment NG05-41. Because Delta outflow would remain the same or increase, there would be no relocation of the low-salinity zone (LSZ) closer to the export facilities.

Comment NG05-50

Comment
LSZ Area. Ms. Brewster argues that the area of LSZ is “essentially the same” whether X2 is at Emmaton or Three-mile Slough. This is a red herring, because my opinions are primarily based on the changed location of the LSZ, not its smaller areal extent.

Nevertheless, since Ms. Brewster has focused attention on this value, it is worth noting that using her “Figure B-1,” it appears that when X2 moves from Emmaton (at about mile point 90 on the x-axis) to Three-mile Slough (at about mile point 93 on the x-axis), the LSZ loses about 10% of its area (i.e., about 500 of 4,500 hectares). Ms. Brewster suggests no reason, and certainly no biological reason, that 4,000 hectares is "essentially the same" as 4,500 hectares for purposes of assessing impacts on smelt.

Response
See response to Comment NG05-49.

Comment NG05-51

Comment
Dr. Nieuwenhuyse apparently agrees with me that in the coming summer months the LSZ is going to be uninhabitable by smelt due to high temperatures and lack of food. Dr. Nieuwenhuyse suggests that this new state of affairs will not cause harm to smelt because they can find temperature and food refuge in the Sacramento Deepwater ship channel upstream of Rio Vista. I am aware of no scientific basis for this assertion. The U.S. Fish and Wildlife Service's 2008 Smelt Biological Opinion does not suggest that the Sacramento Deepwater ship channel upstream of Rio Vista provides a viable temperature and food refuge for Delta smelt when their only recognized habitat – the LSZ in the Delta – has been rendered unsuitable for their survival by the Bureau's water management decisions.

Response
See response to Comment NG05-49.

Comment NG05-52

Comment
In my opinion, the effect of Delta operations this summer of confining smelt to the Sacramento Deepwater ship channel upstream of Rio Vista due to adverse environmental conditions in the LSZ that will be exacerbated by the Transfers, both with and without relaxed outflow standards, with no evidence that they can emerge from the ship channel in the fall to produce another generation of smelt, is significant new information showing that the Transfers will have significant adverse impacts on Delta smelt.

Response
See response to Comment NG05-49.

Comment NG05-53

Comment
On April 25, 2014, Governor Brown issued a Proclamation of a Continued State of Emergency related to the drought. The Proclamation finds that California's water supplies continue to be severely depleted despite a limited amount of rain and snowfall since January, with very limited snowpack in the Sierra Nevada mountains, decreased water levels in California's reservoirs, and reduced flows

in the state's rivers. The Proclamation orders that the provisions of the January 17, 2014 Proclamation remain in full force and also adds several new provisions including: the State Water Board and the Department of Water Resources (DWR) are to expedite requests to move water to areas of need.

Federal water contractors in the Sacramento Valley recently were allocated by the US Bureau of Reclamation (Reclamation) up to 75% of their contract amounts of Central Valley Project (CVP) water this summer, while more "junior" water contractors in the San Joaquin Valley received 0%. The San Joaquin contractors would like to purchase some of the allocated water from the north and transfer it for their use through the federal Central Valley Project export facilities in the Delta to the south. Reclamation, which co-operates the Delta export facilities with the State Water Project, must notice the transfer under the National Environmental Policy Act (NEPA) as a federal action for public review and comment. Reclamation has provided public notice of the proposed transfers under a Finding of No Significant Impact (FONSI) with a supporting Environmental Assessment (EA).

This document summarizes the major findings of my review of Reclamation's findings specifically as they apply to the effects of the proposed water transfers on Longfin and Delta smelt, two endangered species that reside in the Bay-Delta estuary and who may be adversely affected by the proposed water transfers. The Delta Smelt are only found in the Delta and are at their lowest population level ever recorded. Both smelt populations decline significantly in droughts. Water transfers are a contributing stressor in droughts.

Response
See response to Comment NG05-41.

Comment NG05-54

Comment
The proposed water transfers would be carried out under applicable Delta protections for water quality and fish (and other beneficial users). The main protections are from the Delta Water Quality Control Plan (D-1641 Water Quality Standards), two federal Endangered Species Act biological opinions (one from the National Marine Fisheries Service for salmon, steelhead, and sturgeon; the other from the US Fish and Wildlife Service for Delta Smelt), and a State Endangered Species Act Incidental Take Permit (ITP) for state listed salmon, steelhead, and smelt (Longfin and Delta smelt). The State Water Board modifies the Standards regularly with Orders upon receiving requests from the California Department of Water Resources and concurrence from others. Water transfers are generally exempt under these Orders.

The Delta water quality standards have been modified under recent State Water Board orders to save water supplies in reservoirs that have been depleted during the three years of drought. Delta outflow and salinity standards (required minimal limits) have been relaxed for the summer under recent orders to reduce the release of reservoir water to the Delta normally prescribed to block salt water intrusion from San Francisco Bay. The state and federal resource agencies responsible for protecting the listed endangered species in the Delta have generally concurred with provisions of the orders.

Response
See response to Comment NG05-41.

Comment NG05-55

Comment
Water transfers come in various forms and may conform to the existing water quality standards and biological opinions, or have their own special rules from specific Orders or changes to biological opinions after consultations with agencies. The federal Central Valley Project (Shasta, Folsom, and New Melones reservoirs) and State Water Project (Oroville Reservoir) are the major sources of water transfer water. However, generally water transfers involve the sale of water from one entity to another. A good example is the sale of Yuba County Water Agency water from Bullards Bar Reservoir on the North Fork of the Yuba River to state and federal water contractors. The purchased water (often 50,000 acre-feet per year) is released over the summer down the Yuba River into the Delta for export "on top of" normal state and federal Delta exports under a special set of rules. While normal summer exports are limited to 65% of the freshwater inflow to the Delta, water transfer water released from reservoirs to the Delta may be exported at 100% of the added contribution to Delta inflow. Therein lies the basic problem with water transfers through the Delta.

In the Yuba summer transfer example there is a whole array of actions and potential problems or ramifications. First, water is released from the reservoir for an unintended purpose (not Yuba County irrigation). Storage is lowered. Recreation and future supplies are affected. The Yuba River (and Feather River) is subjected to abnormal flow patterns (good and bad). Extra electricity is generated above that normally allowed under the Yuba Accord. Second, the water enters at the north end of the Delta's tidal bowl and is exported on paper at the south end via the South Delta export pumps. What gets exported is really not Yuba water, but a mix of tidewater habitat with endangered species and their foodweb organisms.

Response
See response to Comment NG05-41.

Comment NG05-56

Comment
Another good example of a water transfer through the Delta is the spring 30-day flow pulse from San Joaquin Valley reservoirs (100-150 thousand acre-feet) under the guise of a "fish flow". Normal rules call for export of only 35% of spring Delta inflow, but this transfer is allowed to export 100% or 1:1. This transfer occurs from mid-April to mid-May with several thousand cfs of water entering the South Delta from the San Joaquin River at Vernalis. The sources of the pulse flow are the Sierra reservoirs on the Stanislaus, Merced, and Tuolumne Rivers.

The problem with transfers is that each is usually small and flies under the radar, but together can have a large cumulative effect that generally is not considered and often ignored. Therefore assessments of transfer effects need consider the individual (local) effects, but more importantly the cumulative effects of the entire array of transfers.

Response
The purpose of this EIS/EIR is to provide an analysis of a range of potential water transfers in combination, as described in Chapter 2, Proposed Action and Description of the Alternative; a cumulative effects analysis of other transfers on aquatic resources is included in Section 3.7.6. Delta outflow would remain the same or increase with the implementation of potential transfer activities evaluated under the Proposed Action. See Common Response 14 and response to Comment NG05-41 for additional information.

Comment NG05-57

Comment
The water transfers proposed by Reclamation are just a subset of the overall transfers proposed this summer. Reclamation's Environmental Assessment covers only proposed federal contractor transfers, and thus does not present sufficient information to assess the true nature and full extent of impacts of all the potential transfers that may occur this summer. Therefore this review is limited only to the specific effects of the proposed federal transfers, with some insights as to the overall effect of all the transfers.

Response
The cumulative impacts analysis provided in Section 3.7.6 includes an assessment of potential additional non-federal transfer activities.

Comment NG05-58

Comment
Under State Water Board orders, export restrictions in the Delta water quality standards would not apply to water transfers. Salinity standards would apply;

however, these standards have been relaxed to accommodate water transfers. A small portion of the transfer water amount entering the Delta may not be exported in order to maintain specific salinity standards. Biological opinion export restrictions only apply through June. Thus to avoid these restrictions, the proposal only applies for the summer (July-September). In summer, exports are restricted to 65% of freshwater inflow, but this limitation does not apply to water transfers between state or federal water contractors. The State Water Board orders restrict exports from the Delta to health and safety needs of no more than 1,500 cfs, with the exception of transfers. "Any exports greater than 1,500 cfs shall be limited to natural or abandoned flows, or transfers. Additionally, DWR and Reclamation, in cooperation with the fishery agencies, will consider transfer requests on an individual basis. The Interagency 2014 Drought Transfers Group will help facilitate the approval of proposed transfers." (Source: http://ca.gov/drought/pdf/2014-Operations-Plan.pdf; page 10.)

Response
See response to Comment NG05-41.

Comment NG05-59

Comment
Young Delta smelt being pelagic (open water residing) are at risk to exports from the South Delta under the regular standards and even more so under relaxed standards. Adding higher exports from the water transfers further adds to the risk. Regular without-relaxation conditions occurred as recently as the beginning of May 2014 and are expected to soon revert to the relaxed standard conditions through the summer. Delta smelt young were observed at both the state and federal south Delta export facilities in early May (Smelt Working Group May 12 meeting notes). The process in which young smelt are vulnerable to export is depicted in Figure 4. Early May exports were higher at 2500 cfs than the 1500 cfs of the May 2 State Board Order, because of the San Joaquin River water transfer. Exports of this magnitude, though only about 20% of capacity, draw water south from the central Delta (see my added yellow arrows in Figure 4) to the export facilities (added red circle). Delta outflow in this case was 4000 cfs (the regular standard), slightly higher than that of the 3000 cfs of the relaxed standard. Freshwater inflow in Figure 4 is depicted by my added blue arrows. (Note: freshwater inflow is net inflow and may represent only a small percentage of the actual tidal flows.) Delta smelt collected in the 20-mm Net Survey6 are depicted in Figure 4 by green dots. I also added the approximate location of the average 2 ppt salinity level (red line), which is very near the prescribed location of the regular water quality standard. Under the relaxed standards, this standard location (Emmaton) would move upstream to Three Mile Slough (the left most blue arrow). Note the relocation comes about by less freshwater flow coming down the Sacramento River channel at Three Mile Slough resulting in higher average salinity. With less westward transport young Delta smelt would be less inclined to move west to relative safety. With

higher exports and more southerly transport, young smelt would be more inclined to move south across the Delta to the export pumps to their demise. Thus Delta smelt are more vulnerable to being drawn toward south Delta exports under the relaxed outflow standard and higher exports allowed under the transfer.

Response
The referenced Figure 4 presents delta smelt distribution between April 28 and May 1. The period for long-term water transfers is July-September, when temperatures warm to prohibitive levels in the Delta and delta smelt migrate westward to cooler temperatures. See pages 3.7-33 through 3.7-37 of the Draft EIS/EIR for further details on temperature and smelt location.

Comment NG05-60

Comment
The young Longfin smelt distribution in the same early May 2014 20-mm Net Survey depicts a different risk pattern with Longfin concentrated further downstream in the Bay (Figure 5) than Delta smelt (Figure 4). Thus the Longfin were less vulnerable to the south Delta exports under these regular water quality standards (4000 cfs outflow and 2 ppt salinity at Emmaton). However, under relaxed standards with lower outflow (3000 cfs) and 2 ppt salinity at Three Mile Slough, Longfin concentrations would likely be further upstream in the central Delta and more vulnerable to exports. Increasing exports with water transfers would thus increase the risk to Longfin smelt albeit a lesser overall risk than that for Delta smelt.

Response
See response to Comment NG05-44.

Comment NG05-61

Comment
To further characterize the risk to smelt, I also looked at the early summer distribution Delta smelt in recent drought years 2009 (Figure 6) and 2013 (Figure 7). In each case outflows were slightly higher than the standards and Delta smelt were concentrated in the west and north Delta. With a change to the relaxed standards, Delta smelt in these two situations would likely shift with the 2 ppt salinity line (solid red line) upstream to a new location (dotted red line) where Delta smelt would be at much higher risk to south Delta exports. Indeed, Delta smelt were observed in south Delta export fish-salvage collections in all three periods with the normal standards, low-outflow, low-export conditions (Figures 8, 9, and 10).

Response
See response to Comment NG05-60.

Comment NG05-62

Comment

While Reclamation has not requested water transfers to occur under normal (non-relaxed) standards, under the Orders water transfers could be conducted in this manner. Such a situation may arise if higher abandoned flows from rainstorms increase reservoir storage or Delta inflows and thus provide for (allow) exports higher than 1500 cfs. In which case, water transfers would occur as they have in past years. With the addition of transfers, the risks to smelt would increase as exports would increase under the same outflow. Delta outflow requirements would be 4000 cfs or higher, plus the added exports would increase risk as they occur under the transfer rule of 100% of inflow compared to the normal export rule of 65% exports/inflows. It is my opinion that the added risk to Delta smelt from transfers is lower the higher the total exports, because the relative proportion of the transfers declines with increasing exports. Thus, the relative effect of transfers is higher under low exports because the transfers represent a higher relative proportion of the inflows and exports. The risk can be amplified if the federal contractor transfers represent only a portion of the potential transfers being proposed this summer.

Response

Model outputs indicate that conveyance through both the state and federal facilities for the range of potential transfer activities under the Proposed Action would not be higher than existing conditions in any water years or months other than the transfer period (during dry and critical years from July through September). Opportunistic flow increases from rainstorms are not likely to occur during these months, and the effects to delta smelt from increasing pumping for water transfers are analyzed in Section 3.7 of the EIS/EIR.

Comment NG05-63

Comment

To assess the potential risk to Delta smelt of adding summer transfers under relaxed standards I looked at the distribution of Delta smelt in these same surveys from the beginning of summer in recent drought years 2009 and 2013 to ascertain the potential risk to the Delta smelt from increased exports from transfers. It is my opinion that the risk to Delta smelt from transfers is greater under the new relaxed standards. As stated above, the relaxation of outflow from 4000 cfs to 3000 cfs moves the concentrations of Delta and Longfin smelt further to the east where they are more likely to be drawn to the south Delta exports. Adding 15-25% to Delta exports from the water transfers under these low-outflow, low-export conditions adds significantly to the risk. Smelt would be more likely to enter the north-to-south, cross-Delta flow-transport stream to the south Delta exports. It is for this reason that the summer export standard to protect all beneficial uses is 65% of Delta inflows. Allowing water transfers to occur at or very near 100% ignores this basic premise for protecting the beneficial uses including smelt, other fish, and their habitat-foodweb resources.

If the federal contractor transfers represent only a portion of the potential transfers being proposed this summer, then the risk to Longfin and Delta smelt from higher transfer amounts would be even greater.

Response
The potential transfer activities analyzed under the Proposed Action would occur in water years and months in which smelt would not be present in the Delta due to high water temperatures. Further, Delta outflow would not be reduced in any month, and X2 would be the same or lower (which would be beneficial to smelt). Therefore, delta smelt would not be at higher risk of entrainment due to the potential transfer activities. See response to Comment NG05-41 and the explanation on pages 3.7-33 through 3.7-38 for additional information.

Comment NG05-64

Comment
Opinion on Question 1: Water transfers this summer under normal or relaxed water quality standards would significantly increase the risk to smelt residing in the Delta to being drawn into the south Delta and exported (lost) at the federal and state export facilities.

Response
See response to Comment NG05-63.

Comment NG05-65

Comment
Opinion on Question 2: Water transfers will increase the export of low salinity pelagic habitat; and degrade remaining habitat through increase water temperatures, reduced foodweb productivity, and lower turbidity in smelt nursery areas (from higher river inflows of water transfers); which would reduce growth and survival of Longfin and Delta smelt.

Response
See responses to Comments NG05-44 and NG05-63.

Comment NG05-66

Comment
Opinion on Question 3: The Delta smelt and Longfin smelt populations are at or near record low index levels. Any further stressors such as higher exports from water transfers on the population would significantly increase the already high risk of extinction. The Bay-Delta population of Longfin smelt risk of extinction though less than that of Delta smelt is also higher because the relaxed standards will shift their population upstream from the relative safety of Suisun Bay into the West and Central Delta where the effects of added transfers will be significantly higher.

Response
See response to Comment NG05-63.

Comment NG05-67

Comment
Opinion on Question 4: Water transfers under normal D-1641 standards and under normal dry year conditions with low Delta inflows, low Delta outflows, and low exports pose a significant risk to smelt because transfers have a higher proportional effect on the conditions. Under 1:1 criteria, transfers increase inflow and exports proportionally over outflow, which increases the risk to smelt.

Response
See response to Comment NG05-63.

Comment NG05-68

Comment
Opinion on Question 5: Water transfers in dry year conditions under relaxed D-1641 standards water quality standards would significantly increase the risk to smelt over that under the normal water standards. With even less outflow and a LSZ being further upstream and well into the cross-Delta flow of export water, transfers pose a much greater risk to the smelt

Response
See response to Comment NG05-63.

Comment NG05-69

Comment
(1) The EA for the 2014 North to South Water Transfers does not present sufficient information to assess the true nature and extent of impacts that water transfers may have on Longfin and Delta smelt. Specifically, the EA does not address the added risk from the changes to the water quality standards requested by Reclamation and approved by the State Water Board.

Response
The EA was completed in 2014 and is not included or incorporated by reference in this EIS/EIR. Section 3.7 of the EIS/EIR evaluates effects to fisheries.

Comment NG05-70

Comment
(2) With or without the relaxation of the water quality standards, the transfers are likely to have a significant adverse effect on Longfin and Delta smelt through increased direct loss of young smelt to south Delta exports and indirect

loss from degradation of smelt critical habitat by higher water temperatures, lower turbidity, and reduced foodweb productivity.

Response
See responses to Comments NG05-44 and NG05-63.

Comment NG05-71

Comment
(3) State Board Orders and the April 18 Drought Plan call for changes in Delta water quality standards (D-1641) that increase already high risks to the Bay-Delta ecosystem including Longfin and Delta smelt. Adding water transfers under relaxed standards will add significantly to already high risks.

(3.1) Relaxed outflow standards in summer (reduced outflow from 4000 cfs to 3000 cfs) will reduce the amount of low-salinity habitat in the Delta critical to Longfin and Delta smelt (two listed species that reside primarily in the low salinity zone in late spring and summer), and reduce migration cues for smelt that must pass through the Delta to their fall-winter nursery areas in upper San Francisco Bay. In addition to the decline in area of the low salinity zone, the low salinity zone will be located further upstream (to the east) in the Central and Northern Delta which will result in poor water quality (high water temperatures that may reach lethal levels for smelt, and higher concentration of chemicals including ammonia and pesticides potentially lethal to smelt and their food organisms). Further deterioration of the low salinity zone would occur from higher water temperatures, lower turbidity, and poor Delta foodweb production, as well as the potential upstream expansion of invasive non-native Bay clams. Lower turbidity will reduce smelt growth and survival, and lead to increased predation by nonnative fish species on native fish species including smelt. In July there would be no protection for smelt and other pelagic Bay-Delta fish species and their plankton food supply from planned Delta exports that include water transfers. The overall effects will result in potentially dramatic changes to the Bay-Delta endangered fish populations that will last for decades to come.

(3.2) The proposed change in the lower Sacramento agricultural water quality standard from Emmaton to Three Mile Slough (necessary under the relaxed lower Delta outflow) will raise Delta salinities and allow further reductions in Delta outflows to the detriment of smelt, salmon, and steelhead. Salinity at Emmaton and Rio Vista in the lower Sacramento River will more than double (EC will go from 2 to 5 millimhos at EMM). Salinity in water exported from the south Delta including transfer water will also be higher with relaxed standards.

Response
The relaxed standards in 2014 were the result of a unique hydrologic condition. The purpose of this EIS/EIR is to analyze the potential future impacts of the action alternatives. Relaxation of standards is not likely to occur on a regular

basis, and would occur only under extreme conditions. The EIS/EIR is analyzing the potential of the action alternatives to reduce Delta water quality beyond the No Action/No Project Alternative. The action alternatives would not affect the CVP and SWP's ability to meet water quality standards in the Delta (or reduced standards in the Delta) because the transfers would be operated with carriage water expressly to maintain the water quality. Additionally, water transfers would increase Delta outflow during the July through September transfer window, which could help alleviate the commenter's concerns about low outflows during extreme dry conditions.

Comment NG05-72

Comment
(4) Only federal Central Valley Project water transfers were included in the Environmental Assessment. Significant other transfers are possible this summer, thus no adequate cumulative effects assessment was conducted by Reclamation.

Response
See Chapter 4 and Section 3.7.6, Cumulative Effects for a description of other reasonably foreseeable transfers anticipated during the period of analysis in the EIS/EIR.

Comment NG05-73

Comment
"Special status species would not be affected by the Proposed Action beyond those impacts considered by the BOs and current consultations with NMFS and USFWS." Neither biological opinion prescribes protection for covered species during the summer. However, both opinions recognize existing water quality standards (mainly 65% export/inflow and Delta salinity standards) as valid protections. (e.g., USFWS BO, pages 29, 128)

Response
Because neither delta smelt nor longfin smelt would be present in the area of influence of the export facilities during the transfer period and neither Delta outflow or X2 position would change, the potential range of transfer activities under the action alternatives would not affect these species. See pages 3.7-33 through 3.7-38 of the Draft EIS/EIR for further explanation.

Comment NG05-74

Comment
"Special status fish species are generally not in the Delta during the transfer period (July-September)." Longfin and Delta smelt both will reside in the Delta under the relaxed water quality standards as they do in most drought years.

Nearly the entire Delta smelt population will reside within the Delta this summer with or without the approved changes to the water quality standards.

Response
See response to Comment NG05-73.

Comment NG05-75

Comment
"Effects to these fish species from transferring water during this timeframe were considered in the NMFS and USFWS BOs." While water transfers up to 600,000 acre-feet were considered in the BOs, such water transfers were assumed to occur under existing water quality standards, not under the specific relaxed standards of: 3000 cfs outflow; and ag-salinity standard moved 2.5 miles upstream from Emmaton to Three Mile Slough.

Response
See responses to Comments NG05-18 and NG05-71.

Comment NG05-76

Comment
"Transfers would slightly increase inflow into the Delta, but would not change outflow conditions compared to the No-Action Alternative." Delta outflow would be controlled by new relaxed standard of 3000 cfs. Delta inflows from the Sacramento River would increase when Sacramento Valley contractors do not divert their allocated water and instead allow it to pass through to the Delta for export.

Response
Section 3.2 evaluates Delta outflow effects on water quality. See responses to Comments NG05-18 and NG05-71.

Comment NG05-77

Comment
"The incremental effects of transfers on special status fish species in the Delta from water transfers would be less than significant." The incremental effect of transfers will be significant, especially under the conditions expected with relaxed standards.

Response
See responses to comments NG05-18 and NG05-71.

Comment NG05-78

Comment
“The Proposed Action will not result in cumulative impacts to any resources previously described.” The cumulative effect of all transfers would likely have serious consequences to the smelt populations incrementally above that of the relaxed standards. The Proposed Action being one of the potentially larger transfers would have one of the greatest incremental effects.

Response
The cumulative impacts analysis is presented in Section 3.7.6. For the reasons stated in that section, the incremental contribution of the range of potential transfer activities analyzed in the EIS/EIR would not be cumulatively considerable and cumulative impacts would be less than significant. See responses to comments NG05-18 and NG05-71 for additional information about why the Proposed Action would not have cumulatively considerable impacts. See Common Response 14 for additional information.

Comment Letter NG06, Robyn Difalco, Carol Perkins, Butte Environmental Council, Citizens of Water Watch of Northern California, Butte-Sutter Basin Area Groundwater Users

Comment NG06-1

Comment
Butte Environmental Council (BEC) and the undersigned groups and individuals submit the following comments concerning Long---Term Water Transfers. The comments focus on the legal issues surrounding groundwater substitution water transfers and the technical deficiencies found within Section 3.3 and Appendix D of the EIS/R. Concerned citizens of the northern Sacramento Valley recognize that it is long past the time needed to realize the limitations and variability of our natural water supply. We must learn to live within the confines of that system and stop the exploitation of groundwater and strive to improve protections of this critical, fail-safe source of life.

BEC’s policy statement regarding water identifies our concerns for Northern Sacramento Valley water resources. Specifically, we believe that citizens should have control over local resources; that Northern California’s watersheds must be protected for future generations; and that its ground and surface water must not be exported out of the area to address misuse, waste, and over-allocation elsewhere in California. The undersigned groups and individuals submit these comments holding to one conviction:

The EIS/R should be withdrawn from public circulation until the issues listed herein can be adequately addressed.

Response
Section 3.3 of the EIS/EIR contains a detailed and extensive analysis of potential impacts of the action alternatives to groundwater resources. The analysis found the potential for significant effects to groundwater levels and subsidence; however, Section 3.3 also includes Mitigation Measure GW-1 to avoid and reduce these significant effects. See Common Responses 6 and 7 for additional information.

Comment NG06-2

Comment
A leading-edge organization for hydrogeologists and groundwater professionals recently posted an opinion on the declining groundwater conditions across the state.

Thirty-six alluvial groundwater basins that have a high degree of groundwater use and reliance may possess greater potential to incur water shortages as a result of drought. The basins exist in the North Coast, Central Coast, Sacramento River, Tulare Lake, and South Coast hydrologic regions (Groundwater Resources Association of California, Hydrovisions Summer 2014).

Response
Section 3.3 describes the affected environment for groundwater resources in the area of analysis and also evaluates effects to groundwater resources as a result of the proposed alternatives, including the Proposed Action.

Comment NG06-3

Comment
This EIS/R is inadequate and lacks clarity concerning findings of “no injury to other legal users of the water involved” and “no unreasonable effects on fish and wildlife.” Many of the inhabitants of the northern Sacramento Valley are solely dependent on and are “legal users of water” from the underlying strata, and varying and often disparate aquifer systems of the Sacramento Valley groundwater basin.

Californians have approved millions in bond funding since 2000 for projects that should help her citizens develop and implement strategies to improve water quality, availability, and affordability. These funds should be allocated and spent prior to the development of any project for which the sole objective is focused on ‘supplemental water.’ California’s water supply is over allocated – the very nature of that adjective means that there exists no supplemental water for anyone or anything.

Response
Potential effects to water users of the "underlying strata" are assessed in Section 3.3, Groundwater Resources. The groundwater analysis includes a modeling effort with multiple tools to simulate potential effects to groundwater levels, groundwater quality, and subsidence. Part of the purpose and need for this effort is to provide immediate water supplies to users that are experiencing shortages, so waiting until bond funding is fully expended would not meet the purpose and need. See also Common Response 3 for additional discussion specific to the Sacramento Valley.

Comment NG06-4

Comment
The LTWT EIS/R is contrary to laws encompassing NEPA, CEQA and California Water Code.

The EIS/R should be withdrawn and rewritten to reflect a programmatic EIS/R: The very act of invoking Sec 1745.1 of the California Water Code necessitates a programmatic EIS/R. The document must follow NEPA guidelines for length and tiering as well as detailing the plan for the development and delivery of project level EIS/R(s).

NEPA regulation 40 CFR 1502.7 declares that the text of an EIS for "proposals of unusual scope or complexity shall normally be less than 300 pages." It is impossible for organizations interested in thoughtfully responding to the LTWTP documents to be staffed for a thorough NEPA/CEQA review based on the unreasonable size of the released documentation.

NEPA 40 CFR 6.200(f) To eliminate duplication and to foster efficiency, the Responsible Official should use tiering (see 40 CFR 1502.20 and 1508.28) and incorporate material by reference (see 40 CFR 1502.21) as appropriate.

Response
The California Water Code does not specify that a program-level environmental document is required. The range of potential activities analyzed under the Proposed Action does result in an EIS/EIR that is longer than 300 pages, but it includes many analyses requested by commenters during the scoping period. See Common Response 14.

Comment NG06-5

Comment
Associated tiered documentation must be included and show that transfers are consistent with applicable Groundwater Management Plans (GMPs) or, in the absence of a GMP, the transferring water supplier can show a transfer will not create, or contribute to, conditions of long-term overdraft in the groundwater basin

Response
Section 3.3.1.2.3 has been revised to include all pertinent groundwater substitution transfers related ordinances and GMP's within the area of analysis (i.e. area underlying substitution pumping).Section 3.3 evaluates long-term effects to groundwater levels and Mitigation Measures GW-1 sets forth monitoring and mitigation measures to avoid potentially significant effects to groundwater resources within the area of analysis. See Common Response 6 for additional information.

Comment NG06-6

Comment
Groundwater substitution transfers are illegal if sourced from most Sacramento Valley groundwater basins Section 1220 of the California Water Code states that groundwater cannot be exported from these basins unless pumping complies with a GMP. It is inadequate to simply list associated GMPs in a table (Table 3.3-1); each GMP listed must be included with the EIS/R documentation set and clearly show approval 'by vote from all counties that lie within' the Sacramento Valley groundwater basin.

"states that groundwater cannot be exported from these basins unless pumping complies with a GMP, adopted by the county board of supervisors in collaboration with affected water districts, and approved by a vote from the counties that lie within the basin. (EIS/R p. 3.3-5)"

Response
California Water Code 1220 prohibits direct export of groundwater from within the Sacramento and Delta-Central Sierra Basins. The project does not propose direct export of groundwater. Groundwater substitution transfers occur when sellers choose to pump groundwater in lieu of diverting surface water supplies, thereby making the surface water available for transfer.

Section 3.3.1.2.3 has been revised to include all pertinent groundwater substitution transfers related ordinances and GMP's within the area of analysis (i.e. area underlying substitution pumping). Groundwater Substitution Transfers discussed in the EIS/EIR will comply with all county ordinances listed in Section 3.3.1.2.

Comment NG06-7

Comment
According to the CVPIA Section 3405(a), the following principles must be satisfied for any transfer:

(1) Transfer will be limited to water that would be consumptively used or irretrievably lost to beneficial use;

(2) Transfer will not have significant long-term adverse impact on groundwater conditions; and

(3) Transfer will not adversely affect water supplies for fish and wildlife purposes.

Groundwater substitution transfers do not qualify under the intent of the first item. Groundwater substitution transfers involve foregoing the use of surface water and pumping groundwater. But this requires use of a water source that was not or would not be consumptively used given access to surface water rights. Nor is groundwater available that was irretrievably lost to beneficial use. Neither the natural recharge of groundwater nor the ‘deep percolation’ of excess from applied irrigation water has been defined in California water law as water irretrievably lost to a beneficial use. This first limitation provides no water under groundwater substitution transfers by intent of the law.

Response
Groundwater substitution transfers the sellers' surface water that would have been consumptively used absent the transfer; therefore, these actions meet this provision of the CVPIA. Additional discussion regarding the CVPIA is provided in Section 1.3.1.1 of the EIS/EIR.

Comment NG06-8

Comment
The EIS/R does not provide any defining characteristics of significant long-term adverse impacts to groundwater conditions and fails to adequately identify the current groundwater conditions of the Sacramento Valley. As such, it is impossible for decision makers to decide if impacts might occur from LTWT and to separate from impacts occurring presently.

Response
Significant impacts to groundwater resources analyzed in Section 3.3 (and additional details in Section 3.3.2.2) are impacts that would (1) result in substantial adverse environmental effects or effects to non-transferring parties; (2) cause permanent land subsidence; or (3) degrade groundwater quality such that it would exceed regulatory standards.

Current groundwater conditions within the area of analysis are discussed in Section 3.3.1.3; see Common Response 4. Section 3.3.2.4 describes impacts from the Proposed Action.

The significance criteria for Section 3.3 were clarified to indicate that effects to the environment or non-transferring parties must be substantial to be characterized as significant. This change was made to be consistent with CEQA guidelines, which indicates that a substantial change to a resource leads to a significant impact. This change does not affect the findings of significance in the groundwater analysis, but rather clarifies that those findings of significance are based on a substantial change.

Comment NG06-9

Comment
The EIS/R fails to quantify the interactions between groundwater and surface water, which is known to be a controversial and difficult process. Lacking an understanding of this set of mechanisms leaves public agencies without the proper tools to assess the adverse affects to water supplies for fish and wildlife purposes under current groundwater usage. Increasing groundwater pumping under the climatic stresses of dry and critically dry water years should be unlawful.

Response
The EIS/EIR estimates the groundwater and surface water interaction using the SACFEM2013 groundwater model (see Appendix B) and the Transfer Operations Model (see Appendix D). The linked models estimate the increased recharge to the groundwater aquifer associated with groundwater substitution transfers, and how that recharge could affect stream flows. The model results feed into analyses in multiple sections of the EIS/EIR. Section 3.1.2 analyzes the impacts to water supply associated with the interaction between surface water and groundwater. Section 3.7 assesses potential impacts to fisheries from altered stream flows, and Section 3.8 analyzes potential impacts to riparian vegetation.

Comment NG06-10

Comment
The project description has changed and the EIS/R fails to make this clear. What was stated during and subsequent to the scoping process are in fact no longer correct. It is understood where the 600,000 acre-feet originates. It is the same value that the Bay Delta conservation Plan promotes. What is not clear is why the May 2011 Scoping Report states an entirely different value than documented within this EIS/R.

Commenters were concerned that transfers may include up to 600,000 acre-feet of water annually; however, this EIS/EIR will include a much smaller transfer volume approximately 100,000 to 150,000 acre-feet). [Long-Term Water Transfers: Scoping Report. BOR & SLDMWA. May 2011.]

Response
The Scoping Report described that transfers were limited to an upper limit of 600,000 acre-feet, but would likely involve a much smaller annual volume of 100,000 to 150,000 acre-feet. The Draft EIS/EIR analyzes an upper limit of 511,000 acre-feet, but also explains in Sections 2.3.2.2, 2.3.2.5, and 2.3.2.6 that transfers in a given year would likely be substantially less than this upper limit.

Comment NG06-11

Comment
Federal regulation 40 CFR 1501.1 requires early NEPA integration into planning process prior to the preparation of the EIS emphasizing cooperative consultation among agencies.

(b) Emphasizing cooperative consultation among agencies before the environmental impact statement is prepared rather than submission of adversary comments on a completed document.

Response
Reclamation worked to satisfy these requirements by reaching out to agencies and potentially affected parties through the scoping process and meetings on the Draft EIS/EIR. On December 28, 2010, Reclamation published a Notice of Intent in the Federal Register, and on January 5, 2011, a Notice of Preparation was published with the California State Clearinghouse. These documents started the public scoping process, which is designed to solicit feedback from agencies and potentially affected parties. Public scoping meetings were held between January 11 and 13, 2011 in the cities of Chico, Sacramento, and Los Banos, California. Reclamation and SLDMWA prepared the "Long-Term Water Transfers EIS/EIR Public Scoping Report" (dated May 2011), which summarized the comments and concerns raised during the meetings as well as written comments obtained during the public scoping period.

Comment NG06-12

Comment
Either the Bureau has failed to develop an understanding of the hydrologic system of the northern Sacramento Valley and has abused the mandates of NEPA (40 CFR 1501.1(b)); or the California Department of Water Resources, as a responsible agency to LTWT, is complicit in covering the adverse hydrologic conditions existing in the Sacramento Valley present day.

Response
See Common Response 4.

Comment NG06-13

Comment
Cumulative impact analysis fails to take into consideration all programs present and future: Sec. 1.7 of the EIS/R lists issues of known controversy, yet the cumulative impacts to Water Supply, Water Quality and Groundwater Resources are missing many critical projects and list projects that will not increase dependence on groundwater resources.

The cumulative effects analysis must include all water transfers and programs that result in additional groundwater pumping in the Sacramento region. (EIS/R p. 1-19)

Glenn-Colusa Irrigation District Groundwater Supplemental Supply Project; DWR Future Water Supply Project; and the Bay Delta Conservation Plan currently use groundwater and will increase the exploitation of groundwater supplies from the Sacramento Valley.

Response

The cumulative analysis considers activities expected to be implemented during the timeframe of the range of potential transfer activities evaluated in this EIS/EIR, which is from 2015 to 2024. The BDCP would not be implemented in this timeframe and is not considered in the cumulative analysis. The Glenn Colusa Irrigation District Groundwater Supplemental Supply Project has been added to the cumulative analysis. It is unclear what the DWR Future Water Supply Project is. DWR is working on multiple water storage projects with Reclamation that will not be complete within the timeframe of analysis for the range of potential transfer activities evaluated in the EIS/EIR.

Comment NG06-14

Comment

The purpose and need behind this project is nebulous and imprecise: Facilitating water transfers from willing sellers upstream of the Delta to points south of the Delta are illegal, wasteful, and unnecessary; and do not of themselves define a reasonable purpose for a project.

The purpose of the Proposed Action is to facilitate and approve voluntary water transfers from willing sellers upstream of the Delta… (EIS/R p. 1-2) Water users all over California have a need for immediately implementable and flexible solutions to water supply problems. These problems include shortages from inappropriate allocation of natural supplies; the risks inherent in living in a Mediterranean climate; and poorly envisioned projects that have left behind a wake of environmental destruction and have decimated surface and groundwater supplies.

Water users have the need for immediately implementable and flexible supplemental water supplies to alleviate shortages. (EIS/R p. 1-2) No project should be allowed that focuses on the ‘needs’ of a few. This seems to be the antithesis of the purposes of NEPA and CEQA, which are set in place to ensure protection of the environment and benefit to the public. There would be no need for a project if California were to mandate that we live within the means of our natural water supply. The timing and place of water flow has been significantly altered, to the detriment of the environment, throughout California from the construction of dams and canals and use of rivers as modified canals. These countless acts have in turn created a limitation on our water supply. The placement and slowing of water in unnatural environments at unnatural times has resulted in water quickly evaporating or percolating to replenish overdrafted groundwater or both.

Response
See response to Comment LA02-4.

Comment NG06-15

Comment
The following issues render this EIS/R incomplete; inadequate to mandated findings of "no injury to other legal users" and "no unreasonable effects on fish and wildlife" under NEPA and CEQA; and misleading: these issues preclude meaningful public review.

The EIS/R should be withdrawn from public circulation until the issues listed here can be adequately addressed.

1. The Sacramento Valley groundwater basin is inadequately characterized to assess findings of significance under NEPA and CEQA.

2. Well logs included in the EIS/R depict only very shallow aquifers of the region.

3. EIS/R fails to adequately describe the existing hydrologic conditions of the Sacramento Valley.

4. The selection process for a 'reasonable' range of alternatives is biased.

5. Mitigation methods are inadequate to address the significant impacts resulting from project alternatives.

Response
The issues cited in the comment were addressed in the Draft EIS/EIR or have been updated in the Final EIS/EIR. Additional information describing the groundwater basin has been added to Section 3.3 in response to comments; however, this information does not change the characterization of the basin or the impact descriptions. See Common Response 4 regarding existing hydrologic conditions. The alternative selection process is based on the purpose and need and project objectives, and is documented in detail in Appendix A. Commenters did not suggest new alternatives not considered in the Draft EIS/EIR that would reduce the environmental effects of the action alternatives. Mitigation Measures WS-1, GW-1, AQ-1, and AQ-2 have been clarified in response to comments. See Common Responses 6, 7, 8, and 10 for additional information. These revisions do not trigger the criteria for recirculation set forth in CEQA Guidelines section 15088.5, and recirculation is not necessary.

Comment NG06-16

Comment
BEC incorporates by reference within these comments those of several other correspondents regarding the LTWT.

Response
In accordance with CEQA, the Final EIS/EIR provides written responses to all comments received.

Comment NG06-17

Comment

1. The Sacramento Valley groundwater basin is inadequately characterized to assess findings of significance under NEPA and CEQA for the LTWT EIS/R.

The EIS/R inaccurately and detrimentally characterizes the Sacramento Valley as a large, contiguous, and homogenous groundwater basin that extends from a boundary just north of Red Bluff south to the Cosumnes River. The description of depth to base of fresh water essentially paints the aquifer system as one large alluvial-illed 'bathtub.' Inconsistencies exist throughout the EIS/R that understates the complex nature of the aquifer systems that exist within the basin boundaries of the Sacramento Valley. And, statements such as follows, solidify the intention of this document to misrepresent the groundwater system of the Sacramento Valley (see further discussion of this under Issue 3. below).

Figure 3.3-8 and Figure 3.3-9 show the location and groundwater elevation of select monitoring wells that portray the local groundwater elevations within the Sacramento Valley Groundwater Basin. (EIS/R p. 3.3.-22)

The EIS/R fails to provide adequate discussions concerning the unique surface hydrology, geologic and hydrogeologic characteristics of the subbasins found within the Sacramento Valley. For example, there exists no mention of the confining layers and varying stratigraphy created under differing formation periods and depositional environments of the Tuscan Formation. The data and analyses incorporated in the EIS/R are cherry-picked, providing a 30,000-foot view of the basin and fails to provide a rigorous definition of the environment and groundwater conditions of the valley today. This oversight results in a suspect analysis. The process of revealing or exposing only what is favorable to the Lead Agencies shrouds the methodology of the EIS/R, leaving the public and other agencies inadequate tools to assess the results.

Response
Section 3.3.1.3.2, Geology, Hydrogeology, and Hydrology does not describe the fresh-water bearing formation within the Sacramento Valley as a homogenous and contiguous basin. Figures 3.3-8 and 3.3-9 in Public Draft EIS/EIR (revised

to Figures 3.3-8 a, b, and c in the Final EIS/EIR) have been clarified to show more monitoring well locations. See Common Response 4 for additional information.

Comment NG06-18

Comment

2. Selected well logs included in the EIS/R depict only the very shallow aquifers of the region. Inclusion of this data simply shrouds reality, weakening any credence the associated assessment and analysis may have established with this effort.

The six (6) monitoring wells selected to "portray" local groundwater elevations within the northern Sacramento Valley groundwater basin are all very shallow. The average depth to water below ground surface (bgs) ranges between 5″ and 45″ bgs. While the historical low of any of the wells never exceeded 100″ bgs. These wells do not represent the groundwater elevations nor does the discussion surrounding the hydrographs represent groundwater conditions currently found throughout the northern Sacramento Valley.

Shallow wells shown in the EIS/R may show an endemic decline from underlying aquifers "recovering" water and a long-evolving change in groundwater storage capacity. In the case of confined aquifers, "recovery" might be dewatering the confining layers. Recharge and recovery are not the same hydrologic mechanisms and differ in the ability to ascertain the health of a groundwater production zone. Recovery of groundwater levels in a production zone is not indicative of a balanced aquifer system.

Response

See Common Response 4. Additional groundwater contour maps for the deep, shallow, and intermediate zones have also been included in Section 3.3 and Appendix L.

Comment NG06-19

Comment

Figure 1 shows a significant decline and little recovery that occurred during the summer of 2007. The City of Chico maintains a very steady draw from their groundwater production wells. These hydrographs depict a stress that has altered the efficacy and perhaps the storage capacity of the production zone that these monitoring wells represent. The questions this EIS/R fails to addressed are considerable. What caused this irreversible change in the groundwater source? What affects does this impact have on the quality of the water sourced from this production zone? What affects will this have on the Central Plume? How many other instances of similar significance have occurred throughout the Sacramento Valley groundwater basin? To what extent will similar impacts occur under the pumping proposed through the LTWT throughout the Sacramento Valley groundwater basin?

{See comment letter for Figure 1: Monitoring wells of the Central Plume for intermediate and deep aquifer zones.}

Response
There would be no transfers pumping near the City of Chico. The nearest substitution pumping well is located approximately 10 miles from Chico city limits. Impacts analyzed in Section 3.3.2.4 (See Figures 3.3-28 through 3.3.-33) indicate no drawdown from the Proposed Action would be incurred near the City of Chico.

The affected environment section has been revised to clarify decreasing groundwater level trends noticed across the Sacramento Valley due to current hydrologic conditions. Figure 3.3-10 (renamed as Figure 3.3-14(a)) and new Figure 3.3.-14 (b) show the cumulative change in storage as simulated by CVHM and C2VSim models respectively. Though the conclusions drawn by CVHM and C2VSim differ with respect to simulated storage capacity in the San Joaquin Valley, both models indicate storage capacities in the Sacramento Valley have remained steady since the 1920s.

Impacts to groundwater levels and groundwater quality due to groundwater substitution pumping under the proposed action were evaluated in Section 3.3.2.4.

Comment NG06-20

Comment
3. EIS/R fails to adequately describe the existing hydrologic conditions of the Sacramento Valley. Modeling lacks appropriate boundary conditions and fails to evaluate stresses given current and a best assessment of future conditions.

Use of the SACFEM2013 model to simulate stresses on regional surface and subsurface hydrology due to additional groundwater pumping over baseline from groundwater substitution transfers was a useless analysis of the past. Baseline conditions are not delineated and it is unclear if they represent the modeling period or the proposed period for transfers. It is necessary to model impacts under the most accurate assumptions of the hydrologic conditions surrounding the transfer period to understand and mitigate for the most likely range of stresses. The assessment process fails to do just that.

Standard methods of study for groundwater basins are not easily applied to the Sacramento Valley. Standard assumptions cannot account for the hydrogeologic complexity, such as anisotropy, associated with the stratigraphy and range of geologic materials present in the Tuscan, Mehrten and Tehama formations. Numerical groundwater models are intended to help shed light on the possible range of responses a system might exhibit over space and time given predictable changes in stresses. They should not be used to support decisions that may jeopardize the long-term sustainability of water resources of the northern Sacramento Valley.

Response
See response to Comment SA03-7.

Comment NG06-21

Comment
The following statements from the EIS/R show the vagueness surrounding results of the modeling and analyses. The known or estimated impacts are not clearly quantified or defined making it impossible for public officials to assess potential impacts to their jurisdictions. Specifically, terms like long-term recovery and short- term declines must be defined and quantified for every legal user of water supplies sourced above and below the surface.

…most of the recovery near the pumping zone occurs in the year after the transfer event. Groundwater levels return to approximately 75 percent of the baseline level five years after the single year transfer event in WY 1981 and between 50-75 percent six years after the multi-year transfer event… (EIS/R p. 3.3-70)

…the maximum groundwater level declines resulting from substitution transfers within the Sacramento Valley Groundwater Basin range widely depending on the distance from the transfer groundwater pumping.

Seasonal groundwater level declines would be greater than the typical fluctuation when substitution pumping is included, indicating the potential for adverse effects. (EIS/R p. 3.3-81)

The EIS/R fails to define and quantify the following terms: seasonal groundwater level declines and typical fluctuation (there is nothing typical in the changes experienced presently in this valley, see the decadal groundwater elevation changes in Fig. 2.{See comment letter for Figure 2}). What are the “baselines” for the supporting modeling and analyses behind this EIS/R? Were these “baselines” established under climatic and hydrologic conditions of nearly a half century ago?

Response
Long-term refers to trends that are exhibited over a period of several years or more. Short-term trends are on the order of one year or less. The recovery percentages mentioned in this comment were developed from review of the hydrograph figures in Section 3.3 showing the difference in groundwater levels between the no action and proposed action alternatives. The groundwater level

change contour figures in Section 3.3 show the spatial distribution of the change varies with location: the farther from the pumping well, the less the predicted change in groundwater level. Seasonal groundwater level changes involve a wide variety of factors including rainfall, wetting of streams, and irrigation pumping. The hydrograph figures in Section 3.3 show the typical seasonal changes in groundwater water (i.e., within a year). These changes can be reviewed for years when transfers occur and when they do not. Figure 3.3-27 shows the years when groundwater substitution pumping is simulated. The baseline condition is a transient model simulation without transfer pumping as simulated in the SACFEM2013 model. Appendix D provides additional information on the SACFEM2013 model, and Appendix M includes the SACFEM2013 User's Manual.

Comment NG06-22

Comment

The potential for adverse drawdown effects would increase as the amount of extracted water increased. The potential for adverse effects would be higher during dry years, when baseline fluctuations would already be large and groundwater levels would likely be lower than normal. (EIS/R p. 3.3-81)

The EIS/R fails to define and quantify the adverse drawdown effects. What are the differences in stresses to the entire system under dry and critically dry years? It is disingenuous to document, in a time when wells are going dry across the Sacramento Valley, that reduction in well yields is the greatest concern the modeling and analyses behind this EIS/R has uncovered.

Response

Figure 3.3-27 shows the years when groundwater substitution pumping was simulated in the numerical models. The pumping occurred during dry and critical years. The timing of this pumping can be correlated to the hydrograph Figures 3.3-34 through 3.3-38 and in Appendix E. It is important to note that the rate of aquifer recovery following a groundwater substitution transfer is dependent on the hydrology of the period following the transfer. Wetter trailing periods will cause a faster recovery than a drier trailing period. The simulation of six consecutive transfer years (1987 through 1992) is provided to simulate transfer occurring during a longer-term dry period.

Comment NG06-23

Comment

4. The selection process for a 'reasonable' range of alternatives is biased.

It appears that alternatives were studied only from the perspective of benefits to water supply and not to the full intent of NEPA and CEQA. The process is unreasonably biased toward the narrow interests of the lead agency SLDMWA and does not adequately protect the region from which the water will be produced. The EIS/R must show substantial treatment, that is rigorous exploration and objective evaluation, of all alternatives.

Metrics used to evaluate alternatives and establish a purpose and need for this project are biased and lack objective criteria (Table 2-1, p. 2-4). Meeting the intent of the CVPIA mandates, such as retiring lands would better serve the entire state and would provide immediate and long-term benefits. All Californians are in need of flexibility in the water supply system during dry or critically dry years. Those of us dependent on groundwater should not fear the extraction of their resource for sale by willing sellers during a time when its use will increase.

Flexibility is not a reasonable or fair metric. There are many other projects the Bureau and SLDMWA can develop to secure the water necessary to meet the needs of the region that are based on hydrologic reality of that region.

Robbing one region of their primary source of water to provide another region with additional water is not a reasonable or fair metric to evaluate alternatives in the context that has been established through this project. For example, Agricultural Conservation in the seller service area somehow meets all three---evaluation metrics while Ag conservation in the buyer service region does not.

Immediate: the term proposed for this EIS/EIR is 2015 through 2024. This period is relatively short, and measures need to be able to provide some measurable benefit within this time period.

Flexible: project participants need water in some years, but not in others. They need measures that have the flexibility to be used only when needed.

Provide Substantial Water: project participants need measures that have the capability of providing additional water to regions that are experiencing shortages. (EIS/R p. ES-7; 2-3; 2-4; and 4-1)

Response
See response to Comment SA02-1. Flexibility and providing water are included as metrics because they represent the purpose and need and project objectives for undertaking the project. In addition, the Lead Agencies considered whether alternatives could minimize environmental effects of the proposed action before identifying alternatives to carry forward for more detailed analysis (as described in Section 2.2.2).

Comment NG06-24

Comment
5. Mitigation methods are inadequate to address the significant impacts resulting from project alternatives.

A 'reasonable range' of alternatives was limited by a poorly defined purpose and the screaming bias inherent in the charters of the Lead Agencies'. Environmental impacts and consequences were inappropriately analyzed and lack a fair cumulative analysis. The baseline conditions were not identified or assessed or are nonsense and the existing or known projects dependent on increasing the exploitation of the Sacramento Valley groundwater basin were not included. The EIS/R fails to adequately define the resources that might be impacted: stream flow depletions; irrecoverable groundwater losses; subsidence; and water quality changes in surface and the subsurface. The EIS/R fails to provide a clear line of reasoning in its conclusions related to the direct, indirect, and cumulative impacts. The EIS/R fails to adequately mitigate for potential or known impacts from the project alternatives on the physical, natural, and socioeconomic environment of the region.

Response

In response to comments, information elaborating on the description of the affected environment has been included in the Final EIS/EIR (when available). Similarly, some commenters suggested specific topics that could be strengthened within the mitigation measures. These comments led to clarifying edits to Mitigation Measures WS-1, GW-1, AQ-1, and AQ-2. See Common Responses 6, 7, 8, and 10 for additional information.

Comment NG06-25

Comment

NEPA requires that mitigation involve:

§ 1508.20 Mitigation. Mitigation includes: (a) Avoiding the impact altogether by not taking a certain action or parts of an action. (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation. (c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment. (d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action. (e) Compensating for the impact by replacing or providing substitute resources or environments.

Groundwater substitution transfers could decrease flows in neighboring surface water bodies and alter existing subsurface hydrology resulting in a variety of effects to groundwater levels, land subsidence, and groundwater quality. The EIS/R indicates repeatedly that groundwater basins require an unknown amount of time to recharge following a transfer.

The reductions in CVP and SWP supplies are not complete within one year, but can extend over multiple years as the groundwater aquifer refills. (EIS/R p. 3.1-17)

a. Streamflow deletion: Applying a Streamflow Depletion Factor is not a mitigation method (SW-1). It simply and often erroneously identifies how

> much surface water might be lost due to groundwater pumping. It is a method of charging willing sellers for water the state owns (stream flow) that is assumed to be lost to groundwater pumping. According to Trevor Joseph, DWR, streamflow depletion factors are controversial and little understood with regard to surface and groundwater interactions and the time delays associated with "additional pumping."

Response
As described in Section 3.1.2.4.1, the effects of streamflow depletion on water supplies are uncertain, and are largely dependent on the hydrologic conditions after a transfer (which are unknown when the transfer is negotiated). Mitigation Measure WS-1 is the best available method to mitigate the potentially significant impacts of the alternatives to water supplies as a result of surface water-groundwater interactions. Mitigation Measure WS-1 is not attempting to address all possible impacts associated with surface and groundwater interaction; instead, it focuses solely on the potentially significant effects to SWP and CVP supplies associated with this interaction. The potential effects to other environmental resources are analyzed in Sections 3.3, Groundwater; 3.7, Fisheries; and 3.8, Vegetation and Wildlife. See Common Response 8 for additional information.

Comment NG06-26

Comment
Dependence on GMPs to reduce the significance of impacts as a result of groundwater substitution water transfers is not an adequate mitigation method (GW---1). In 2014, DWR and the California Water Foundation performed separate studies to assess the current state of groundwater management planning in California. Both organizations found GMPs lacking mandated components necessary to promote good groundwater management practices and monitor groundwater levels. DWR found plans that include all California Water Code requirements cover just 17% of the groundwater basins defined in Bulletin 118.

Response
See Common Response 6.

Comment NG06-27

Comment
Subsidence: The potential for serious impacts due to subsidence are clearly defined by DWR's latest report (Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California, CA Department of Water Resources, October 2014). The fact that this report is not referenced is problematic, shedding more light on the egregious analytical shortcomings of this EIS/R.

Groundwater extraction for groundwater substitution transfers would decrease groundwater levels, increasing the potential for subsidence. Most areas of the Sacramento Valley Groundwater Basin have not experienced land subsidence that has caused impacts to the overlying land. (EIS/R p. 3.3-82)

Response
This document was not available in time to add data to the Draft EIS/EIR. In response to this comment, figures and data from DWR's Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California have been included in Section 3.3.

Comment NG06-28

Comment
Water quality: The environmental assessment surrounding the LTWT completely ignores groundwater quality issues. There are numerous plumes throughout the Sacramento Valley for which the Department of Toxic Substance Control has oversight.

Response
Section 3.3.1.3 has been revised to include GeoTracker Clean Up Site information.

Comment NG06-29

Comment
The EIS/R should be withdrawn from public circulation; and The EIS/R should be modified to: Reflect the elements and requirements of a programmatic EIS/R, strictly adhering to page limitations and tiering of appropriate project level environmental documentation; and Reflect a legally appropriate lead agency, such as a group of agencies, including SLDMWA and the counties that overlie the DWR Bulletin 118 groundwater basins and confined (deeper) aquifers from which groundwater substitution transfers may occur, organized into a cooperative effort by contract, joint exercise of powers, or similar device.

Response
See Common Response 1 and response to Comment NG03-8.

Comment Letter NG07, Jeffrey Volberg, California Waterfowl

Comment NG07-1

Comment
The California Waterfowl Association is a statewide nonprofit organization whose principal objective is the conservation of the state's waterfowl, wetlands, and hunting heritage. California Waterfowl believes hunters have been the most important force in conserving waterfowl and wetlands. California Waterfowl biologists are leading experts on designing, operating, and maintaining managed

wetlands throughout California, including the Sacramento/San Joaquin River Delta and the Suisun Marsh.

Since 1945, California Waterfowl has been active in creating and maintaining managed wetlands habitat for migratory waterfowl, including ducks and geese. Because of the loss of 95 percent of the historical wetlands in California, the remaining wetlands, two-thirds of which are in private ownership, have to be intensively managed to provide the optimum habitat value for migratory waterfowl. While not listed under the state or federal endangered species acts, migratory waterfowl are protected by legislation or treaty, including the North American Wetlands Conservation Act (NACWA) and the international Migratory Bird Treaty.

The state and federal government and private landowners such as farmers and duck clubs have invested millions of dollars in managed wetland for the primary benefit of migratory waterfowl. These managed wetlands also benefit a variety of other bird species, as well as reptiles, fish, and mammals. They use natural and artificial water flows to flood wetlands, and then use developed infrastructure to hold and drain floodwaters as appropriate to provide flood resources and suitable seasonal habitat.

California Waterfowl has reviewed the Draft EIS/EIR on proposed long-term water transfers. As proposed in the current drafts, long-term water transfers could have significant and unavoidable impacts on wetland and waterfowl resources in the Sacramento and San Joaquin. Section 3.8 of Chapter 3 discusses environmental impacts to terrestrial resources from the water transfers. California Waterfowl's main concern is with the natural communities and agricultural habitats in the sellers' service area identified in Section 3.8.1.3.1. California Waterfowl is primarily interested in impacts arising from Alternative 2, 3 and 4.

In California Waterfowl's estimation, the greatest impacts to migratory waterfowl would result from cropland idling and shifting transfers, as discussed in Section 3.8.2.1.2. Migratory waterfowl depend heavily for food resources on the post-harvest and winter flooding of rice fields for decomposition of rice stubble. Section 3.8.2.1.2 correctly identifies the impacts of cropland idling and shifting transfers on migratory waterfowl. The idling of cropland and the shifting of water will deprive waterfowl of food resources and habitat. However, as also pointed out at the top of page 3.8-35, fallowing of fields provides an opportunity to develop nesting habitat.

Response

Section 3.8 presents a comprehensive analysis of potential impacts to biological resources, including waterfowl, and concludes that all impacts would be less than significant or, in the case of groundwater substitution reducing stream flows that support natural communities in some small streams, would be less than significant with mitigation. Contrary to the allegation in the comment, there would be no significant and unavoidable impacts on wetland and waterfowl resources in the Sacramento and San Joaquin River delta. See Common Response 13 for additional discussion.

Comment NG07-2

Comment
California Waterfowl was the sponsor of a bill in the state Legislature that declares it is the policy of the state to encourage the planting of dry cover crops on fallowed fields for the purpose of providing nesting habitat for local, resident birds, such as mallards. SB 749 (Wolk - Chapter 387, Statutes of 2013) requires the Department of Water Resources to provide guidelines to landowners on how to create and maintain nesting cover for resident waterfowl and other birds on fallowed lands. The EIS/EIR should include a requirement of this type of affirmative action to mitigate for the loss of habitat from fallowed fields.

Response
Related to water transfers, SB 749 states landowners shall be encouraged to cultivate or retain non-irrigated cover crops or natural vegetation to provide waterfowl, upland game bird, and other wildlife habitat, provided that all other water transfer requirements are met. New text has been added to Section 2.3.2.1, regarding potential water transfer methods, to describe the habitat benefit of allowing dry cover crops on idled fields.

Comment Letter NG08, Chelsea Tu, Center for Biological Diversity

Comment NG08-1

Comment
The Center for Biological Diversity is a national nonprofit organization with nearly 158,000 members and activists in California who are dedicated to the protection of endangered species and wild places. The Center has worked to protect and restore endangered species and their habitats in the Sacramento River and San Joaquin River watersheds since the late 1990s.

The proposes water transfers would export water from the Sacramento and San Joaquin Regions to the Bay Area and Central Valley from 2015-2024 (project). The Project would occur through methods including reservoir releases, groundwater substitution, and crop idling/shifting. These water transfers would drain both surface and groundwater resource from the Sacramento River and San Joaquin River watersheds (Exporting Areas), imposing significant and irreversible threats to the sensitive species that rely on these water resources and associated aquatic and riparian habitats to survive. However, the DEIS/EIR fails to establish an adequate baseline by which to assess Project impacts, fails to adopt an acceptable methodology for accurately determining existing conditions and potential Project impacts, and fails to sufficiently assess or provide adequate measures to minimize or mitigate the impacts on sensitive species and their habitats within the Exporting Areas.

Response

The EIS/EIR established an adequate baseline as described in the Affected Environment/Environmental Setting sections of the document. The Lead Agencies and the expert preparers of the EIS/EIR applied accepted methods to analyze impacts and evaluated impacts consistent with appropriate significance criteria sections. When necessary, and when impacts were potentially significant, mitigation measures were included to avoid or substantially lessen impacts to a less-than-significant level.

Comment NG08-2

Comment

The DEIS/EIR concludes that reservoir release will have less than significant impacts on natural communities and special-status species since they would not reduce reservoir storage in Export Areas by more than 10% during normal to wet water years. (DEIR/EIR, at 3.8-47). In particular, the DEIS/EIR concludes that, with the exception of Bear River, reservoir releases from the Project under the Proposed Action would reduce surface water flows by less than 10% and therefore less than significant levels in the Sacramento River watershed. (DEIS/EIR, at 3.8-49) The 10% threshold of significance appears arbitrary since it does not correspond with the significance criteria established, and doe not refer to other sections of the DEIS/EIR. (DEIS/EIR, at 3.8-49) Additionally, the DEIS/EIR unreasonably assumes there would be sufficient surface water flows within the Exporting Areas for the 10% drawdown during drought periods.

Response

The significance criteria are based on the CEQA Guidelines, which provide that a significant impact would occur if it would "cause a substantial reduction in the size or distribution of any natural community." Substantial is not defined in the CEQA guidelines, but in this case reductions in reservoir storage of less than 10 percent are not expected to result in a substantial reduction in natural communities because reductions at this level would be within the normal range of operations for the reservoirs. Further, several reservoir operators are also obligated to protect natural resources within the reservoirs and in the downstream rivers. Surface water flows within rivers are also expected to fall within historical ranges and therefore are not expected to result in a substantial reduction in the size or distribution of a natural community.

Comment NG08-3

Comment

The DEIR/EIS also lacks historic flows data on twenty-one smaller rivers that would be impacted by the Project. (DEIR/EIS, ay 3.8-51) Therefore the DEIS/EIR fails to provide sufficient information regarding existing conditions in order to establish an adequate baseline for assessing impacts. Consequently, the DEIR/EIS cannot accurately assess potential Project impacts or provide mitigation measures without first establishing a baseline of existing conditions from which to analyze.

Response
The analysis disclosed there is limited data available for these streams. These streams have a small amount of flow and are not typically gauged (hence the lack of data for the streams), but reductions in groundwater would indicate that in-stream flows could be affected. The analysis concluded that while there may be effects on these streams, any potentially significant effects would be avoided with implementation of Mitigation Measure GW-1.

Comment NG08-4

Comment
The DEIS/EIR also estimates that since the Project would reduce surface water flow and Delta outflow but therefore would have no significant biological impacts. (DEIR/EIS, at 3.8-62; 3.7-12) However, the DEIR/EIS provides inadequate data to support these conclusions. The Project will likely result in significant impacts to listed fish species including Chinook salmon and Central Valley steelhead, green and white sturgeon, and Delta and longfin smelt. For instance, the DEIR/EIS states that water transfers could alter stream flow and temperature in the upper Sacramento River. (DEIR/EIS, at 3.7-12) Yet the DEIS/EIR concludes that the Project would not result in significant effect on this and other species based simply on the 10% flow reduction criteria (DEIS/EIR, at 3.7-25)

Response
The EIS/EIR used the 10 percent (and 1 cfs in smaller streams) flow reduction criteria as initial screening criteria to determine whether a stream needed further evaluation of biological impacts. Refer to Section 3.7.2.1 for more information on the scientific reasoning behind the use of these criteria. See response to Comment NG10-28 for additional information. In the case of reservoir storage affecting instream flows and, therefore, winter-run Chinook salmon spawning or rearing habitat, the analysis found no effect to mean monthly instream flows in the Sacramento River by water year type using the 10 percent criterion. Therefore, it concludes that this habitat would not be affected.

Comment NG08-5

Comment
Additionally, the DEIR/EIS admits that the Project would reduce reservoir waters by 18.2% during critically dry years in August and September. (Id.) These drawdown estimates during critically dry years such as this year are unacceptable since there will unlikely be sufficient water for the Project to operate without depleting the entire reservoir storage during drought periods.

The DEIR/EIS is thus misleading by claiming that reduction in reservoir storage would be less than significant over all, while downplaying the fact that drawdown during critically dry years like this one would be significant and likely infeasible.

Response
The reference to a decrease of 18.2 percent refers to a reduction in the overall surface area of the reservoir, not the volume of water held in the reservoir.

The cited changes in reservoir levels are related to reservoir release transfers, where water that would have stayed in storage could be transferred. This type of transfer is only applicable if the water would have stayed in storage during the transfer year, and this type of transfer may not be available in every year. A change in reservoir storage in transfer years would not affect downstream flows or supplies because this water would have stayed in storage absent a transfer and would not have contributed to downstream flows and supplies. After the transfer, as the reservoir refills, downstream flows could be decreased. As stated in Section 2.3.2.1, transfers related to stored reservoir releases would include refill agreements to limit refill to wet periods and therefore would not significantly impact downstream water users.

Comment NG08-6

Comment
First, the data that the DEIR/EIS relies on to assess groundwater substitution impacts on stream water is severely outdated. The impacts of groundwater substitution transfer on steam water depletion was calculated based on data on water export availability in the Region from 1970 to 2003 (DEIS/EIR, at 3.8-38) This method fails to include data that reflect reduced exports based on current water realities or regulatory constraints including the 2008 and 2009 biological opinions. Thus the DEIR/EIR fails to establish an adequate baseline by which to assess Project impacts.

Response
See Common Response 5.

Comment NG08-7

Comment
Similarly, criteria that the DEIS/EIR adopts to evaluate groundwater substitution impacts on surface waterways are also flawed. DEIR/EIS dismisses small waterways near modeled groundwater transfer areas as not warranting further modeling if water flow for these small waterways will be reduced by 1 cubic-foot per second or 10% since "the effect was considered too small to have a substantial effect on terrestrial species." (DEIR/EIS, at 3.8-38). This appears to be an arbitrary threshold of significance for evaluating impacts on small waterways since it does not correspond with significance criteria on 3.8-43 and

the DEIR/EIS does not refer to other sections of the document for support. (DEIR/EIS, at 3.8-43). The DEIR/EIS also fails to discuss how groundwater substitution would affect aquatic species in small waterways. A 1 cubic-foot per second reduction in water flow could affect both aquatic and terrestrial species especially in drought periods.

The Project would increase groundwater pumping for irrigation in the Exporting Areas to substitute surface water that would be exported, which the DEIR/EIS states could result in a reduction in a level of groundwater in the vicinity of pumps (DEIR/EIS, at 3.8-31).

However, the DEIR concludes that groundwater drawdown from increased will be less than significant since groundwater modeling results indicate that shallow groundwater is typically deeper than 15 feet in most locations under existing conditions and not associated with groundwater-dependent ecosystems. Even if species such the valley oak rely on deeper groundwater, the DEIR/EIS states groundwater drawdown impacts to these species to be minimal by asserting that "these species have further adapted to California's Mediterranean climate of wet winters and hot dry summers." (DEIR/EIS, at 3.8-32) The DEIR/EIS concludes that groundwater drawdown under the Proposed Action would have less than significant impacts on natural communities and special-status plants. (DEIS/EIR, at 3.8-47) The only justification the DEIR/EIS affords in reaching this conclusion is that "Plants within these communities would be able to adjust to the small reductions in groundwater levels because the drawdown is expected to occur slowly through the growing season, allowing plants to adjust their root growth to accommodate the change." (Id.) These assertions are not supported in the DEIR/EIS.

Response

Additional analysis of small waterways is unnecessary because changes in flow are expected to be within the normal range of annual fluctuation of these waterways. Some waterways are ephemeral and are subject to a wide range of flow conditions dependent on annual hydrology, and others are part of a managed system that also results in variation in flows. Groundwater substitution impacts on surface waterways are generally expected to be within this annual variation. Notwithstanding, Mitigation Measure GW-1 is proposed as an additional precaution to avoid potential significant impacts. See Common Responses 6, 7, and 10 for additional information. Aquatic species in small waterways are not expected to be affected for the same reason. Overall, the vegetation along these waterways are adapted to this fluctuation and to the temporal nature of water in these waterways.

Comment NG08-8

Comment

The DEIR/EIS further dismisses the negative impacts of groundwater drawdown that would result from the Project on riparian ecosystems, stating that “Because of the interaction of surface flows and groundwater flows in riparian systems, including associated wetlands, enables faster recharge of groundwater, these systems are less likely to be impacted by groundwater drawdown as a result of the action alternatives.” (Id.) This statement ignores the fact that Exporting Areas will take a double hit of reduce surface and groundwater resources. The DEIR/EIS also inappropriately assumes that there would be sufficient surface waters would to recharge groundwater, ignoring that this is not the case during drought periods. In addition, surface and groundwater resources in the Sacramento region are highly interconnected. (Howard 2010.) Therefore any drawdown of surface water or groundwater would very likely impact the level of the other. Given the Exporting Area’s high surface and groundwater connectivity the DEIR/EIS fails to accurately address the likelihood that reducing surface water flow will reduce groundwater recharge potential in the area.

Response
See response to Comment NG01-33.

Comment NG08-9

Comment
The DEIR/EIS would require implementing entities to adopt monitoring program and mitigation plans to alleviate impacts from groundwater substitution transfers. (DEIR/EIS, at 3.3-88 to 3.3-91). However, these measures are inadequate to minimize and mitigate the significant impacts that would result from groundwater drawdown since they do not provide sufficient information for decision-makers or the public to be able to ascertain whether they would be effective or enforceable. In particular, the DEIR/EIS fails to require monitoring and reviewing the impacts groundwater pumping on connected surface waters and groundwater-dependent ecosystems. Furthermore, the DEIR/EIS inappropriately defers the responsibility for developing specific mitigation plans as well as criteria for significance to each individual seller. (DEIR, at 3.3-90.)

Response
Mitigation measure GW-1 states that a monitoring and mitigation plan will be developed as part of the groundwater substitution transfer proposal. The concept and process for these plans is based on DWR's "Draft Technical Information for Preparing Waters Transfer Proposals." Each monitoring and mitigation plan will be customized for the local conditions surrounding the potential seller. Local conditions make it difficult to pre-define the required monitoring and mitigation efforts specific to each seller. The monitoring and measurement of potential impacts to changes in surface water-groundwater interaction and groundwater-dependent ecosystems is difficult to measure on a real-time basis during groundwater substitution pumping. Mitigation measure GW-1 is being implemented to provide a quicker assessment of potential changes in groundwater levels due to groundwater substitution transfers.

Changes in groundwater levels would be manifest sooner than a resulting change in groundwater-surface water interaction or ecosystem health. See Common Responses 6, 7, and 10 for additional information.

Comment NG08-10

Comment
Finally, the DEIR/EIS fail to and should be revised to address how it would comply with existing groundwater management plans in the Exporting Areas as well as the statewide groundwater legislation that will be in effect beginning January 1, 2015.

Response
Section 3.3.1.2.3 has been revised to include all pertinent groundwater substitution transfers related ordinances and GMP's within the area of analysis (i.e. area underlying substitution pumping).Summaries of the Sustainable Groundwater Management Act (Senate Bill 1168, Assembly Bill 1739, and Senate Bill 1319) have been included in Section 3.3.1.2.2.

Comment NG08-11

Comment
The Proposed Action would allow idling/shifting of 8,500 acres of upland cropland and 51,473 acres of seasonally flooded agriculture. (DEIR/EIS, at 3.8-63 and 3.8-64.) The DEIR/EIS recognizes that cropland idling/crop shifting would potentially affect some wildlife species that depend on cropland for foraging and/or depend on habitat associated with cropland and managed agricultural lands, as well as downstream habitat dependent upon agricultural flow returns. (DEIR/EIS, at 3.8-33.)

However, the DEIR/EIS states without support that "bird species that would be potentially affected by idling of upland crops would be capable of dispersing to other areas or other non-idled parcels." (Id.) The DEIR/EIS unreasonably assumes that migratory birds will still be able to find adequate food in years when upland crops are fallowed for transfers. However, in drought years, birds are already stressed by lack of food availability. Additionally, the DEIR/EIS itself recognizes yet fails to take into account that birds with limited distribution and specific breeding and foraging requirements including the greater sandhill crane and black tern will not adapt to crop idling/shifting. (DEIR/EIS, at 3.8-26 to3.8-27.)

Response
With respect to the black tern and its inability to adapt to cropland idling/shifting, Shuford's 2001 study states that the approximately 400,000 to 500,000 acres of rice planted annually in the Sacramento Valley may far exceed the average amount of shallow natural water habitat historically available for nesting terns before rice agriculture. Today black terns are heavily dependent

on flooded rice fields for nesting. However, during the extensive black tern surveys conducted in 1997 throughout the Sacramento Valley, approximately 1,987 pairs were estimated to be nesting in rice fields at a time when only 75 percent of rice fields were planted due to El Nino (Shuford 2001). Therefore, a reduction of up to 10.5 percent in rice cultivation is not likely to have a significant effect on nesting black terns. With respect to sandhill cranes, water transfers will be limited near known wintering areas in the Butte Sink and will be avoided near refuges, which support more than 50 percent and up to 70 percent of the Central Valley greater sandhill wintering population during October and November (Pogson and Lindstedt 1991). This measure has been refined to minimize crop idling in known wintering areas that support high concentrations of waterfowl and shorebirds, such as wildlife refuges and wildlife areas known to support sandhill cranes. See Common Response 10.

Comment NG08-12

Comment

The DEIR/EIS also admits that crop idling/shifting could contribute to habitat fragmentation by preventing species or moving between areas. (DEIR, at 3.8-35.) The DEIR/EIS acknowledges that the “distribution of these water year types within the action period is unknown. Additionally, the exact locations of cropland idling/shifting actions would not be known until the spring of each year, when water acquisition decisions are made.” (DEIR/EIS, at 3.8-35.) The DEIR/EIS does not have or provide sufficient information regarding where/when crop idling/shifting will take place, and therefore cannot calculate the potential for habitat reduction and fragmentation will result from crop idling/shifting activities. Yet the DEIR/EIS concludes that “because crop rotation and idling are standard practices, species that reside in agricultural areas adjust to these types of activities.” (Id.) This statement is not supported by fact and contrary to the DEIR/EIS’ previous statements regarding recognizing habitat fragmentation as a threat to species survival. (DEIR/EIS, at 3.8-33 to 3.8-35.)

Response

The Draft EIS/EIR identifies on page 3.8-35 that habitat fragmentation could be a potential effect of cropland idling/shifting and that habitat fragmentation can have a significant negative impact on wildlife. However, these are general statements about cropland idling and habitat fragmentation and are not specific to implementation of the range of potential transfer activities analyzed in the EIS/EIR. Cropland idling/shifting under the action alternatives would occur in addition to standard farming practices (EIS/EIR, page 3.8-35). This statement is not intended to dismiss effects but only to provide information related to existing conditions, which will factor into the effects analysis for each alternative as further described under Section 3.8.2.4. The purpose of Section 3.8.2.1 (pages 3.8-33 to 3.8-35) is to describe how effects on wildlife were evaluated (i.e., qualitatively based on the potential amounts and frequency of cropland idled).

Comment NG08-13

Comment
The DEIR/EIS provides that upland crop idling/shifting would not impact migratory bird populations since there are other areas to forage and species will adapt by looking for other forage areas. (DEIR/EIS, at 3.8-63.) As discussed above, the DEIR/EIS does not adequately address the significant adverse impacts that would result from these activities. The DEIR/EIS also does not provide any measures to mitigate these impacts. Instead, the DEIR/EIS simply states that “cropland idling decisions would be made early in the year before the general breeding season of most birds that have the potential to occur in the area of analysis,” without providing further detail on if or how these decisions would reduce impacts to bird species (DEIR, 3.8-63.)

The DEIR/EIS provides that proposed environmental commitments would reduce potential impacts to seasonally flooded cropland idling/shifting to less than significant by ensuring canals bordering rice parcels continue to carry water even when adjacent parcels are idled. (DEIR/EIS, at 3.8-65, 3.8-67.) The DEIR/EIS assumes that watered canals provide sufficient habitat for bird species, and fails to explain how these canals would sufficiently make up for the nearly 51,500 acres of habitat for migratory birds and other birds including the tri-colored blackbird, western pond turtle, giant garter snake, and other protected and sensitive species that would be lost due to fallowing the rice parcels.

This Project will only worsen those existing conditions under the drought, and inadequate mitigation is proposed to mitigate the significant resulting impacts to migratory birds and other species that currently rely on agricultural lands for survival.

Response
See Common Response 12 for a discussion of giant garter snake and Common Response 13 for a discussion of migratory birds. Regarding the commenter's allegation that the Draft EIS/EIR assumes watered canals provide sufficient habitat for birds and other protected species, that statement is incorrect and unsubstantiated. Maintaining watered canals within idled rice fields minimizes impacts from habitat fragmentation by maintaining dispersal habitat for species such as pond turtle and giant garter snake, and providing some resting and foraging areas for birds.

Comment NG08-14

Comment
Thank you for the opportunity to submit comments on this proposed Project. We look forward to working to assure that the Project and environmental review conforms to the requirements of state and federal law and to assure that all significant impacts to the environment are fully analyzed, mitigated or avoided.

In light of many significant, unavoidable environmental impacts that will result from the Project, we strongly urge the Project not be approved in its current form. Please do not hesitate to contact the Center with any questions at the number listed below. We look forward to reviewing the U.S. Bureau of Reclamation’s responses to these comments in the Final EIR/EIS for this Project once it has been completed.

Response
See Common Response 2.

Comment Letter NG09, Rachel Zwillinger, Defenders of Wildlife

Comment NG09-1

Comment
I have a quick question about the Long-Term Water Transfers Draft EIS-EIR. Section 6.2.3 of the draft states that "Reclamation will submit a Biological Assessment for USFWS review under Section 7 of the Federal Endangered Species Act." Will there be a single biological opinion that covers all of the transfers that are analyzed in the Draft EIS-EIR? And do you have any sense of when the Section 7 analysis will occur?

Response
The biological opinion (BO) will cover those actions that have potential to result in “a take” of a federally listed species. Section 7 consultation was initiated with USFWS on October 7, 2014 and the biological assessment (BA) was submitted on November 4, 2014. Development of the BO will occur within approximately 135 days after the BA is considered complete. Reclamation expects there will be a single biological opinion for the transfers.

Comment Letter NG10, Rachel Zwillinger, Defenders of Wildlife

Comment NG10-1

Comment
On behalf of Defenders of Wildlife, which has approximately 1,200,000 supporters and members, 180,000 of whom are Californians, we are writing to provide comments on the Long-Term Water Transfers Draft Environmental Impact Statement/Environmental Impact Report ("Draft"). We are sympathetic to the fact that management decisions involving water transfers need to occur quickly, and believe that an Environmental Impact Statement ("EIS")/Environmental Impact Report ("EIR") covering an extended time period could be beneficial. However, the Draft suffers from several fundamental flaws that undermine its ability to provide information regarding the environmental impacts of the proposed long-term water transfers, and that render the document legally inadequate.

First, the Draft includes several "environmental commitments" intended to avoid significant impacts that could be caused by crop idling transfers. These commitments, however, are inadequate to protect the threatened giant garter snake and bird species that depend upon agricultural lands in the project area. Because significant environmental impacts will remain after implementation of the proposed commitments, we have suggested additional environmental commitments that should be included either as part of the project description, or as mitigation measures. Second, the Draft entirely fails to analyze the proposed water transfers' impacts on waterfowl, shorebirds, and south of Delta refuges, although the impacts to these public trust resources could be profound. Third, the Draft uses an arbitrary and not biologically-based screening threshold to avoid analyzing the impacts that flow reductions caused by the proposed transfers could have on fisheries and sensitive terrestrial species. The Draft also fails to account for climate change impacts in its operational modeling, does not consider an adequate range of alternatives, and fails to include foreseeable projects in its cumulative impacts analysis.

Response
This introductory comment includes multiple points that are addressed in more detail in subsequent comments; the detailed responses are included with the subsequent comments.

Comment NG10-2

Comment
These deficiencies and the others that we describe below are so substantial that we believe the Bureau of Reclamation ("Reclamation") and the San Luis & Delta-Mendota Water Authority ("SLDMWA") should issue a revised draft EIS/EIR for the proposed long-term water transfers. Remedying the problems in the current Draft will require modifications to the proposed action and significant new analysis, and the public and the project proponents would benefit from another round of review before the document is finalized. On the pages that follow, we discuss the problems with the Draft in greater detail, and provide suggestions for how the deficiencies should be addressed in a revised draft EIS/EIR.

Response
See response to Comment LA14-5.

Comment NG10-3

Comment
I. The Draft Fails to Adequately Analyze Impacts to Wildlife from Crop Idling Transfers, and Fails to Prescribe Required Mitigation. The National Environmental Policy Act ("NEPA") has "twin aims. First, it places upon [a federal] agency the obligation to consider every significant aspect of the environmental impact of a proposed action. Second, it ensures that the agency

will inform the public that it has indeed considered environmental concerns in its decision making process." Baltimore Gas & Elec. Co. v. Natural Res. De! Council, Inc., 462 U.S. 87, 97 (1983) (citation and internal quotation marks omitted). To achieve these goals, "[a]n EIS must include a comprehensive discussion of all substantial environmental impacts and inform the public of any reasonable alternatives which could avoid or minimize these adverse impacts." High Sierra Hikers Ass 'n v. Us. Dep't of Interior, 848 F. Supp. 2d 1036, 1048-1049 (N.D. Cal. 2012) (citing 40 C.F.R. § 1502.1). NEPA "emphasizes the importance of coherent and comprehensive up-front environmental analysis to ensure informed decision making to the end that the agency will not act on incomplete information, only to regret its decision after it is too late to correct." Blue Mts. Biodiversity Project v. Blackwood, 161 F.3d 1208, 1216 (9th Cir. 1998) (quotation marks and citation omitted).

Similarly, the California Environmental Quality Act ("CEQA") is intended to inform decision makers and the public about the potentially significant environmental effects of proposed projects. See, e.g., 14 Cal. Code Regs. § 15002. To this end, an EIR "shall include a detailed statement setting forth ... [a]ll significant effects on the environment of the proposed project" (Cal. Pub. Res. Code § 21100), and "must present information in such a manner that the foreseeable impacts of pursuing the project can actually be understood and weighed." Vineyard Area Citizens for Responsible Growth, Inc. v. City of Ranch 0 Cordova, 40 Cal. 4th 412,450 (2007). If a significant effect on the environment is identified, an EIR is required to include provisions to avoid or mitigate the significant effect. Cal. Pub. Res. Code § 21081. Mitigation must be "fully enforceable through permit conditions, agreements, or other measures," (id. § 21081.6 (b)) and there must be a reporting or monitoring program to ensure that the mitigation measures are implemented (id. § 21081.6 (a)). "The purpose of these requirements is to ensure that feasible mitigation measures will actually be implemented as a condition of development, and not merely adopted and then neglected or disregarded." Cal. Clean Energy Comm. v. City of Woodland, 225 Cal. App. 4th 173, 189 (2014) (citation omitted).

Response
Potential impacts on wildlife are analyzed in Section 3.8.2.4.3 of the Draft EIS/EIR. See Common Response 10.

Comment NG10-4

Comment
A. The Environmental Commitments are Insufficient to Avoid Significant Impacts to Wildlife from Crop Idling Transfers and Additional Mitigation is Required. The proposed action includes several "environmental commitments," which are intended to "avoid potential environmental impacts from water transfers." Draft EIS/EIR at 2-29. These environmental commitments are critical to the Draft's conclusion that the proposed action will not have a significant impact on special status plant and animal species. For

example, the Draft concludes that significant impacts to the following species from crop idling transfers will be avoided, in whole or in part, by implementation of the environmental commitments: giant garter snake (id. at 3.8-70); Pacific pond turtle (id. at 3.8-71 to 3.8-72); greater sandhill crane (id. At 3.8-76); long-billed curlew (id. at 3.8-76); tricolored blackbird (id. at 3.8-77); white-faced ibis (id. at 3.8-78); purple martin (id. at 3.8-79); yellow-headed blackbird [Footnote: We assume that the discussion of the purple martin in the section titled "Yellow-Headed Blackbird" was an error, and that the Draft intended to refer to the yellow-headed blackbird.] (id. at 3.8-79 to 3.8-80); special status plant species (id. at 3.8-67); and special status bird species (id. at 3.8-74,3.8-80).

However, as we explain below, these critically important environmental commitments are inadequate to avoid significant impacts to the species listed above, including the giant garter snake and sensitive birds. Because the impacts from crop idling transfers remain significant after implementation of the environmental commitments, CEQA requires that the action agencies identify additional mitigation measures that, if implemented, would reduce the impacts of the project to below the significance threshold. See Cal. Pub. Res. Code § 21081. In the sections that follow, we explain why the environmental commitments are inadequate to ameliorate significant impacts from crop idling transfers, and suggest additional mitigation measures that, if implemented, would help the agencies comply with legally-required mitigation obligations.

1. The Environmental Commitments Do Not Adequately Protect Giant Garter Snakes. The giant garter snake is listed as threated under both the Federal Endangered Species Act and California Endangered Species Act. See Draft EIS/EIR at 3.8-23. The snake "primarily occurs in areas with dense networks of canals among rice agriculture and wetlands," and has been observed within the Sacramento Valley portion of the Seller Service Area. Id. at 3.8-23 to 3.8-24. The Draft acknowledges that giant garter snakes may be substantially impacted by crop idling transfers. For example, it states that "[a]ny level of cropland idling/shifting would reduce the availability of stable wetland areas during a particular transfer year and may reduce suitable giant garter snake foraging habitat and increase the risk of predation on individual giant garter snakes." Id. at 3.8-69. Yet the Draft concludes that the proposed action would have a less than significant impact on the giant garter snake "because a relatively small proportion (no more than 10.5 percent) of the rice acreage would be affected in any given year and the Environmental Commitments would avoid or reduce many of the potential impacts associated with this activity and the displacement of giant garter snake that could result." Id. at 3.8-70.

The Draft's reliance on the purportedly small amount of rice acreage that would be idled under the proposed action is completely unsupported. The Draft provides no analysis of the population-level impact of a 10.5 percent reduction in habitat. Further, the long-term transfers will occur primarily in dry years, when rice acreage is already substantially reduced. See id. at 1-2 (project purpose and need indicating that transfers will occur during dry years); 3.8-69 (acknowledging that planted rice acreage is reduced by drought conditions). The California Rice Commission, for example, has reported that about 140,000 acres of rice, which amounts to 25 percent of last year's crop, went unplanted this year because of water shortfalls. [Footnote: See, e.g., http://www.capitalpress.com/Californial20141021/rice-growers-wrap-up-drought-diminished-harvest.] A 10.5 percent reduction in suitable habitat on top of already reduced rice acreage is substantial, and the Draft cannot assert that such a reduction is insignificant without biological analysis.

Response

The commentor is incorrect in the statement that biological resources impacts from crop idling transfers remain significant after implementation of the environmental commitments, thereby requiring additional mitigation. Based on the analysis presented in Section 3.8, as supported by substantial evidence provided therewith, impacts associated with cropland idling/shifting under the Proposed Action would be less than significant (see Table 3.8-10). That conclusion takes into account the environmental commitments related to biological resources. See also Common Responses 10, 12, and 13. Regarding current drought impacts, see response to Comment NG13-7.

Comment NG10-5

Comment

This leaves only the environmental commitments to support the no significant impact finding, and these too fail to ensure that significant impacts are avoided. It appears that the giant garter snake-focused environmental commitments were derived from previous Endangered Species Act biological opinions involving water transfers, including the Biological Opinion for Reclamation's 2010-2011 Water Transfer Program. See U.S. Fish and Wildlife Service ("FWS"), Endangered Species Consultation on the Bureau of Reclamation's Proposed Central Valley Project Water Transfer Program for 2010 - 2011 (Mar. 2010) at 5-7 (attached as Exhibit A) (presenting "conservation measures" that are similar to Draft's environmental commitments); see also FWS, Endangered Species Consultation on the Proposed 2009 Drought Water Bank for the State of California (Apr. 2009) at 7-8 (attached as Exhibit B) (same). The biological opinions incorporated conservation measures that are similar to the Draft's environmental commitments into Reasonable and Prudent Measures, and concluded that compliance with those measures was "necessary and appropriate" to minimize the impact of take caused by the proposed crop idling transfers. Exh. A at 40; Exh. B at 38.

The California Department of Water Resources subsequently reaffirmed that "the conservation measures outlined in the USFWS biological opinion for Reclamation's 2010-2011 Water Transfer Program represent the most current and best scientific information on protective measures for the giant garter snake," and indicated that DWR "will require transfer proponents to incorporate in their transfer proposals those conservation measures from the biological opinion relevant to crop idling." California Department of Water Resources, DRAFT Technical Information for Preparing Water Transfer Proposals (Oct. 2013) at 22-23, available at http://www.water.ca.gov/watertransfers/ docs/DTIWT 2014_ Final_Draft.pdf.

The Draft's environmental commitments, however, are considerably less protective than the conservation measures that FWS and DWR have deemed to be necessary and appropriate, and reflective of the best scientific information available. First, the biological opinions required that the block size of idled rice parcels would be limited to 320 acres with no more than 20 percent of rice fields idled cumulatively (from all sources of fallowing) in each county. They further provided that the idled parcels would not be located on opposite sides of a canal or other waterway, and would not be immediately adjacent to another fallowed parcel. Exh. A at 5-6; Exh. B at 7. Prior to the 2009 and 2010 biological opinions, FWS had concluded that a 160-acre limitation on the size of idled rice parcels was appropriate. See FWS, Programmatic Biological Opinion on the Proposed Environmental Water Account Program (Jan. 2004) at 18 (attached as Exhibit C). Defenders of Wildlife previously submitted comments indicating that increasing the parcel size from 160 to 320 acres would be harmful to giant garter snakes because the size of their home range is 40 and 90 acres, and forcing individuals to travel farther than this range may result in mortality. See Comments on Addendum to the Environmental Water Account EIRIEIS (Jan. 2009) (attached as Exhibit D). Yet the current Draft's environmental commitments do not include any limitation on the acreage of fallowed parcels, the cumulative percentage of rice fields in any county that can be idled, or the layout of idled parcels relative to each other and to particular habitat features.

Response
See Common Responses 10 and 12.

Comment NG10-6

Comment
Second, the biological opinions' conservation measures included a requirement that a field cannot be fallowed more than two irrigation seasons in a row. Exh. A at 6; Exh. B at 7. Again, this important conservation measure is entirely missing from the Draft's environmental commitments.

Response
See Common Response 12.

Comment NG10-7

Comment
Third, the biological opinions required that the water seller maintain a depth of at least two feet of water in the major irrigation and drainage canals to provide a movement corridor for giant garter snakes. Exh. A at 6; Exh. B at 7. The Draft, on the other hand, provides that "[c]anal water depths should be similar to years when transfers do not occur or, where information on existing water depths is limited, at least two feet of water will be considered sufficient." Draft EIS/EIR at 2-29. The biological opinions' clear requirement of two feet of water is easier to monitor and enforce, and more protective of the giant garter snake.

Response
The purpose of this environmental commitment (see Section 2.3.2.4) is to maintain habitat within major canals at existing conditions. Where existing conditions cannot be determined, the canal depth will be maintained at a minimum depth of 2 feet to provide suitable dispersal habitat for giant garter snake. This requirement was refined from the prior BOs so that a land owner would not be required to retain more water in a canal than what is typical for that system.

Comment NG10-8

Comment
Finally, the prior biological opinions all prohibited transfers from certain sensitive areas, including the Natomas Basin. Exh. A at 6; Exh. B at 7-8; Exh. C at 18. As discussed in Section 1.A.4, below, the Draft does not make clear whether all transfers from areas with known priority giant garter snake populations will be prohibited. Such a prohibition is essential to protecting the threatened giant garter snake.

Response
Environmental commitments listed in Section 2.3.2.4 state that lands in the Natomas Basin will not be permitted to participate in cropland idling transfers, in addition to locations of other known priority giant garter snake populations.

Comment NG10-9

Comment
The Draft fails to justify its departure from these conservation practices that FWS and DWR have previously deemed to be the minimum requirements necessary and appropriate for protecting sensitive giant garter snake populations from crop idling transfers. Yet it inexplicably concludes that the environmental commitments would avoid or reduce to insignificant levels the proposed action's impacts on giant garter snakes. The Draft's departure from conservation measures that have been widely accepted as necessary to protect the giant garter snake undermines its no significant impact conclusion, and further mitigation is

required. At a minimum, the environmental commitments must include all of the giant garter snake protections that were included in the 2009 and 2010 biological opinions. Further, we continue to believe that the 320-acre parcel-size limitation is not biologically justified and is insufficiently protective of the giant garter snake, and that a 160-acre limitation is warranted.

Response
See Common Response 12.

Comment NG10-10

Comment
2. The Environmental Commitments Do Not Protect Birds from Impacts Caused by Crop Idling Transfers Involving Rice Fields. In addition to the giant garter snake, crop idling transfers involving seasonally flooded agricultural lands (i.e., rice) would affect waterfowl, shorebirds, water birds, and riparian songbird that rely on the fields for forage and nesting habitat. The Draft explains that "[s]easonally flooded agriculture, specifically rice fields, and its associated uplands, drainage ditches, irrigation canals, and dikes, provide potentially suitable habitat for ... a variety of water birds including, but not limited to egrets, herons, ducks, and geese." Draft EIS/EIR at 3.8-34. It also indicates that rice fields provide habitat and forage for special status bird species, including the greater sandhill crane, black tern, purple martin, tricolored blackbird, white-faced ibis, yellow-headed blackbird, and long-billed curlew. Id. at 3.8-25 to 3.8-30; 3.8-74. The Draft acknowledges that crop idling transfers will impact these species by reducing available forage and nesting habitat. Id. at 3.8-74 to 3.8-80.

These impacts are likely to be significant. The Draft indicates that the 51,473 acres of rice that could be idled in any year is equivalent to 10.5 percent of the average amount of land in rice production from 1992 to 2012. Id. at 3.8-69. The water transfers will occur in dry years, however, when planted rice acreage, other agricultural habitat, and wildlife refuge habitat are already greatly reduced. Thus, the crop idling transfers, in combination with other dry-year habitat reductions, will likely cause only a small fraction of the food and habitat necessary to sustain the special status bird species and other migratory birds to be available at critical times during the year.

The Draft concludes, however, that the proposed action would have a less than significant impact on special status bird species because there would be a less than significant impact on the habitats that support these species. Id. at 3.8-80. The impacts to seasonally flooded agricultural habitats, it concludes, would not be significant because of implementation of the environmental commitments. Id. at 3.8-65. [Footnote: As discussed infra, Section I.B, the Draft cannot rely on the availability of other suitable habitat to show that the proposed action will not have a significant impact because the Draft provides no analysis of the adequacy or availability of such habitat.] There is only one environmental commitment, however, that is specifically designed to protect birds. It states that, "[i]n order to limit reduction in the amount of over-winter forage for migratory birds, including greater sandhill crane, cropland idling transfers will be minimized near known wintering areas in the Butte Sink." Id. at 2-30.

Clearly, this one environmental commitment that is geographically limited to the Butte Sink is insufficient to mitigate impacts from the idling of rice fields throughout the Sellers' service area because simply limiting habitat loss in one area does not ameliorate the impacts from habitat destruction elsewhere. Further, as discussed in Section I.A.4, the bird-focused commitment is so vague that it would provide little concrete protection for over-wintering birds in the Butte Sink.

Response
See Common Responses 10 and 13.

Comment NG10-11

Comment
To the extent the Draft relies on the environmental commitments that are focused on protecting the giant garter snake, these commitments are inadequate to reduce impacts to bird species to insignificant levels. The giant garter snake commitments focus on habitat that is particularly important for that species, including major irrigation and drainage canals, smaller drains and conveyance infrastructure, and areas with known priority giant garter snake populations. While birds would receive some benefit from these protections, the commitments only reduce impacts to a very small percentage of the important bird habitat that will be lost as a result of the crop idling transfers.

Thus, the Draft's conclusion that impacts to special status bird species will be insignificant because of implementation of the environmental commitments does not withstand scrutiny. The one bird-focused commitment is inadequate, and the giant garter snake protections only address a very small percentage of the important bird habitat that will be impacted by crop idling transfers. Because the proposed action will result in significant impacts to special status bird species, and the environmental commitments are insufficient to ameliorate these impacts, additional mitigation is required.

First, we suggest including an environmental commitment that requires landowners on idled rice fields to cultivate or retain nonirrigated cover crops or natural vegetation to provide habitat and forage. Such a commitment would be in keeping with California Water Code section 1018, which provides that, "[w]hen agricultural lands are being idled in order to provide water for transfer …, landowners shall be encouraged to cultivate or retain nonirrigated cover crops or natural vegetation to provide waterfowl, upland game bird, and other wildlife habitat, provided that all other water transfer requirements are met." A report issued by California Waterfowl suggests that vetch and other cover crops can provide valuable habitat for birds, helping to mitigate impacts from idled rice fields. See California Waterfowl, Rice-Cover Crop Rotation Pilot Project (Feb. 2013) (attached as Exhibit E).

Second, we suggest including an environmental commitment that requires Reclamation to deliver a specific amount, such as 10 percent, of the water transferred in any crop idling transfer to south of Delta wildlife refuges that provide habitat for birds and other species that are impacted by the transfers. This environmental commitment would help to partially offset the habitat loss and refuge impacts caused by the proposed crop idling transfers. [Footnote: The Proposed Action's impacts on south of Delta refuges are discussed in Section III, below.]

Third, we recommend including an environmental commitment that prohibits crop idling transfers on fields that are within 2 kilometers of wetlands and refuges, riparian corridors, and known Sandhill crane roost sites. This commitment is important because landscape context, particularly the amount and proximity of flooded wetland habitat, has been shown to be important to predicting shorebird abundance in wetland-agriculture mosaics. [Footnote: See Taft O. W, and Haig S. M. 2006. Landscape context mediates influence of local food abundance on wetland use by wintering shorebirds in an agricultural valley. Biological Conservation 128: 298-307; Elphick, C. S. 2008. Landscape effects on waterbird densities in California rice fields: Taxonomic differences, scale-dependence, and conservation implications. Water birds 31 :62-69.] Landscape context is also important for other water birds-the vast majority of heron and egret nesting colonies in the Sacramento Valley are in riparian stands along the major rivers and streams, [Footnote: Shuford, W. D. 2014. Patterns of distribution and abundance of breeding colonial water birds in the interior of California, 2009-2012. A report of Point Blue Conservation Science to California Department of Fish and Wildlife and U.S. Fish and Wildlife Service (Region 8). Available at www.fws.gov/mountain-prairie/species/birds/westem colonial.] and these birds must fly out to irrigated agricultural fields (mainly rice, also alfalfa, irrigated pasture, wetlands) to forage for themselves and to bring back food to nestlings. Additionally, wintering Sandhill cranes in the Central Valley forage mainly within 2 km of nighttime roost sites with suitable water depths and isolation from disturbance.7 Restricting crop idling transfers near wetlands and refuges, riparian corridors, and known Sandhill crane roost sites will help to minimize the proposed action's impacts on important bird species. [Footnote: Implementation details for these and other proposed environmental commitments must be developed before they can be integrated into a final EIS/EIR. Allowing time for another round of comments on a revised draft document will help to ensure that all of the environmental commitments are clear and enforceable.]

Response
See Common Responses 10 and 13.

Comment NG10-12

Comment

3. The Environmental Commitments Do Not Protect Birds from Impacts Caused by Crop Idling Transfers Involving Upland Crops. The proposed action also includes idling of up to 8,500 acres of upland crops, including idling of between 16 and 20 percent of existing com acreage, depending on the county. Draft EIS/EIR at 3.8-63. In Sutter and Solano Counties, idling of upland crops could result in a 9 percent loss in residual feed. Id. According to the Draft, some upland crops, such as com and wheat, are "highly beneficial to wildlife" (id. at 3.8-33), and several special status bird species, including greater sandhill cranes, long-billed curlews, and tricolored blackbirds rely on upland crops for forage and habitat. Id. at 3.8-25, 3.8-28, 3.8-29, 3.8-74. The Draft acknowledges that transfers involving the idling of upland crops could affect these species (see, e.g., id. at 3.8-74 to 3.8-77), and the impacts to these birds could be significant. As discussed above, the water transfers will occur in dry years, when other habitat is already substantially reduced. The food supply reduction caused by the crop idling transfers, in combination with other reductions known to occur in dry years, could cause food shortages for special status bird species and other migratory birds that depend upon Central Valley habitats.

   The Draft concludes, however, that "[b]ecause of the limited amount of upland crop acreage that would be idled under this alternative, and in conjunction with the environmental commitments described in Section 2.3.2.4, and because this is within the historic range of variation for the individual crops, cropland idling/shifting in the Seller Service Area is not expected to significantly impact wildlife species dependent on upland cropland habitat." Id. at 3.8-63 to 3.8-64.

   This conclusion does not withstand scrutiny. First, the Draft provides no analysis to support the conclusion that the elimination of 8,500 acres of upland crop habitat will not have a significant impact, and as discussed above, the impact could be profound. Further, the assertion that the idling is not problematic because it is within the historic range of variation for individual crops misses the point-the crop idling transfers will occur during dry years, when planted acreage is already reduced. The idled acreage will be additive to the reductions that have historically occurred in dry years, and will likely be cumulatively substantial. As discussed in Section I.B, below, the Draft's conclusory statements that impacts to birds will not be significant because there is sufficient alternative habitat and forage available are legally inadequate because they are unsupported by any analysis.

Response

See Common Responses 10 and 13.

Comment NG10-13

Comment
The Draft's reliance on the environmental commitments is also misplaced. The one bird-focused commitment is geographically limited and unacceptably vague, and the protections for giant garter snakes are not relevant to upland crops, as giant garter snakes only exist in flooded agricultural habitats. The Draft's conclusion that crop idling transfers involving upland crops won't have significant impacts on special status bird species is unsupported, and in light of the evidence that impacts to these species will be significant, additional mitigation is required.

As discussed with respect to water transfers involving the idling of rice fields, we recommend including an environmental commitment that requires landowners with idled upland crops to cultivate or retain nonirrigated cover crops or natural vegetation in conformity with Water Code section 1018. We also recommend addition of an environmental commitment requiring Reclamation to deliver a specific percentage of the water made available from any crop idling transfer to south of Delta refuges. Additionally, we suggest including a commitment that prohibits crop idling transfers on fields that are within 2 kilometers of wetlands and refuges, riparian corridors, and known Sandhill crane roost sites.

Response
The analysis and supporting evidence presented in Section 3.8, along with the environmental commitments presented therein, are sufficient to conclude that impacts to special status bird species will be less than significant. No further mitigation is warranted. See also Common Response 10.

Comment NG10-14

Comment
We also recommend addition of a few environmental commitments that are specifically focused on upland crop habitat. Specifically, we suggest including a commitment that prohibits the idling of com, winter wheat/triticale, or other grain crops that are particularly important to cranes and waterfowl. If water transfers involving the idling of these crops are not prohibited, we suggest including two additional commitments. First, the idling of com, winter wheat/triticale, and other grain crops' should be restricted to regions where there is a limited extent of such crops overall, and to areas with little or no current or historical use by greater sandhill cranes. Second, we suggest including an environmental commitment that limits transfers involving the idling of com to areas where this crop is traditionally not flooded after harvest, as flooded com supports a greater variety of bird species than does dry corn. [Footnote: Shuford, W. D., M. E. Reiter, K. M. Strum, C. J. Gregory, M. M. Gilbert, and C. M. Hickey. 2013. The effects of crop treatments on migrating and

wintering water birds at Staten Island, 2010-2012. Final Report to The Nature Conservancy, 190 Cohasset Road, Suite 177, Chico, CA 95926.]

Response
As described on page 3.8-63 of the Draft EIS/EIR, upland cropland idling could result in up to a two percent reduction of residual feed in Glenn, Colusa, and Yolo Counties and up to a nine percent reduction in residual feed in Sutter and Solano Counties. These reductions are well within the historical range of upland variation and would not be a significant change in existing conditions. No mitigation specific to upland cropland is warranted. See Common Response 10 for further discussion of migratory birds.

Comment NG10-15

Comment
4. The Environmental Commitments are Unacceptably Vague and No Enforcement Mechanism is Apparent. According to Reclamation's NEP A Handbook, "[e]nvironmental commitments are written statements of intent made by Reclamation to monitor and mitigate for potential adverse environmental impacts of an action." US Bureau of Reclamation, Reclamation's NEPA Handbook (Feb. 2012) at 3-15, available at http://www.usbr.gov/nepa/docs/NEPA_Handbook2012.pdf. Reclamation is required to allocate funds necessary to carry out the commitments, monitor and evaluate the commitments' effectiveness, and document results. Id.at 3-16. Additionally, while implementation can be delegated to a third party as a permit condition, compliance with the environmental commitments remains Reclamation's responsibility. Id. The Handbook provides details regarding creation of an environmental commitments program, plan, and checklist to ensure the environmental commitments are appropriately implemented. Id. at 9-5 to 9-6.

   Further, though they are integrated into description of the proposed action, the environmental commitments effectively operate as mitigation measures. CEQA requires that mitigation measures be "fully enforceable through permit conditions, agreements, or other measures." Cal. Pub. Res. Code § 21 081.6(b). This requirement helps to ensure that "mitigation measures will actually be implemented... , and not merely adopted and then neglected or disregarded." Cal. Clean Energy Comm, 225 Cal. App. 4th at 189.

   The Draft, however, does not appear to require that the environmental commitments be integrated as permit conditions, and does not make clear how Reclamation will enforce the commitments. The Draft merely provides that "Reclamation will have access to the land to verify how the water transfer is being made available and to verify that actions to protect the giant garter snake are being implemented," but does not explain how Reclamation will ensure compliance. Draft EIS/EIR at 2-29.

> To adhere to Reclamation's NEPA Handbook and CEQA, and to ensure that the environmental commitments are enforced, we recommend that the environmental commitments be incorporated into the terms of contracts governing the water transfers. This approach has been used before-for example, the 2009 Biological Assessment for the Drought Water Bank provided that conservation measures for the giant garter snake "will be incorporated into contracts between DWR and the water seller." 2009 Drought Water Bank Biological Assessment (attached as Exhibit F) at 11. The Biological Assessment elaborated that the contracts would include provisions allowing DWR to access the fallowed parcels to make sure the conservation measures were being implemented. Id. Incorporating similar terms into the contracts governing the long-term water transfers would help to ensure that the environmental commitments are more than empty promises.

Response
See Common Response 10.

Comment NG10-16

Comment
Additionally, the environmental commitments are so vague that enforcement will be impossible, and any potential benefits are likely illusory. First, the bird-focused commitment provides that "cropland idling transfers will be minimized near known wintering areas in the 10 Butte Sink," but it fails to define "minimized" and does not indicate how "known wintering areas" will be identified. Draft EIS/EIR at 2-30. Additionally, it does not specify what entity will oversee the proposed action to ensure that transfers near known wintering habitat are minimized. Unless additional clarity is provided, it will be impossible to effectively implement and enforce this commitment.

Response
See Common Response 10.

Comment NG10-17

Comment
The commitments that focus on the giant garter snake are also so vague that implementation will be impossible. For example, one commitment provides that "[d]istricts proposing water transfers made available from idled rice fields will ensure that adequate water is available for priority habitat with a high likelihood of giant garter snake occurrence." Id. The term "adequate water" is not defined, and the following commitment indicates that crop idling transfers will be permitted in priority habitat. !d. This suggests that a landowner could receive credit for transferring water out of priority habitat while still maintaining adequate water for giant garter snakes. This would likely be impossible because removing water from their habitat exposes giant garter

snakes to displacement and the associated risks of predation and reduced food availability. See id. at 3.8-70.

Response
See Common Response 12.

Comment NG10-18

Comment
Additionally, the environmental commitment regarding areas with known priority giant garter snake populations is ambiguous. It provides that:

Areas with known priority giant garter snake populations will not be permitted to participate in cropland idling/shifting transfers. Water sellers can request a case-by-case evaluation of whether a specific field would be precluded from participating in long-term water transfers. These areas include lands adjacent to naturalized lands and refuges and corridors between these areas, such as:

- Fields abutting or immediately adjacent to Little Butte Creek between Llano Seco and Upper Butte Basin Wildlife Area, Butte Creek between Upper Butte Basin and Gray Lodge Wildlife areas, Colusa Basin drainage canal between Delevan and Colusa National Wildlife Refuges, Gilsizer Slough, Colusa Drainage Canal, the land side of the Toe Drain along the Sutter Bypass, Willow Slough and Willow Slough Bypass in Yolo County, Hunters and Logan Creeks between Sacramento and Delevan National Wildlife Refuges; and

- Lands in the Natomas Basin.

Id. at 2-30. It is not clear from the text whether the areas that are specifically listed will be categorically excluded from participating in transfers, or whether landowners within these areas will be able to request a case-by-case determination regarding particular fields. As discussed above, if the latter is the intended interpretation, this is a major departure from the conservation measures included in recent giant garter snake biological opinions. Further, merely permitting landowners to request a parcel-specific evaluation is inadequate-what will be the consequence if a water seller chooses not to request such an evaluation?

Response
All water transfer requests will be evaluated by Reclamation to determine if they are in areas that have the potential to affect known giant garter snake population or areas with a high probability of giant garter snake occurrence. These evaluations are not made by the seller. Further descriptions of priority populations and consistency with prior biological opinions are provided in Common Response 12, Giant Garter Snake.

Comment NG10-19

Comment
Because the vague and unenforceable nature of the environmental commitments will render their benefits illusory, significant impacts will remain from crop idling transfers. The environmental commitments are legally inadequate and must be rewritten so that they are clear, protective, and enforceable, or alternative mitigation measures must be provided.

Response
See Common Response 10.

Comment NG10-20

Comment
B. The Draft Makes Unsupported Assumptions Regarding the Availability of Alternative Habitat and Forage for Birds, Undermining its Conclusion that Impacts from Crop Idling Transfers Will Be Insignificant. To comply with CEQA, "[a] legally adequate EIR must produce information sufficient to permit a reasonable choice of alternatives so far as environmental aspects are concerned." Kings County Farm Bureau v. City of Hanford, 221 Cal. App. 3d 692, 733 (1990) (quotation marks and citation omitted). "A conclusory statement unsupported by empirical or experimental data, scientific authorities, or explanatory information of any kind not only fails to crystallize issues but affords no basis for a comparison of the problems involved with the proposed project and the difficulties involved in the alternatives." Whitman v. Board a/Supervisors, 88 Cal. App. 3d 397, 411 (1979) (quotation marks and citations omitted). Similarly, one of NEPA's primary purposes is "to guarantee relevant information is available to the public." N Plains Res. Council, Inc. v. Surface Transp. Bd., 668 F.3d 1067, 1072 (9th Cir. 2011); Natural Res. De! Council v. US Forest Serv., 421 F .3d 797, 811 (9th Cir. 2005) ("Where the information in the initial EIS was so incomplete or misleading that the decision maker and the public could not make an informed comparison of the alternatives, revision of an EIS may be necessary to provide a reasonable, good faith, and objective presentation of the subjects required by NEP A." (quotation marks and citation omitted)).

The Draft's analysis of impacts to birds from crop idling transfers falls far short of these standards. In particular, the Draft relies upon entirely unsubstantiated assertions regarding the availability of alternative forage and habitat to support its conclusion that the proposed action will have a less than significant impact on birds. For example, with respect to rice fallowing, it states that "[t]he decision to idle or shift a field would be made early in the year. So for species that migrate into the area seasonally (mainly birds), those arriving in the spring would not be impacted as they would select suitable habitat upon their arrival." Draft EIS/EIR at 3.8-65. The Draft contains no analysis, however, to show that adequate suitable habitat would be available in all water year types. Similarly, for upland crops, it asserts that "[i]dling would reduce forage areas, but species would respond by looking for forage in other habitats. The bird species that would be potentially affected by idling of upland crops would be capable of dispersing to other areas or other non-idled parcels." Id. at 3.8-63. Again, there is no analysis to show that adequate alternative food supplies exist. With respect to impacts to special status bird species, the Draft asserts that "[t]hese species are highly mobile and could easily relocate to other suitable habitats that would continue to exist in the surrounding areas." Id. at 3.8-80; see also id. at 3.8-75, 3.8-78. The Draft is devoid of information regarding the availability of alternative suitable habitat in the surrounding areas.

Response
See Common Response 13.

Comment NG10-21

Comment
The Draft's assumption that adequate alternative forage and habitat exist ignores the context in which the transfers will occur. Importantly, the Draft fails to account for the fact that water transfers will occur in dry years, when suitable habitat is least likely to be available. For example, during this drought year, 25 percent fewer acres of rice were planted in the Sacramento Valley than were planted the previous year. Additionally, water deliveries to federal, state, and privately managed wildlife refuges were substantially curtailed. The Draft also indicates that State Water Project crop idling transfers will likely occur at the same time as the long-term transfers, further reducing available habitat. Id. at 3.9-46 ("Cropland idling implemented under the SWP transfers could result in a maximum of 26,342 acres of idled rice land.").

Moreover, existing evidence suggests that the Draft's assumption that adequate alternative habitat will be available may be incorrect. For example, Ducks Unlimited used the bioenergetic model TRUEMET to evaluate the impact of California's drought on waterfowl in the Central Valley. See Dr. Mark Petrie, Ducks Unlimited, Inc., California's Drought and Potential Impacts on Waterfowl (May 2014) (attached as Exhibit G). The modeling showed that, under severe drought conditions, dabbling duck food supplies would be exhausted by early December, before bird numbers traditionally peak in the Valley, and dark geese and white geese food supplies would be exhausted by early February and late January, respectively. Id. at 10.

The impacts to birds from habitat reductions caused by the long-term transfers in dry years when habitat is already reduced could be profound. For example, a reduction of food availability would send birds back to their spring breeding grounds in poor condition, which would greatly reduce breeding success. In addition, the significant reduction in waterfowl habitat would cause overcrowding, which has in the past exacerbated outbreaks of avian diseases such as cholera and botulism. Such conditions could affect waterfowl populations for years to come.

Response
See response to Comment NG13-7 and Common Response 13.

Comment NG10-22

Comment
Because the Draft's conclusory statements regarding alternative bird habitat are "unsupported by empirical or experimental data, scientific authorities, or explanatory information of any kind," they fail to comply with applicable law and additional analysis is required. See Whitman, 88 Cal. App. 3d at 411. We suggest that, at a minimum, a revised draft EIS/EIR should include bioenergetics modeling to assess the impact that crop idling transfers will have on available food supplies in various water year types and in light of other reductions in available habitat. TRUEMET modeling was conducted for the Bay Delta Conservation Plan ("BDCP") environmental documents, and such modeling would be appropriate here. See, e.g., BDCP Draft EIS/EIR at 12-729; 12-2559. [Footnote: All chapters from the BDCP Draft EIS/EIR that are cited in this letter are available at http://baydeltaconservationplan.com/PublicReview/PublicReviewDraftEIR-EIS.aspx.]

Response
See Common Response 13.

Comment NG10-23

Comment
II. The Draft Improperly Fails to Analyze Impacts to Waterfowl and Shorebirds

Though the proposed action would likely have substantial impacts on waterfowl and shorebirds, the Draft entirely fails to discuss or analyze impacts to these species. [Footnote: The Draft does, however, acknowledge that waterfowl and shorebirds rely on seasonally flooded agricultural habitat. See, e.g., Draft EIS/EIR at 3.8-14 (indicating that post-harvest winter flooding "provides habitat for waterfowl and other wildlife," that invertebrates in flooded fields "are particularly important to shorebirds," and that "[r]ice fields provide pair, brood, and nesting habitat for birds such as mallard duck, northern pintail, and terns").] Such an analysis is required by CEQA, which provides that "[a]n EIR shall identify and focus on the significant environmental effects of the proposed project." 14 Cal. Code Regs. § 15126.2. [Footnote: NEPA also requires an analysis of the proposed action's effects on waterfowl and shorebirds, as these impacts are an important part of the environmental consequences of the proposed action. See Nat 'I Parks & Conservation Ass'n v. BLM, 606 F.3d 1058, 1072 (9th Cir. 2010) ("Under NEPA, an EIS must contain a 'reasonably thorough' discussion of an action's environmental consequences." (citing State of California v. Block, 690 F.2d 753,761 (9th Cir. 1982))).] "[S]ignificant effect on the environment," in tum, "means a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance." Id. § 15382.

It is clear that crop idling transfers could lead to a substantial adverse change in the condition waterfowl and shorebirds within the project area. For example, modeling of population energy demand and population energy supply for dabbling ducks in the Central Valley shows that reduced winter-flooded rice acreage due to drought causes food demand to exceed supply. California's Drought and Potential Impacts on Waterfowl, Exh. G. When further drought-related habitat reductions are taken into consideration, food demand far exceeds supply for dabbling ducks, and demand also outpaces supply for dark geese and white geese. Id. Water transfers involving the idling of seasonally flooded agricultural habitat will occur primarily in dry years when habitat is already reduced, and will further diminish the already inadequate food supplies available to migratory waterfowl. Shorebirds, which also rely on seasonally flooded agricultural habitat, could be similarly impacted by crop idling transfers. Because impacts to waterfowl and shorebirds are an important part of the significant environmental effects of the proposed action, the Draft must include an analysis of impacts to these species.

The importance and feasibility of this analysis is underscored by the BDCP Draft EIS/EIR, which included substantial assessment of impacts to waterfowl and shorebirds. See, e.g., BDCP Draft EIS/EIR at 12-729 to 12-745. The BDCP environmental document emphasized that "[m]anaged wetlands, tidal natural communities, and cultivated lands (including grain and hay crops, pasture, field crops, rice, and idle lands) provide freshwater nesting, feeding, and resting habitat for a large number of Pacific flyway waterfowl and shorebirds." Id. at 12-729. It recognized that the proposed Plan would modify habitat in a manner that could affect these species, the included substantial analysis to understand the nature and extent of those impacts. See, e.g., id. at 12-729 to 12-745. The BDCP Draft EIS/EIR also acknowledged the Central Valley Joint Venture's conservation goals, and analyzed impacts to waterfowl and shorebirds in light of the Joint Venture's 2006 Implementation Plan. Id. at 12-729 to 12-730. In addition to qualitative discussions of impacts to waterfowl and shorebirds, the BDCP environmental document included analysis from the TRUEMET model to quantify the proposed action's impacts on waterfowl. See, e.g., id. at 12-729.

The long-term water transfers would affect the same shorebirds and waterfowl as the proposed BDCP, and there is no valid reason for the Draft's complete exclusion of these species from its impacts analysis. We recommend that a revised draft EIS/EIR include both qualitative and quantitative analysis of the proposed action's impacts on waterfowl and shorebirds.

Response
See response to Comment NG10-14 and Common Responses 10 and 13.

Comment NG10-24

Comment
III. The Draft Improperly Ignores South of Delta State Wildlife Areas and Federal Wildlife Refuges. A. The Draft Fails to Analyze Potentially Significant Impacts to South of Delta Refuges California law requires that an EIR "must include a description of the physical environmental conditions in the vicinity of the project." 14 Cal. Code Regs. § 15125(a). The CEQA Guidelines emphasize that "[k]nowledge of the regional setting is critical to the assessment of environmental impacts," and that "[s]pecial emphasis should be placed on environmental resources that are rare or unique to that region and would be affected by the project." Id. § 15125(c). A failure to accurately describe the environmental setting may render an EIR inadequate, inter alia, because important environmental impacts from the proposed action are likely to be omitted. See San Joaquin Raptor/Wildlife Rescue Ctr. v. Cnty. Of Stanislaus, 27 Cal. App. 4th 713, 729 (1994) ("For the reasons set forth above, the description of the environmental setting of the project site and surrounding area is inaccurate, incomplete and misleading; it does not comply with State CEQA Guidelines section 15125. Without accurate and complete information pertaining to the setting of the project and surrounding uses, it cannot be found that the FEIR adequately investigated and discussed the environmental impacts of the . . . project."). Similarly NEPA requires a "full and fair discussion of significant environmental impacts," and a failure to discuss a significant impact can render an EIS legally inadequate. 40 C.F.R. § 1502.1.

Here, the Draft is fatally flawed because it fails to include important south of Delta State Wildlife Areas and Federal Wildlife Refuges in its description of the proposed action's environmental setting, and fails to analyze impacts to these important resources. See Draft EIS/EIR at 3.8-15 to 3.8-17. This omission is particularly odd because the Draft acknowledges that, within SLDMWA, "[w]ater for habitat management occurs on approximately 120,000 acres of refuge lands, which receive approximately 250,000 to 300,000 acre-feet (AF) per water year." Id. at ES-4.

Yet it is clear that the proposed action could have significant impacts on south of Delta refuges. First, the proposed action could result in increased avian overcrowding. Crop idling transfers will reduce available habitat and forage in the Sacramento Valley, placing additional pressure on the already-stressed south of Delta habitats. Overcrowding could reduce breeding success for important bird species, exacerbated outbreaks of diseases such as cholera and botulism, and could affect waterfowl populations for years to come.

Response
See Common Response 9.

Comment NG10-25

Comment
Second, the Draft does not clearly discuss the order of priority for use of CVP conveyance facilities. If deliveries to the refuges are not appropriately prioritized, the refuges could be left without adequate water to support migratory bird populations. The Draft states that "[t]ransfers that must be conveyed through the Delta are limited to periods when capacity at C.W. 'Bill' Jones Pumping Plant (Jones Pumping Plant) and Harvey O. Banks Pumping plant (Bank Pumping Plant) is available typically from July through September, and only after Project needs are met." Id. at 2-18 (emphasis added). The Draft must clarify whether "Project needs" includes all deliveries to refuges that are required under the CVPIA. If Level 2 and Level 4 refuge deliveries are not considered "Project needs," then the Draft must analyze how the proposed action could impact water delivers to the south of Delta refuges, and how any potentially reduced deliveries could impact migratory birds and other species that depend upon the refuges.

Response
See Common Response 9.

Comment NG10-26

Comment
Third, the proposed action could increase the price of available water, making it impossible for Reclamation to purchase incremental Level 4 refuge supplies. A revised draft EIS/EIR should analyze how the proposed action will impact water prices, and whether price changes will affect Reclamation's ability to provide full deliveries to the south of Delta refuges.

Response
See Common Response 9.

Comment NG10-27

Comment
B. The Draft Should Include Transfers to South of Delta Refuges. Because it appears that impacts to south of Delta refuges could be significant, the Draft should include measures to mitigate these impacts. See Cal Pub Res. Code § 21081. A first step toward providing this mitigation would be to include transfers to south of Delta refuges in this environmental review. Reclamation needs flexibility to move available water quickly to protect these public trust resources, and including refuge transfers in this EIS/EIR would help to provide this flexibility. In dry years, north-to-south transfers can provide critically important water to south of Delta refuges. For example, this year, Reclamation transferred a portion of the permanent refuge supply that it purchased from the Anderson-Cottonwood Irrigation

District from north of Delta refuges that could not physically receive the water, to the Kern National Wildlife Refuge, which is south of the Delta. Including such transfers in the proposed action would streamline approval and reduce transaction costs, allowing Reclamation to expeditiously provide water that is desperately needed for wetland habitat south of the Delta. We hope to see transfers to south of Delta refuges included in the proposed action in a revised draft EIS/EIR.

Response
See Common Response 9.

Comment NG10-28

Comment
IV. The Draft Fails to Adequately Analyze Impacts to Fish and Wildlife from Groundwater Substitution and Reservoir Release Transfers. A. The Draft Uses Inappropriate Screening Thresholds to Avoid Analyzing Biological Impacts from Flow Reductions. 1. The Draft Fails to Analyze Impacts to Fisheries Caused by Flow Reductions. The Draft's analysis of impacts to fisheries from instream flow reductions caused by the proposed action is seriously deficient because the Draft applies an arbitrary, not biologically based screening threshold to avoid analyzing potentially significant impacts. In particular, the Draft concludes that a reduction in instream flow would only be biologically significant if it involved both a 10 percent change in mean flow by water year type and a minimum change in flow of 1 cfs. Draft EIS/EIR at 3.7-20. These two thresholds were used as an initial screen, and further analysis to assess biologically significant impacts to fisheries was only conducted if flow reductions were both greater than 10 percent and greater than 1 cfs. Id. at 3.7-21.

Based on application of these thresholds, the biological impacts from flow reductions in vast majority of waterways in the Sellers' service area were never assessed. For example, the Draft states: Under the Proposed Action, mean monthly modeled flows would be reduced by less than ten percent on the Sacramento, Feather, Yuba, and American rivers. Based on the screening level criteria, these flow reductions are not considered substantial. Therefore, the effects of the Proposed Action on fisheries in these rivers would be less than significant. Id. at 3.7-25. Because the Draft concluded that the impacts would be less significant based on the 10 percent significance threshold, impacts to fisheries on these critically important waterways were not analyzed. Similarly, the screening thresholds were applied to exclude the following waterways from any assessment of biological impacts caused by flow reductions: Deer Creek (in Tehama County), Antelope Creek, Paynes Creek, Elder Creek, Mill Creek (in Tehama County), Thomes Creek, Mill Creek (Thomes Creek tributary), Butte Creek, Auburn Ravine, Freshwater Creek, Colusa Basin Drain, Putah Creek, and Wilson Creek. Id.

The Draft does not, and cannot, adequately justify its use of these arbitrary thresholds. The document explains that "[t]he ten percent threshold was used to determine measurable flow changes based on several major legally certified environmental documents in the Central Valley related to fisheries," including the Trinity River Mainstem Fishery Restoration Record of Decision (December 2000), the San Joaquin River Agreement Record of Decision (March 1999), the Freeport Regional Water Project Record of Decision (January 2005), and the Lower Yuba Accord EIRIEIS (October 2007). Id. at 3.7-20. Reliance on these old documents is misplaced because they do not reflect the best available scientific information, and because most of the documents were drafted for programs that increased flows. The Draft does not include any information regarding the biological significance of these thresholds, such as their relationship to water temperature, available spawning area, or other important factors.

Response
The 10 percent screening threshold for instream flow in rivers and creek is one of multiple criteria used to determine whether there were significant impacts on aquatic and terrestrial resources. Use of the 10 percent threshold is described in Section 3.7.2.1.3. As stated in the text, the use of the 10 percent value is to distinguish between effects that are a result of "model noise" and actual impacts of an alternative. This criterion is commonly used by experts in analyzing potential effects on Central Valley fisheries.

The analysis does not end there; it also evaluates whether an alternative causes a less than 1 cfs change in instream flows. This threshold was more biological in nature and was applied to every month of modeling. If a change of less than 1 cfs occurred in any single month during the entire modeled period (1976-2003), the waterway was examined further for biological effects. The combination of these two criteria provides an extremely conservative screening process which each river must undergo. If either criterion was "violated" for a river or stream, a further analysis was conducted to evaluate the biological significance of the flow change, such as those conducted for the Bear River, Cache Creek, Stony Creek, Coon Creek, and Little Chico Creek.

The EIS/EIR uses a biological basis for its analysis; the 10 percent threshold is justified as a screening threshold of physical modeling outputs and the analysis is extremely conservative, relying on several layers of analysis to arrive at a conclusion.

Comment NG10-29

Comment
Further, agencies have recently used a more conservative screening threshold to determine the potential significance of flow reductions. For example, the December 2013 Draft EIS/EIR for the proposed BDCP used a 5 percent screening threshold: Physical modeling outputs each month and water year type

were compared for between model scenarios at multiple locations to determine whether there were differences between scenarios at each location. A "difference" was defined as a >5% difference between the pair of model scenarios in at least one water year type in at least 1 month. If a difference was found at a location, subsequent biological modeling and analyses for fish species that occur in that location were conducted and reported for that location. If no differences were found, subsequent biological modeling and analyses for fish species that occur in that location were deemed unnecessary and were not conducted.

BDCP Draft EIS/EIR at 11-202. The BDCP draft environmental document does not appear to use the additional 1 cfs threshold. Though the Draft and BDCP analyze impacts from flow reductions on the same rivers, the Draft does not attempt to explain why a less conservative threshold is appropriate for analysis of the proposed action's impacts to fish.

Because the Draft's reliance on the 10 percent and 1 cfs screening thresholds is inappropriate, and because impacts to special status fish species on the waterways that were eliminated based on application of the thresholds may be significant, further analysis is required. We recommend that a revised draft EIS/EIR analyze the significance of impacts based only on biological criteria, such as water temperature and changes to habitat quality. Alternatively, if a significance threshold for flow reductions is used, it should be at least as conservative as the 5 percent threshold used in the BDCP Draft EIS/EIR.

Response

BDCP is a different project looking at effects in larger rivers. It involves a different spatial scale and the margin of error is higher on an absolute scale. In addition, a 1 cfs threshold was used as an additional conservative screening criterion. See response to Comment NG10-28 for additional information.

Comment NG10-30

Comment

2. The Draft Fails to Analyze Impacts to Vegetation and Wildlife from Flow Reductions. The Draft uses the same screening thresholds from the fisheries chapter to determine whether flow reductions will have a significant impact on terrestrial species. Draft EIR/EIS at 3.8-38 ("If the flow reduction caused by implementing the transfer action would be less than one cubic feet per second (cfs) and less than ten percent change in mean flow by water year type, then no further analysis was required, because the effect was considered too small to have a substantial effect on terrestrial species."). The Draft justifies its use of these thresholds based on the same outdated documents it relied on in the fisheries section, even though the fisheries section indicates that those environmental reports were "related to fisheries." Id. at 3.8-39, 3.7-20. The use of these thresholds therefore appears to be even more arbitrary with respect to

impacts to terrestrial species because the 10 percent threshold was derived from fisheries-related analysis.

Based on application of these thresholds, the vast majority of rivers and streams with special status terrestrial species were eliminated from consideration before biological impacts to those species could be analyzed. The following waterways were eliminated from further consideration based on the screening thresholds: Sacramento River, Feather River, Yuba River, American River, Deer Creek (in Tehama County), Antelope Creek, Paynes Creek, Seven Mile Creek, Elder Creek, Mill Creek (in Tehama County), Thomes Creek, Mill Creek (Thomes Creek tributary), Butte Creek, Auburn Ravine, Honcut Creek, Freshwater Creek, Colusa Basin Drain, Upper Sycamore Slough, Funks Creek, Putah Creek, Spring Valley Creek, Walker Creek, North Fork Walker Creek, Wilson Creek, Stone Corral Creek, Little Chico Creek, and the South Fork of Willow Creek. Id. at 3.8-49 to 3.8-50.

Because application of the screening threshold was inappropriate, and flow reductions from the proposed action could have a significant impact on special status terrestrial species that rely on the eliminated waterways, further analysis is required.

Response
See Common Response 11.

Comment NG10-31

Comment

B. The Draft's Conclusions Regarding Impacts to Fish and Wildlife from Reduced Instream Flows on Specific Rivers are Unsupported 1. The Draft's Conclusions that Important Fish Species Will Not Be Impacted Lack Biological Support. For the rivers in which modeled flow reductions would exceed 10 percent and l cfs in any month, the Draft purports to conduct further biological analysis to determine whether the flow reduction would have a significant impact on special status fish species. Draft EIS/EIR at 3.7-21. The presented analysis, however, is entirely qualitative and extremely cursory. Though the Lead Agencies are familiar with a variety of modeling tools that could have helped to more fully understand the proposed action's impacts on fisheries, no modeling of biological impacts was conducted. The extensive modeling that was used in the BDCP Draft EIS/EIR suggests various tools that could have been used, including SALMOD, the Sacramento Ecological Flows Tool, and the Reclamation Temperature Model. While these and other available models have flaws, they provide important insights into how flow reductions will impact fisheries. The Draft's failure to conduct any modeling substantially undermines its conclusions that the proposed action will not result in significant impacts to special status fish species.

Response
The modeling tools referenced in the comment only apply to specific rivers that were not the subject of further analysis based on the screening analysis of physical modeling outputs, as described in Section 3.7.2.1.3. For example, SacEFT only applies to the Sacramento River, which would experience very little change in flows under the Proposed Action and therefore did not require analysis beyond examining changes in flows. The qualitative analysis used for the smaller streams (i.e., Coon Creek, Stony Creek, Little Chico Creek, and Cache Creek) and larger waterways without other modeling tools (e.g., Bear River) used the best available science because no better quantitative tools were available for use, and the analysis was based on the biology of the species evaluated.

Comment NG10-32

Comment
Further, the Draft's qualitative assessment of biological impacts from flow reductions is of such poor quality that it cannot be considered reliable. For example, for Stony Creek and Coon Creek, the Draft concludes that, because "significant" flow reductions-i.e., greater than 10 percent and 1 cfs – will happen infrequently, the impacts to special status fish species will be less than significant. Draft EIS/EIR at 3.7-28 to 3.7-29. The Draft does not explain, however, why the frequency of a low-flow event is dispositive as to biological impacts, and it is not at all clear that a single occurrence of low flows and high temperatures could not significantly impact sensitive fish populations. Additionally, with respect to Stony Creek, if a 5 percent significance threshold was used instead of a 10 percent threshold, "significant" flow reductions would occur in many more months. Id. at 3.8-56 to 3.8-57. For Coon Creek, the Draft doesn't even mention which species could be impacted. Id. at 3.7-29.

Response
See responses to Comments FA01-55 and NG10-28. The species and life stages present in each waterbody and waterway evaluated, including Coon Creek, are found in Table 3.7-2.

Comment NG10-33

Comment
With respect to Little Chico Creek, the Draft appears to conclude that, because the Creek already suffers from low flows, additional flow reductions will not be problematic. Id. at 3.7-29. The Draft cannot simply write off the biological impacts from an increased frequency of low flow events without providing any analysis of effects on temperature, habitat suitability and availability, and other important factors.

Response
For the same reasons the EIS/EIR analyzes flows in Little Chico Creek during periods when fish are present, there is no need to analyze the flows when the species are not present. Because the creek has low flows under the baseline condition, the species of concern would not be present during the periods stated. There was no attempt to "write off the biological impacts" as the commenter suggests; instead, the analysis compares the conditions in Little Chico Creek with and without the project during months when species are present.

In response to another comment related to this section, an additional analysis of the frequency of dropping below 0 cfs and 0.5 cfs was added to the text in Section 3.7.2.4.1. This additional analysis further supports the conclusion that impacts would be less than significant.

Comment NG10-34

Comment
On Cache Creek, the Draft concludes that there will be no impact to Fall-run Chinook salmon because connectivity for migration only exists in wet years, and there are no significant instream flow reductions in wet years. Id. at 3.7-28. The significance determination is based on the unsupported 10 percent figure, however, and use of a more conservative threshold would show that a significant flow reduction would occur in October in wet years. See id. at 3.8-55.

Response
See response to Comment NG10-28.

Comment NG10-35

Comment
The Draft also appears to erroneously exclude waterways that may contain special status fish species from further biological review. The Draft states that "[n]o field sampling information is available regarding the presence of special-status fish species in the following waterways: Seven Mile Creek, Elder Creek, Spring Valley Creek, North Fork Walker Creek, and Wilson Creek." Id. at 3.7-9. It elaborates that, "[w]ithout further information, it was assumed that these streams could support special-status fish species and, therefore, further biological analyses were conducted in these waterways." Id. In the following paragraph, however, the Draft states that field sampling data and reports indicate that special status fish species are not present in Seven Mile Creek, Spring Valley Creek, North Fork Walker Creek, and Wilson Creek, and accordingly that no further biological analysis was conducted for these waterways. Id. A revised draft EIS/EIR should clarify whether there is field sampling information available for these Creeks, and should conduct biological analysis if information regarding the presence of special status fish species is not available.

Response
The text has been revised to include the correct information. The correction does not materially affect the conclusions of the analysis.

Comment NG10-36

Comment
The impacts of the proposed action on fisheries remain unclear because the Draft uses inappropriate screening thresholds, fails to model biological impacts, and includes logically unsound qualitative assessments of biological impacts from admittedly significant flow reductions. To comply with CEQA and NEPA's legal requirements that an EIS/EIR provide the public with sufficient information to understand the environmental impacts of a proposed project and meaningfully compare alternatives, substantially more analysis is required, including modeling to understand the biological implications of flow reductions.

Response
The impacts analysis looked at the full range of potential effects to all target species in all waterways that could potentially be affected by each alternative using the best available science and analytical tools. The approach is described in Sections 3.7.2.1 and 3.8.2.1, significance thresholds are listed in Sections 3.7.2.2 and 3.8.2.2, and the results for each alternative are provided in Sections 3.7.2.3 through 3.7.2.6 and 3.8.2.3 through 3.8.2.6. The methods, logic, and science behind the findings of less than significant for biological impacts are supported in these sections.

Comment NG10-37

Comment
2. The Draft's Conclusions that Vegetation and Wildlife Will Not Be Impacted Lack Biological Support. Similarly, for terrestrial species, the Draft's analysis of biological impacts on the few waterways that it analyzes after application of the screening thresholds is unacceptably cursory. For example, for Coon Creek, the Draft concludes that impacts to terrestrial species will not be significant because substantial flow reductions will occur infrequently. Draft EIS/EIR at 3.8-59. The Draft does not present any biological information or analysis to show that the frequency of low-flow events determines the impacts of those events on sensitive species.

Response
The EIS/EIR conclusions regarding impacts to vegetation and wildlife are based on the analyses and supporting substantial evidence summarized in Section 3.8. See response to Comment SA01-21 regarding impacts to wildlife in Coon Creek.

Comment NG10-38

Comment
With respect to Little Chico Creek and Bear River, the Draft seems to conclude that flow reductions will have a less than significant impact on terrestrial species because the flow reductions are likely to occur when water levels are already low. Id. at 3.8-59 to 3.8-61. These conclusions are unsupported by data or analysis. Further, it seems that flow reductions could have a particularly profound impact during dry years or periods when streamflow is already low, as every drop of available water would be critical for riparian ecosystems. Further analysis that actually describes the anticipated impacts to the terrestrial species that rely on these waterways is required.

Response
The maximum flow changes predicted at full groundwater substitution would be a maximum 0.04 cfs reduction for Little Chico Creek. This is an insubstantial loss and would not be expected to have a significant effect on either natural communities or special-status wildlife. Bear River flow reductions greater than 10 percent would only be expected to occur during February in the wet season, and are not expected to affect vegetation. Impacts to natural communities and wildlife would be less than significant.

Comment NG10-39

Comment
Finally, for Cache Creek and Stony Creek, the Draft concludes that flow reductions could have a significant impact on the riparian natural communities associated with these streams. Id. at 3.8-52 to 3.8-53, 3.8-58. These impacts would be reduced to less-than-significant levels, the Draft concludes, through implementation of the groundwater mitigation measure. Id. As discussed in the next section, however, the groundwater mitigation measure is insufficiently protective, and significant impacts will remain after its implementation.

Response
Vegetation monitoring requirements have been clarified in Mitigation Measure GW-1. See Common Responses 6 and 10.

Comment NG10-40

Comment
C. The Mitigation Measure for Potentially Significant Impacts from Groundwater Substitution Transfers is Inadequate. In several instances, the Draft: relies on Mitigation Measure OW -1 (see Draft: EIS/EIR at 3.3-88 to 3.3-91) to conclude that otherwise significant impacts will be reduced to less-than significant levels. For example, it relies on the groundwater mitigation measure to avoid significant impact to natural communities along Cache Creek and Stony Creek (id. at 3.8-52 to 3.8-53,3.8-58), and to

> ameliorate potentially significant impacts to fish and terrestrial species associated with small streams for which no historical flow data are available (id. at 3.7-26,3.8-51). Similarly, the Draft: concludes that the groundwater mitigation measure would help to eliminate the possibility of cumulatively significant impacts to fisheries. Id. at 3.7-56. With respect to impacts to vegetation and wildlife, the Draft: generally concludes that the "Environmental Commitments described in Section 2.3.2.4 and Mitigation Measure OW-1 described in Section 3.3 would eliminate or reduce the potentially substantial effects of water transfer actions." Id. at 3.8-90.

Mitigation Measure OW -1 requires potential sellers to comply with a specific set of monitoring provisions, and to create and implement a mitigation plan. Id. at 3.3-88 to 3.3-91. "The purpose of Mitigation Measure OW -1 is to monitor groundwater levels during transfers to avoid potential effects. If any effects occur despite the monitoring efforts, the mitigation plan will describe how to address those effects." Id. at 3.3 -91. The monitoring requirements include measurement of well discharge rates and volumes, groundwater-level measurements, and assessments of land subsidence. Id. at 3.3-88 to 3.3-89. The Draft: requires that a mitigation plan include "[d]evelopment of mitigation options," and suggests particular actions, including curtailment of pumping, reimbursement for increased pumping costs, and reimbursement for expenses caused by infrastructure damage from land subsidence. Id. at 3.3-90 to 3.3-91.

Response
Based on the analysis and supporting evidence summarized in Section 3.8, Mitigation Measure GW-1 is sufficient to reduce impacts to a level that is less than significant. See also Common Response 10.

Comment NG10-41

Comment
There are no specific actions, however, to address significant impacts to fisheries and riparian communities that could result from streamflow depletions associated with groundwater substitution transfers. This is problematic because, as discussed above, the Draft: recognizes that groundwater substitution transfers could cause significant impacts to fish and terrestrial species, and relies on Mitigation Measure OW-l to reduce these impacts to less-than-significant levels. By relying on not-yet-created plans to mitigate impacts to fish and wildlife, without demonstrating how these impacts can be mitigated, the Draft: violates CEQA's prohibition on deferred mitigation. See, e.g., City of Long Beach v. Los Angeles Unified Sch. Dist., 176 Cal. App. 4th 889, 915-16 (2009) ("Impermissible deferral of mitigation measures occurs when an EIR puts off analysis or orders a report without either setting standards or demonstrating how the impact can be mitigated in the manner described in the BIR. "). [Footnote: The environmental commitment focused on groundwater substitution transfers does not fix this problem because it merely requires that mitigation plans address impacts to water resources needed for special status

species protection, but does not provide any guidance as to how the impacts can be mitigated. See Draft EIS/EIR at 2-29.]

To remedy this problem, a revised draft EIS/EIR should include particular actions that sellers can take to mitigate significant impacts to fisheries, vegetation, and wildlife caused by groundwater substitution transfers. For example, the revised draft could include a mitigation action requiring a seller who is responsible for a flow reduction that significantly impacts fish and wildlife to curtail pumping and dedicate a portion of his surface water supply to flows for fish and wildlife until the waterway is no longer impacted by the seller's transfer-related groundwater pumping.

Response
Related to fisheries resources, all impacts were found to be less than significant, therefore no mitigation is necessary. All references to mitigation measures were removed from Section 3.7 to avoid confusion.

Vegetation monitoring requirements have been clarified in Mitigation Measure GW-1. See Common Responses 6 and 10.

Comment NG10-42

Comment
V. The Draft Fails to Analyze Impacts to Wildlife from Increased Irrigation of Drainage-Impaired Lands in the Buyers' Service Area. The Draft also fails to adequately analyze impacts to water quality and wildlife that could occur in the Buyers' service area as a result of increased irrigation of drainage-impaired lands. It is well known that substantial acreage within SLDMWA is compromised by the accumulation of selenium-laden drainage water in the shallow groundwater table. For example, as of2006, there were approximately 298,000 acres of drainage-impaired lands within Westlands Water District. U.S. Bureau of Reclamation, San Luis Drainage Feature Re-evaluation Final Environmental Impact Statement (May 2006) at ES-15, available at http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=61. The Draft acknowledges that increased irrigation of lands with contaminated drainage water could impact surface waters in the region because "increased irrigation could cause water to accumulate in the shallow root zone and could leach pollutants into the groundwater and potentially drain into the neighboring surface water bodies." Draft EIS/EIR at 3.2-41. As is clear from the experience at Kesterson Reservoir, drainage-water discharges to surface waters can have profound impacts on wildlife, including sensitive migratory birds.

The Draft, however, concludes that increased irrigation of drainage-impaired lands will not be a problem because the proposed action would be implemented in dry years, so "most water would be applied to permanent crops or crops planted on prime or important farmlands," and "farmers would continue to leave marginal land and drainage impaired lands out of production and use water provided by the Proposed Action for more productive lands." Id. But this statement is contradicted elsewhere in the Draft. For example, the chapter on agricultural land use states that the proposed action would "increase water supplies and potentially allow growers to place previously idled land into production." Id. at 3.9-48. Additionally, the Draft indicates that the Exchange Contractors could sell up to 150,000 acre feet, and that "both projects could sell their water to the same buyers." Id. at 3.8-93. It clearly remains possible that the proposed action would result in increased irrigation of drainage-impaired lands.

Response
Section 3.2.2.4.2 includes an assessment of whether increased agricultural irrigation in the buyers' area could affect water quality. The assessment indicates the irrigation would not be focused on drainage-impaired lands because growers would focus limited supplies during shortages on permanent crops or crops planted on prime or important farmland. The impact finding is that agricultural runoff would not significantly degrade water quality in San Joaquin Valley waterways, which would indicate the effort would not result in water quality-related impacts to wildlife in the area.

Comment NG10-43

Comment
The Draft also suggests that any drainage created by the proposed action would not be problematic "given drainage management, water conservation actions and existing regulatory compliance efforts already implemented in that area." Id. at 3.2-41. Yet the status of drainage management in the region remains unclear. Reclamation is in the process of finalizing a settlement agreement with Westlands that would shift responsibility for providing drainage services from the federal government to the district. See Principles of Agreement for a Proposed Settlement Between the United States and Westlands Water District Regarding Drainage (Dec. 2013) (attached as Exh. H). Though the draft settlement agreement has not been made public, the attached Principles of Agreement suggest that that the deal may not include important safeguards such as performance' standards, monitoring requirements, federal oversight, and enforcement mechanisms to ensure that any drainage-water discharges are properly managed. Further, the Principles of Agreement indicate that the settlement will only require Westlands to retire 100,000 acres, leaving almost 200,000 acres of drainage-impaired land within the district eligible for irrigation. In light of the major deficiencies in the pending settlement, the Draft cannot rely on "existing regulatory compliance efforts" to avoid addressing the drainage-related impacts that the proposed action could cause.

Because the proposed action could lead to increased irrigation of drainage impaired lands in Westlands and other districts, causing potential impacts to birds and other wildlife, and because it is uncertain whether there will be an effective drainage management plan in place, a revised draft EIS/EIR should include a quantitative analysis of potential environmental impacts from this increased irrigation, including water quality impacts to surface waters in the Buyers' service area, as well as an assessment of potential impacts to migratory birds and other wildlife.

Response

The impact analysis does not rely on specific conditions of the Westlands drainage settlement to find that impacts would be less than significant. The description of the potential impact explains transfer water would not likely be used for irrigation of marginal or drainage-impaired lands. This factor, when combined with other factors such as the small incremental amount of agricultural discharge from water transfers and drainage management in the area, resulted in a less than significant finding. Furthermore, in the absence of a settlement of federal drainage obligations, Reclamation is working to address drainage-impaired lands under the authority and duties imposed by federal law. As part of those activities, the San Luis Drainage Feature Re-Evaluation and Grassland Bypass Project 2010-2019 both underwent a separate environmental compliance and public comment process that thoroughly addressed issues of continued irrigation of agricultural lands with CVP water and the production of drainage. More information on those projects and public review can be found at http://www.usbr.gov/mp/sccao/sld/ and http://www.usbr.gov/mp/grassland/.

See responses to Comments NG03-125 and NG03-141 for additional information.

Comment NG10-44

Comment

VI. The Draft Fails to Analyze an Adequate Range of Alternatives. Both CEQA and NEP A require consideration of a reasonable range of alternative actions that might achieve similar goals with less environmental impact. Cal. Pub. Res. Code §§ 21002, 21061,21100; 14 Cal. Code Regs. § 15126.6; 42 U.S.C. § 4332; 40 C.F.R. §§ 1502.14, 1508.25(b). "The existence of a viable but unexamined alternative renders an environmental impact statement inadequate." Natural Res. Def. Council, 421 F.3d at 813 (quotation marks and citation omitted). Further, CEQA is designed to prevent public agencies from approving projects if feasible alternatives or mitigation measures would substantially lessen the significant environmental effects. Cal. Pub. Res. Code § 21002.

Here, the Draft has failed to analyze an alternative that could achieve the project purpose with a less substantial environmental impact. The Draft analyzes four alternatives: (1) no action/no project; (2) full range of transfers (proposed action); (3) no cropland modifications; and (4) no groundwater substitution. Draft EIS/EIR at 2-6. While the two action alternatives other than the proposed alternative restrict the available methods of transfer, the Draft does not consider any action alternative that restricts the quantity of water that may be transferred.

Cropland modification transfers and groundwater substitution transfers affect environmental resources differently, and the alternatives that exclude one or the other method reduce some, but not all, impacts associated with the proposed action. An alternative that reduces the amount of water that could be transferred, for example to 50 percent of the amount included in the proposed action, for both cropland modification transfers and groundwater substitution transfers would reduce almost all of the environmental impacts caused by the proposed action to some extent. Because such an alternative would still meet the project's objectives, and would substantially reduce environmental impacts, it should be included and fully analyzed as an alternative in a revised draft EIS/EIR.

Response
The three action alternatives have different upper limits for water transfers. Alternative 2 could have up to about 511,000 acre-feet of transfers, Alternative 3 could have up to about 391,000 acre-feet of transfers, and Alternative 4 could have up to about 277,000 acre-feet of transfers. These alternatives already represent a range of potential total transfers, with Alternative 4 including about half the total amount of transfers in Alternative 2. The request to analyze different upper limits for transfers is satisfied within this current range of alternatives.

Comment NG10-45

Comment
VII. The Draft Fails to Account for Climate Change Impacts. It is well accepted that changes to California's temperature and precipitation regime will occur in the future, and these changes will affect nearly all aspects of the CVP system. Further, the Draft acknowledges that, among other impacts, "[c]limate change will continue to affect natural ecosystems, including changes to biodiversity, location of species and the capacity of ecosystems to moderate the consequences of climate disturbances such as droughts. In particular, species and habitats that are already facing challenges will be the most impacted by climate change." Draft EIS/EIR at 3.6-13 (citations omitted).

Though it recognizes that climate change impacts are occurring now, the Draft concludes that climate change will not significantly impact the proposed action because of the action's ten year timeframe: "Because of the short-term duration of the Proposed Action (10 years), any effects of climate change on this alternative are expected to be minimal. Impacts to the Proposed Action from climate change would be less than significant." Id. at 3.6-21 to 3.6-22. Similarly, in its analysis of impacts to fisheries, the Draft concludes that climate change will not alter conditions in reservoirs, rivers and creeks, or the Delta because there will be limited climate change predicted over the project's ten year duration. Id. at 3.7-23 to 3.7-24. Beyond these conclusory statements, the Draft includes no modeling or analysis to show the proposed action's impacts in light of expected climate change.

The Draft's approach to climate change is a substantial departure from recently produced environmental documents in which climate change is incorporated into the operational modeling for the project. For example, Reclamation incorporated climate change into the modeling and assessment of environmental impacts for the BDCP's draft environmental documents. See, e.g., BDCP Draft EIS/EIR at 4-6,5-47 to 5-49, and Appendix 3E. In the BDCP Draft EIS/EIR, the "CALSIM model was used to simulate how projected changes in runoff (i.e., reservoir inflows) for two future climate periods, 2025 and 2060 conditions, would affect existing reservoir operations and Delta inflows in the project area." Id. at Appendix 29B-I. Importantly, the above quote reflects that the BDCP Draft EIS/EIR included climate changes impacts in its operational model for 2025 – only one year after the time period covered by the proposed action. The proposed BDCP and the proposed action have overlapping action areas and operational considerations, and BDCP's modeling of climate change impacts in 2025 undermines the Draft's position that climate change impacts within a ten year time frame will be inconsequential.

Because the Draft's analysis and operational modeling does not reflect likely operations in the future with climate change, the Draft's assessment of potential environmental impacts fails to accurately assess the impacts of the proposed action in light of climate change. This approach is not consistent with CEQA or NEPA, and the operational modeling must be revised to incorporate climate change in order to accurately assess potential environmental impacts.

Response
As described in Appendix B, Water Operations Assessment, the CalSim II modeling completed for this analysis simulates the operation of the CVP and SWP "using 82 years of historical hydrology from water year 1922 through 2003" (see page B-4). Because the modeling incorporates known climatic variability, it by definition considers any changes in hydrology from climate change. The appendix further states that "[t]he Project's ten-year period allows simulation of a single level of development under the assumptions that conditions are not likely to change significantly over such a short time horizon" (see page B-19). Although climate change will continue to occur during the project's implementation, the effects are expected to be minimal as demonstrated in Section 3.6, Climate Change, and specifically in Section 3.6.1.3, Existing Conditions.

Comment NG10-46

Comment
VIII. The Draft Fails to Adequately Assess Cumulative Impacts. The Draft fails to adequately consider cumulative impacts because it fails to include an assessment of potentially cumulative projects. Initial comments on the proposed action that the Glenn-Colusa Irrigation District ("GCID") submitted to Reclamation on October 14, 2014 illustrate the problem. GCID's letter describes its Groundwater Supplemental Supply Program, through which it is

proposing to install and operate five new groundwater production wells and operate an additional five existing wells for use within GCID during dry and critically dry water years. The letter indicates that the wells would have a production capacity of approximately 2,500 gallons per minute, and would operate during dry and critically dry water years for a cumulative total annual pumping volume of up to 28,500 acre feet. The letter indicates that pumping under the Groundwater Supplemental Supply Program would likely occur in the same years as the long-term transfers that the Draft analyzes. Yet the Draft does not include GelD's Program in its analysis of cumulative impacts to groundwater resources. See Draft EIS/EIR at 3.3-91 to 3.3-92. The cumulative impacts caused by groundwater substitution transfers covered by the proposed action and groundwater pumping under GelD's new program could be significant, and further analysis is required. More generally, GelD's letter suggests that the Draft's authors did not adequately survey the proposed action's potential sellers to understand their future operations, raising questions about other likely projects that have been excluded from the Draft's cumulative impacts analysis.

Response

Information on GCID's Groundwater Supplemental Supply Program was not available at the time the cumulative analysis was completed for the Draft EIS/EIR. The cumulative analysis for Groundwater Resources has been updated to include GCID's program.

Comment Letter NG11, Joni Stellar, Frack-Free Butte County

Comment NG11-1

Comment

A profound need exists to reconcile ALL proposed water transfer policies with California’s new Groundwater legislation, existing over-commitment of surface waters, and the current massive, long-term drought conditions. Groundwater levels are in severe decline in Northern California – and proposed transfers will only make this situation worse. Lack of snow and rain is limiting recharge of aquifers. Insufficient surface flows into San Francisco Bay and Delta are negatively impacting this most important estuary to fisheries on the West Coast. There simply isn’t enough water to go around.

Many people living in Northern CA express deep and valid concerns about their wells going dry. People need water for personal needs, farming, fishing, recreation, and more. Yet, any hope for a “sustainable relationship” between the North State residents and our water supplies is evaporated by plans to transfer so much water south.

Governmental agencies should use the best, most current and pertinent data to make analyses of water systems so as to make good predictions and plans. However, the baseline data your agency uses to plan transfers of water out of

Northern California includes only the years 1973-2003. As the current extensive, severe drought continues, more current data must be incorporated to make appropriate predictions and plans. Careful conservation and wise use of precious water can be better planned using more accurate data.

Response
See Common Response 5.

Comment NG11-2

Comment
Please help everyone in California confront the realities of the current drought and on-going climate change. Conserving water should be the major focus of government agencies and corporations, as well as residents and small farmers. For example, directing farmers to plant crops that use far less water than many current agribusinesses 'need,' and to use drip irrigation instead of ‘flood’ irrigation methods still in common use. Residents and municipalities should greatly reduce turf grass and other water-intensive landscaping, replacing it with less water-thirsty plantings.

We cannot afford to have Northern California streams, lakes, and groundwater drained just to transfer water to reservoirs and tunnels designed to help Southern California water districts and big agricultural corporations make profits and maintain their status quo. The costs to our communities and environment (including forests, animals, fishes), and taxes, are simply too high. We do not want or need a “Cadillac Desert” in California.

Response
The Lead Agencies recognize the importance of water conservation as part of a water supply portfolio. Reclamation has included Water Re-Use and Conservation as one of the critical CVP/SWP operational considerations to address drought in the "Interagency 2015 Drought Strategy" (available from http://www.usbr.gov/mp/drought/docs/WY2015/Drought_OPInteragency2015_Drought_Strategy.pdf). Additionally, Reclamation requires CVP contractors to implement water use efficiency best management practices as required by CVPIA Section 3405(e). Water conservation efforts included as alternatives to the Proposed Action would need to be in addition to the efforts already planned for implementation; therefore, they represent conservation actions that require substantial infrastructure and investment and would not be immediately implementable.

Comment Letter NG12, Grace Marvin, Sierra Club, Yahi Group

Comment NG12-1

Comment

As Conservation Chair of the Yahi Group of the Sierra Club, I attended your "public meeting" on 10/21/2014 concerning Long-Term Water Transfers Draft EIR/EIS. In light of my concerns about the talk, I asked questions at the meeting linking the need to connect the spirit behind the groundwater legislation adopted by Governor Brown for our state and the transfer policies. Subsequently, I reviewed the Sierra Club water policy (developed by the Club's California Nevada Regional Conservation Policies or CNRCC in 1993 and amended in 2004 and 2009). There I saw how the transfer policy you presented violated the spirit of the club's water policies that are devoted to careful preservation and wise use of our natural resources.

Response

Section 3.3.1.2, Regulatory Setting has been edited to include a summary of the Sustainable Groundwater Management Act adopted in September 2014. Additionally, as stated in Section 3.3.4.1, "basins designated as high- and medium-priority with critical overdraft conditions as part of DWR's sustainable groundwater management act work, will suspend transfers until (1) a groundwater sustainability plan (GSP) is developed and the adopted GSP recognizes transfers as a sustainable practice; or (2) an existing GMP recognizes transfers as a sustainable practice."

This EIS/EIR provides a thorough and systematic evaluation of a broad range of environmental issues and discloses any potential impacts to natural resources (i.e., water supply, water quality, groundwater resources, vegetation and wildlife) as a result of the Proposed Action. This disclosure will help decision-makers select the action to take to move forward.

Comment NG12-2

Comment

The CNRCC states on goal is to "preserve and restore naturally functioning biodiverse, and productive aquatic ecosystems throughout California." In my opinion, to do so requires that agencies use pertinent data to make analyses of water systems so as to make better predictions. But the baseline data your agency uses to plan transfer water out of the north state cover the years 1973-2003. Since we are no seeing uniquely dry conditions now and well into the future, why not use more current data to make predictions? "Careful preservation and wise use" of our water can be better planned using more accurate data.

Response

See Common Response 5.

Comment NG12-3

Comment
Another process that is violated in the transfer policies is the following: "Develop a sustainable relationship between people and the aquatic environment to meet the needs of each." As we heard at the 10/21/2014 meeting a large number of people expressed deep concerns about their wells being either completely dry or nearly so. People need this water for personal needs, farming, fishing, recreation, and more. Yet, any hope for a "sustainable relationship" between many of us in the north state and our water supplies was evaporated by the plans to transfer water south.

Response
The potential for the action alternatives to affect groundwater levels (including the potential to exacerbate drought-related groundwater level declines) is considered in Section 3.3, Groundwater Resources. This section includes Mitigation Measure GW-1, which requires monitoring for groundwater levels and mitigation to avoid potentially significant adverse effects.

Comment NG12-4

Comment
Furthermore, the Water Ethic spelled out in the CNRCC policy is that individuals and organizations should "utilize water conserving practices in agricultural and urban areas." But no mention was made of any kind of effort to direct famers to plant crops that use far less water than many current agribusinesses need."

Response
The concept of increasing agricultural water use efficiency in the buyers' area was considered in the EIS/EIR as part of the Agricultural Conservation (Buyer Service Area) alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives, as it would not be immediately implementable and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment NG12-5

Comment
Finally, Sierra Club is focused on the environment -which we are supposed to enjoy, preserve, and protect. Many other aspects of the CNRCC policy are violated with the water transfer policy, but I ask you to pay special attention to this one, since you are part of an institution that is capable of making such changes: "Adapt water use, pollution control, land use, and other social and economic patterns to reduce and avoid conflicts with environmental needs." Please help us in the north state in confronting the current drought and on-going

climate change. We cannot afford to have our streams, lakes, groundwater, and rivers drained in order to transfer water to reservoirs and tunnels designed to help southern water districts and agricultural corporations make profits that cost our environment (including trees, animals, fish) so much. We do not want another "cadillac desert" in California.

Response
See Common Response 2.

Comment Letter NG13, Jay Ziegler, The Nature Conservancy, California Chapter

Comment NG13-1

Comment
As both a conservation organization and land owner in the Delta and Sacramento Valley, The Nature Conservancy (TNC) has been engaged in the Central Valley and Delta for many years to advance the recovery of endangered species, restore and preserve multiple types of habitat, and seek to apply sound science and practical solutions that work for nature and people.

Of particular interest to the Conservancy is the importance of achieving overall sustainable water management practices in California; both for the benefit of people and natural systems. The California Water Action Plan recognizes that this includes imperative actions such as improving groundwater management, better managing our surface flows, restoring wetlands and watersheds, and facilitating water transfers. The challenge facing California's water managers, including the federal agencies and water districts who are the principal entities that will participate in—and benefit from—this Long-Term Water Transfer program, is to implement water transfer programs in a manner that is clear and transparent, based on sound science, and which minimizes impacts by design, especially in areas of origin.

We agree that water transfers are an important tool for overall sustainable water management when properly designed and implemented with appropriate mitigation; however, we are concerned about the potential impacts that could occur with implementation of the Proposed Action, and we are not confident that these impacts have been addressed through the mitigation measures and environmental commitments outlined in the Draft EIS/EIR.

In particular, The Nature Conservancy is concerned about the impacts to fish and wildlife that could result from surface water and groundwater transfers of the magnitude envisioned in the Draft EIS/EIR, especially related to sustainable groundwater and surface water management. We are also concerned that the fallowing described in the Proposed Action may impact wildlife-friendly farming necessary for Pacific Flyway habitat for migratory birds. For example, water transfers are likely to result in the idling of riceland and other compatible agricultural land in the Sacramento Valley, where now the water applied to many of these crops serves multiple purposes and represents a decade of cooperation and innovation between our organization, our partners, and the landowners with whom we work. As we discuss below, more robust environmental commitments are critical to address the potentially significant impacts of the Proposed Action, and also present an opportunity to demonstrate true sustainable water management that works for both people and natural systems. Additionally, the Draft EIS/EIR must demonstrate a clear linkage and rationale between the environmental commitment or measure and what impact will be avoided or mitigated, and use best available science.

Response

The environmental commitments in Section 2.3.2.4 reflect information from consultation with the U. S. Fish and Wildlife Service and the most recent scientific studies on giant garter snakes from the U. S. Geologic Survey. Section 3.7 analyzes potential impacts to fisheries, and finds that changes in streamflow would not significantly affect fish because the changes would be small and/or would not occur at times and locations when fish are present. Section 3.8 assesses potential effects to terrestrial species from cropland idling and riparian vegetation from groundwater substitution.

Comment NG13-2

Comment

1. Environmental commitments are inadequate to avoid or mitigate impacts, and must give environmental consequences a "hard look."

The Draft EIS/EIR includes environmental commitments to mitigate for the impacts of the proposed long- term transfers. The Bureau of Reclamation's NEPA Handbook describes "environmental commitments" as "written statements of intent made by Reclamation to monitor and mitigate for potential adverse environmental impacts of an action associated with any phase of planning, construction, and operation and maintenance (O&M) activities. It is a term used by Reclamation to reflect the concept addressed in 40 CFR 1505.3." Section 1505.3 of part 40 of the Code of Federal Regulations refers to the implementation of mitigation measures. The Draft EIS/EIR also describes the environmental commitments as comparable to the mitigation measures required under CEQA. Thus, the environmental commitments are intended to be mitigation measures.

NEPA requires that the environmental impact statement give a "hard look" at the environmental consequences of the proposed project. Minnesota Public Interest Research Group v. Butz, 541 F.2d 1292, 1301 (8th Cir. 1976), quoting Kleppe v. Sierra Club, 96 S.Ct. 2718 (1976). With respect to mitigation measures, a "hard look" requires that the measures "be discussed in sufficient detail to ensure that environmental consequences have been fairly evaluated." Carmel-by-the-Sea v. U.S. Dept. of Transportation, 123 F.3d 1142, 1154 (9th Cir. 1992) (internal citation omitted). "A mere listing of mitigation measures is insufficient to quality as a reasoned discussion." Northwest Indian Cemetery Protective Assoc. v. Peterson, 795 F.2d 688, 697 (9th Cir. 1986), rev's on other grounds, 108 S.Ct. 1319 (1988). Failure to include a "reasonably thorough discussion of mitigation measures . . . would undermine the action-forcing goals of [NEPA]." Carmel-by-the-Sea, supra, at p. 1154.

CEQA requires that an EIR describe in detail "[m]itigation measures proposed to minimize significant effects on the environment." (Pub. Resources Code, § 21100, subd. (b)(3).) The CEQA Guidelines, the implementing regulations for CEQA[1] set forth the detail required for an adequate description of mitigation measures. Section 15126.4, subdivision (a)(1) provides that an "EIR shall describe feasible measures which would minimize adverse impacts." And section 15126.4, subdivision (a)(2) requires that "[m]itigation measures must be fully enforceable through permit conditions, agreements, or other legally-binding instruments.

Response
The Environmental Commitments in Chapter 2.3.2.4 describe limitations on transfers and operational restrictions that SLDMWA and Reclamation would incorporate in how they review and approve proposed transfers. See Common Response 14. Most of these measures include restrictions related to potential effects on giant garter snakes. Including these environmental commitments does not preclude an analysis of environmental effects. The Draft EIS/EIR analyzes potential environmental consequences to the giant garter snake in compliance with NEPA and CEQA starting on page 3.8-68.

Comment NG13-3

Comment
The environmental commitments included in the project description are inadequate as mitigation measures under both NEPA and CEQA. The descriptions are perfunctory and conclusory. For example, with respect to the impact on fisheries, the Draft EIS/EIR concludes without analysis that "The environmental commitments described in Section 2.3.2.4 incorporated into the project will reduce or eliminate significant impacts to fisheries resources and fish species of management concern. No additional mitigation is required." (Draft EIS/EIR Ch. 3, § 3.7.4.) Presumably based on this conclusion, the Draft EIS/EIR goes on to conclude that "[n]one of the action alternatives would result in potentially significant unavoidable impacts on fisheries." (Draft EIS/EIR Ch. 3, § 3.7.5.) Section 3.7.4 does not specify which of the environmental commitments will mitigate for impacts to fisheries or how that mitigation is expected to occur. More significant, none of the environmental commitments described in Alternative 2, the Proposed Action, addresses impacts to fisheries or measures for protecting fisheries. The Draft EIS/EIR fails to fully describe impacts to fisheries and mitigation for those impacts the requisite hard look and therefore is inadequate.

Response
No effects on fisheries were found and mitigation measures are unnecessary. All references to environmental commitments were removed from the fisheries section (Section 3.7) to avoid confusion, except in Section 3.7.4 which indicates environmental commitments will be incorporated in the project to avoid significant impacts to fisheries resources and fish species of management concern.

Comment NG13-4

Comment
With respect to wetland plants and wildlife, the Draft EIS/EIR Section 3.8, page 3.8-64 states that: "The reduction in available habitat in rice fields and the associated reduction in the availability of waste grains and prey items as forage to wildlife species that use seasonally flooded agriculture for some portion of their lifecycle, could result in potentially significant effects to those species. These impacts are reduced by the environmental commitments in Section 2.3.2.4." There is no elaboration or discussion of the rationale for this conclusion. It is not evident from the list of environmental commitments how any of the commitments would reduce the impacts to migratory birds and other wetland-dependent species that use flooded agricultural land to a less-than-significant level.

At a minimum, environmental commitments or mitigation measures should build on previously accepted protective measures that were determined through robust analysis. For example, environmental commitments should at a minimum include all of the giant garter snake protections that were included in the 2009 and 2010 biological opinions

Response
See Common Responses 10, 12, and 13.

Comment NG13-5

Comment
2. Environmental commitments to address impacts to migratory and resident water birds must be expanded based on best available science and consider cumulative impacts from all sources of habitat reduction in the Central Valley.

The one environmental commitment listed in Section 2.3.2.4 that is specifically written to mitigate for potentially significant impacts to birds states that minimizing cropland idling transfers in the Butte Sink will limit reductions in over-winter forage for migratory birds. As described in the Central Valley Joint Venture (CVJV) Implementation Plan as well as many peer-reviewed journal articles, known wintering areas for migratory water birds as well as priority habitat for shorebirds in spring and late summer extend far beyond the Butte

Sink. Additionally, simply minimizing idling transfers in a specific area will not minimize the impact of the Proposed Action on migratory birds and resident waterfowl, as there will still be an overall reduction of available habitat in the Sacramento Valley due to the Proposed Action. Comparing the net reduction in available quality foraging habitat and bioenergetics (food) supply to the needs of the bird population across the Valley is the more appropriate metric to gauge impacts; this type of analysis was done as part of the Bay Delta Conservation Plan EIS/EIR, but not for this Draft EIS/EIR

Response
See Common Responses 10 and 13.

Comment NG13-6

Comment
Crop idling transfers described in the Proposed Action will particularly reduce available habitat and forage in the Sacramento Valley in dry years. Although the Draft EIS/EIR limits idling to 51,473 acres of rice per year, this does not account for the impact already dry conditions may be having on habitat, the majority of which is now provided by flooded agricultural land. Chronic drought conditions over the last 3 years have led to fewer and fewer acres of flooded habitat available for birds at key times and places during their annual Pacific Flyway migration. This year conditions are particularly bad with abundant birds arriving from a good breeding season in the arctic only to find overcrowded conditions on available flooded habitat areas. Our scientists remain vigilant for cholera and botulism outbreaks that may impact special status species. We are so concerned that, with private funding, TNC has been working with landowners to create flooded habitat conditions thousands of acres as an emergency backstop to severe shortages in migratory bird habitat during this drought year.

Response
See Common Response 13.

Comment NG13-7

Comment
Although the Draft EIS/EIR describes the 51,473 acre limit as roughly equivalent to 10.5% of the average land in rice production from 1992 to 2012 (page 3.8-69), only about 140,000 acres of typical rice acreage was in production this year 1, and only about 50,000 acres of those were flooded for post-harvest decomposition, leaving only a small fraction of critical habitat available at critical times to migrating birds. Increased idling of compatible crops from the Proposed Action, particularly in dry years, will place additional pressure on the already-stressed refuges and compatible agricultural habitats, potentially resulting in significant impacts to species that depend on those habitats. There are ways to quantify this impact; for example, Ducks Unlimited

has estimated that a “25 percent reduction in the number of acres in rice production would result in a loss of capacity to support about 600,000 ducks.”2

Response
The California Rice Commission reported as of October 2014 that 420,000 acres were planted in rice for 2014, a 25 percent reduction from the previous year. Overall, this is a 15 percent reduction from the 20-year mean for rice production within the Sacramento Valley. Post-harvest practices (i.e., flooding, burning, and disking) are highly variable from year to year and predictions regarding the reduction of post-harvest forage impacts are not feasible based solely on the amount of rice planted. It would be expected that for a given year, the percent reduction in rice planted would have a similar percent reduction in post-harvest forage. See Common Response 13 for additional information.

Comment NG13-8

Comment
The fourth environmental commitment listed in the Draft EIS/EIR states that Reclamation will provide maps to the USFWS showing the parcels of riceland that are idled, but provides no further details about the use of these maps or FWS input will mitigate potential impacts described in the Draft EIS/EIR. How will the FWS use this information to make decisions regarding the Proposed Action? Will these maps be developed in conjunction with the FWS prior to the transfer, or after idling decisions are already made? How will this mitigate potential environmental impacts, particularly to terrestrial resources such as migratory birds?

Response
See Common Responses 10 and 12.

Comment NG13-9

Comment
Environmental commitments should be added that minimize the extent of idled land allowable in a basin so that it does not fall below CVJV habitat objectives or other protective, biologically-based thresholds. A maximum allowable percentage of idled rice should be set by county, accounting for all sources of fallowing, including drought and other transfer programs. These limits should be developed with biological analysis that demonstrates the impact on wetland-dependent species will not be significant. For example, bioenergetics modeling (such as TRUMET3) should be done to assess the impact that crop idling transfers and other habitat reductions cumulatively will have on available food supplies in various water year types, and establish limits that provide adequate food supply. Maps should be developed which compare available shallow mudflat habitat with and without the Proposed Action to gauge potential impacts to shorebird habitat at their critical migration periods.

Response
See Common Responses 12 and 13.

Comment NG13-10

Comment
To lessen impacts to migratory birds, we recommend that the environmental commitments and mitigation measures incorporate consultation with the CVJV partner organizations as well as the FWS, and that the process for review and enforceability be described in detail in the Draft EIS/EIR. The science and conservation organizations and agencies that comprise the CVJV, including the Bureau of Reclamation, work collaboratively to protect, restore, and enhance habitats for birds, in accordance with conservation actions identified in the CVJV Implementation Plan. This Plan sets quantitative habitat objectives based on best available science to ensure sustainable populations of migrant and resident birds in California, a critical area which has lost over 90 percent of its wetlands, within the context of the habitat in the entire Pacific Flyway. The Plan's objectives incorporate a baseline of habitat expected to be provided by private lands. Habitat provided by private wetlands and post-harvest flooded agricultural land is depended on to provide 60 percent of the energetic needs of waterfowl in the Central Valley during winter as well as vital nesting and brooding habitat for many other species.

Partner CVJV organizations, including TNC, have completed studies that establish likelihood of occurrence of shorebirds and other priority migratory bird species over time and space throughout the Central Valley, and have developed maps which should be used to establish where and when crop idling or shifting transfers could occur each year under the Proposed Action to minimize impact to these species. TNC would welcome the opportunity to work with project proponents along with state and federal agencies to advise appropriate use and interpretation of this best available science to minimize impacts to shorebirds and other species, but this must be explicitly described in the environmental commitments or mitigation measures. Such scientific evaluation should consider impacts to flows, floodplains, riparian habitat, and wetlands that reflect multiple habitat values.

Response
Private wetlands, refuges, and established wildlife areas will continue to provide habitat for migratory birds if the range of potential transfer activities analyzed under the Proposed Action is implemented. See Common Responses 10 and 13 for additional information.

Comment NG13-11

Comment
Environmental commitments should include such actions as creating surrogate habitat at key times of year near the idled land. The Proposed Action should be

linked to the environmental commitment; for example, flooding idled rice fields using a small reserved proportion of the total quantity of water approved for a transfer could provide habitat for migrating birds at key times of year, while also allowing most water to be transferred. This type of action, in combination with others, could help reduce the impact of some rice idling.

Response
See Common Response 13.

Comment NG13-12

Comment

3. Potential significant impact on Reclamation's ability to deliver water to refuges should be analyzed and lessened through environmental commitments.

We are concerned that expanded transfers through the Delta will affect the Refuge Water Supply Program's ability to acquire, convey, and deliver water to refuges south of the Delta, a statutory obligation of Reclamation per the Central Valley Project Improvement Act (CVPIA).

The Draft EIS/EIR does not analyze the proposed water transfers' impacts on CVPIA refuges, although with increased competition for water conveyance through the Delta, the impacts to these public and private wetlands could be significant, especially in drought years south of the Delta. This year, for example, East Bear Creek Unit (within the San Luis National Wildlife Refuge Complex) and Kern National Wildlife Refuge are receiving very little water due to conveyance constraints and limited water availability. Wetland habitat there will be impacted for several years by these water shortages. With additional competition for water, reduced water availability, and increasing water costs, the Proposed Action could only make the situation more challenging

Response
See Common Response 9.

Comment NG13-13

Comment
The Environmental Setting should include a description of state wildlife areas and federal wildlife refuges. This seems to have been neglected in this Draft EIS/EIR, even though some of the participating agencies are involved in conveying refuge water and Reclamation is responsible for its delivery under CVPIA. Potential significant impacts from the Proposed Action should include water supply impacts to CVPIA wildlife refuges and the special status species they support. An independent panel convened to review the Refuge Water Supply Program (RWSP) in 2008-2009 found that, "The inability to consistently deliver firm and dependable Incremental Level 4 Water has, on

occasion, pre-empted spring and summer irrigations and maintenance of pond water, which has compromised the potential to stimulate germination of some plants, to maximize seed production, or to maintain summer pond water, which is required for successful breeding and survival of some of the sensitive and at-risk species that depend on the wetland habitats in refuges." Because refuges already receive less water than what is required by CVPIA, further declines in refuge water deliveries could result in potentially significant impacts to these habitats and the special-status species they support.

Response
See Common Response 9.

Comment NG13-14

Comment
The Draft EIS/EIR (page 2-18) states that transfers through the Delta will be "limited to periods when capacity at C.W. 'Bill' Jones Pumping Plant (Jones Pumping Plant) and Harvey O. Banks Pumping Plant (Bank Pumping Plant) is available typically from July through September, and only after Project needs are met." The Draft EIS/EIR is not explicit about whether refuge water deliveries are considered a Project need. Because delivery of Level 2 and Incremental Level 4 water to refuges is a Central Valley Project obligation required by CVPIA Section 3406(d), we believe that Project needs implicitly include refuge water supplies, and that Level 2 and Incremental Level 4 water should have priority over the water transfers proposed in this Draft EIR. However, if Reclamation does not consider refuge water a Project need, then the Draft should analyze how the Proposed Action could impact water delivers to the south of Delta refuges, and how any potentially reduced deliveries could impact migratory birds and other species that depend upon the refuges.

Response
See Common Response 9.

Comment NG13-15

Comment
Currently the RWSP does not deliver Full Level 4 water supplies to all refuges. The 2013 CVPIA Annual Report "Chapter 6 - Progress to Date Toward CVPIA Performance Goals" reported only 39% progress towards acquiring Incremental Level 4 supplies to date and 36% progress towards conveying Incremental Level 4 water supplies, although 100% attainment was required by 2002.5 The Nature Conservancy has worked for several years to understand these constraints and is currently working with Reclamation and CVP agricultural contractors to develop pilot projects that help address these constraints. One key constraint relevant to the Proposed Action is the increasing costs of acquiring and conveying water to refuges. Currently, because of budget and policy constraints and water availability, the RWSP relies primarily on spot-

market water purchases rather than permanent acquisitions to provide some Incremental Level 4 water supplies to refuges. The increasing costs have outpaced the RWSP’s limited annual budget to meet Full Level 4 water supplies, resulting in less and less water acquired and delivered each year. The Proposed Action could increase the price of available spot-market water even more, which would impact the RWSP’s ability to purchase Incremental Level 4 water supplies, further impacting CVPIA refuge water deliveries and the waterbird populations they support. The Draft EIS/EIR should analyze how the Proposed Action will impact water prices, and whether price changes will affect Reclamation's ability to meet its refuge water obligations under CVPIA.

Response
See Common Response 9.

Comment NG13-16

Comment
To help mitigate impacts to refuge water supplies and the habitats they support, we recommend an environmental commitment be added that makes a percentage of each transfer available for purchase by the Refuge Water Supply Program towards meeting Full Level 4 water obligations. That amount would not be credited to the transferor if the RWSP chose to purchase it, and instead it would be schedulable by the Interagency Refuge Water Management Team for delivery to any delivery-short refuge, with reimbursement to the transferor by the RWSP.

The RWSP could also more efficiently manage its existing water supplies across all refuges and meet CVPIA mandates if north-to-south-of-Delta conveyance of RWSP-acquired water supplies and conserved refuge water was less constrained. The Proposed Action increases those constraints by increasing competition for conveying water transfers through the Delta. The situation is made even more difficult because refuges were not included in the Draft EIS/EIR as potential transferors or recipients of this water. To improve this situation and minimize the potential for significant impact, we recommend that an environmental commitment be added that allocates a percentage of allowable CVP transfer capacity each month to the RWSP. Under the commitment, the RWSP would have the first opportunity to schedule water during the window up to a certain flow or volume, if needed for optimal use of available refuge water supplies. Alternatively, an environmental commitment could be added that reserves a percentage of each transfer through the Delta for use by the RWSP towards meeting Full Level 4 water obligations. The full transfer quantity would be transferred through the Delta when scheduled by the transferring parties, but once south of the Delta, the refuge-reserved percentage could be stored in San Luis Reservoir for later delivery to a south-of-Delta refuge.

Response
See Common Response 9.

Comment NG13-17

Comment
4. Impacts from groundwater substitution transfers should be accurately simulated and more clearly illustrated. The Draft EIS/EIR should account for compounding impacts of multiple or repeated groundwater substitution transfers over time, and water supply and environmental impacts should be mitigated until recovery is achieved.

4a. The connection between groundwater and surface water must be accurately simulated.

The ability to rigorously simulate interaction of groundwater and surface water is of great importance to assessing the potential environmental impacts of groundwater substitution transfers in this EIS/EIR because groundwater substitution pumping ultimately comes at the expense of streamflow. A coupled surface water-groundwater model provides for simultaneous solution of flow conditions in these physically coupled systems, thereby allowing for more representative simulation of the interaction of surface water and groundwater. Unfortunately, the groundwater model used for this Draft EIS/EIR analysis (SACFEM2013) is not coupled in this way. Instead, water levels (stages) in the streams are specified by the user. This does not reflect the reality that stream stage rises and falls through time during operation of surface water facilities and changes in groundwater pumping. This issue is likely most important for smaller streams, where changes in stage may lead to more significant changes in flow to or from the groundwater basin. Using SACFEM2013, how were specified stream stages arrived at, and are they ‘conservative’ relative to streamflow depletion impact analysis? The Draft EIS/EIR should include a discussion of how stream stages were decided upon, the potential errors that could arise from specifying heads in streams with this model, and demonstrate why these potential errors are negligible in evaluating environmental impacts in both large and small streams or why they do not compromise the validity of the impact evaluation.

Response
Figure 3.3-27 shows the 12 hydrologic years during which groundwater substitution transfers are simulated. Included in this period is a period of six consecutive years (1987 through 1992) of groundwater substitution pumping. Including 1994, there is a period when substitution pumping is simulated for seven of eight years.

Section D.3.4.1, Head-dependent Boundaries (Appendix D), describes the stream stages used in the SACFEM2013 model. The stream stages applied in the model are not constant. The stages vary along each of the simulated streams and also vary in time. The variable stream stage in the model more accurately represents the up-and-down nature of stream depth during wet and dry periods of the year. The SACFEM2013 model also simulates periods when a stream may be dry by removing surface flow from that node. The stream is allowed to re-wet when that stream is likely to have experienced the reintroduction of flow.

Comment NG13-18

Comment

4b. The impacts on riparian communities from lowered groundwater levels must be avoided or mitigated.

Section 3.8.2.4.1 of the Draft EIS/EIR states that the flow in many small streams would be impacted by more than 10 percent with implementation of groundwater substitution transfers described in the Proposed Action. Figures 3.3-31 a, b and c shows that, as a result of these stream depletions, water table levels will be lowered more than one foot over much of the project area including along many streams and tributaries, and in many places drawdown may be as much as five feet. Natural riparian communities for some distance away from the rivers (the riparian corridor), and along many miles of rivers, could be impacted by these lowered groundwater levels; however, the Draft EIS/EIR only addresses potential impacts to riparian communities due to streamflow depletions—it does not estimate the impacts on natural riparian communities from the lowered water levels that will result from the pumping.

The impacts of these groundwater level drawdowns on riparian corridor communities need to be addressed. This is especially important since, as noted on page 3.8-47, groundwater levels that decline any deeper than key threshold levels (estimated at 15 feet below ground surface on page 3.8-47) will not meet the needs of many plants. In this light, declines of 1 to 5 feet could be significant in many riparian areas, and these impacts must be avoided or mitigated, thus the importance of detailed and transparent modeling and monitoring.

Response

See Common Responses 10 and 11.

Comment NG13-19

Comment

4c. Streamflow depletion resulting from groundwater substitution transfers must be fully accounted for, and the compounding quantity and duration of impacts must be reflected in the analysis and mitigation described in detail in Mitigation Measure WS-1.

Groundwater and surface water systems are interconnected; as a result, groundwater pumping ultimately leads to what is termed "streamflow depletion." This streamflow depletion may be the result of either reduced groundwater discharge to the stream, in which case the stream experiences less gain (groundwater inflow) than before pumping was initiated, or it may be the result of additional induced infiltration from the stream, in which case the stream loses more water than it did prior to groundwater pumping. According to well established principles of groundwater-surface water systems, total stream depletion (from both reduced discharge and induced infiltration from the stream) will trend towards the amount of groundwater pumping in a given area over time, less other potential boundary effects such as subsurface outflow from the basin or changes in small watershed inflow.

Streamflow depletion can occur for many years after groundwater pumping has ceased, and this long-term streamflow depletion and associated impacts must be considered and accounted for. Long-term impacts from multiple years of transfers are especially important to account for since impacts are additive and therefore potentially more severe. The Draft EIS/EIR should include a full water budgeting accounting of where pumped groundwater is coming from and the related duration of streamflow depletion to disclose the location, magnitude, and duration of potential impacts.

Response

As described in Section 3.1, the purpose of Mitigation Measure WS-1 is to address potential water supply effects from streamflow depletion on CVP and SWP contractors that receive water conveyed through the Delta. See Common Response 8 for additional information. This comment refers to streamflow depletion effects on smaller streams and watersheds, but these potential effects are different from those described in the water supply analysis.

Streamflow depletion from groundwater substitution has the potential to decrease surface water flows in waterways as the groundwater basin refills. The EIS/EIR estimates these potential effects, including the compounding effects from multiple consecutive years of transfers, using the SACFEM2013 groundwater model, the CalSim model, and the Transfer Operation Model. The changes in streamflow have the potential to affect multiple resources; these effects are analyzed in Sections 3.1, Water Supply; 3.7, Fisheries; and 3.8, Vegetation and Wildlife. The water supply section investigates how changes in streamflow could affect water supply, and concludes the potential effects would be focused on CVP and SWP users that receive water conveyed through the Delta.

The comment seems to focus more on the potential for watershed effects to environmental resources, which are analyzed in Sections 3.7, Fisheries and 3.8, Vegetation and Wildlife. The analysis of impacts to fisheries found the flow changes would be small and would not occur at times or in locations that would adversely affect sensitive species. The analysis of impacts to vegetation and wildlife found the flow changes could affect riparian vegetation along these waterways, but the monitoring measures included in Mitigation Measure GW-1 would reduce these effects to less than significant levels. See Common Responses 6 and 7 for additional information.

Comment NG13-20

Comment

Simulations performed by TNC using DWR's C2VSim integrated ground and surface water model of the Central Valley indicate that groundwater pumping at scales similar to the Proposed Action affects a large area and, very importantly, that streamflow depletion from even a single year of such pumping persists for decades7. The timing of these impacts is illustrated in Figure 1, below.

Figure 1 shows that streamflow depletion is significant for many years after pumping has ceased, with only about 65 percent of ultimate stream depletion expressed even 5 years after pumping has stopped. It takes 25 years for the system to nearly fully "recover" (90 percent "depletion recovery"). Although different assumptions regarding well locations and depth will lead to differently shaped depletion curves, the best information available suggests that impacts from pumping will persist for decades for wells distributed over wide areas and depths, as is the case for the Proposed Action. In contrast, Figure 3.1-3 of the EIS/EIR does not reflect this full duration of impact, at least as expressed in percent changes in CVP and SWP exports. Please explain how the modeling done for this Draft EIS/EIR accounts for the compounding impacts to water supplies from multiple years of pumping, and how the duration of impact through full recovery will be accounted and mitigated under Mitigation Measure WS-1.

Response

Figure 3.3-27 shows the 12 hydrologic years during which groundwater substitution transfers are simulated. Included in this period is a period of six consecutive years (1987 through 1992) of groundwater substitution pumping. Including 1994, there is a period when substitution pumping is simulated for seven of eight years. The SACFEM2013 results from this entire simulation were used as input to the Transfer Operations Model (TOM). Because the entire transient simulation result set is used in the TOM, the TOM results therefore incorporate the "compounding impacts" of transfers in consecutive years. Figure B-5 in Appendix B shows the total change in stream-aquifer interaction due to the groundwater substitution pumping. The data presented in this figure incorporates the transient simulation results, including the years of consecutive transfers. Mitigation measure WS-1 includes a streamflow depletion factor that is a percentage of the total groundwater substitution transfer that will not be credited to the potential seller. This factor is developed to offset the effects on streamflow due to the groundwater substitution pumping.

Comment NG13-21

Comment
To appropriately characterize the potential water supply and environmental impacts of the Proposed Action, the Draft EIS/EIR must more clearly answer the question, “Which streams are likely to be depleted, by how much, and for how long?” The EIS/EIR needs to better account for the source of pumped water and its related cumulative impacts over time to both water rights holders (both export rights and in-valley rights) and the environment, and avoid or fully mitigate for those impacts. To fully mitigate for groundwater substitution pumping impacts on water supplies, Section 3.1.4.1, Mitigation Measure WS-1, must describe in detail how the streamflow depletion factor will be developed, account for compounding, and be applied over the duration of the project and beyond until recovery is achieved.

Response
As discussed in response to Comment NG13-19, the EIS/EIR used a series of linked models to estimate changes in streamflow for waterways throughout the Sacramento Valley. These potential changes were considered in the water supply impact analysis, but the analysis identified that the potential impacts would be focused on CVP and SWP users that receive water conveyed through the Delta.

See Common Response 8 for additional information.

Comment NG13-22

Comment
In recognition of the potentially significant environmental impacts of streamflow depletion from groundwater substitution transfers, the secondary effects of changes in groundwater levels resulting from the Proposed Action (Section 3.3.2, page 3.3-59) should include: “(4) a reduction in groundwater levels that significantly impacts surface flows (streams or rivers) or the species, habitats, and other beneficial uses of these stream flows.” Application of Mitigation Measure WS-1 should include consultation with fish and wildlife agencies during annual development of the streamflow depletion factor so potentially significant environmental impacts can be avoided early.

Response
The paragraph referenced in this comment has been revised to include references to the environmental consequences analysis for fisheries (as described in Section 3.7, Fisheries). The paragraph had already referenced Section 3.8, Vegetation and Wildlife, for impacts to these resources. See Common Response 8.

Comment NG13-23

Comment

5. Environmental commitments should more fully develop a suite of additional actions that ultimately result in additional benefits for nature and provide incentives for those actions such as a transfer priority system to drive their implementation and adoption.

The Central Valley is already highly altered and many aquatic and terrestrial species dependent on its land and watersheds are already on the brink of extinction. The Sacramento Valley has made great advances in using a finite water supply for multiple benefits, such as optimizing diversions so both fish flows, migratory birds, and rice straw decomposition can occur simultaneously, with the same water supply. This progress could be thwarted and significant environmental and water supply impacts could result from transferring hundreds of thousands of acre-feet annually across basins and away from the Sacramento Valley where water is already used for multiple benefits.

To drive improvement and sustainability over time and mitigate for the loss of this progress, we recommend that an additional environmental commitments be included to develop a suite of additional actions that could be done in conjunction with water transfers in such a manner that transfers which also deliver other benefits for nature are prioritized within the system. That is, those agencies or transferring entities which provide the most robust monitoring, wildlife-friendly farming practices, and habitat- protecting regimes should be prioritized over transfers with less attention to environmental values and mitigation. We envision such practices will require both adequate incentives and monitoring to demonstrate performance. For example, the timing, capacity or priority to convey a particular transfer through the Delta could be enhanced to a degree proportional to the benefits created for nature by a chosen set of actions. The suite of actions and their relative value to nature could be developed in conjunction with input from TNC and other NGOs in consultation with state and federal wildlife agencies. Such actions should be designed in a manner that provides flexibility to meet multiple habitat values and applies new, cutting-edge ways to use water for multiple benefits on private and public lands and waterways. Implementing such a program would help drive conservation as a co-equal priority to water transfers designed to benefit urban and agricultural water uses, and will accommodate a broader use of water than otherwise would be accomplished through large scale water transfers.

Response

As an agency, Reclamation has many goals and ongoing projects. It is involved in other efforts to enhance habitat and water supply for migratory birds, but that is not part of the purpose and need for this effort.

Comment Letter IN01, Bob Adams

Comment IN01-1

Comment
Don't even think about taking water out of Butte County! We'll be in your face starting now. I've never given over $20 to any cause. Starting now, Aqualliance get all my spare cash.

What kind of rotten, disassociated, (with any real people) bastards would even try this kind of crap!

[A sentence from this comment was not disclosed here because of offensive language. The full content of the letter is included in Appendix O.]

Response
See Common Response 2.

Comment Letter IN02, Geoffrey Baugher

Comment IN02-1

Comment
I would like to protest the 10 year water transfer plan and express my frustration at the short period of time for public input.

Response
See Common Response 2. The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment IN02-2

Comment
Public awareness in Northern CA is growing fast concerning the San Joaquin Valleys misguided water wishes. Along with ground water levels dropping and the ever-expanding tree farms around us, the smell of fear is pushing a greedy political process.

Response
See Common Responses 2 and 4.

Comment IN02-3

Comment
And the fish?

Response
Impacts to fisheries are evaluated in Section 3.7.

Comment Letter IN03, Linda Calbreath

Comment IN03-1

Comment
As a resident of Northern California, I am opposed to the Long-Term Water Transfers of Northern CA. groundwater that is proposed by the Bureau of Reclamation.

Response
See Common Response 2.

Comment IN03-2

Comment
Located in Northern CA., the Tuscan Aquifer is one of the last remaining intact aquifers. Pumping up to 600,000 acre feet of our groundwater pre year for 10 years will cause irreparable harm to the Tuscan Aquifer and Northern CA, as a whole and only serve to benefit a very few water profiteers at the expense of the rest of the population and the environment- our beloved oak trees are already at risk.

Response
The Tuscan Aquifer is a deep water source (more than 500 feet) and is not readily available to oak trees. Oak tree roots lie predominantly within the first 2-3 feet below the ground surface while deeper tap roots can extend to 80 feet. Oak trees obtain groundwater from the upper soil horizons and not directly from aquifers. There may be some increase in the pumping within or near the Tuscan Aquifer, but not nearly as much as the commenter states. The maximum amount of potential transfers is about 511,000 acre-feet, with less than 300,000 acre-feet of groundwater substitution transfers. Additionally, the groundwater substitution transfers would be from multiple groundwater basins and multiple aquifers within each basin (including the Tehama Formation). The effects of groundwater substitution pumping would not be focused on the Tuscan Formation. See Section 3.3, Groundwater Resources and Common Response 4 for additional information.

Comment IN03-3

Comment
California is experiencing of one of the worst droughts in history. The lakes and reservoirs in Northern California are already at or below historic lows. Most streams that used to run year around are very low or dry. Many wells in an around the entire North State are running dry. Long range weather forecasts indicate there will not be any significant rainfall again this year to recharge the

groundwater or refill the lakes and reservoirs and yet this proposal would take our water and sell it to those that have already decimated their own water sources.

Rain and snow melt flows into Shasta Dam and Lake Oroville and then is shipped south to Central and Southern CA. Northern CA water is already heavily diverted and now there is this proposal to take our groundwater. Most cities and towns in Northern CA rely solely on groundwater. If that is pumped dry, there are no other alternative water sources.

Over and over again, aquifers throughout California have been overdrawn (more water is taken out than is replaced) and left permanently damaged. Irreparable subsidence (the land sinks when the water is drained from the aquifer) has been the result of many of these aquifers. As only one example, the San Joaquin Valley has seen irreparable subsidence (land sinking) by as much as 25 feet from 1925 to 1977.

Response
Section 3.3 has been revised to clarify the effects of current drought conditions to groundwater resources within the area of analysis. See Common Response 4 for details on information added regarding wells going dry in the Sacramento Valley region.

The evaluation of environmental impacts discussed in Section 3.3.2.4 is based on modeling that simulates past hydrologic trends (1970-2003), including six continuous years of dry weather conditions (1987-1992). This document does not simulate or predict future hydrology trends. Section 3.3.2.4 also discusses subsidence impacts. Mitigation Measure GW-1 (discussed in Section 3.3.4.1) sets forth monitoring and mitigation measures to avoid potentially significant adverse environmental effects. See Common Responses 6 and 7 for additional information.

Comment IN03-4

Comment
California is a semi arid desert. California farmers use 80% of all fresh water available in the state. It makes no sense to allow farmers to continue to use flood irrigation and plant permanent high water use crops in a desert and continue to sacrifice water sources in one area to satisfy the thirst for water in another. Cities that do not have a sustainable source of fresh water need to reuse their water through tertiary water treatment and desalination plants and implement strict conservation measures. Using billions of gallons of fresh water for hydraulic fracturing and then polluting the remaining fresh water with the waste water is absolutely insane. Continuing to dry up sources of fresh water is short sighted. Unless we stop this trend, there will be no fresh water left for crops, environment or people.

Response
The concepts of increasing agricultural water use efficiency and reducing agricultural acreage were considered in the EIS/EIR as part of the Agricultural Conservation (Buyer Service Area) and Land Retirement alternatives, respectively. These alternatives were not carried forward for more detailed analysis because they would not meet key elements of the purpose and need and basic project objectives. Agricultural conservation would not be immediate or provide additional water, and land retirement would not be immediate or flexible, and would not provide additional water. See Appendix A for more details on the screening of these alternatives.

Comment IN03-5

Comment
I am sure you saw the recent 60 minutes episode on this subject which aired November 16. Studies by Hydrologist Jay Famiglietti at UC Irvine should be taken into account as part of the EPA impact study.

Response
Section 3.3.1.3.2 has been revised to include monthly groundwater storage estimates for Sacramento and San Joaquin Valley from Famigletti et al. 2011.

Comment Letter IN04, Lynne Elhardt

Comment IN04-1

Comment
It has only been in recent days that this abhorrent proposal has come to light in our neighborhood. I may not be up on all current events, but because my neighbors, who are farmers, doctors and lawyers, were unaware as well, it is obvious this proposal is sneaky and dirty handed.

The San Joaquin Valley has obviously not been a good steward of their water and now you want to penalize us and put our lively hoods and households in a very grave situation. Everyday I turn on the faucet, hoping my well will still produce. My neighbor, half a mile away, just drilled a new well at a cost of $30,000+. Although, this looks like it's just a transfer of surface water via our canal system, it will mean further tapping of our ground water, which has dropped significantly in the past few years. To approve a proposal, based on a study of water years dating back 40 years, knowing we are in the worst drought on record, is incomprehensible.

I urge you to look at the real picture here and take the $$$ out of the equation.

Response
See Common Response 2.

Comment Letter IN05, Virginia Freeman

Comment IN05-1

Comment
The Sacramento Wild Life Refuge outside of Willows, CA, needs to leave their water where it is. Our area is already groundwater deficient in it's upper levels due to over drafting in the lower levels. I know, because in my area alone, our ground water has "recharged", and I say that lightly. Our upper strata water "came back" after the local nut growers and corn growers stopped irrigating. They *robbed* us of our domestic well water, and since they quit sucking the water out of the ground for THEIR money making farm practices for the year, we have GAINED 35 FEET. (Look over your head and up 35 feet for A CONCEPT of how MUCH that is, then think of how many acres there are of that 35 foot gain of water below us.) This water is going to all disappear once the farmers, once again, steal our water for their nut crops.

KEEP GLENN COUNTY WATER IN GLENN COUNTY and let Merced pump for theirs!

Response
See Common Response 2.

Comment Letter IN06, Heather Gray

Comment IN06-1

Comment
I am writing to strongly disagree with the proposed 10 year water transfer of 195 billion gallons per year to the San Joaquin Valley. ARE YOU INSANE??? With the alarming drought that we are going through and PEOPLES wells going dry right and left, how can you even dream that this is going to happen without a devastating effect to Northern California? Instead of using this water transfer as a pipe dream (literally) why don't you start building systems through out the area for Rain Harvesting?

Thank you for your time. Please show some creative thinking, using your brains and come up with a more sustainable plan for our future.

Response
See Common Response 2.

Comment Letter IN07, Steven Hammond

Comment IN07-1

Comment
I am extremely concerned that the proposed water transfers from Northern California will result in irreparable damage to the aquifer in the area where I live, in Chico, California. I have been following this issue for years, and am convinced that the research on the negative effects of the proposed transfers has been strikingly inadequate. It is no secret that a great deal of the proposed water to be transferred (SOLD) will be substituted by the sellers in my area by "replacing" the water they sold with groundwater, which could deplete the aquifer in this area terribly. Many local wells in outlying areas have already been going dry.

I truly believe that the effects of this could be precipitate a disaster for my home - have you ever been to Chico? It is a very lovely small city for which the saving grace is a well-established canopy of trees. It is not at all a stretch to project that if the groundwater levels fall sufficiently this could become another Owens Valley.

Response
See response to Comment LA02-1.

Comment IN07-2

Comment
Additionally, I think that factors such as the wasteful use of water in the southern districts who want the water have not been adequately addressed either. To continue growing nut trees in the desert, which takes tons of water, is simply not a good reason to deplete another region's water supply! The possibility of stopping this practice, and other possible ways of conserving and using water appropriately, have not been given enough consideration!

I truly think that the proposed massive water transfers are merely an example of robbing Peter to pay Paul - and are not only a mistake, and just plain wrong, but are also very short-sighted and need to be stopped until careful and longitudinal research can be completed.

I have to admit I mistrust your intentions, given what has occurred in this matter so far. I'd like to be shown that you are not in the pocket of those with the money to "BUY" what really shouldn't be available just because they want it, and because there are those who will "SELL" what isn't really theirs to sell: water.

Response
See response to Comment IN03-4.

Comment Letter IN08, Scott Lape

Comment IN08-1

Comment

I'm strongly opposed to any water transfers out of Northern California.

Response
See Common Response 2.

Comment IN08-2

Comment

Local groundwater supplies are seriously depleted, and there is no reason to expect that the aquifer will regenerate any time soon.

Response
Section 3.3 describes the potential environmental consequences of the Proposed Action and alternatives on groundwater resources. Common Response 4 describes how additional information has been added to Section 3.3.1 based on public comments to further characterize the existing conditions of groundwater resources. Section 3.3.2 analyzes the potential for the aquifer to recharge after groundwater substitution transfers.

Comment IN08-3

Comment

We don't know what the effects of climate change will be, and the precautionary principles suggests that we plan for the worst.

Response
Section 3.6 of the EIS/EIR considers potential effects of the alternatives on climate change. Additionally, this section indicates that climate change could potentially affect the aquifers from both over exploitation because of reduced surface water supplies and from saltwater intrusion that could occur from sea level rise (see Section 3.6-12). Impacts to the aquifers from groundwater substitution are discussed in detail in Section 3.3, Groundwater Resources. As described in Section 3.3, any effects on the aquifers from groundwater substitution would be less than significant with implementation of Mitigation Measure GW-1. See Common Response 6 for additional information regarding groundwater monitoring and mitigation. Because of the relatively short-term duration of the range of potential transfer activities under the action alternatives (10 years), they are not expected to have adverse effects on the aquifers, including cumulative effects from climate change.

Comment IN08-4

Comment

We have seen the effects of unsustainable agriculture in the San Joaquin Valley. Why should we allow greedy agribusiness to destroy the Tuscan aquifer the way they have destroyed the aquifers in the San Joaquin Valley?

Response
See Common Responses 2 and 3.

Comment Letter IN09, Linda Lohse

Comment IN09-1

Comment

I do not approve of any transfers of groundwater. No action/no project is the only choice.

Response
See Common Response 2.

Comment Letter IN10, John MacTavish

Comment IN10-1

Comment
Please provide justification for using a study period ending in 2003? Please include in your response California population changes and farmed acres at the end of 2003 compared with 2013. I would also like to know actual water demands (usage) for the years 2003 and 2013. It would also be helpful to see your projections for future water usage going out for the next 100 years.

Response
See Common Response 5.

Comment IN10-2

Comment
Who were the other consultants you considered to provide independent analysis and possible solutions? Was the selection done in a bid for services process? If so, is the RFP and bid submission available for review?

Response
Under NEPA and CEQA, the Lead Agencies are soliciting public comments on substantive comments on the environmental document. This comment is not related to scope, content, or adequacy of the Draft EIS/EIR, which was prepared in accordance with the requirements of NEPA and CEQA.

Comment IN10-3

Comment
Please provide the names, addresses, qualifications and phone numbers of the "decision makers."

Response
For Reclamation, the decision on how to move forward will be made by Mr. David Murillo, the Regional Director of the Mid-Pacific Region. More information about Mr. Murillo's background is available at http://www.usbr.gov/mp/PA/RD/index.html, and he is available by phone at 916-978-5100. For SLDMWA the decision will be made by the Board of Directors, who can be contacted at 209-826-9696. More information about this decision-making body is available at http://www.sldwma.org/learn-more/board-of-directors/. See Common Response 14.

Comment IN10-4

Comment
Why were there no stakeholders from each of the effected communities/counties included in this process?

Response
Reclamation and SLDMWA reached out to potentially affected parties through the scoping process and meetings on the Draft EIS/EIR. On December 28, 2010, Reclamation published a Notice of Intent in the Federal Register, and on January 5, 2011, a Notice of Preparation was published with the California State Clearinghouse. These documents started the public scoping process, which is designed to solicit feedback from potentially affected parties. Public scoping meetings were held between January 11 and 13, 2011 in the cities of Chico, Sacramento, and Los Banos, California. Reclamation and SLDMWA prepared the "Long-Term Water Transfers EIS/EIR Public Scoping Report" (dated May 2011), which summarized the comments and concerns raised during the meetings as well as written public comments obtained during the public scoping period. Reclamation and SLDMWA also held public hearings to solicit comments on topics addressed in the Draft EIS/EIR on October 15, 16, and 21, 2014. During the course of the scoping process, participation and input was received from over 45 parties located throughout the project study area.

Comment IN10-5

Comment
Who initiated the water transfer concept? Reclamation or San Luis/Mendota?

Response
The potential for water transfers is codified in the California Water Code (as described in Section 1.3.2 of the Draft EIS/EIR). The specific transfers covered

under this Draft EIS/EIR would be originated by the parties to the transfer (a seller from Table 2-5 and a buyer from Table 2-6). These parties would submit information to Reclamation for review and approval before the Lead Agencies could facilitate a transfer (as described in Section 1.5). See Common Response 14.

Comment IN10-6

Comment
Why was the alternative of stopping or reducing tree crop plantings in the areas in need of water not offered as a possible solution?

Response
The concept of reducing crops planted in the buyers' area was considered in the EIS/EIR as part of the Land Retirement in San Joaquin Valley alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives, as it would not be immediate or flexible, and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment IN10-7

Comment
Why was the alternative of selling surface water entitlements without groundwater replacements considered as an option?

Response
The concept of purchasing surface water entitlements was considered in the EIS/EIR as part of the Water Rights Purchase alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives, as it would not be immediate and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment IN10-8

Comment
How much ground water in acre feet is in the Tuscan aquifer? Any recent reading within the last year will do. What are the last ten years measurements in acre feet? Please provide the basis/calculation methodology of your response.

Response
The comment refers to the Tuscan Aquifer System; however, pumping for groundwater substitution transfers from Glenn Colusa ID, Reclamation 1004, and Butte WD would be from the Tehama Aquifer System and not the Tuscan Aquifer System. See Common Response 4.

Comment IN10-9

Comment
How do we know for certain that groundwater storage will "recharge" over time? This was the vague unsubstantiated claim made in the consultants report.

Response
The historical water level data presented in Section 3.3.1.3, Affected Environment shows that groundwater levels, in general, tend to decline during dry periods and recover during wet periods.

Comment IN10-10

Comment
This is a personal question to you as one of the "decision makers," how can you in good conscience support pumping groundwater from a finite/fragile resource (when proof exists of other aquifers being damaged or pumped dry) to farm inappropriate crops in arid land? This is so short sighted and wrong.

Response
See Common Response 2.

Comment Letter IN11, H. Elena Middleton

Comment IN11-1

Comment
I strongly oppose the proposed water transfers. I believe that there is not enough knowledge of the potential destructive and irreversible effects on groundwater, creeks, environment and north state farms.

Response
See Common Responses 2 and 3.

Comment Letter IN12, MBK Engineers

Comment IN12-1

Comment

Thank you for the opportunity to review and provide comments to the Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report Public Draft (Draft EIS/EIR). The purpose of this letter is to provide a list of our comments and observations based on our review of the Draft EIS/EIR and information that we have available to clarify details associated with potential water transfer participants identified in the Draft EIS/EIR. We have attempted to identify the specific page and section for our comments; however, there may be other locations in the Draft EIS/EIR where our comments would apply. Following your review of our letter, please ocntact our office if you require any clarifications or additional information. The following is a list of our comments and observations:

1. Page ES-6, Table ES-2: Based on data provided by Gilsizer Slough Ranch, the maximum potential transfer quantity should be 4,500 acre-feet. This comment also applies to Table 2-4.

Response

The detailed groundwater pumping data provided by Gilsizer Slough indicated they did not have the pumping capacity to provide 4,500 AF. In March, seller information reduced the capacity to 3,900 AF as shown in Tables ES-2 and 2-4.

Comment IN12-2

Comment

2. Page ES-10, 1st Paragraph. Identifies that "…a CVP seller would forbear (i.e., temporarily suspend) the diversion of some of their Base Supply…" We believe that a transfer of water involving a CVP seller may also include a portion of the CVP seller's Project Water supply. Thus, we believe the Draft EIS/EIR should cover water transfers involving Project Water to provide flexibility to the potential water transfer participants.

Response

This paragraph is specifically discussing transfers accomplished through forbearance agreements. Forbearance agreements can only be used for transfers of Base Supply. Project water would be able to be transferred, but such actions would use a more traditional transfer agreement involving the State Water Resources Control Board.

Comment IN12-3

Comment

3. Page ES-10, Section ES.4.1. We believe there may be opportunities to make surface water available during the month of October. For example, the Draft EIS/EIR should provide for the potential that surface water may be made available by groundwater substitution for rice straw decomposition. Thus, we believe the potential period for surface water made available by groundwater substitution should include April through October.

Response

The window to move transferred water through the Delta to the buyers is from July through September (see Section 2.3.2.1). Making water available through rice decomposition was considered as an alternative in this EIS/EIR (see Table 2-1 and Appendix A); however, it was not carried forward for more detailed analysis because it would not be immediate or flexible.

Comment IN12-4

Comment

4. Page ES-11, Section ES.4.4. The description of establishing a baseline for crop shifting should refer to the methodology outlined in the Draft Technical Information for Preparing Water Transfer Proposals (DTIWT) in order to maintain consistency.

Response

The Draft Technical Information for Preparing Water Transfer Proposals includes additional details on how to implement water transfers. Because it is more focused on implementation details, it is not referenced in the Executive Summary.

Comment IN12-5

Comment

5. Page 2-17, Table 2-5. Based on data provided by Gilsizer Slough Ranch, the upper limit for July-September groundwater substitution transfer should be 3,000 acre feet. This comment also applies to Table 2-7 and Appendix A, Table 5-1.

Response

See response to Comment IN12-1.

Comment IN12-6

Comment

6. Page 2-26, 1st paragraph. Identifies that water transfers involving Merced Irrigation District (Merced ID) through delivery methods (excluding Banks and Jones Pumping Plants) could be used throughout the irrigation season of April through September. We believe this should be clarified to provide flexibility for these delivery methods to be used throughout the year for water transfers involving Merced ID.

Response

Transfers involving Merced ID have four potential delivery mechanisms. Three of them involve diverting water from surface water (from the Delta, the San Joaquin River, or the Merced River). The EIS/EIR does not analyze the potential to make those diversions in different times of the year, when impacts could be different from those described. The fourth delivery mechanism, however, would route the transfer water through Merced ID's internal conveyance facilities to one of the refuges in the San Luis Unit for exchange. This transfer method would not change surface water flows or diversions; therefore, it would not affect potential impacts if the timing of the transfer changed. The EIS/EIR has been clarified to indicate this transfer delivery method could be used year-round.

Comment IN12-7

Comment

7. Pages 3.1-6 through 3.1-12. Quantities listed in the descriptions of the potential sellers should correspond to quantities in Table ES-2 and Table 2-5. Specifically, the quantities for Conaway Preservation Group, Pleasant Grove-Verona Mutual Water Company, Te Velde Revocable Family Trust, Garden Highway Mutual Water Company and Gilsizer Slough Ranch should be revised.

Response

Section 3.1.1.3.1 has been revised to be consistent with Tables ES-2 and 2-4.

Comment IN12-8

Comment

8. Page 3.1-6, Footnote 3. Footnote 3 should be clarified to identify the following: "Conaway Preservation Group (CPG) has assigned portions of its water rights and Sacramento River Settlement Contract to the Woodland Davis Clean Water Agency (Agency). Amendment No. 1 to CPG's Settlement Contract, which identifies the assignment of 10,000 AF to the Agency, is effective upon the earlier of the Agency diverting water or January 15, 2016. After that time, CPG may receive surface water under the portion assigned to the Agency."

Response

Footnote 3 has been revised accordingly.

Comment IN12-9

Comment

9. Page 3.1-8, River Garden Farms. The description should be clarified to identify that River Garden Farms supplements its surface water supply with groundwater wells (i.e., eliminate reference to "three" groundwater wells).

Response

The section has been revised accordingly.

Comment IN12-10

Comment

10. Page 3.1-10, Tule Basin Farms. The description should be clarified to identify that Tule Basin Farms diverts water from the West Borrow Pit of the Sutter Bypass (i.e., eliminate reference to the "Feather River").

Response

The section has been revised accordingly.

Comment IN12-11

Comment

11. Page 3.1-13. Merced Irrigation District. The description should be clarified to identify that: "Merced ID supplies water principally for agricultural purposes." (i.e., eliminate reference to the "M&I" purposes).

Response

The section has been revised accordingly.

Comment IN12-12

Comment

12. Page 3.1-21, Section 3.1.4.1. Relative to the streamflow depletion factor, in the case that the U.S. Bureau of Reclamation (Reclamation) and/or the Department of Water Resources (DWR) believe that the factor is to be refined for the following transfer season, there should be a date by which the water transfer participants, Reclamation, and DWR discuss potential refinements to the streamflow depletion factor (e.g., by December 1).

Response

See Common Response 8.

Comment IN12-13

Comment

13. Page 3.2-31 through Page 3.2-50. It appears that tables identified in Section 3.2 and Sections 3.13 through 3.17 are intended to present the same information for a particular alternative; however, the data in the tables are different. For an example, see Table 3.2-23 and Table 3.17-1. We believe the differences between the relevant tables should be examined in further detail to provide clarification and consistency.

Response

Numbers have been corrected in the Final EIS/EIR to be consistent. The changes were small and did not affect the analysis of potential impacts to environmental resources.

Comment IN12-14

Comment

14. Page 3.2-41, Last Paragraph. There may be other circumstances that affect storage in San Luis Reservoir that would not lead to decreased storage for nearly all months of the year, such as transfer water that may be temporarily held in San Luis Reservoir prior to delivery to the buyer. We believe this should be clarified/explained in additional detail.

Response
Clarifications have been made to the water quality section to incorporate this concept.

Comment IN12-15

Comment
15. Page 3.3-5, 5th Paragraph. In regard to well completion reports, we believe that groundwater wells approved in 2009 through 2014 should be accepted for future groundwater substitution transfers unless technical evidence indicates use of the well could result in impacts to third parties or the environment. This is consistent with the Addendum to Draft Technical Information for Preparing Water Transfer Proposals dated January 2014, prepared by DWR and Reclamation.

Response
The January 2014 document referenced by the commenter was developed to facilitate transfers given the projection that 2014 was to be a critically dry year. The DRAFT Technical Information for Preparing Water Transfer Proposal has since been revised (November 2014) and does not include the pre-approval of previously approved groundwater wells.

Comment IN12-16

Comment
16. Page 3.3-29, 1st Bullet. The land subsidence identified is characterized as "inelastic" from 2013 to 2014. Due to the brief time period following the observed subsidence to date, and considering the persistent drought conditions, we believe that the term "inelastic" should be removed.

Response
The first bulleted item on page 3.3-29 has been revised to read, "DWR observed land subsidence estimated at approximately 0.2 foot from 2012 to 2013 and an additional 0.6 foot from 2013 to 2014 (DWR 2014b)."

Comment IN12-17

Comment
17. Page 3.3-69, Table 3.3-3. The following are clarifications to the data listed in Table 3.3-3, as follows:

- Conaway Preservation Group: 70-980 feet.
- Garden Highway Mutual Water Company: 115-250 feet.
- Natomas Central Mutual Water Company: 110-960 feet.
- Pelger Mutual Water Company: 4 wells, 101-485 feet.
- Pleasant Grove-Verona Mutual Water Company: 34 wells, 99-260 feet.

- Reclamation District 1004: 21 wells, 56-430 feet.
- River Garden Farms: 9 wells, 170-686 feet.
- Te Velde Revocable Family Trust: 150-455 feet.
- Tule Basin Farm: 120-405 feet.

Response
Well data modeled and summarized in Table 3.3-3 was based on information received from potential sellers. Seller correspondence has been documented in the administrative record.

Comment IN12-18

Comment
18. Page 3.3-89, Land Subsidence Bullet. As stated in the current DTIWT, Reclamation and DWR should coordinate with the water transfer proponent to develop a mutually agreed upon subsidence monitoring program for areas with documented historic land subsidence and higher susceptibility to land subsidence. This should be identified in this section, as the current paragraph seems to indicate that subsidence monitoring is required for all participating sellers; however, subsidence may not be necessary for each area.

Response
See Common Response 7.

Comment IN12-19

Comment
19. Page 3.7-1, Section 3.7. The sub-sections to Section 3.7 refer to time periods for potential water transfers. In order to preserve flexibility for the timing of potential water transfers, we believe Section 3.7 should include additional clarification that water transfers may occur during periods other than July through September. This may also need to be addressed in Appendix A (see Page 3-4, Section 3.6.1). One example of the potential for transfers occurring during other periods is identified on Page ES-9: "Through Delta transfers would be limited to the period when USFWS and NOAA Fisheries find transfers to be acceptable, typically July through September, unless a change is made in a particular water year based on concurrence from USFWS and NOAA Fisheries."

Response
See Response to Comment LA12-83.

Comment IN12-20

Comment

20. Section 3.10.1.3. Sacramento County is not included in the Regional Economics analysis. The reason for this is unclear; and should be identified in this section.

Response

Sacramento County is included in the area of analysis for Regional Economics (see Figure 3.10-1). Existing conditions information for Sacramento County has been added. Effects to Sacramento County were evaluated in Section 3.10. There would be no cropland idling in Sacramento County, so effects related to cropland idling transfers described in Section 3.10 would not apply.

Comment IN12-21

Comment

21. Page 3.10-23, Cropland Idling Acreages. It is uncertain whether the analysis for the Draft EIS/EIR would limit the crop acreage that may be idled (or shifted) to the estimates identified in this section, including Sections 3.3, 3.8, and 3.9. We believe that these sections should provide for potential adjustments to the maximum acreage idled or shifted to allow for flexibility.

Response

When transfers are proposed, the Lead Agencies will determine if the impacts are fully captured within this EIS/EIR. Generally, cropland idling transfers would need to stay within the maximum acreages per region identified in Table 3.10-22 because these acreages are analyzed in multiple resource areas of the EIS/EIR. See Common Response 14.

Comment Letter IN13, Mary McCluskey

Comment IN13-1

Comment

I am writing to express my concern over the Environmental Impact Report of the proposed 10 year water transfer program. I have read the report, and even though I am not a lawyer, it is easy to tell that the report was written with little regard to the impacts to Northern California.

Response

See Common Response 3.

Comment IN13-2

Comment
I have also read the letter written to you and to the San Luis Delta-Mendota Water Authority by the Butte County Board of Supervisors. As a resident of Butte County, I fully support their position in the letter - that the report is "seriously flawed" and needs revision.

Response
See the responses to Butte County's letter (LA02).

Comment IN13-3

Comment
I also support their request for an additional 90 days for public review.

Response
The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment Letter IN14, Peter Ratner

Comment IN14-1

Comment
I am opposed to any water transfer to Southern California unless and until mandatory conservation measures are adopted by the agencies wanting the transfers. In this current drought, it is irresponsible at the least to contrive the use of water for such non sustainable uses as lawns and golf courses and irrigating dessert land for farming.

Response
The action alternatives include water transfers to agricultural water users in the Central Valley, not in southern California. The concept of increasing agricultural water use efficiency was considered in the EIS/EIR as part of the Agricultural Conservation (Buyer Service Area) alternative. This alternative was not carried forward because it would not reduce environmental effects of the other alternatives or meet key elements of the purpose and need or basic project objectives. This alternative would not be immediate and would not provide additional water. See Appendix A for more details on the screening of these alternatives.

Comment Letter IN15, Edwin Roland McNutt

Comment IN15-1

Comment
ES 4.1 Groundwater substitution: "Groundwater storage would fill slowly over time." Unacceptable wording for EIS. We need to know exactly how long…Table 2.9 Proposed Mitigation "None" Unacceptable.

Response
Section ES.4.1 describes groundwater substitution transfers and states that "Groundwater storage would refill (or "recharge") over time." The duration required to recharge the aquifer following a groundwater substitution transfer depends on the hydrology of the years following the transfer. The aquifer would refill more quickly if subsequent years are wet, compared to a slower recharge if the subsequent years are relatively dry. Figures 3.3-34 through 3.3-38 provide a graphical representation of the change in groundwater level with and without groundwater substitution pumping at several locations in the Sacramento Valley. Appendix E contains figures for additional locations. The rate of aquifer recovery (or recharge) can be seen in the rate at which the blue line (Alternative 2) approaches the dashed-red line (Baseline). The lead agencies have identified Mitigation Measure GW-1 to avoid potentially significant environmental impacts. See Common Responses 6 and 7.

Comment IN15-2

Comment
I witnessed your dog and pony show at Chico. The unaddressed elephant in the room, to which almost all comments were directed to, was the issue of regeneration, which was not calculated in EIS. Groundwater substitution is like inheriting a fortune and squandering it, living high on the hog until it's all gone and you're left in poverty. The wise person sets up that fortune as a public trust, so that its lasts all you life, and your children's and grandchildren's in perpetuity. Northern California says no to water transfers, especially when you have NO DATA on aquifer regeneration.

Response
Section 3.3 describes the potential environmental consequences of the Proposed Action and alternatives on groundwater resources.

Comment Letter IN16, Margaret Rader

Comment IN16-1

Comment
I am in full support of all comments made by members of the audience in Chico on Tuesday 10/20/14.

I particularly agree with one gentleman who felt that the primary basis for long term water transfers is greed. The desire of a few to control our valuable water resources is beyond reason given the current drought situation (not previous drought history) in the Northern Sacramento Valley.

Response
See Common Response 2.

Comment Letter IN17, Sherri Scott

Comment IN17-1

Comment
I would like to share my opposition to the taking or selling ('transfers') of any water that affects my home and evirons, being the North State, not from surface nor from ground sources. They are all intertwined as a whole ecosystem and it all affects me and my health, my livelihood, my thriving agricultural community, and the natural and diverse beauty of nature that brought me to this area. I represent many others who moved to this area for exactly the same reasons and your proposal threatens our way of life!

Response
See Common Response 2.

Comment IN17-2

Comment
Currently I am witnessing a terrible die off of 50-100 year old trees on the farm. This is at a terrible loss of shade and habitat, but in economic terms that adds costs to summer cooling, high costs of employing tree work to prevent the loss of property as the trees fall or loose limbs, as well as the loss to property if the limbs escape maintenance.

Response
Many factors responsible for tree die-off are unrelated to water transfers. Effects of the current statewide drought are far reaching. Groundwater levels supporting many older trees have been dropping for a variety of reasons and could account for the death of some mature trees. Section 3.3 describes the potential environmental consequences of the range of potential activities under the Proposed Action and alternatives on groundwater resources. No additional analysis or changes to the EIR/EIS are needed.

Comment IN17-3

Comment
Many farmers I know had to dig their well deeper this year and/or lost their pump due to a drop in the water. Our ag well that has gone dry each summer for the last 3 years for August, was dry before the summer even began this year.

Fortunately we have been able to use a small domestic well as our back up. Regardless, each year knowing that our water supply could be compromised, we make conscious decisions on how much land we can farm and what types of crops can be managed with what we have. This is responsible farming. I refuse to allow folks who view water irresponsibly, relying on water needy crops and industries, to take the water that feeds me, my community, and my ecosystem.

I see all around me in neighborhoods and on hikes that plants and trees are dying. I rely on this shade cover to cool me in the summer. The trees rely on the water that its roots worked so hard over a long period of time to reach. The plants around them rely on the shade and water that the trees provide. The animals, the insects, the birds, the mushrooms, the microorganisms and us humans all rely on this.

I hear repeated stories at the farmers market from customers who are witnessing the same things about the effects of drought: dead/dying trees, more insect pressure, more desperate invasions of their fenced off gardens by deer and other animals. They are noticing for the first time or higher occurrences of large predators desperately roaming into human populated areas to find food.

Response

Several figures in Section 3.3 show historical groundwater levels in several wells throughout the Sacramento Valley. In general, groundwater levels tend to decline in dry or drought periods. In wetter years groundwater levels recharge. The current dry period appears to show trends toward decreasing water levels similar to previous years. Figures 3.3-28 through 3.3-33 show the potential change in groundwater level due to groundwater substitution pumping. These figures are for simulated conditions in a historical dry year (1976) and following four years of substitution pumping in a dry period (1990). Figures 3.3-34 through 3.3-38 provide a graphic representation of the change in groundwater level with and without groundwater substitution pumping at several locations in the Sacramento Valley. Appendix E contains figures for additional locations. The rate of aquifer recovery (or recharge) can be seen in the rate at which the blue line (Alternative 2) approaches the dashed-red line (Baseline). Impacts to vegetation and wildlife are covered in Section 3.8.

Comment IN17-4

Comment

It is inconsiderable to even suggest that the water removal in this water proposal will not affect us residents of the North State, us farmers, us nature lovers, us shade lovers! It is unconscionable to even suggest that the money and needs of Westlands Water District are more important than those that fell in love with this area, moved here, laid their literal and figurative roots down, paid their taxes, and have no real say in actions that SEVERELY affect their way of life and in their livelihoods! It is ridiculous! It is atrocious! IT IS GREEDY!

Response
See Common Response 2.

Comment Letter IN18, Amalie Sorenson

Comment IN18-1

Comment
We are farmers (my family) for generations- and generations to come (hopefully). We farm sustainably. We and outraged others will fight this criminal water-stealing legally. Get a life, please! We could be friends in this, but not by your tactics alone.

[A sentence from this comment was not disclosed here because of offensive language. The full content of the letter is included in Appendix O.]

Response
See Common Response 2.

Comment Letter IN19, Tony St. Amant

Comment IN19-1

Comment
Your agency and the San Luis & Delta-Mendota Water Authority held a hearing in Chico earlier this week on the public draft EIS/EIR for long-term water transfers. The EIS/EIR attempts to justify the transfer of between 360,000 and 600,000 acre feet of water per year for ten years from sellers upstream of the Delta to water users south of the Delta and in the San Francisco Bay Area.

Response
The purpose of the Draft EIS/EIR is not to justify water transfers, but rather to disclose potential environmental impacts for decision-makers and identify mitigation measures to reduce or avoid those impacts. The comment cites the upper limits of 360,000 to 600,000 acre-feet, but those upper limits are related to transfer quantities addressed in the Biological Opinions on the Coordinated Operations of the CVP and SWP (see Section 1.3.1.2). These quantities reflect the transfer amounts that are addressed in the current biological opinions on CVP and SWP operations in the Delta; the action alternatives in this EIS/EIR are not proposing to transfer this entire quantity. The maximum quantity proposed under the action alternatives in any year would be about 511,000 acre-feet, and in most years when transfers occur substantially less water would be transferred (see Section 2.3.2.2).

Comment IN19-2

Comment
A critical fact came out during the hearing. The data for EIS/EIR's hydrologic analysis is based on the period 1970-2003. None of the climatologic or hydrologic reality the state has experienced since that time is included: none of the increasing evidence that we are actually in a period of climate change and none of clear, decade-long trends in groundwater declines seen in an increasing number of areas in the Northern Sacramento Valley.

Response
See Common Response 5.

Comment IN19-3

Comment
The excuse offered by Carrie Buckman of CDM Smith, your consultant, was that the chosen water model is not up to date. The unanswered questions would be, "Why was an out-of-date model chosen?" and as, this analysis has been planned since at least late-2010 and modeling shortcomings have been known for at those four years, if none is available, "Why hasn't' an up to date model been developed to fulfill this need that has been identified as critical to a large portion of California agriculture?" If the cost of a transfer program includes the need for an up-to-date model, then the proponent should be responsible for developing that model and validating it through a rigorous peer review process. Choosing an out-of-date model should not be an allowable choice.

I can see how SLDMWA would be pleased with hydrologic data that ended in 2003, but I don’t understand how your agency could support such an analytic shortcoming. It would seem to me that, as a federal agency, the Bureau would have a balanced responsibility between the welfare of water source areas north of the Sacramento Delta and water consumption areas south of the Delta. Your agency's support of this terribly flawed agency, the Bureau would have a balanced responsibility between the welfare of water source area north of the Sacramento Delta and water consumption area south of the Delta. Your agency's support of this terribly flawed analysis results in an inappropriate bias in support of the agencies that wish to import water to compensate for their decades long indifference to sustainable water supplies.

I urge the Bureau to withdraw the EIS/EIR until it is supported by up-to-date hydrologic and climatologic data analyzed through a vigorously peer-reviewed model.

Response
See Common Response 5. Additionally, the SACFEM2013 and CalSim II models represent the best available science for performing the analysis completed in support of the EIS/EIR and are not out of date. These models

were reviewed and updated specifically for this project. SACFEM2013 is an update to a previous version of SACFEM that was peer reviewed in 2011 and revised and refined in response to comments from the peer review. CalSim II was jointly developed by DWR and Reclamation for analysis of CVP and SWP operations and planning studies. Portions of CalSim II have been peer reviewed and revised in response to peer review comments. CalSim II is widely used and accepted and is continually updated in response to changes that can affect CVP/SWP operations.

Comment Letter IN20, Tony St. Amant

Comment IN20-1

Comment
Issue: The San Luis & Delta-Mendota Water Authority is inappropriate as a lead agency for the Long-Term Water Transfers Environmental Impact Statement/Environmental Impact Report, September 2014.

Summary: The SLDMWA does not meet California Environmental Quality Act (CEQA) Requirements to be the lead agency for this EIR, and there is an unmitigable conflict of interest inherent with SLDMWA as the sole lead agency.

Recommendation: The EIS/EIR should be withdrawn from public circulation; and the lead agency should be changed to: An appropriate state agency with SLDMWA and the counties that overlie the DWR Bulletin 118 groundwater basins and confined (deeper) aquifers from which groundwater substitution transfers may occur designated as responsible agencies; or A group of agencies, including SLDMWA and the counties that overlie the DWR Bulletin 188 groundwater basins and confined (deeper) aquifers from which groundwater substitution transfers may occur, organized into a cooperative effort by contract, joint exercise of powers, or similar device (14 CCR Sec. 15051(d)).

Response
See Common Response 1.

Comment IN20-2

Comment
SLDMWA does not meet CEQA requirements to be the lead agency. SLDMWA is a joint powers public agency that encompasses approximately 2.1 million acres of 29 water service contractors within he western San Joaquin Valley and San Benito and Santa Clara counties. Its boundaries are coextensive with those of its members (Amended and Restated Joint Exercise of Powers Agreement [SLDMWA JPA], San Luis & Delta-Mendota Water Agency, January 1, 1992, para. 3, pg. 4.) All of the SLDMWA's purposes and powers are

centered on providing benefit to member organizations (SLDMWA JPA, para. 6, pp. 4-7).

SLDMWA is a narrowly purposed regional organization, yet it is designated as the lead-and therefore, certifying - agency for this EIS/EIR, which has the potential to impact the long-term water supplies and environment of a number of California counties well removed from its geographical boundaries. This relationship does not comply with CEQA or Title 14, California Code of Regulations, nor does it recognize provisions of the Sustainable Groundwater Management Act.

CEQA Sec. 21067 defines a lead agency as the public agency that has the principal responsibility for carrying out or approving a project which may have a significant effect on the environment. SLDMWA represents only half of the long-term water transfer process - the potential buyers. The other half - the potential sellers- is comprised of 29 independent agencies (Long-Term Water Transfers Public Draft EIS/EIR, September 2014, Table ES-2), none of which are designated even as responsible agencies in accordance with CEQA Sec. 21069. 1

4 CCR Sec. 15051 (b)(1), confirms SLDMWA as an inappropriate organization to be the lead agency: "The Lead Agency will normally be the agency with general governmental powers, such as a city or county, rather than an agency with a single or limited purpose…"

Response
See Common Response 1.

Comment IN20-3

Comment
Beyond the environmentally-oriented requirements of CEQA and Title 14, the process should integrate the legislative intent of the Sustainable Groundwater Management Act, which among other things is to recognize and preserve the authority of cities and counties to manage groundwater pursuant to their police powers (Sustainable Groundwater Management Act, Uncodified Findings (b)(5)) and that water transfers must respect applicable city and county ordinances (Sustainable Groundwater Management Act, Sec. 10726.4, (a)(3)). SLDMWA is not the appropriate agency to be certifying findings that may relate to those authorities outside of its own boundaries.

With SLDMWA a lead agency and no potential sellers or source counties designated as responsible agencies, the process is unreasonable biased toward the narrow functional interests of SLDMWA and its joint agencies.

Potential sellers and source counties need to be authoritatively involved in any EIS/EIR certification process that holds the potential for long-term effects on their groundwater sustainability, as does this one. The ability to submit comments for consideration by SLDMWA and USBR falls far short of a valid, balanced process.

Response
See Common Response 1.

Comment IN20-4

Comment
There is an inherent and unmitigable conflict of interest with SLDMWA as the lead agency.

Common law doctrine requires a public officer to exercise his or her powers with disinterested skill and primarily for the benefit of the public. Actual injury is not required. A public officer is barred from putting himself in a position in which he may be tempted by his own private interests to disregard his principals and the interest of others (Conflicts of Interest, Office of the Attorney General, 2010, para. B, pg. 102).

The structure of the unmitigable conflict of interest is embodied in three classes of interests which ought to be on equal ground in the water transfer EIS/EIR process but which are not:

Class 1: Willing buyers , represented by the EIS/EIR lead agency SLDMWA. The willing buyers of transferred water, some or all of the 29 members of the SLDMWA joint powers agreement, are at risk of suffering serious financial losses if they are unable to import water from other areas of the state over the next 10 years. Per its joint powers responsibilities, SLDMWA is obligated to act in the interest of, and for the benefit of, member agencies. Consequently it would be a breach of fiduciary responsibility for SLDMWA to act for the benefit of any other organization at the expense of its joint powers partners. SLDMWA is obligated to seek as much water as its member agencies need from source areas without regard for the economic or environmental impact on those areas. Yet the final EIS/EIR will reflect SLDMWA's independent judgment and analysis (14 CCR 15090(a)(3)), with no requirement to incorporate any concerns of source area public agencies, groundwater-dependent entities, or groundwater-dependent individuals.

Class 2: Willing sellers unrepresented in the EIS/EIR process and representing no one in the source areas but their own individual single-purpose organizations. Willing sellers have no standing in the EIS/EIR. While their actions are integral to execution of the proposed water transfers, they were not accorded Responsible Agency status as seems to be indicated by CEQA Sec. 21069. But even if they had been accorded Responsible Agency status, that status would have put their interests in conflict with the third class of interests, groundwater users in the source areas who are not willing sellers. This conflict exists in the northern Sacramento Valley because the willing sellers share water basins with other groundwater users as described below. The core of this conflict is that willing sellers stand to gain revenue from their sales while those who do not sell - and have no standing in the selling process - stand to incur expenses as water levels decrease from groundwater substitution transfers because of their need to deepen wells and/or drill new wells.

Class 3: Groundwater users in the source area who are not willing sellers, but who share their groundwater sources (basins) with willing sellers. Groundwater users in the northern Sacramento Valley who are not willing sellers of transfer water are groundwater-dependent cities and towns, groundwater-dependent rural homeowners, and groundwater-dependent agriculturalists. They are a large majority of the population in the northern Sacramento Valley in comparison to the estimated two percent of the population who comprise the potential sellers. This class stands to incur expenses as water levels decrease because of the need to deepen wells and/or drill new wells in response to lowered groundwater levels that will result from groundwater substitution transfers. Their appropriate representation would be counties, which also hold statutory authority over groundwater, but counties have not been accorded agency status in the process.

If SLDMWA is a public agency, conflict of interest constraints must disqualify if from its role as sole lead agency for the long-term water transfer EIR. If SLDMWA is not a public agency, it is not eligible to the be the lead agency.

Conflicts of interest abound in the project and in the EIS/EIR, all of which should have been recognized during the scoping process four years ago. The fact they were not could be interpreted as a confirmation of biases that went into developing the project and producing the draft EIS/EIR. The time-frame for moving the water transfer project forward is critical, but SLDMWA's and USBR's failures to properly plan and coordinate this project override the interests of source area organizations and citizens.

SLDMWA's and USBR's failure to integrate agencies into the EIS/EIR effort in a way that balances obvious and well known conflicting interests, whether caused by administrative oversight or bias, cannot be allowed to stand. The stakes for long-term water sustainability in the northern Sacramento Valley are just too high.

Response
See Common Response 1.

Comment Letter IN21, Karen Stinson

Comment IN21-1

Comment
I attended the EIS/EIR Public Meeting in Chico on October 15, 2014. I am writing to you today to show my support for my community and for the natural resources we are so blessed with here in Butte County. I am writing to urge you to have more research done on the long term effects of transferring water from the Sacramento River and from Tuscan Aquifer. In these times of out of control climate change and extreme weather conditions, I urge you to error on the side of caution when it concerns our water. Thank you and God Bless.

Response
See Common Response 3.

Comment Letter IN22, Paula Sunn

Comment IN22-1

Comment
I live north of the Delta and am very concerned at the water transfers that have been occurring on a temporary basis and even more so about the EIS/EIR that would facilitate longer term water transfers.

Historically, in California, areas with less population, but with adequate water supplies have been exploited in order to keep the dryer, desert areas of the state from having to make the difficult decisions about whether current land use patterns are sustainable, regardless of the environmental and economic degradation that occurs in the areas of origin. The Owens Valley is a good example of this.

Response
Water transfers are one of several management actions favored under state and federal law. The comment suggests that an alternative to water transfers is making "difficult decisions" to retire land. The concept of reducing crops planted in the buyers' area was considered in the EIS/EIR as part of the Land Retirement in San Joaquin Valley alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives, as it would not be immediate or flexible and would not provide additional water. See Appendix A for more details on the screening of this alternative. See Common Response 14.

Comment IN22-2

Comment
The EIS/EIR is flawed in not having a way to take into account that the data used to draw conclusions is outdated and that there are already problems occurring in the north state due to the ongoing drought, exacerbated by the transfers that are happening now. In short, there is no evidence that there will be future water supplies that will be sufficient to maintain the current patterns of usage in the areas of origin, much less enough to transfer water south to sustain agriculture in areas that have already overexploited their supplies, especially during the dryer periods that the EIS/EIR is intended to cover.

Response
See response to Comment IN03-3.

Comment IN22-3

Comment
It strikes me that economic interests of those served by the San Luis & Delta-Mendota Water Authority as well as those in the areas of origin who have surface water rights to sell, while replacing this water with further groundwater pumping, ignores the long term ecological degradation that will occur as well as the populations in the north they rely on these supplies. Economic gain for a few is not what should be driving decisions made about resources relied upon by many.

I urge you to not only reject this current EIS/EIR, but to do what you can to stop the current temporary water transfers.

Response
See Common Response 2.

Comment Letter IN23, Melinda Teves

Comment IN23-1

Comment
No on groundwater substitution transfers.

No on putting these decisions in the hands of buyers and sellers with self-interest in mind.

No on implementing water transfers prior to localities taking over groundwater decisions per recent legislation.

Response
See Common Response 2.

Comment IN23-2

Comment
No on formulating plans based on data before 2004.

Response
See Common Response 5.

Comment IN23-3

Comment
No on these proposed water transfers.

Response
See Common Response 2.

Comment Letter IN24, Sally Wallace

Comment IN24-1

Comment
Everyone I know in Northern California, just about, is violently opposed to this Water Transfer. It is inconceivable that you would not only allow it but instigate it. One bad drought year, and this is the worst we have had in years, is not a good enough reason to send our water to Southern California.

Response
See Common Response 2.

Comment IN24-2

Comment
You might suggest they start desalination projects on ocean water, instead.

Response
The concept of seawater desalination was considered in the EIS/EIR as part of the Desalination - Seawater alternative. This alternative was not carried forward for more detailed analysis because it would not meet the key elements of the purpose and need or basic project objectives, as it would not be immediately implementable. See Appendix A for more details on the screening of this alternative.

Comment IN24-3

Comment
Another solution is more careful watering by the farmers…in the central and southern parts of the state…they have been rather profligate with water use over the years.

Response
The concept of increasing agricultural water use efficiency in the buyers' area was considered in the EIS/EIR as part of the Agricultural Conservation (Buyer Service Area) alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives, as it would not be immediately implementable and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment IN24-4

Comment
Most of all, we have to leave enough water in streams and rivers and forests for the wildlife…#1 priority, or should be.

At the very least, postpone the dams and transfers to the future…its starting to rain, give nature a chance and don't make panic decisions.

Response
See Common Response 3.

Comment Letter IN25, Suzette Welch

Comment IN25-1

Comment
I urge you not to more forward with the proposed water transfers to San Luis and Delta Mendota Water Authority. I am in opposition to the timing of the water transfers "especially in periods of drought" and the size of the proposed water transfers which will allow water to be brought in northern California then sold to a desert area in Central California - the San Luis and Delta Mendota Water Authority.

Response
See Common Response 2.

Comment IN25-2

Comment
The area to receive transfers of water from Northern California is a desert. They have ruined their aquifer by over pumping and now have subsidence so there is less underground space to store water the groundwater that they do get. What should be done in Southern Central Valley is planting of annual crops in years when they have enough water in the area to allow these crops. Instead trees were planted there so that farmers could show that they needed water every year. Now these Southern factory farmers want us to ship water south.

Response
Removing tree crops in favor of annual crops would be similar to the Land Retirement in the San Joaquin Valley alternative in the EIS/EIR. This alternative would not meet the key elements of the purpose and need or basic project objectives because it would not be immediate or flexible, and it would not provide additional water.

Comment IN25-3

Comment
We have need of our water in Northern California to support our many family farms. We especially need to keep all the water possible in years like this year where there is not enough water due to a four year drought.

Response
Water transfers are between willing sellers and willing buyers. It is expected that sellers would not participate in transfers if they need to use water on their farms.

Comment IN25-4

Comment
There is a big fallacy in your report. The hydrologic period analyzed in the EIS/EIR is from 1970-2003, neglecting the last 11 years because the model wasn't up to date. Thus the analysis doesn't take into account the current drought.

Response
See Common Response 5.

Comment IN25-5

Comment
How can you say in your EIR that there will be no environmental impact on the are of origin of the water when there are already wells drying up in this area due to over pumping.

We have wells going dry right now in the foothills and in North and South Chico. People there don't have water to drink and you propose to take more surface water from willing sellers. These sellers are people with water rights and are just out to make money no matter the cost to the land. They sell the surface water and then they pump water out of the aquifer taking needed water from other and making the shallower wells run dry. Pumping the aquifer will drop the depth of water in the water table which will result in loss of our ecosystem. Our beautiful meadows and oak forests will die from lack of water. You will turn around part of California into desert like the Owens Valley.

Response
Section 3.8, Vegetation and Wildlife evaluates impacts from groundwater substitution transfers on natural communities. Mitigation Measure GW-1 (discussed in Section 3.3.4.1) sets forth monitoring and mitigation measures to avoid potentially significant adverse environmental effects. See Common Responses 6 and 7 for additional information.

Comment Letter IN26, Seamus Yeo

Comment IN26-1

Comment
I am writing regarding to your recent proposal for the Long Term Water Transfer, that was uploaded to the Environmental Impact Assessment government website on September 2014. I will be doing as part of a course assignment to review the Public Draft of the Environmental Impact Assessment.

The introductions and proposed actions are well informed in terms of history of the area, location and the different lakes that could be involved, service provided and companies that are involved. However, the lack of explanation on what the current infrastructure of CVP and what method would be used to transfer water from the seller to the buyer. The cost of maintenance of the 10 year period would be questioned and should be mentioned.

Response
Information about the CVP and the key facilities is included in Section 1.2.1, and methods to transfer water are described in Section 2.3.2.1. Because water transfers would not involve new facilities, there would be no increased cost of maintenance above what the CVP and SWP would spend under the No Action/No Project Alternative.

Comment IN26-2

Comment
In the assessment of water, it has been well written for understanding the quality and quantity of supply and the water. Through the use of laws, regulations and information on each lake which water will be extracted, it has given a good overall look. However, the lack of details of each total capacity of water and how much water will used during the transfer is questionable. The only information given was how much water could be extracted but no relation to the overall total amount of water.

Response
Table 2-4 in Chapter 2, Proposed Action and Description of the Alternatives, delineates the maximum potential transfer for each seller in acre-feet. Future transfer amounts would be determined at the time of the agreement. See Common Response 14.

Comment IN26-3

Comment
In the geology and soil, they have provided many different topography of maps regarding to the soil that are present around California, along with the different method of translocation of various soils. It would be good if you can provide a 3D infrastructure of the current CVP, and the area that they have been built on.

Response
Relevant maps are provided showing the resources in the project area that could be affected by the alternatives. None of the alternatives involves changing the CVP infrastructure, so these maps are not necessary for the analysis.

Comment IN26-4

Comment
In Air Quality the data provided for different compounds, in direct impact of Carbon dioxide in water is noted and each different method of transferring water is noted. The cumulative effects are also noted well, there is no need for additional information.

Response
Comment noted.

Comment IN26-5

Comment
In Climate Change, it is well written that the most direct issues are affecting the transfer. However, the indirect to animals and soil is a rather difficult to research in. Note that monitoring the possibility of invasive species invading upstream is a plausible situation, which is not noted in Cumulative effects. If there is an Accelerated erosion doing storm water, would it not also accumulate possible sediments that would damage flood control.

Response
Issues related to invasive species are discussed in Section 3.8, Vegetation and Wildlife. Additionally, issues related to the effects of the action alternatives on flood control are discussed in Section 3.17, Flood Control.

Comment IN26-6

Comment
In the flood control, the information provided is well responded and the mitigation and the acceptance of some area unable to endure flood possibility should be taken into account. However, the flood control also holds some of the key factors into the methane hold possible harm to the environment especially animals that could not survive in acidic environments.

Response
The purpose of the flood control section is to describe existing flood control within the area of analysis and discuss the potential effects on flooding and flood control from the proposed alternatives throughout the entirety of the area of analysis. Effects of the proposed alternatives on methane are discussed in Section 3.5 and effects on vegetation and wildlife are discussed in Section 3.8.

Comment IN26-7

Comment
The Draft Environmental Impact Assessment would provide a useful tool as it cover many aspects of environmental concerns which will help the community in decision and project managers to decide. However, it could use a little more information about the water supply as ecologist and many other scientist in that field may question how much water is "sustainable." You have only stated how much water could be taken out, without having mentioning the total amount of water that is current there.

Overall, I would like to say that in general that the draft environmental statement is well researched and very informative. I would like that if you can add additional material on a more local levels, as it would affect them the most and their knowledge from experience would affect the overall projects and the cost of maintenance over the 10 years and a timeline. In addition, I would like you to add additional information on monitoring as climate change on the over all levels of water and geology and soil, as those two would inhibit many of the long term water transfer and possible damage in the future.

Response
Table 2-4 in Chapter 2, Proposed Action and Description of the Alternatives delineates the maximum potential transfer for each seller in acre-feet. An analysis of the potential long-term impacts to the groundwater aquifer is included in Section 3.3. The impacts associated with climate change and geology and soils are summarized in Sections 3.6 and 3.4, respectively.

Comment Letter IN27, Julian Zener

Comment IN27-1

Comment
I am strongly against the USBR proposal to facilitate the transfer of Sacramento Valley water (mainly by conjunctive use) to south of the Delta and San Francisco Bay water districts.

Response
See Common Response 2.

Comment IN27-2

Comment
Several glaring lapses in the proposal stand out. Limiting the baseline years to 1973 to 2003 avoids the last decade of climate change effects and our severe prolonged current drought.

Response
See Common Response 5.

Comment IN27-3

Comment
In recent years the Sacramento Valley general water table has significantly dropped with accompanying ground subsidence. Residential and agriculture wells have gone dry.

Response
See Common Response 4.

Comment IN27-4

Comment
And the proposed water transfers will occur during drought and severe drought years – just when the immediate and long term harm to our river, streams and aquifer would be the greatest. The USBR suggestion that water tables will generally reconstitute in the future is completely unsubstantiated.

Response
The need for water transfers tends to occur during drier periods when the potential buyers need additional supply. The groundwater and surface water analyses, including numerical and analytical modeling, are documented in several sections throughout the EIS/EIR. Impacts to groundwater levels and surface water-groundwater interaction are discussed in Sections 3.1 and 3.3. Section 3.3.1 provides a discussion of the existing conditions in the Sacramento Valley. This discussion includes hydrographs of past water levels that show, in general, recovery of groundwater levels in wetter years.

Comment IN27-5

Comment
No consideration of the accumulative effects on the watershed (ecology is included) in the USBR analysis.

Response
Sections 3.7 and 3.8 evaluate cumulative effects to fisheries and vegetation and wildlife resources, respectively. Chapter 4 defines the cumulative effects analysis approach.

Comment IN27-6

Comment
No significant long-term economic analysis is evident comparing the transient benefit to the Westlands Water District versus the destruction of the Northern California watershed – the source of 60-70% of California water.

Response
Section 3.10 evaluates the economic effects of the range of potential activities under the Proposed Action and alternatives in the buyer and seller service areas over the 10-year timeframe.

Comment IN27-7

Comment
Please put science above political and lobbying pressures to preserve the Sacramento Valley Watershed. – Thank you.

Response
See Common Response 2.

Comment Letter IN28, John Scott

Comment IN28-1

Comment
This EIS/R must be withdrawn, because it is totally inadequate as any EIR/EIS could ever be.

Response
See Common Responses 2 and 3.

Comment IN28-2

Comment
Follow the comments of the Butte Environmental Council. Your EIS/EIR is so bad that I feel I need to protect and maintain my legal rights in this matter.

Response
Comments from the Butte Environmental Council are in comment letter NG06. Responses to the comments are included with that letter.

Public Hearing PH02, Los Banos, California

Comment PH02-1

Comment
Why were the CVP to CVP refuge related transfers not included in this environmental impact report or statement?

Response
The EIS/EIR analyzes a range of potential transfers from willing sellers to CVP contractors. Reclamation is not a direct party to the transfer, but is involved only to approve and facilitate transfers. See Common Response 14. The CVP refuge transfers are different because Reclamation negotiates and contracts for this transfer water; therefore, they are addressed through a separate environmental compliance process. See Common Response 9.

CVP transfers separate from the range of potential activities analyzed under the Proposed Action, but having the potential to result in cumulative environmental impacts when considered in conjunction with the potential activities under the Proposed Action, have been considered in the cumulative impacts analyses within the EIS/EIR. Such CVP transfers are identified in Chapter 4, and the associated potential for cumulative impacts is addressed where appropriate throughout Chapter 3.

Comment PH02-2

Comment
Will refuge water transfers be affected in any way, either refuge to refuge or CVP contractor to CVP contractor?

Response
The range of potential water transfer activities evaluated in this EIS/EIR would not affect Level 2 or 4 refuge supplies, as discussed in Common Response 9.

Comment PH02-3

Comment
Will refuge transfers have a priority in that they may not meet statutory but contractual obligations?

Response
Transfers will not affect acquisition or delivery of refuge supplies.

Comment PH02-4

Comment
Will this in any way affect Reclamation's ability to get our level two supplies in future years, noting that this year we are at 65 percent when contracts indicate that we would only receive a minimum of 75 percent?

Response
See response to Comment PH02-2.

Public Hearing PH03, Chico, California

Comment PH03-1

Comment
I'd like to comment on the inadequacy of the programmatic EIR. First, there's been an effort to maintain a very tight reign on time, on the time intervals that's being considered. My family came here in 1857. I came 90 years later, but we have a long memory. When my grandparents were young, a part of their annual food budget was pitchforking salmon out of Rock Creek and canning them. Rock Creek no longer flows year round. Several places I can show you where there were Indian villages, which were situated on the banks of now dry creeks. On the end of West Sacramento Avenue, there was a spring, a large spring, that no longer flows. When we first drilled some of our wells, they were artesian. Now we've had to extend the bowls twice. So for a very long time, things have been changing in this valley. We are in the process of doing exactly to this valley what we did to the San Joaquin Valley, and to pretend and restrict sharply the space and the time for this EIR is inexcusable because the cumulative impacts that we have seen on our farm and in our valley have been very substantial and to limit this -- the measurements of subsidence and water drawdown to the area where the water is being donated is indefensible. Thank you.

Response
The EIS/EIR analysis of potential impacts related to land subsidence and groundwater drawdown is not limited to “where the water is being donated.” As described in Section 3.3.1.1 of the EIS/EIR, the area of analysis for potential impacts to groundwater resources, including but not limited to subsidence and groundwater drawdown, addresses both the seller service area, including water districts that have groundwater pumping capabilities and have expressed an interest in groundwater substitution transfers, and the buyer service area. The analysis of potential project-related impacts is measured from a baseline representative of current groundwater conditions, which would have already accounted for changes in groundwater levels compared to previous eras. The EIS/EIR provides an extensive analysis of potential impacts to groundwater resources and, as indicated in Section 3.3.5, concludes that none of the alternatives would result in potentially significant unavoidable impacts after

mitigation. Additionally, it should be noted that under CEQA, alternatives are compared to existing environmental conditions (rather than historic conditions) to determine potential environmental impacts. Under NEPA, action alternatives are compared to the future No Action Alternative, which reflects future environmental conditions absent the action alternatives. See Common Responses 6, 7, and 9 for additional information.

Comment PH03-2

Comment

Looking at the map, it looks like most, if not all, of the potential groundwater sellers are figuratively at the bottom of the water barrel. They're at the bottom of the aquifer. They're selling our water out from underneath us. You put a straw at the bottom of that and depressurize the aquifer, like Glenn and Colusa County are doing right now -- yeah, there's water real close to the surface down by the Sacramento River, but when you pull that water out and you sell it and you ship it out of here, the people in the foothills go dry, and everybody else -- and if you look at the county maps of the groundwater that's being monitored, it is depleting nearly a foot a year on average. I don't care how much it rains, and this is a continuing decline of our groundwater, and to transfer any water in our current groundwater catastrophe, which is a worldwide problem, is ludicrous, and to increase the transfers is even more ludicrous. You should be cutting back on not increasing them. This is ridiculous and it is going to put us out of business, and I'm a farmer, and I've already got one well dry. And I've never seen water even close to this, and it's going down quickly. The groundwater is already depleted down in the southern end, and they are not going to be able to use it on dry years. It's gone. It's subsided. The pore space is gone, and they're looking to us to deplete us and we'll be in the same boat. And allowing these private irrigation districts to turn around and sell their water and pump and think that they can fallow a little land and that's okay is another ridiculous aspect. How can you -- how can you even justify that? I don't even know. I don't know where you get your science from. There's all kind of information. It's easily findable.

Response

Multiple technical studies have been conducted to evaluate the potential impacts to groundwater levels. The models used in these studies were considered to be the best available tools. The models simulate changes in groundwater levels that may result from the alternatives discussed in the EIS/EIR. The models were used to estimate the changes in groundwater level that may result from the groundwater substitution pumping in Alternative 2. The results of the model simulations are shown in Section 3.3.2.4. Several figures in Section 3.3 show the historical groundwater levels in several wells throughout the Sacramento Valley. In general, groundwater levels tend to decline in dry or drought periods, and in wetter years groundwater levels recharge. The current dry period appears to show trends toward decreasing water levels similar to previous years. Figures 3.3-28 through 3.3-33 show the potential change in groundwater level due to groundwater substitution pumping. These figures are for simulated conditions in a historically dry year (1976) and following four years of substitution pumping in a dry period (1990). Figures 3.3-34 through 3.3-38 provide a graphical representation of the change in groundwater level with and without groundwater substitution pumping at several locations in the Sacramento Valley. Appendix E contains figures for additional locations. The rate of aquifer recovery (or recharge) can be seen in the rate at which the blue line (Alternative 2) approaches the dashed-red line (Baseline). Mitigation Measure GW-1 includes actions related to impacts from groundwater level declines and subsidence. The inclusion of Measure GW-1 reduces the impact on groundwater resources to less than significant levels. Common Response 6 provides additional information.

Comment PH03-3

Comment
And these mega wells that are going in at the end of our Tuscan Aquifer -- I'm in that aquifer, and these -- you know, they're pumping a million gallons a day and they're transferring and they're selling it out. They're making a lot of money. Now, you take economic impacts down in the southern part where they've already destroyed their aquifer and you compare it to us, we're small potatoes. That is not a fair situation to justify destroying an aquifer.

Response
Table 2-4 provides the upper limit on the volume of water each of the potential sellers may transfer. Table 2-5 provides the distribution of transfers by transfer method. Section 3.3.2, Environmental Consequences/Environmental Impacts provides the results of the analysis of potential impacts to groundwater levels in the aquifer in the Sacramento Valley. Economic analyses relating to the alternatives are provided in Section 3.10, Regional Economics.

Comment PH03-4

Comment
The cumulative effects are already being seen on the flora and fauna in this region, and how it can be more, I don't know. That's it.

Response
Cumulative effects on biological resources are described in Section 3.8.6 of the Draft EIS/EIR.

Comment PH03-5

Comment
I haven't heard anything here tonight that gives me any assurance that you're not going to pump our aquifer dry. I know you have your models there that are

supposed to predict that everything is going to be okay. There's going to be no problem, but if you don't mind if I don't believe that, do you?

Response
Multiple technical studies have been conducted to evaluate the potential impacts to groundwater levels. The models used in these studies were considered to be the best available tools. The models simulate changes in groundwater levels that may result from the alternatives discussed in the EIS/EIR. The models were used to estimate the changes in groundwater level that may result from the groundwater substitution pumping in Alternative 2. The results of the model simulations are shown in Section 3.3.2.4. Section 3.3.2.4.2 specifically shows simulated groundwater levels in the Sacramento Valley groundwater basin. The figures in this section show the change in groundwater level due to the estimated groundwater substitution pumping spatially across the Sacramento Valley (Figures 3.3-28 through 3.3-33) and also throughout the duration of the simulation (Figures 3.3-34 through 3.3-38). Additional model results are shown in figures in Appendix E.

Comment PH03-6

Comment
We've had to live with so much bureaucratic bungling and deal with unattended consequences throughout the years, that this looks like the epitome of them all. I can't believe that you people can sit here in good faith and say that you want to do this to us. Thank you.

Response
See Common Response 2.

Comment PH03-7

Comment
I represent -- my husband and I own a small dairy farm and cheese factory. We are the second smallest area in the State of California. We have just 30 cows on 20 acres of irrigated pasture. We are in Glenn County; however, we do not belong to the Glenn-Colusa Irrigation District. We have two wells on our property, one for domestic use and one to irrigate our pasture. I would like there to be the alternative number one, no action and no program on the basis of the willing sellers. I know Glenn-Colusa Irrigation District has been mentioned. Although I'm in Glenn County, I don't have any voice in what they do, and what they do affects my farm. Therefore, I feel that small farmers, like my husband and I, are disenfranchised in these decision-making processes. No one comes to our door and say, Tim and Jill, do you mind if we pump a lot of water so that your pump -- your well may run dry? No one has asked me how this affects my farm.

Response
See Common Responses 6 and 7 regarding mitigation and monitoring to avoid potentially significant impacts to third party wells.

Comment PH03-8

Comment
As a board member for the Chico Certified Farmer's Market, I represent many small farmers in Butte County, Glenn County, Colusa County, Tehama County. We are very small farmers. No one is asking us if it's okay if we are willing sellers, and yet, it's our water that our livelihoods depend on that is going to leave the North State for good, and this will have a very drastic economic impact on this region. Thank you.

Response
Reclamation asked water districts throughout the Sacramento Valley if they were interested in participating in the range of potential actions to be analyzed in this EIS/EIR. Agencies identified in Chapter 2 responded to Reclamation with an interest in participating. These districts would ask their growers if they want to sell water for transfer each year. No water will be transferred from a non-willing seller. Section 3.10 evaluates the economic effects of the potential transfers. See Common Response 14.

Comment PH03-9

Comment
I heard an estimate that the amount of water to be shipped out is 20 times more water than the City of Chico uses each year. If that's the case, Chico has a hundred-thousand population. That would be like putting two million people into the area and saying that's not going to damage our aquifer. You have to pave over Glenn County, Colusa County and Butte County to put two million people in there, which is more than the City of Sacramento, slash, Sacramento and Stockton, and supposedly, you're going to ship that much water out per year. So how is that not going to drop the groundwater table and kill all of the oak trees? We live in an oak woodland, not a desert like San Joaquin Valley and not create a new desert? I mean, why would anybody even think that that could be possible?

Response
The maximum potential transfer amount is 511,094 acre-feet per year (Table 2-4). This total includes transfer via multiple mechanisms including groundwater substitution, cropland idling, stored reservoir releases, and conservation. The upper limit on groundwater substitution is 126,921 acre-feet between April and June and 163,574 acre-feet between July and September (Table 2-5).

Comment PH03-10

Comment

So -- and then the other -- in the environmental report, they're saying climate change is a slow thing. Well, we're already in the middle of it. Look at our snow pack. We have almost none of it, and all our wells are running dry, creeks are running dry. It's already happening. It's not a slow process. It's already -- we're already in the middle of it. So it doesn't seem like -- I realize that greed is a motivational factor. I mean, we have a -- as an example, what happened in the San Joaquin Valley by the way you guys managed your water. You guys put in almond trees, when you should have been growing tomatoes. It takes five times more water to grow almonds down there than it does up here, and so now you guys are sucking up more water than you needed to, and then also what about mitigation of factors of water usage for all your cities, Stockton, Fresno. Those are pretty big cities. I don't think you guys are trying to even think about how you could conserve on a much greater level, but it seems like you want to mismanage our water, destroy our valley, like you already did historically.

Response

Climate change is a "slow" process, in that the effects of climate change build gradually over the years. The greatest effects are expected to occur toward the end of the 21st century. The analysis presented in the Public Draft EIS/EIR acknowledges that climate change is occurring and ongoing, as discussed in Section 3.6.1.3, Existing Conditions; this section includes projections of predicted climate change effects through the end of the century. For each of the alternatives, the analysis presents both the estimated effects of the alternative on climate change and climate change's potential effect on the alternative. The action alternatives include water transfers up to 10 years in the future, and these were compared to the predicted climate change effects that could occur during this time. Past actions, such as the types of crops grown in the Central Valley, are beyond the scope of this environmental assessment. The effects of the action alternatives on water supply are addressed further in Section 3.1, Water Supply.

Comment PH03-11

Comment

I am a scientist. I am a farmer. I am here because I'm very concerned. As a scientist, I know that models do try to guess the potential situation, and I think it's a flaw if your models don't include drought years. I'm concerned because we have had a lot of problems with water this year. Here. Not in San Joaquin. Here in Butte County. So I wonder if we are going to be embarking in a project which is, more or less, what happened to Owens Valley or Mono Lake with the transfer of water to LA or Hetch Hetchy when they transferred water to San Francisco. I don't know whether there would be a way to go back.

Response
See Common Response 5.

Comment PH03-12

Comment
The other thing that concerns me is that you mentioned sellers and buyers. So that means that there is a profit. Somebody is benefiting. We are transferring water, but money is going into some pockets that is not our pocket; it's a few pockets. So if it's for the common good of California, maybe we should not donate, as the word that was used here, donate our water. We should just give it because there is a public domain necessity. There should not be any profit. So this is similar to the risk that we embarked on when the banks were bailed out in the recent recession. Thank you.

Response
Prices for water transfers are negotiated between the willing sellers and willing buyers and are not a subject of the environmental analysis in this EIS/EIR.

Comment PH03-13

Comment
I would like to address groundwater substitution, as I read in the Environmental Impact Statement. I think executive summary page 4.1, and they define it as regenerating -- no, repumping out groundwater in order to refill surface water that our good neighbors, Glenn-Colusa Irrigation is doing right now. They didn't say that in their quote, but they also said groundwater substitution and regeneration happens, I quote, slowly over time, unquote. This is totally inadequate language for Environmental Impact Report, and I think when it comes time for lawsuits, this would be a soft area that you guys are vulnerable at, and this is the way that we fight this kind of pork barrel legislation. And so your language, not being scientific at all, you need a study on regeneration of groundwater, and of course, nobody knows how that happens. Is that what you're going to say? We don't know, so what we're going to do -- we'll just pump until it goes dry and then we'll know that regeneration doesn't happen, it happens slowly over time, as I quote. So I think I'm willing to put off this groundwater substitution until slowly over time we do a study to find out what exactly is regeneration rate of our aquifer. I haven't got my yellow card yet, so I'm going to read this little --Groundwater substitution is like inheriting a fortune and squandering it, living high on the hog until it's all gone, and you're left with nothing. That's what our Glenn-Colusa Irrigation neighbors are doing. The wise person sets up that inherited fortune as a trust so that it lasts all your life and all your children's lives and the grandchildren and people in perpetuity.

Response
Section 3.3.2.4 discusses simulated recovery at water tables and pumping zones at Location 21 (near Sycamore Mutual Water Company), Location 14 (near

Cordua ID) and Location 31 (near Sacramento County WA). Additional data on groundwater levels over time throughout the basin has been added to Section 3.3.2.4.

Comment PH03-14

Comment

Over the years -- I've been in the Chico area 50 years and been in the drilling business for 40 years. During that time, we've punctured about 10,000 wells in the four northern counties, and yeah, we've seen a lot of changes, in the last three years, basically four years. It's basically this year, and you're not addressing the current things, you know, let me give you one current thing. Up at Red Bluff, they have the Red Bluff diversion dam. That was built in the '60s, cost somewhere around 50 million. And the first thing that was wrong with it, we needed to encourage the salmon. So we set up a hatchery and filled the canal with rock, right-sized rock, and the only problem is we run the water through it, but the salmon didn't get that e-mail. They didn't show up. So, well, the problem is the gravel needs to be washed, get away the silt and the moss. So we washed it. I don't know how many million was spent. The next thing we needed to do is redo the pumps because the pumps are pumping too fast and they're killing the smelt. So we pulled them out and for about 12, 15 million, put in Archimedes. I'm going to have to go beyond a little bit. I'm not hurrying -- but Archimedes pumps in, and then, well, I don't know where the orders come from, I guess up there, but they decided that that all had to go. So they allocated 200 million, put in a covert dam, streams, and a tunnel underneath the Red Bank Creek syphon. There's nine big pumps from 300 horse to 600 horse to shovel water through the syphon on down into the canal which terminates down in Dunnigan. There's another small canal that terminates in Corning. Well, when they did this, they said you've got to open up the gates to the dam. Opened the gates three years ago. Since that time, there's been 60 domestic wells dry up in the Antelope area and that's where the water doesn't go around anymore, 60 of them. Now, this is something you folks need to consider because I remember the California Groundwater Association. I do not speak for them. I speak for Wes Heitman, but I've been in lots and lots of meetings, and when you pump groundwater, especially with the kind that they're going to do and are doing in Colusa, a funnel takes place, and the drawdown keeps going down until the pump breaks suction. It may not do it this year, but it will do it, because they're going to pump those pumps 24/7, and they're going to put five more in next year.

Response

Section 3.3.1.3, Affected Environment has been revised to clarify the impacts of current drought conditions to the groundwater resources within the area of analysis. The revised section also includes documented information on wells going dry in the Sacramento Valley.

Comment PH03-15

Comment
Now, there's one thing that all you folks need to look at. Go to your -- go to Google and type in Owens Valley. You'll get a real education.

Response
See Common Response 2.

Comment PH03-16

Comment
I'm a local environmentalist around here, and I would just like to make a few comments. One is that the Tuscan Aquifer that we have, actually is mostly salt water. It's only the top thin layer that's fresh water. So we have far less water than anybody thinks that is actually useable. We have groundwater depletion, a lot of people were talking about. We have a subsidence, and water is vital to our way of life and our economy, and it's just how stupid do you think we are? That's my question. Thank you.

Response
See Common Response 4, pumping for groundwater substitution transfers would occur primarily outside the Tuscan formation.Section 3.3 evaluates impacts to subsidence (also see Common Response 7) and Section 3.10 evaluates impacts to local economies. Mitigation Measure GW-1 (discussed in Section 3.3.4.1) avoids or reduces potential adverse environmental effects.

Comment PH03-17

Comment
I invite the element of water to join us and guide us in this important decision that we are all faced with. To me, the issue of water in my native valley is very simple. Water is our own internal emotional heart. When I look out on the landscape, when I see blocked rivers with dams, I feel it inside my heart. I feel the blocked arteries preventing us as humans, us as the nervous system of the earth to let our senses fully open, to fully embody the love all around us. I invite us to build connections in our community, to consciously reach out and align ourselves with our truest source of power. I invite water to flow beneath the bridges that we built. I also encourage people to pee outside. Thank you.

Response
This comment focuses on project impact on water supply, vegetation and wildlife, fish species, and flood control. See Sections 3.1, 3.8, 3.7, and 3.17, respectively for a description of potential impacts to these resources from the four alternatives.

Comment PH03-18

Comment

I just have a question tonight I was hoping you could answer. It's about the media release put out by Aqua Alliance, Obama selling out to California to Westlands Water District. It basically states that Obama administration has a settlement with -- for a lawsuit filed by Westlands Water District against the Federal Government for failing to provide agricultural draining service, and the settlement gives Westlands 890,000 acre feet of water a year exempt from acreage limitations and the public had no input over that settlement other than trying to influence Congress to change that. That's more water than we're talking about tonight. So doesn't that make this hearing moot? That's my question.

Response

Reclamation is working to address drainage-impaired lands under the authority and duties imposed by federal law. As part of those activities, the San Luis Drainage Feature Re-Evaluation underwent a separate environmental compliance and public comment process. More information on that project and public review can be found at this website: http://www.usbr.gov/mp/sccao/sld/

See responses to Comments NG03-125 and NG03-141 for additional information.

Comment PH03-19

Comment

So just over 30 years ago when I moved into this area, I lived above Bangor in the foothills, and I went to the little store there and met a gentleman who was doing research on the desertification of California, Northern California, on a federal grant. So this is not new information in any way to our Federal Government, and persons, in general, who live here, that water is depleting in our area from a number of sources and stressed from factors within our control and mostly completely out of our control. We have these mega wells. We have the actual drought, which is a lack of precipitation, and then we have a growing population and growing population needs in your areas and global warming. Our temperature is rising significantly. I have cows. I have crops. They all require -- we all require more when it's hot, and when these summers are so long. And we need to think not about those -- those years when we did -- you did include a seven-year drought period. Very good. We're in an unprecedented drought that has not come anywhere near ceasing. So we need to plan for the worst-case scenario. We can't just hope for the best. We need to honor Gaia, this young woman who came here. She's talking about the planet, the earth, what we've been given to take care of. Please let us make good decisions here. Let us make the right decisions. I feel for you. I feel for the land of the swimming pools and green lawns and the nice crops, but we are trying to survive. Those people that live here that have 30 years, 40 years on the land, we just want to survive. We want to leave a little something by for the ones that come after us. Thank you.

Response
This comment focuses on project impact on water supply, agricultural resources, and climate change. See Sections 3.1, 3.9, and 3.6, respectively, for a description of potential impacts to these resources from the range of potential activities under the Proposed Action and alternatives.

Comment PH03-20

Comment
To the CEQA/NEPA document, you need to incorporate the Lawson memo into the analysis that discloses the impacts to streams, therefore, the groundwater because the streams will try to fill the groundwater when it's empty. It could be as serious as 44 percent, and that is not part of your current analysis, and that was from a Public Records Act request to DWR. So it's certainly within the circle of the water brethren.

Response
The referenced Lawson memo was based on the previous SACFEM model, and therefore is outdated. The updated SACFEM2013 model incorporated significant updates in both data and assumptions. This EIS/EIR incorporates the latest data as disclosed within the document. Potential changes to streamflow and their associated environmental effects are assessed in Sections 3.7, Fisheries and 3.8, Vegetation and Wildlife. Section 3.1 analyzes potential effects to water supplies.

Comment PH03-21

Comment
I find it astonishing as well that Big Chico Creek is not listed as a significant tributary. That's a huge oversight.

Response
Big Chico Creek was inadvertently omitted in the initial analysis; however, additional review of the modeling outputs found there are no flow changes of greater than 1 cfs or more than 10 percent, including any related to Big Chico Creek. The results specific to Big Chico Creek have been added to the appropriate sections of the EIS/EIR, including Section 3.8.2.4.1.

Comment PH03-22

Comment
In regards to alternatives. I would like to suggest some in the area of delivery, not in the area of origin. Let's tip this a little on its head. How about some cropland idling in the area of demand? How about changing cropping patterns, as other people have suggested, back to annual crops instead of these perennials.

Response
The concept of reducing crops planted in the buyers' area was considered in the EIS/EIR as part of the Land Retirement in San Joaquin Valley alternative (see Table 2-1 and Appendix A). It was not carried forward for more detailed analysis because it did not meet the key elements of the purpose and need or basic project objectives, as it would not be immediate or flexible, and would not provide additional water. See Appendix A for more details on the screening of this alternative.

Comment PH03-23

Comment
I would also like to offer that there's been some misinformation, and I'm not saying that it's intentional, but in the presentation, it is diminishing the impacts, and it's not helpful to the public. I know you're smart people and you know that the majority here are completely opposed to this heinous idea, but you should at least present honest figures on the high side, not just the low side. When you talked about during -- on those frequency slides, there was 12 out of the last 33 years that transfers occurred. That is not true. You have to add -- and this is a cumulative picture here. It was 12 out of the last 14 years cumulatively there have some been major transfers out of this region. Well, let's get that straight, and I have an idea how I think you guys should do this because there was tremendous misinformation sent over the KZFR radio program news last night, and I know Mr. Moore is a nice man, and I'm sure he's overwhelmed at the Bureau of Reclamation, but my God, some of that information was so wrong that I think you are -- you owe us a correction and a major one in a major way, and I am suggesting a fact sheet. Mr. Willis stated that there would be 511,000 potential acre feet sold through a ten-year period, as I mentioned tonight, and I had your person acknowledge, no, that's each year over ten years. The document, you may plan for 511,000, but you're analyzing up to 600,000. So let's be honest. That is what could happen. And he stated that the comment period ended November 12th. Well, it doesn't end until December 1st, and he also stated, and I thought this was so disingenuous, and again, I don't think he was either thinking clearly or prepared. He said this project may not start for years, like lots of Bureau projects do. Well, this one, they want -- you guys want to go quickly. So I would suggest some major outreach up here that corrects this misinformation what went out over the radio, and we will submit extensive and exhaustive written comments, and we plan to see you in court.

Response
See Common Response 2. Previous transfers to the buyers in the EIS/EIR are discussed in more detail in Section 1.4 of the EIS/EIR.

Comment PH03-24

Comment

I can only imagine the game of straws that landed you all here, and I feel like this is just a formality, that you kind of have to come and let us share our voices, and I'm sorry that it has to happen this way. That we can't actually get to know each other in some way. I'm a farmer here. That's my daughter in the back. She's one year old. One of the wells on our property has gone dry. We've seen 30 feet drop in the water table in five years. We're monitoring. We're keeping track. That put one family out of business on our property. I've been stewing 40 acres on the edge of Chico for six years now. We have another 60 feet before our wells dry. That may be three more years of farming. I've been seeing each year trees that are about a hundred years old dying on our property planted by the man who first planted Golden Gate Park planted the trees on our property and they're dying in very fast numbers. To think that this is not going to turn this land into a desert, just like it did down south is silly to me. It seems like that is happening very quickly, and the only thing I feel left with up here is to let you know that I don't think that any of this is really going to change what you all are going to push through. It seems like your mind is set, that people who want it, that need it, and the money is there. So that would leave us left to continue mobilizing and to boycott all foods grown with this water and all foods grown by people selling this water. So that is my intention to be organized in that way. Thank you.

Response

Section 3.3 evaluates impacts to groundwater resources. Section 3.8 evaluates effects to biological resources, including trees. See Common Response 2 regarding project opposition.

Comment PH03-25

Comment

I'm really sorry to see you here tonight, but I'm here, and I just wanted to bring up an issue that hasn't been brought up. I live on 12 acres. It's a small farm that raises four-season crops, beautiful organic crops, and we live on the edge of Chico, what's called the green line, side of the green line. We have industrial near us from the victor industries to plume. We have a legacy of TCE, and on another side of our property, there's MTBE from the Kinder Morgan Tank Farm. And so recently because our well has gone down 25 feet, the Department of Water and -- I mean, the Regional Water Quality Control Board and the Department of Toxic Substances Control decided to test our well because of -- the contractor told me when he was there testing, that when you change the hydrology of these wells so much by the drop of the water table, you're pulling these toxics faster and in different directions. So I would like that to be part of what you're studying because you're putting people at risk from historical toxic spills. We have at least five plumes in Chico, and people who are in Chico are on municipal water, but those who are immediately outside of the city limits are using wells. And so you have a responsibility to all of us to not draw down our water anymore, and to -- and to make sure that the water that remains to us is safe. Although, I completely oppose everything you're doing here.

Response
Mitigation Measure GW-1 includes requirements related to water quality. See Common Response 6 for additional information.

Comment PH03-26

Comment
And I think I just -- this is the second water meeting I've been to. I appreciate everybody here and the work they're doing. The thing that bothers me is the buyer and seller. People use water. It flows through their land, but who owns the water? And I don't really understand how people can buy and sell land -- water. I understand that people have to use it. So maybe the paradigm that I would like to advocate for is the public process that through -- you know, through our Government that controls the water. There's no private buying and selling of water.

Response
Government regulations allow for, and in fact encourage and promote, the transfer of water. The Lead Agencies have prepared this EIS/EIR as one component of the process to ensure that transfers are implemented responsibly and comply with regulations. See Common Response 14.

Comment PH03-27

Comment
And I would just like to suggest to everyone that they look at the National Geographic's last month's issue. I just got the new issue, so it is last month, but it should be out in the store shelves. But they had a big article on California's water, and the bottom line is the snows are less and less, and I'm sure there are plenty of people here that remember in the good old days the Sierra snows were a lot deeper, and we occasionally would have a big snow, but the general, the decline is there, and the snows are less and less and that has been our -- our storage, and it's declining.

And then the other part is we got more and more people and we keep moving in more and more people, and it's already been mentioned about crops that take more and more water, like almonds, and letting them grow down south where it's dry.

Response
Section 3.6, Climate Change acknowledges that snowpack is projected to decline compared to measurements between 1971 and 2000 (see page 3.6-11). Water transfers would be used only to help meet existing demands and would

not serve any new demands in the buyers' service areas (see page ES-1). Therefore, any water transfers would not be used to induce new growth in crops.

Comment PH03-28

Comment
And I think the bottom line is it's really not about water. It's about greed. And we all -- I think a lot of us understand that, and the politicians, we know, are bought off and owned and the news media is corporate owned, and I think a lot of us feel like a little bit helpless standing up to the Government on this kind of thing. And like that woman just said, who owns the water? The wells are interconnected, and we don't even understand the hydrology that's going on, and it just doesn't make sense to me. So thank you.

Response
The EIS/EIR uses extensive data from the groundwater basin and hydrology to evaluate effects of water transfers. The water transfers analyzed in the environmental document are potential transactions between willing buyers and willing sellers. The Lead Agencies (as well as responsible and trustee agencies) ensure that transfers are compliant with existing laws and water rights.

Comment PH03-29

Comment
I just want to make one comment and especially involving economics. When we ship our water down south, if we sell it to southern farmers who grow walnuts or almonds and they sell these products to China, Japan and other countries, we're not only exporting our water out of Northern California; we're exporting our water out of the state.

Response
Water transfers do not affect export policies for crops. Water is being transferred to the San Joaquin Valley, not out of the state.

Comment PH03-30

Comment
I also have a pretty much a big-picture question, is this public hearing, can it have any impact on impeding your process here? That's kind of a big question, I've been formulating while I was watching this process, if our comments can have any impact in impeding your process. Thank you.

Response
See Common Response 2.

Comment PH03-31

Comment
I came to Butte County about 30 years ago, and a couple miles up from where I live -- I live in Yankee Hill, there's a trailer park called Big Bend Trailer Park, and it's been there for quite a few years and this year they were on Channel 13, and basically, a community of 30 homes there, their well's gone dry and they have no water. Basically, I see this whole process here as, you know, a mega transfer for corporations. Corporations, you know, are trying to appease us, the little people, and basically, you know, there's no, you know, possibility that, you know, we are going to get any compensation, even though we're losing our water rights here. And I just want to say that, this is basically a mega transfer for corporations, and you know, this is just kind of a dog and pony show for us to, you know, to be at peace. Thank you.

Response
Figures 3.3-28 through 3.3-33 show the simulated drawdown after a single year and multi-year transfer event. Impacts from groundwater substitution are not expected to cause any drawdown near Yankee Hill.

Mitigation Measure GW-1 (discussed in Section 3.3.4.1) requires mitigation and monitoring to avoid potentially significant effects to other legal users of water within the area of analysis. See Common Responses 6 and 9 for additional information.

Comment PH03-32

Comment
I'm against water transfers. I'd like to know as part of a question, did they reduce any of the water transfers since the drought has started? I would like that answered at the end of the session.

Response
See Common Response 2.

Comment PH03-33

Comment
How do you know the impact it's going to have when I called -- I got bounced around to agencies from Sacramento to Butte County to all over when I said our well, our ag well went dry. We're farmers in Durham, ten miles south of Chico. They had no method of recording it. So how are you analyzing or recording any impact on the residents of the county when there's not even a method to contact those to find out -- our neighbor's well is dry. Wells on the midway are dry. Wells in north Chico are dry. I'm worried that my house in north Chico is going to go dry.

Response
Section 3.3.1.3.2 has been revised to include information collected by DWR on dry wells within the groundwater resources area of analysis.

See Common Response 6 for additional information.

Comment PH03-34

Comment
We have an ag well that gives us ag water, electricity rates. Since that well is now dry, we're now using the house well at the farm I work at. Those rates are double. More than double. So as a cost to a farmer, we're seeing increased prices already. It's having an economic impact on us, your water transfers. They're not helping the water table maintain itself.

Response
Section 3.10 discusses economic effects of changes in groundwater levels as a result of the proposed alternatives and the resulting effects on groundwater pumping costs.

Comment PH03-35

Comment
I'm going to talk as long as I want. It's really emotional. When the cost for a new well, if you can get one drilled, they're telling us it's a one-year wait to get a new well drilled. That a new well would need to go to 400 feet. My house well is at 85 feet now. The water is at about 55 or 60 feet. The ag well is at 65 -- the ag well, we maybe have 10 or 15 more, I'm sorry. At the farm, the house well is within 10 to 15 feet of drying up.

Response
See Common Response 6.

Comment PH03-36

Comment
We were afraid to plant crops this year. Are you going to support us? You all have jobs. You're out conducting these sessions. You all have a job. We will be out of jobs. The residents of Butte County and Sacramento will be out of food, of local grown food. We supply the farmers market in Chico and Sacramento. Without water, we can't grow food.

Response
See Common Response 2.

Comment PH03-37

Comment
Three years ago at the meeting, a long-time farmer from here asked how are we going to prove that our wells are going dry because of water transfers? They said how is a small farmer going to come up with the money to sue you or to sue a farmer that's selling off the Tuscan Aquifer from underneath us. We're here now. Wells are dry. People are getting water trucked in. So not only with the cost of the well -- not only is there a year wait to get a well put in --

Response
See Common Response 6.

Comment PH03-38

Comment
-- about $40,000. So until you people who all have jobs with this water transfer situation volunteer to compensate us residents until you go out door to door and ask people their water situation so you have a clear handle, there should not be one drop of water leaving this county.

Response
See Common Response 2.

Comment PH03-39

Comment
As a citizen of Butte County and Chico with a degree in hydrology, I find the fact that you guys in this Environmental Impact Report cherry picked one of the wettest periods in our history in California egregiously. And I find it twofold, one, because that's the best-case scenario, and two, because these water transfers won't occur during those periods. They would occur during the driest periods, which are the worst-case scenarios, which you're not even studying.

Response
See Common Response 5.

Comment PH03-40

Comment
The problem is when the drawdown occurs, we're going to have subsidence. The woman who was answering questions up here earlier was deflecting the fact that subsidence is not reversible. I'm talking about closed aquifers. You guys aren't going to be pumping from open aquifers. If you are, that's just water coming from the rivers anyway and they're just pumping it back in and making a buck. I'm talking about the closed aquifers that are going to sink and the aquifer is going to lose its storage capacity.

Response
Sacramento Valley is an open aquifer. The storage capacity of the Sacramento Valley has been discussed in detail in Section 3.3.1.3.2. Section 3.3 evaluates effects of subsidence.

Comment PH03-41

Comment
In addition, like many people have brought up, what's going to be the impact on this area because of that? Wells, you know, when someone's well goes dry and they have to have their well drilled deeper or their pump dropped, are they going to reference this meeting and say, well, they said there were monitoring techniques being used. Well, all these vague and ambiguous terms you're using to cover yourself, like "monitoring" and "mitigation" without any real cement anything, that's not going to help out the person with no water. That's not going to help out our community, and you're not addressing that at all.

Response
See Common Response 6.

Comment PH03-42

Comment
My husband and I own a small farm in the foothills above Lake Oroville, and I thank God every day I am able to get water out of our well because it's not a given thing. I'm here tonight to strongly disagree with the proposed ten-year water transfer of the 195 billion gallons per year to the San Joaquin Valley. This is insane.

With the alarming drought that California is going through and people's wells going dry, how can you even dream that this is going to happen without a devastating effect to Northern California? Instead of your water transfer pipe dream, literally, why don't you start building a sustainable system of rain harvesting throughout the area and better yet, throughout California.

Response
See Common Response 2.

Comment PH03-43

Comment
Especially, Frances coming up representing the San Luis Delta-Mendota Water Authority, although, I guess that's who you're representing and probably Westlands Society who gets the water, facing this hostile crowd. Although, I do have to wonder why the Department of Water Resources is not the CEQA lead agency in this, rather than the buyer. It really doesn't make sense. It seems like a real flaw in the study.

Response
See Common Response 1.

Comment PH03-44

Comment
Secondly, during that -- in 2006, the Sacramento Valley Integrated Regional Water Management Plan under the direction of the North California Water Association and DWR engineers put together a draft framework for monitoring the recommendations was to monitor for groundwater-dependent ecosystems. This is monitoring in the shallowest portions of the aquifer that may be impacted by the cumulative demands on the aquifer. These are not Creekside monitoring systems. These are monitoring systems that would make sure that our valley oak groves, the remaining valley oak groves in California that exist in the Sacramento Valley still have access to that 60 to 70 feet of water that they need to survive.

Response
See Common Response 11. Oak trees obtain a majority of their water from their fine roots system located within the first three feet of the soil surface. The main function of the sinker roots and taproot in a mature oak tree is structural support and not mineral and moisture uptake. The lack of direct precipitation (i.e., drought) is a more likely cause of oak tree stress than lowering groundwater.

Comment PH03-45

Comment
Number three, your -- the presentation said groundwater levels would recover in the long run. We heard this over and over again in many situations. Finally, our local DWR people are starting to contest this. Dan McManus, one of our regional DWR leaders wrote a letter saying specifically saying, this is not -- they're not recovering, and it's not climate change. The past 150 years have been unusually wet. California experiences droughts that last decades. We need our groundwater to buffer these. Look at paleoclimatology in your analysis.

Response
Impact analysis tools (SACFEM2013, CalSim) used in this EIS/EIR have been calibrated to historic conditions from WY 1970 through WY 2009. WY 1970 through 2009 include highly variable hydrology from very wet periods to very dry periods. See Common Response 5.

Comment PH03-46

Comment
I strongly urge you to choose alternative 1, the no project, but don't stop there. You've got to stop the so-called temporary transfers that have been occurring and escalating over the past years. We are organized. We will resist this water heist. If you persist in coming to grab our water, we will take you to court.

Response
See Common Response 2.

Comment PH03-47

Comment
I worked in Water Reclamation in the past, and I have a question because I'm kind of new in the area, and as far as the local reclamation facilities -- and maybe somebody can answer this question locally, just keeping it local, how are they redistributing -- redistributing, sorry, their water to the locals, or is it going into Sacramento and kind of being flushed away, and is there any way that that can be -- put money -- somehow bring money in and let's redo our projects to where that water just goes right back to the local farmers like many projects across the nation are doing right now? So that's just a -- I don't know, any way.

Response
The Bureau of Reclamation is a federal agency, and is not related to local reclamation facilities.

Comment PH03-48

Comment
In your analysis, I would like to know if you've addressed the forest cut that has been happening?

Response
The potential water transfer activities analyzed under the Proposed Action will not result in tree removal and as such, forest cutting was not analyzed in the Draft EIS/EIR.

Comment PH03-49

Comment
The forests in Cohasset above Chico are sick, and creeks are dry. And another point, I understand that the Tuscan Aquifer is not like a big body of water, but it's a sponge. What do we know about this sponge?

Response
The small changes in groundwater levels resulting from the range of potential activities analyzed under the Proposed Action would not affect the Tuscan

Aquifer. Additionally, proposed groundwater pumping will be from multiple basins and different aquifers in those basins, including the Tehama Aquifer. The groundwater systems are described in Section 3.3 of the EIS/EIR. Also, see Common Response 4.

Comment PH03-50

Comment
A third thing I'm concerned with, something that was said by Woody Barns at one of the Board of Forestry meetings when it got hot and heavy, and that was, Oh, stop. Stop. Stop. Don't get so excited. We're dealing with 50 years of educated lies. I now read in the Nature Conservancy magazine, by the head of the Nature Conservancy, that we need to cut trees because they're taking our water. I read in the Susanville newspaper that we need to cut the Sierra Nevada. They have a proposed plan for a massive amounts of trees to be cut in the Sierra Nevada, it's the Sierra Nevada's sustainable forest management. They want to cut more trees. The Nature Conservancy's head wants to cut more trees. Anybody that knows about hydrological biology knows that the trees hold the water, and by capillary action, the trees bring water and our oxygen supply to us. These are educated lies. I really caution you to further educated lies.

Response
Tree removal is not proposed as part of the project.

Comment PH03-51

Comment
My family came here in 1836 into the San Francisco Valley. In some fashion, they had farmed in the Bay Area, the San Joaquin and Sacramento Valleys in perpetuity since then. I worked with Bureau of Reclamation as a drill rig operator helper in the early 1970s on the Tehama-Colusa and the Delta-Mendota canal. I currently live on well water in Durham. I'm experiencing some of the things that we heard.

More importantly, I was in -- I was in the cotton field in -- out of the side of Mendota when the lead hydrologists for the USBR CVP had lunch with us, and he said what we're doing here will kill this valley within 40 years. It will be over -- it will be overbuilt. The water will be overused. There will be the expectation that the water will be unlimited from the north, and we will return this back to desert from whence it came, and that's what's happening with out our water here.

Nobody, nobody south of the Delta deserves one drop of our water. Let it go back to fallow like where it came from. They don't deserve it. 75 percent of the crops grown there go outside the United States. The people that are harvesting them are working for poverty wages in poisonous conditions. It does nobody any good and now they want to take from us. It's patently wrong. It's immoral. It's disgusting, and anybody who participates in it is either a creep or a fool.

Response
See Common Response 2.

Comment PH03-52

Comment
I have objections to option 2, 3, and 4. The only one that I would like is the one that says do nothing, other than others that have been brought up, we already have to shut down some of the temporary transfers that are already going on. Taking more water in dry years, as we can see currently, when it's dry, it's dry here, too. So doubling the amount of water you want to take while it's already dry is only going to negatively impact us more.

Response
See Common Response 2.

Comment PH03-53

Comment
I didn't really get a good answer to my question about the economic aspect. It isn't really clearly explained. You lump Butte and Sutter together. There's a negative employment factor of 118, loss of labor encumber 4.16 million and an output loss of 13.84 million. I would like to know if that's every single year or over the entire ten-year period? You can answer me later.

Response
Text has been added to the assessment methods in Section 3.10 to further clarify the economic modeling. Economic effects from cropland idling transfers would occur in years when cropland idling transfers are implemented. These are the maximum effects that could happen in a single year. If maximum cropland idling transfers occurred each year, then these effects would occur each year. Chapter 2 discusses the expected frequency of transfers and the priority order for the transfer methods. Under the Proposed Action, cropland idling transfers have the lowest priority for the buyers.

Comment PH03-54

Comment
Finally, I don't think that you're considering the long-term impacts of eco-tourism, the loss of economy because of dying riparian forest that could happen due to your water transfers. There also will be loss of property value due to dry wells.

Response
As discussed in Section 3.8, water transfers would not have significant impacts on riparian forests. There would be no indirect effects on eco-tourism due to water transfers. Additional analysis has been provided in Section 3.10 on economic effects if wells potentially dry out.

Comment PH03-55

Comment
I'm director of Butte County Department of Water and Resource Conservation. Welcome back. The Butte County Board of Supervisors wrote in comments during the scoping process a number of years ago, and as well as I think a lot of people here voiced concerns and wrote letters in, and it's been a couple of years. You folks have done a lot of work, produced a lot of documents. We've started to go through it. You've heard a lot of passionate comments today and some technical comments. We're going through it also for the county and the board and the community, but you've gone three years or so doing your work. We've had a couple of weeks to provide comments to go through the voluminous documents and analyses, which we will read. We will go through everything, but we're going to need more time. Started to peel away the layers of the onion. There are significant issues, some new issues that have come up at two, you know, be courteous to the community and responsive. I think you really should afford people more time. You've had three years to redo this. You're going to have a ten-year program you're proposing. If nothing else, afford more time, and I think someone suggested, too, come back before you finalize a document. It is a legal document with your response to comments and do this and be responsive, whether you're going to get the answers you want, but afford the community the time to review the materials in detail and come back before you finalize it. Thank you.

Response
The Lead Agencies are unable to accommodate the request for additional review time beyond CEQA and NEPA requirements.

Comment PH03-56

Comment
It's been said that this is the last healthy aquifer in California, but its health is in steady decline, not just in recent years, not just during this drought, but over ten years, over 20 and 30 years. It's been said that our region is in balance with its water supply and its water demands, but you've heard the testimony of people here tonight that shows that that is clearly not the case, and it's not only the human water demand that is falling short. The ecosystem is falling short of its water needs, as well.

Response
Section 3.3 describes groundwater conditions and evaluates and mitigates effects of the alternatives. Section 3.7 evaluates effects to fisheries and Section 3.8 evaluates effects to vegetation and wildlife.

Comment PH03-57

Comment
Other regions of California are out of balance. That is clear. The groundwater legislation in California is supposed to require that each region balance its water budget. What seems clear is that the San Joaquin Valley proposes to balance their water budget with Northern Sacramento Valley water. And we can't allow that to happen.

Response
Section 3.3.1.3 discusses the existing condition of the Sacramento and San Joaquin groundwater basins.

Comment PH03-58

Comment
You haven't heard one speaker here tonight who supports this project. This community is calling for the no action no project alternative.

Response
See Common Response 2.

Comment PH03-59

Comment
I own some land where I live a few blocks from here. My well -- my well was -- the ground table was about 40 feet in July 2010. In late August, it was 67, come up to 61 with the irrigation season ending, but -- and I don't have nearly as much as stake as the people here who earn their livelihood off the land.

Response
Section 3.3 evaluates effects to groundwater resources.

Comment PH03-60

Comment
And I wanted to comment on -- I listened with particular interest to an answer that was given to a question about the economic model that -- well, the modeling that was used and the data that was used, and it only went up to 2003 because something about the modeling tools didn't -- just didn't permit using data beyond 2003, which would have -- could possibly have really skewed the information, and I -- you know, I -- since 1970s, since the early days of the computer industry, I've written computer software, designed it, managed teams

of people who create it, and a computer program is -- I respect the technology behind the modeling. Computer program is really a very -- very, very detailed, almost fetishly detailed model that projects things are going to work under a certain set of conditions, and I -- one of the things that I always had to work with many engineers. They get so buried in their technology, that they lose a sense of common sense perspective. So, hey, look, this software you're producing that's supposed to give a financial statement is producing a ludicrous financial statement. It doesn't pass the common sense test. Look up from your numbers for a minute, okay, and think about -- think a little bit, take a step back.And I'm reminded of that when I heard these answers to this question about this model. Look at the people here and the impact and the concern. All these wells are drying up in the midst of an unprecedented drought. Think about that. Think about that. Look at the impact of that. Take that into consideration. It doesn't pass the common sense test.

Response
IMPLAN was the model used for the economic analysis. The analysis used 2011 economic data, which was the most recent available data at the time of the analysis.

Comment PH03-61

Comment
We're all people, right, here? We're all people, and we need water every single day, and our water lives under ground here. So we should leave it there, right? I mean, why do we need to pump it and put it somewhere else? I don't see how ya'll can't understand that. I don't see how -- how you can't hear everyone saying the same thing, that we're in terrible, dry conditions.

Response
See Common Response 2.

Comment PH03-62

Comment
I mean, I'm a farmer here in Chico. Our pumps have dropped -- our well has dropped 20 feet in two years. That burned up one of our submersible pumps, a bunch of money out of the window. It burned it up. So what if it's the worst-case scenario, and actually everything does drop really low and it comes in a desert and all the oak trees die and people move away and it's a really terrible situation. How are you going to feel when that happens? How does that make you guys feel? If you go home you're like, oh, well, we pumped up their water. Oh, well. How are you going to go to bed at night? Shame. Shame on ya'll. Shame.

Response
Section 3.3 evaluates effects to groundwater resources, Section 3.8 evaluates effects to vegetation and wildlife, and Section 3.10 evaluates effects to the regional economies.

Comment PH03-63

Comment
I don't know anything at all about water. I've been sitting in the front row on the left-hand side. There's three people here who have a tongue pinched and pieces of paper in front of them and nobody wrote down a single word all evening, and it just kind of makes me curious as to whether you didn't really hear anything that was worth thinking about or if you just don't gave damn.

Response
All comments from the public hearings were recorded by a court reporter. The transcripts are a part of the Final EIS/EIR, and the Lead Agencies have considered and responded to all comments made during the public hearings.

Comment PH03-64

Comment
I'm here taking pictures for our local online news magazine, Chico Soul, and I've been really trying to be objective, you know, and not say anything, as a photo journalist is supposed to do, but I cannot remain objective. I have to -- I have to get up here and say something because at least four or five of the farmers that grow my food, their well -- I'm hearing their wells are going dry. I'm getting really concerned that the food that they grow for me that I go to the farmers market every week, that is where we buy our food, and if these farmers that feed me, that grow my food, if their wells are going dry, I'm really concerned, and I will be supporting Aqua Alliance to litigate. Thank you.

Response
See Common Response 2.

Comment PH03-65

Comment
I came here four years ago. I am a rainforest child from the Kitsap Peninsula in Washington State. When I came here, I stopped in Portland and they laughed at me, they're like, why are you going to California? There's no water there? And I told them I was chasing the sun. I'm from Seattle. It's the suicide capital of the nation, and I think California may very well take that. What we're witnessing here, is incredible thirst, both through population, scorching temperatures, and as a student of permaculture and I see a small community here that's very solution focused. I definitely encourage the rest of the world to step up.

I'm part of a generation where we realize we have to dig our heels in. My T-shirt is "in soil we trust." God is in the soil, Soil is in us, and if we are to survive as a human race, I think we need to sit down at many tables and possibly put our hearts forward, our money aside, and just think about the long-term projection of this world. I just watched Chasing Ice last night. It's a very beautiful documentary about a very passionate photographer who is doing time lapse photography on two different sites, in Montana and Iceland and Greenland, Siberia and Tibet and watching incredible shrinking of icebergs, and I think maybe tonight is represented in a similar feat underneath our ground where there's a great shrinking.

So I hope all the words here can go into our hearts and our souls and when we go back to our offices and go back to the street and go back to our farms, may we let them sink in a little bit, percolate and come up with some good solutions that we can work with in our communities here and far. Thank you so much for your conscious consideration and being open minded. Thank you.

Response
The purpose and need and project objectives of this Draft EIS/EIR are to help address the water shortages experienced in California. The Draft EIS/EIR includes an assessment of the potential impacts to environmental resources, including agricultural resources, from the identified range of potential transfer activities in relation to the no action and action alternatives.

Comment PH03-66

Comment
I just want you to go look at Mt. Lassen. We are at the edge of the Cascades. Paradise is the last butte of the Cascades. The Cascades come in from Canada and they stop right here and Sierra Nevada Brewery is actually brewed with Cascadian water, and if you look up at Mt. Lassen, all of the -- we have five major waterways that come through Chico, and if we don't have snow pack on Mt. Lassen this year, we will have no rivers.

We look at Mt. Shasta, and we see that 5- and 10,000 years of glaciers are melting on the north side of Shasta. If you look at Shasta Lake, you will see it's coming down to a little puddle. It's dropping one to two feet a day. So there is -- if we need -- we need to do rain dances. We need to do everything. You cannot steal the remainder of our water. This is so -- we -- if you were here -- if you spent the night, and you probably aren't, you can wake up and look at Mt. Lassen and Mt. Shasta. If we have no snow pack, no water will come down into Butte Creek, Little Chico Creek, Big Chico Creek, Deer Creek, Mill Creek, we are in a very, very tough year, and we need lots and lots and lots of snow. And we -- if we don't get it, like we got last year, we are going to be suffering for no surface water and then you're stealing our groundwater? Shame.

Response
Section 3.1 analyzes potential changes to surface water supplies associated with the action alternatives. Common Response 5 includes a discussion of recent dry hydrology and how this hydrology fits with the modeled time period. Section 3.6 discusses the potential impacts of the action alternatives on climate change.

Comment PH03-67

Comment
So we all realize there's a lot of money in politics behind what you're going to put forth. We can pretty much be assured of that, and I'll expose some of my ignorance. I'm not sure how people on the Board of Reclamation get their positions. It's certainly not by being voting, I wouldn't guess, but even so, I think I would like to say there's some changes blowing in the wind. I think that people like Paul Gosselin, who was hearing for his community and support them, their wishes, who get their support when times come, and I think in some way or another, people who don't listen to the community, I can't imagine you've heard much different in any of the other two meetings you've been at, that they continue to put forth things that people don't want, won't be in position to have that power for a long time, I think. That's my opinion. And so certainly, I don't support it.

Response
The Bureau of Reclamation is a federal agency, and the Commissioner is appointed by the Secretary of the Interior.

Comment PH03-68

Comment
On the first proposition, I don't quite understand it, and I thought maybe you could explain it to me. It says they want seven-and-a-half-billion dollars in general obligation bonds for the state water supply, infrastructure projects including surface and groundwater storage. Now, where are you getting the groundwater to store? That's my question.

Response
Any of the potential transfer activities evaluated under the action alternatives in this EIS/EIR would not be funded by the recently-passed water bond. The water bond would fund separate studies and projects.

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Appendix K

Mitigation Monitoring and Reporting Program

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Appendix K
Mitigation Monitoring and Reporting Program

K.1 Introduction

The proposed Long-Term Water Transfers (Project) would result in the potential for significant environmental impacts associated with water supply, air quality, groundwater resources, and agricultural land use. Mitigation measures have been incorporated into the Project to reduce impacts to less than significant levels. The mitigation measures for the Project must be adopted by Reclamation and the San Luis & Delta-Mendota Water Authority (SLDMWA), in conjunction with adoption of the Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

Section 21081.6 of the Public Resources Code (PRC) and California Environmental Quality Act (CEQA) Guidelines section 15097 require the Lead Agency for each project that is subject to CEQA to monitor performance of the mitigation measures included in any environmental document to ensure that implementation does, in fact, take place. The PRC requires the Lead Agency to adopt a monitoring and reporting program for assessing and ensuring the implementation of required mitigation measures.

In accordance with PRC Section 21081.6, SLDMWA has developed this Mitigation Monitoring and Reporting Program (MMRP) for the Project. The purpose of the MMRP is to ensure activities associated with transferring water comply with all applicable environmental mitigation requirements.

K.2 Mitigation and Monitoring

Table K-1 lists the mitigation measures identified in the EIS/EIR, responsible parties, the time frame for implementation, and the monitoring parties. A column is provided for the monitoring party to sign-off on the implementation of each mitigation measure.

In addition to the mitigation measures, several environmental commitments would be enacted to reduce potential environmental impacts from water transfers. The environmental commitments are included in this MMRP to verify compliance as transfers move forward. Table K-2 shows these commitments, the responsible parties, time frame for implementation, and the monitoring parties.

Table K-1. Mitigation Measures

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion	
						Initials	Date
WS-1	The purpose of Mitigation Measure WS-1 is to address potential streamflow depletion effects to Central Valley Project (CVP) and State Water Project (SWP) water supply. Reclamation will apply a streamflow depletion factor to mitigate potential water supply impacts from the additional groundwater pumping due to groundwater substitution transfers. The streamflow depletion factor equates to a percentage of the total groundwater substitution transfer that will not be credited to the transferor and is intended to offset the streamflow effects of the added groundwater pumping due to transfer. As described in the impact analysis, the magnitude of the potential water supply impact depends on hydrologic conditions surrounding the transfer period (both before and after). The exact percentage of the streamflow depletion factor will be assessed and determined on a regular basis by Reclamation and California Department of Water Resources (DWR), in consultation with buyers and sellers, based on the best technical information available at that time. The percentage will be determined based on hydrologic conditions, groundwater and surface water modeling, monitoring information, and past transfer data. Application of the streamflow depletion factor will offset potential water supply effects and reduce them to a less than significant level. The streamflow depletion factor may not change every year, but will be refined as new information becomes available and may become more site specific as better data and groundwater modeling becomes available. The minimum streamflow depletion factor (based on modeling completed for this EIS/EIR) will be 13	Reclamation	Reclamation and DWR	CVP and SWP operations reporting.	Ongoing.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	percent, but this factor may be adjusted based on additional information on local conditions. Reclamation and DWR require the imposition of a streamflow depletion factor because they will not move transfer water if doing so will violate the no injury rule. This process to evaluate and determine the streamflow depletion factor will help verify that the factor reduces potential impacts to avoid legal injury to CVP or SWP water supplies and a substantial impact or injury.						
GW-1	The *DRAFT Technical Information for Preparing Water Transfer Proposals* (Reclamation and DWR 2014) provide guidance for the development of proposals for groundwater substitution water transfers. The technical information informs the development of the monitoring and mitigation program for the range of potential transfer activities evaluated in this EIS/EIR, which will be updated as appropriate based on the most current version of the technical paper each year of the ten-year term of potential activities. The objective of Mitigation Measure GW-1 is to avoid significant adverse environmental effects and ensure prompt corrective action in the event unanticipated effects nevertheless occur. The measure accomplishes this by monitoring groundwater and/or surface water levels during transfers to avoid potential effects. The objectives of this process are to: (1) minimize potential effects to other legal users of water; (2) provide a process for review and response to reported effects to non-transferring parties; (3) assure that a local mitigation strategy is in place prior to the groundwater transfer; and (4) mitigate significant adverse environmental effects that occur. Reclamation will verify that sellers adopt and implement these	Participating Sellers	Reclamation	Seller transfer application package.	Prior to water transfers.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	mitigation measures to avoid potentially significant adverse effects related to groundwater extraction. In addition, each entity participating in a groundwater substitution transfer must confirm that the proposed groundwater pumping will be compatible with state and local regulations and Groundwater Management Plans (GMPs). As Groundwater Sustainability Plans (GSPs) are developed by Groundwater Sustainability Agencies, potential sellers must confirm that the proposed pumping is compatible with applicable GSPs.						
GW-1	Well Review Process Potential sellers must submit well data for Reclamation and, where appropriate, DWR review, as part of the transfer approval process. Required information will be detailed in the most current version of the *DRAFT Technical Information for Preparing Water Transfer Proposals*.	Participating sellers	Reclamation	Seller transfer application package.	Prior to water transfers.		
GW-1	Monitoring Program Potential sellers must complete and implement a monitoring program subject to Reclamation's approval that shall, at a minimum, include the following components:	Participating sellers	Reclamation	Seller transfer application package and monitoring reports.	Prior to, during, and after water transfers.		
GW-1	*Monitoring Well Network* The monitoring program shall incorporate a sufficient number of monitoring wells, as determined by Reclamation in relation to local conditions, to accurately characterize groundwater levels and response in the area before, during, and after transfer pumping takes place. Depending on local conditions, additional groundwater level monitoring may be required near ecological resource areas.	Participating sellers	Reclamation	Seller transfer application package and monitoring data.	Plan submitted prior to water transfers; monitoring information submitted during and after transfer.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
GW-1	*Groundwater Pumping Measurements* All wells pumping to replace surface water designated for transfer shall be configured with a permanent instantaneous and totalizing flow meter capable of accurately measuring well discharge rates and volumes. Flow meter readings will be recorded just prior to initiation of pumping and at designated times, but no less than monthly and as close as practical to the last day of the month, throughout the duration of the transfer.	Participating sellers	Reclamation	Seller transfer application package with field spot-checks and monitoring data.	Prior to, during, and after water transfers.		
GW-1	*Groundwater Levels* Sellers will collect measurements of groundwater levels in both participating transfer wells and monitoring wells. Groundwater level monitoring will include measurements before, during and after transfer-related pumping. The seller will measure groundwater levels as follows: • Prior to transfer: Groundwater levels will be measured monthly from March in the year of the proposed transfer until the start of the transfer (where possible). • Start of transfer: Groundwater levels will be measured on the same day that the transfer begins, prior to the pump being turned on. • During transfer: Groundwater levels will be measured throughout the transfer period at the frequency specified in the most current *DRAFT Technical Information for Preparing Water Transfer Proposals.* • Post-transfer: Groundwater levels will be measured weekly for one month after the end of transfer pumping, after which groundwater levels will be measured monthly through March of the year following the transfer. Sellers thus monitor effects to groundwater levels that may result from the proposed transfer and avoid significant impacts. The primary criteria used	Participating sellers	Reclamation	Regular inspection, monitoring data, and report on effects to deep-rooted vegetation, if necessary.	Prior to, during, and after water transfers.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	to identify significant impacts to groundwater levels are the Basin Management Objectives (BMOs) set by GMPs. In the Sacramento Valley, several counties have established GMPs to provide guidance in managing the resource. The existing GMPs and BMOs are discussed in Section 3.3.1.2, Regulatory Setting. In areas where quantitative BMOs do not exist, Reclamation, SLDMWA, and the potential seller(s) will coordinate closely with potentially impacted third parties to collect and monitor groundwater data. If a third party expects that it may be impacted by a proposed transfer, that party should contact Reclamation and the seller with its concern. The burden of collecting groundwater data will not be the responsibility of the third party. If warranted, groundwater level monitoring to address the third-party's concern may be incorporated in the monitoring and mitigation plans required by Mitigation Measure GW-1. Additionally, to avoid effects to vegetation, sellers will monitor groundwater depth data to verify that significant adverse effects to deep-rooted vegetation are avoided. If monitoring data indicate that water levels have dropped more than 10 feet where groundwater was 10 to 25 feet below ground surface prior to starting the transfer of surface water made available from groundwater substitution actions, the seller must implement actions set forth in the mitigation plan. If historic data show that groundwater elevations in the area of transfer have typically varied by more than this amount annually during the proposed transfer period, then the transfer may be allowed to proceed. If there is no deep-rooted vegetation (i.e., oaks that would have tap roots greater than 10 feet deep) within one-half mile of the transfer area or the vegetation is located						

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	along waterways that will continue to have water during the transfer, the transfer may be allowed to proceed. If significant adverse impacts to deep-rooted vegetation occur as a result of the transfer despite the monitoring efforts and implementation of the mitigation plan, the seller will prepare a report documenting the result of the restoration activity to plant, maintain, and monitor restoration of vegetation for 5 years to replace the losses.						
GW-1	*Groundwater Quality* For municipal sellers, the comprehensive water quality testing requirements of Title 22 are considered sufficient for the water transfer monitoring program. Agricultural sellers shall measure specific conductance in samples from each participating production well. Samples shall be collected when the seller first initiates pumping, monthly during the transfer period, and at the termination of transfer pumping.	Municipal sellers	Reclamation	Inspections during transfer period and monitoring data.	Prior to, during, and after water transfers.		
GW-1	*Land Subsidence* Subsidence monitoring will be required if groundwater levels could decline below historic low levels during the proposed water transfer. If the measured groundwater level falls below the historic low level, land surface elevation measurements in strategic locations within and/or near the transfer area will be required. Measurements may include (1) extensometer monitoring, (2) continuous Global Positioning System (GPS) monitoring, or (3) extensive land-elevation benchmark surveys conducted by a licensed surveyor. This data could be collected by the seller or from other sources (such as public extensometer data). Measurements must be completed on a monthly basis during the transfer. If the land surface elevation survey indicates an	Participating sellers	Reclamation	Regular inspections and monitoring data.	Prior to, during, and after water transfers.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	elevation decrease between 0.1 foot and 0.2 foot from the initial measurement, the seller could have significant impacts and would need to start the process identified in the Mitigation Plan. The seller will also work with Reclamation to assess the accuracy of the survey measurements based on current limitations of technology, professional engineering/surveying judgment, and any other data available in or near the transferring area. The threshold of 0.1 foot was chosen as this value is typical of the elastic (i.e., recoverable) portion of subsidence; the threshold of 0.2 foot was selected considering limitations of current land survey technology. This threshold is supported by a review of data from the several extensometers within the Sacramento Valley.						
GW-1	*Coordination Plan* The monitoring program will include a plan to coordinate the collection and organization of monitoring data. This plan will describe how input from third parties will be incorporated into the monitoring program, and will include a plan for communication with Reclamation as well as other decision makers and third parties.	Participating sellers	Reclamation	Seller transfer application package with Coordination Plan.	Prior to water transfers.		
GW-1	*Evaluation and Reporting* The monitoring program will describe the method of reporting monitoring data. At a minimum, sellers will provide data summary tables to Reclamation, both during and after transfer-related groundwater pumping. Post-program reporting will continue through March of the year following the transfer. Sellers will provide a final summary report to Reclamation evaluating the effects of the water transfer. The final report will identify transfer-related impacts on groundwater and surface water (both during and after pumping), and the extent and significance, if any, of effects on local groundwater users. It shall include groundwater elevation	Participating sellers	Reclamation	Seller transfer application package and monitoring data and report.	Plan submitted prior to water transfers; monitoring information submitted during and after transfer.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	contour maps for the area in which transfer operations are located, showing pre-transfer groundwater elevations, groundwater elevations at the end of the transfer, and recovered groundwater elevations in March of the year following the transfer. The summary report shall also identify the extent and significance, if any, of transfer-related effects to ecological resources such as fish, wildlife, and vegetation resources.						
GW-1	Mitigation Plan Potential sellers must complete and implement a mitigation plan. If the seller's monitoring efforts indicate that the operation of wells for groundwater substitution pumping are causing substantial adverse impacts, the seller will be responsible for mitigating any significant environmental impacts that occur. Mitigation actions must be implemented to reduce impacts to a less than significant level and could include: • Curtailment of pumping until natural recharge corrects the issue. • Lowering of pumping bowls in non-transferring wells affected by transfer pumping. • Reimbursement for significant increases in pumping costs due to the additional groundwater pumping to support the transfer. • Curtailment of pumping until water levels raise above historic lows if non-reversible subsidence is detected (based on local data to identify elastic versus inelastic subsidence). • Reimbursement for modifications to infrastructure that may be affected by non-reversible subsidence. • Other appropriate actions as determined by Reclamation. As summarized above, the purpose of Mitigation Measure GW-1 is to monitor groundwater levels	Participating sellers	Reclamation	Mitigation plan, monitoring data for mitigation activities, and regular inspections of mitigation activities.	Prior to, during, and after water transfers.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	during transfers to avoid potentially significant adverse effects. The mitigation plan will describe how to address any significant effects that occur despite the monitoring efforts. The objectives of this process are to: (1) minimize potential effects to other legal users of water; (2) provide a process for review and response to reported effects; and (3) assure that a local mitigation strategy is in place prior to the groundwater transfer. Accordingly, to ensure that mitigation plans will be feasible, effective, and tailored to local conditions, the plan must include the following elements: • A procedure for the seller to receive reports of purported environmental effects or effects to non-transferring parties; • A procedure for investigating any reported effect; • Development of mitigation options, in cooperation with the affected parties, for legitimate significant effects; and • Assurances that adequate financial resources are available to cover reasonably anticipated mitigation needs. Mitigation to avoid potentially significant subsidence impacts and ensure prompt corrective action in the event of unanticipated effects nevertheless occur is described by the following stages. *Stage 1: Groundwater Levels* Irreversible subsidence would not occur if groundwater levels stay above historic low levels for the entire transfer season. As groundwater is pumped from an aquifer, the pore water pressure in the aquifer is reduced. This reduction in pore water pressure increases the effective stress on the structure of the aquifer itself. This increase in effective stress can cause the aquifer structure to deform, or compress, resulting in the subsidence of						

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	the ground surface elevation. Subsidence can be irreversible if the reduced effective stress is lower than historically low effective stress. Typically this would be the result of groundwater levels reaching levels lower than the historical low level. If groundwater level monitoring indicates that groundwater levels remain above historic low levels, then no additional actions for subsidence monitoring or mitigation are necessary. *Stage 2: Ground Surface Elevations*Stage 2 includes monthly ground surface monitoring during water transfers if they could cause groundwater levels to fall below historic low levels, as described above in the Monitoring Plan. If ground surface elevations decrease between 0.1 and 0.2 foot, the seller will evaluate the accuracy of the information based on the current limitations of technology, professional engineering/surveying judgment, and other local data. If the elevations decline more than 0.2 feet, this change could indicate inelastic subsidence, which would trigger a shift to Stage 3. *Stage 3: Local Investigation* If the threshold of 0.2 foot of ground surface elevation change is exceeded, the seller shall cease groundwater substitution pumping for the transfer until one of the following occurs: (1) groundwater levels recover above historic low groundwater levels; (2) seller completes a more detailed local investigation identifying hydrogeologic conditions that could potentially allow continued transfer from a subset of wells (if the seller can provide evidence that this pumping is not expected to cause additional subsidence); or (3) seller completes an investigation of local infrastructure that could be affected by subsidence (such as water delivery						

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
	infrastructure, water supply facilities, flood protection facilities, highways, etc.) indicating the local threshold of subsidence that could be experienced before these facilities would be adversely affected. Any option should also consider the effect of non-transfer pumping that may be causing subsidence. *Stage 4: Mitigation* If subsidence effects to local infrastructure occur despite monitoring efforts, then the sellers must work with the lead agencies to determine whether the measured subsidence may be caused by water transfers. Any significant adverse subsidence effects caused by transfer activities must be addressed and a contingency plan in the event of a need for further corrective action must be approved by Reclamation before transfers could continue after Stage 3. *Stage 5: Continued Monitoring* The sellers will continue to monitor for subsidence while groundwater levels remain below historic low levels. If the seller has ceased transfer-related pumping but groundwater levels remain below historic lows, subsidence monitoring will need to continue until the spring following the transfer. The results of subsidence monitoring will be factored into monitoring and mitigation plans for future transfers.						

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
AQ-1	Selling agency would reduce pumping at diesel or natural gas wells to reduce emissions to below the thresholds. If an agency is transferring water through cropland idling and groundwater substitution in the same year, the reduction in vehicle emissions can partially offset groundwater substitution pumping at a rate of 4.25 acre-feet (AF) of water produced by idling to one acre-foot of groundwater pumped. Agencies may also decide to replace old diesel or natural gas wells to reduce emission below the thresholds. Any selling agencies with potentially significant emissions, as determined by this EIS/EIR, will be required to maintain daily recordkeeping logs that document the specific engine to be used for groundwater substitution transfers, the power rating (hp), and applicable emission factors. Emission calculations will be completed daily for comparison to the significance thresholds determined for each selling agency. The recordkeeping logs will be sent to Reclamation monthly for verification that emissions are within the allowable limits. Reclamation will also work with the water agencies to inform individual growers of incentive funding available through the Natural Resources Conservation Service's Environmental Quality Incentives Program. Funded conservation practices including the replacement of internal combustion engines in irrigation pumps; therefore, the program may be used by growers to further reduce criteria pollutant emissions.	Selling agency	Reclamation	Daily recordkeeping logs specifying the engines operated by each selling agency with potentially significant emissions and calculated criteria pollutant emissions.	Monthly during transfer.		

Measure No.	Mitigation Measure	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion	
						Initials	Date
AQ-2	Any engines operating in the area of analysis that are capable of operating as either electric or natural gas engines would only operate with electricity during any groundwater transfers. Any selling agencies with these engines will be required to maintain daily recordkeeping logs that document the engines used for groundwater substitution transfers and the type of fuel used. The recordkeeping logs will be sent to Reclamation monthly for verification that the engines are operating in compliance with the mitigation measure.	Selling agency	Reclamation	Daily recordkeeping logs documenting the engines used for groundwater substitution transfers and the fuel type used.	Monthly during transfer.		
LU-1	Water would not be acquired from a particular parcel of land if idling the land would result in a lower classification of Important Farmland as defined under the Farmland Mapping and Monitoring Program (FMMP). The selling agency will provide cropping history of specific parcels to be idled for the transfer to Reclamation to determine if idling will result in a change in classification from Important Farmland.	Selling agency	Reclamation	Maps of fields to be idled with land classification and past cropping patterns for field to be idled.	Prior to water transfer.		

Table K-2. Environmental Commitments

Environmental Commitments	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
In groundwater basins where sellers are in the same groundwater subbasin as protected aquatic habitats, such as giant garter snake preserves and conservation banks, groundwater substitution will be allowed as part of the long term water transfers if the seller can demonstrate that any impacts to water resources needed for special-status species protection have been addressed. In these areas, sellers will be required to address these impacts as part of their mitigation plan.	Participating Sellers	Reclamation	Seller transfer application package.	Prior to water transfers.		
Carriage water (a portion of the transfer that is not diverted in the Delta and becomes Delta outflow) will be used to maintain water quality in the Delta. Carriage water calculations will also reflect conveyance losses as the water moves from its source to the Delta export pumps, and is conveyed from the Delta to buyers. Carriage water is represented as a percent of the transfer that does not reach the buyer, and this percent is calculated during the transfer based on real-time monitoring information in the Delta. Typical carriage water amounts range from 20 to 30 percent for transfers from the Sacramento Valley, and about 10 percent for transfers from the San Joaquin Valley.	Reclamation	Reclamation	CVP operations reporting.	During water transfers.		

Environmental Commitments	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
As part of the approval process for long-term water transfers, Reclamation will have access to the land to verify how the water transfer is being made available and to verify that actions to protect the giant garter snake are being implemented. At the end of each water transfer year, Reclamation will prepare a monitoring report that contains maps of all cropland idling actions that occurred within the range of potential transfer activities analyzed in this EIS/EIR, results of any newly available scientific research and monitoring pertinent to water transfer actions, and a discussion of conservation measure effectiveness. The report will be submitted to United States Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW) in February, prior to the next year of potential transfers. Reclamation will coordinate with USFWS and CDFW on the contents and findings of the annual report prior to additional transfers.	Participating Sellers	Reclamation	Seller transfer application package with regular inspections of transfer actions. Reclamation will compile and submit annual report to USFWS and CDFW	Access provided prior to and during water transfers; inspections ongoing; report submitted annually to USFWS and CDFW		
Reclamation will establish annual meetings with the USFWS to discuss the contents and findings of the annual report. These meetings will be scheduled following the distribution of the monitoring report and prior to the next transfer season.	Reclamation	Reclamation	Distribution of monitoring report to USFWS and occurrence of annual meeting.	Meeting occurs prior to the next transfer season.		
Reclamation will provide a map(s) to the USFWS in June of each year showing the parcels of riceland that are proposed for the purpose of transferring water for that year. These maps will be prepared to comport to Reclamation's geographic information system (GIS) standards.	Participating Sellers	Reclamation	Completed mapping package from sellers showing parcels idled. Reclamation will prepare complete package for USFWS.	June of each transfer season.		
Movement corridors for aquatic species (including pond turtle and giant garter snake) include major irrigation and drainage canals. The water seller will keep adequate water in major irrigation and drainage canals. Canal water depths should be similar to years when transfers do not occur or, where information on existing water depths is limited, at least two feet of water will be considered sufficient.	Participating Sellers	Reclamation	Seller transfer application package with field spot-checks.	Ongoing during transfer season.		

Environmental Commitments	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion	
					Initials	Date
Districts proposing water transfers made available from idled rice fields will ensure that adequate water is available for priority habitat with a high likelihood of giant garter snake occurrence. The determination of priority habitat will be made through coordination with giant garter snake experts, Geographic Information System (GIS) analysis of proximity to historic tule marsh, and GIS analysis of suitable habitat. The priority habitat areas are indicated on the priority habitat maps for participating water agencies and will be maintained by Reclamation. As new information becomes available, these maps will be updated in coordination with USFWS and CDFW. In addition to mapped priority habitat, fields abutting or immediately adjacent to federal wildlife refuges will be considered priority habitat.	Participating Sellers	Reclamation	Seller transfer application package with field spot-checks. Priority habitat maps reviewed and updated as needed prior to each transfer season.	Field spot checks to occur during the transfer season, priority habitat to be reviewed and update prior to the next transfer season.		
Maintaining water in smaller drains and conveyance infrastructure supports key habitat attributes such as emergent vegetation for giant garter snake for escape cover and foraging habitat. If crop idling/shifting occurs in priority habitat areas, Reclamation will work with contractors to document that adequate water remains in drains and canals in those priority areas. Documentation may include flow records, photo documentation, or other means of documentation agreed to by Reclamation and USFWS.	Participating Sellers	Reclamation	Seller transfer application package with field spot-checks.	Ongoing during transfer season.		

Environmental Commitments	Responsible Party	Monitoring Party	Method of Verification	Timing of Verification	Verification of Completion Initials	Date
Mapped priority habitat known to be occupied by giant garter snake and priority habitats with a high likelihood for giant garter snake occurrence (60 percent or greater probability) will not be permitted to participate in cropland idling/shifting transfers. Water sellers can request a case-by-case evaluation of whether a specific field would be precluded from participating in long-term water transfers. These areas include lands adjacent to naturalized lands and refuges and corridors between these areas, such as: • Fields abutting or immediately adjacent to Little Butte Creek between Llano Seco and Upper Butte Basin Wildlife Area, Butte Creek between Upper Butte Basin and Gray Lodge Wildlife areas, Colusa Basin drainage canal between Delevan and Colusa National Wildlife Refuges, Gilsizer Slough, Colusa Drainage Canal, the land side of the Toe Drain along the Sutter Bypass, Willow Slough and Willow Slough Bypass in Yolo County, Hunters and Logan Creeks between Sacramento and Delevan National Wildlife Refuges; and • Lands in the Natomas Basin.	Participating Sellers	Reclamation	Seller transfer application package, maps of fields to be idled, and field spot-checks of land idled.	Prior to and during water transfers.		
Sellers will perform giant garter snake best management practices, including educating maintenance personnel to recognize and avoid contact with giant garter snake, dredging only one side of a conveyance channel per year, and implementing other measures to enhance habitat for giant garter snake. Implementation of best management practices will be documented by the sellers and verified by Reclamation and will be included in the annual monitoring report.	Participating Sellers	Reclamation	Seller transfer application package with field spot-checks and documented in annual monitoring report.	Ongoing.		
In order to limit reduction in the amount of over-winter forage for migratory birds, including greater sandhill crane, cropland idling transfers will be minimized near known wintering areas that support high concentrations of waterfowl and shorebirds, such as wildlife refuges and established wildlife areas.	Participating Sellers	Reclamation	Seller transfer application package, maps of fields to be idled, and field spot-checks	Prior to and during transfer season.		

K.3 List of Acronyms

AF – Acre-feet

BMOs – Basin Management Objectives

CDFW – California Department of Fish and Game

CEQA – California Environmental Quality Act

CVP – Central Valley Project

DWR – California Department of Water Resources

EIR – Environmental Impact Report

EIS – Environmental Impact Statement

FMMP – Farmland Mapping and Monitoring Program

GIS – Geographic Information System

GMP – Groundwater Management Plan

GSP – Groundwater Sustainability Plan

GPS – Global Positioning System

MMRP – Mitigation and Monitoring Program

PRC – Public Resources Code

Reclamation – Bureau of Reclamation

SLDMWA – San Luis & Delta–Mendota Water Authority

SWP – State Water Project

USFWS – United States Fish and Wildlife Service

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Appendix L

Groundwater Existing Conditions

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Source for all Appendix L Data:

DWR. Water Data Library 2015, Available at: http://www.water.ca.gov/waterdatalibrary/docs/Hydstra/index.cfm?site=22N02W15C002M. Accessed March, 2015.

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Location Maps for Shallow, Intermediate and Deep Groundwater Monitoring Wells

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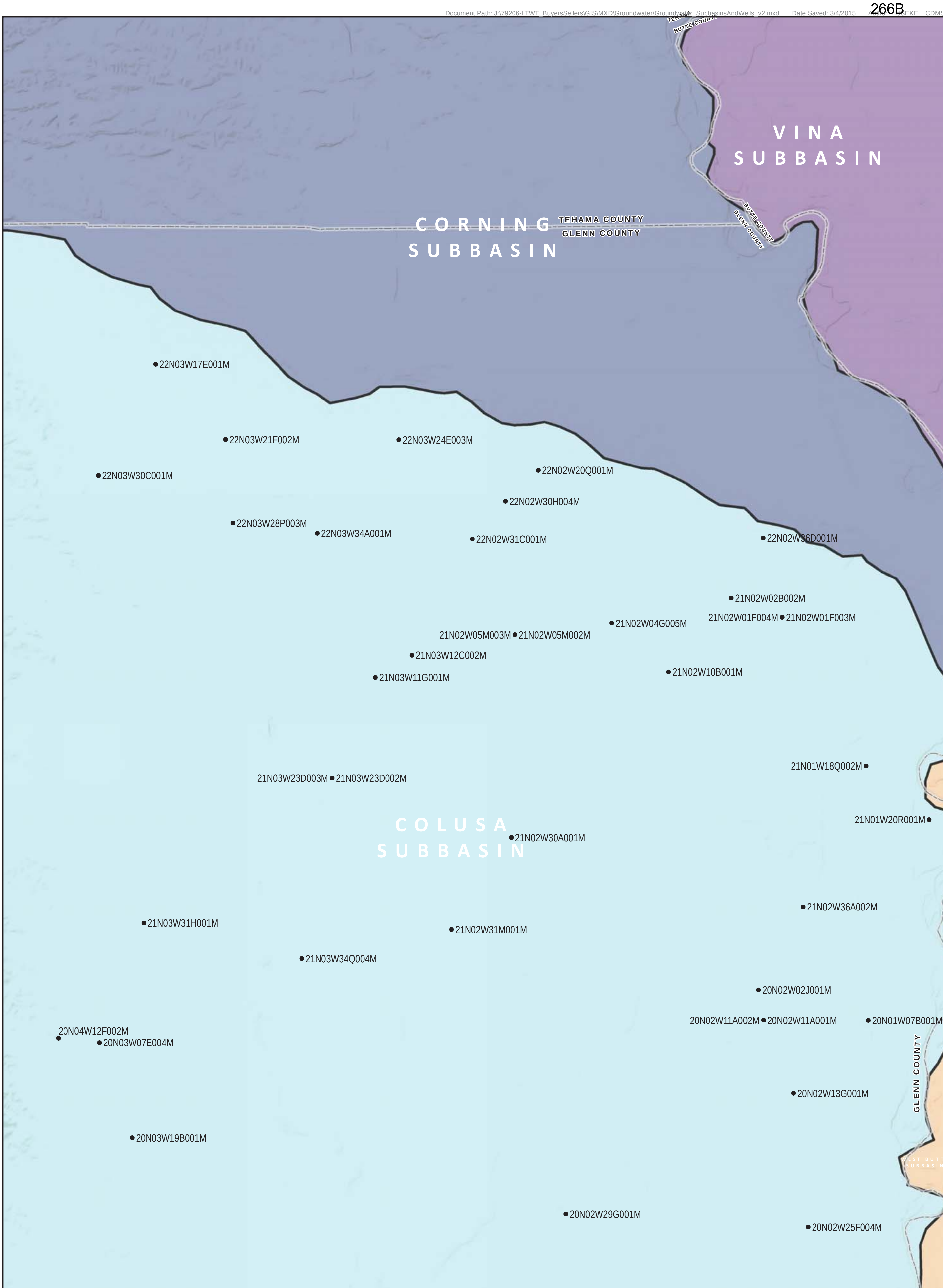

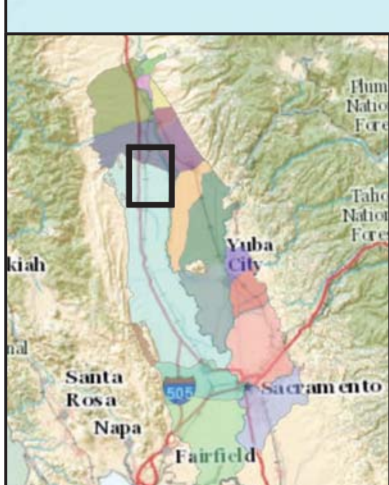

Location of Shallow Groundwater Monitoring Wells

Colusa Subbasin

Part 1 of 4

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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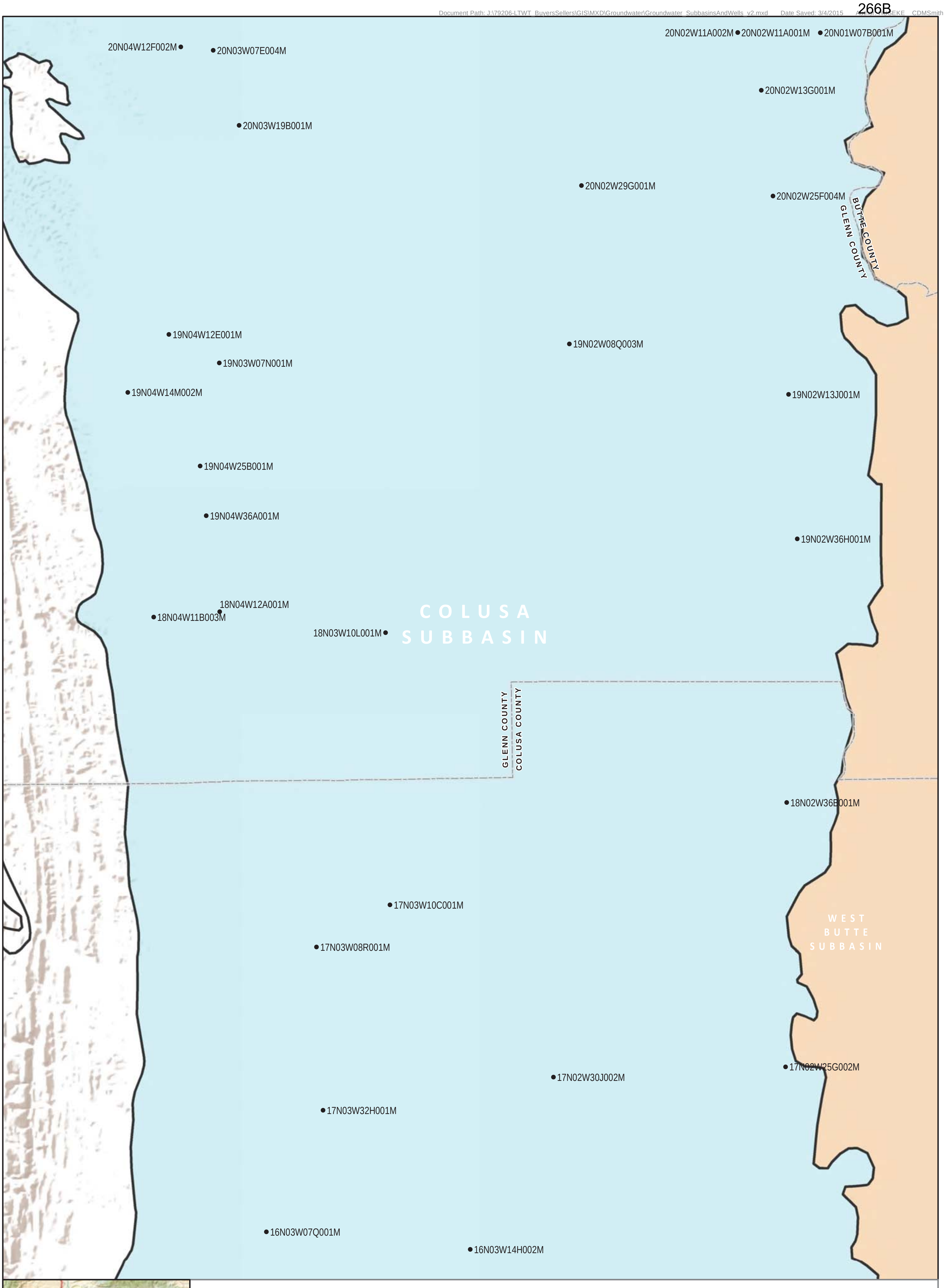

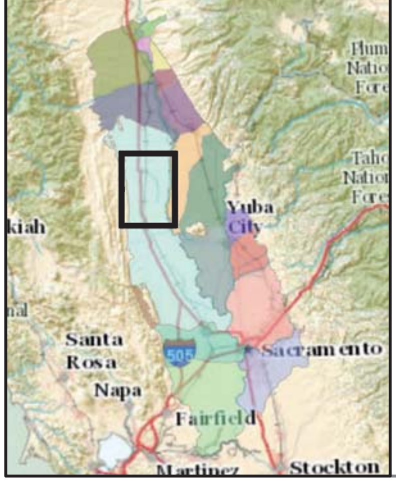

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Location of Shallow Groundwater Monitoring Wells
Colusa Subbasin
Part 2 of 4

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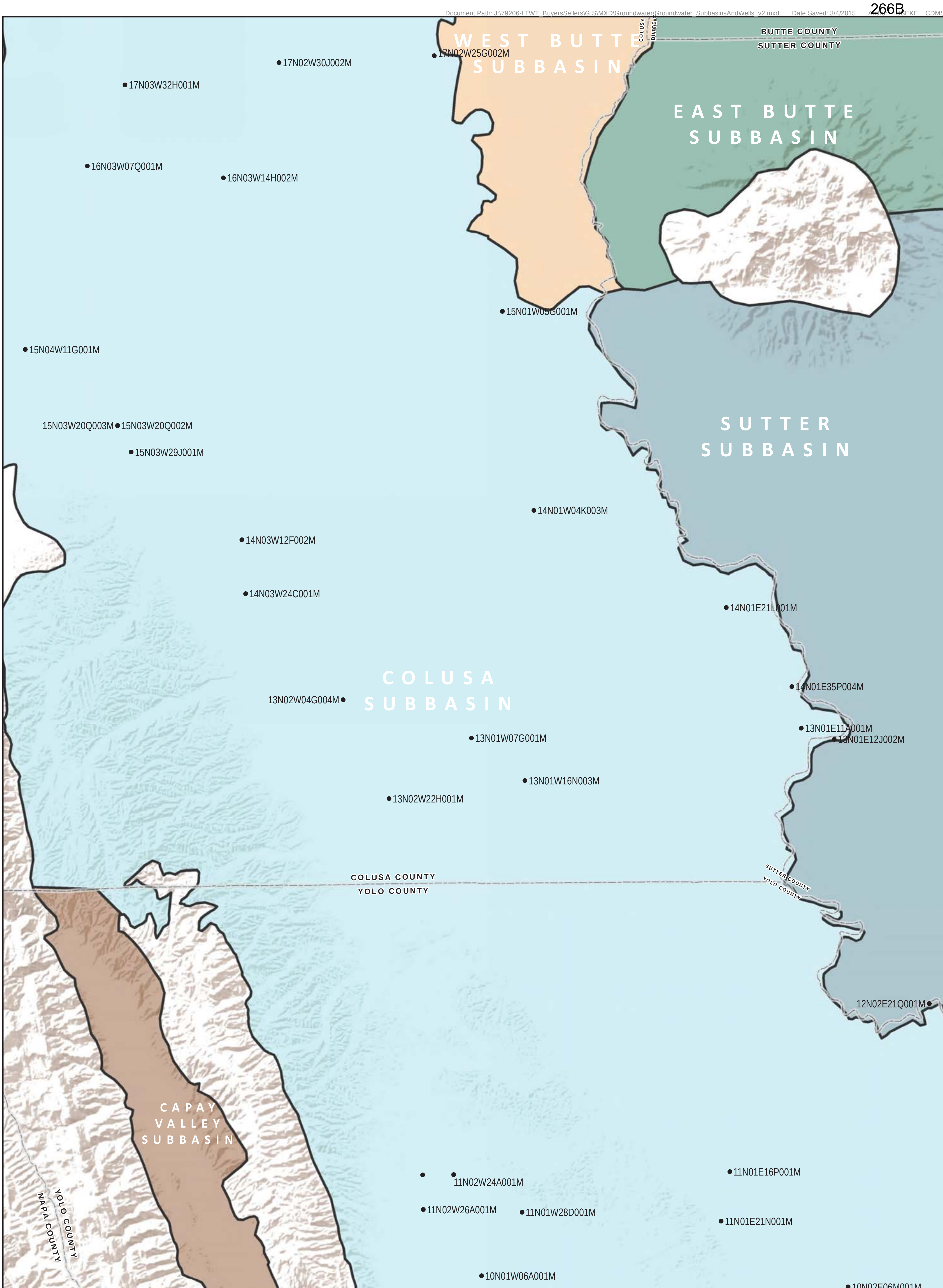

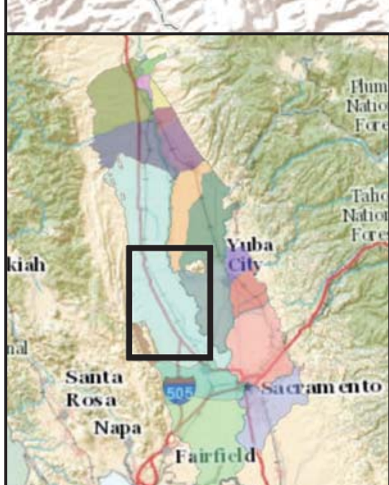

Location of Shallow Groundwater Monitoring Wells

Colusa Subbasin

Part 3 of 4

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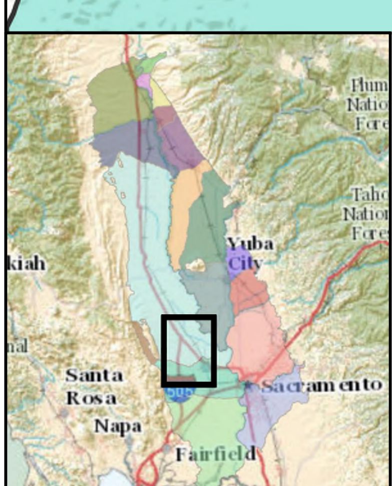

Location of Shallow Groundwater Monitoring Wells

Colusa Subbasin

Part 4 of 4

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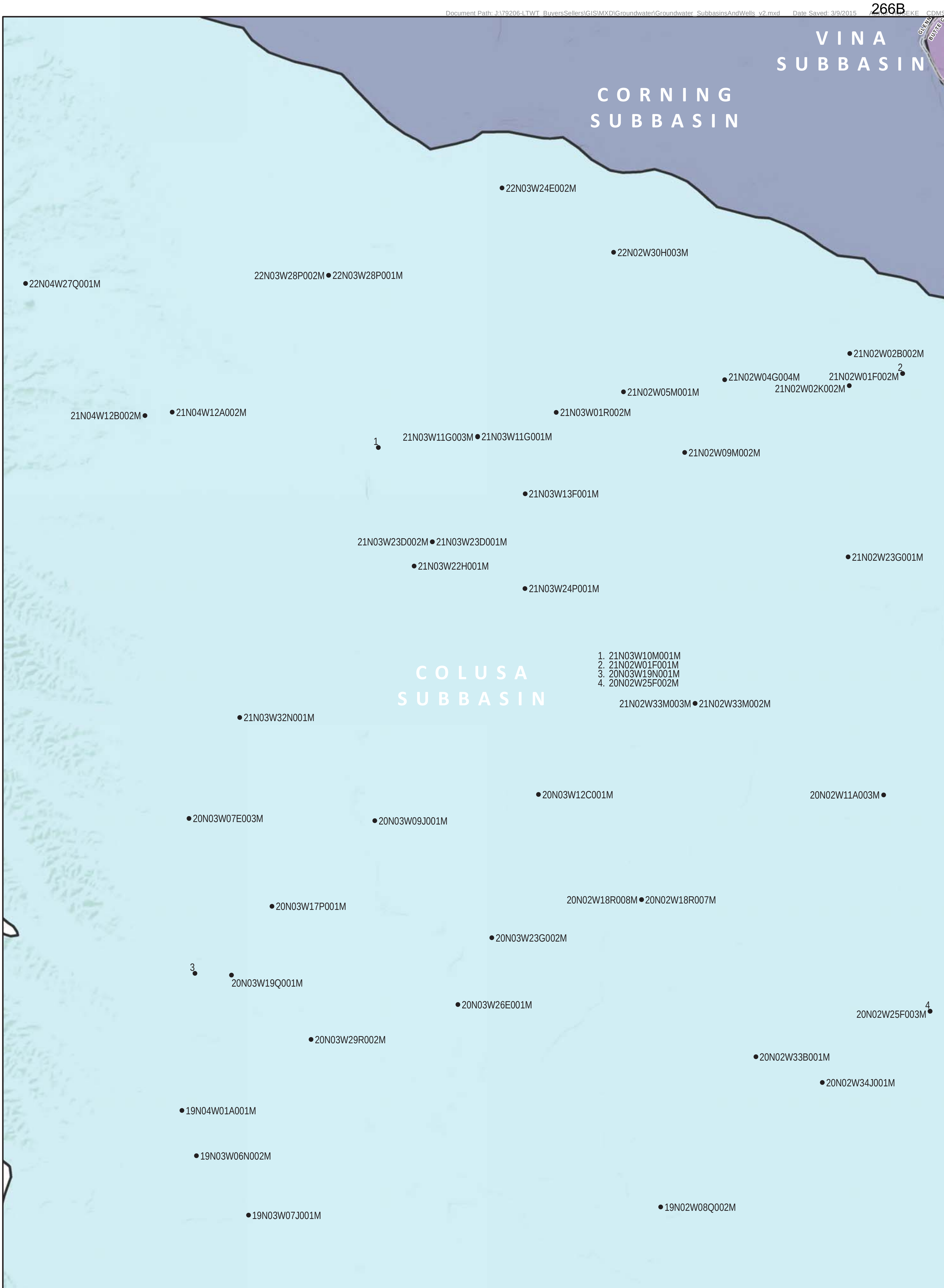

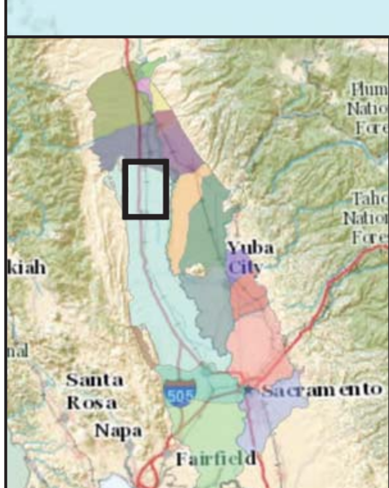

Location of Intermediate Depth Groundwater Monitoring Wells

Colusa Subbasin
Part 1 of 4

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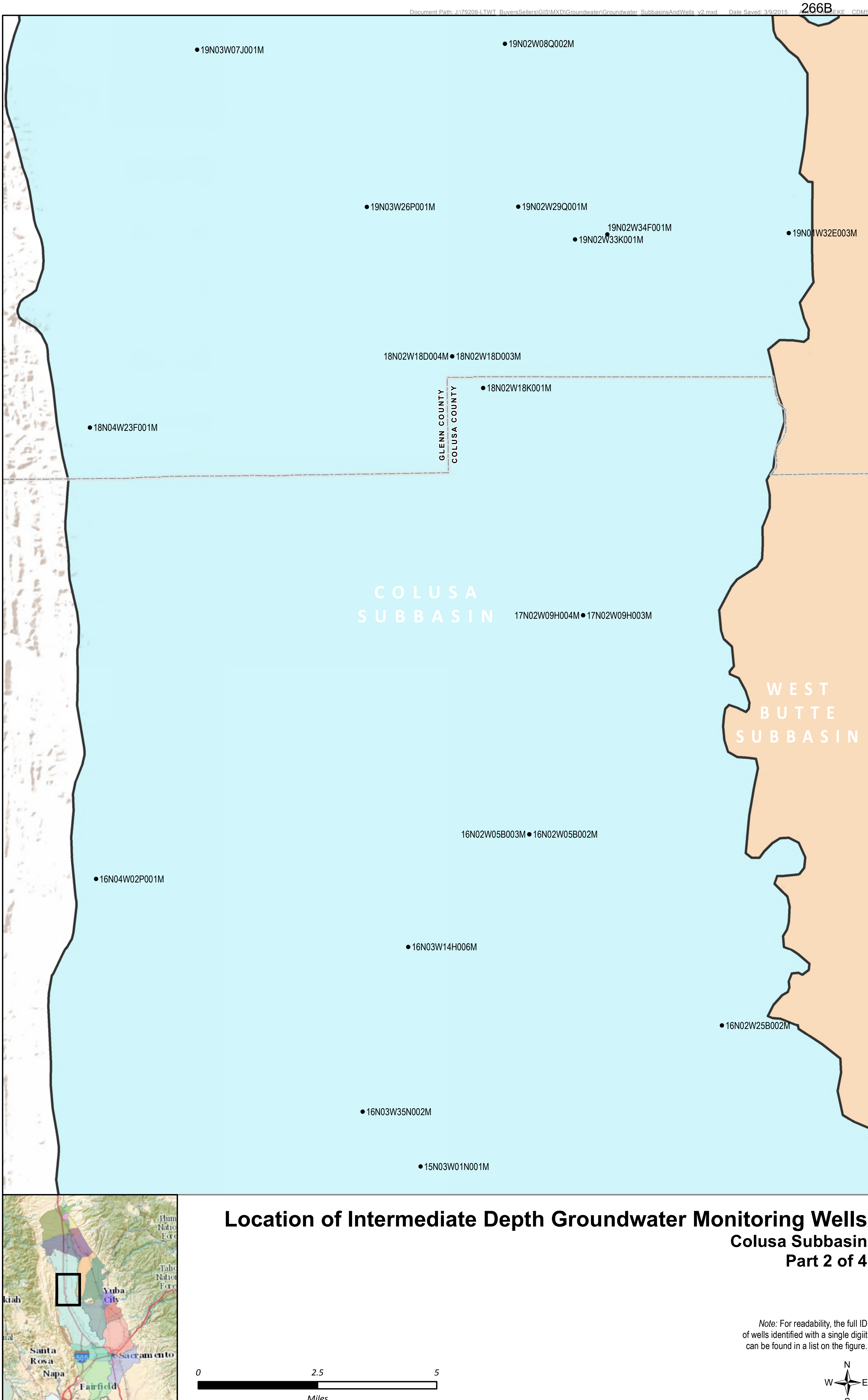

Location of Intermediate Depth Groundwater Monitoring Wells

Colusa Subbasin

Part 2 of 4

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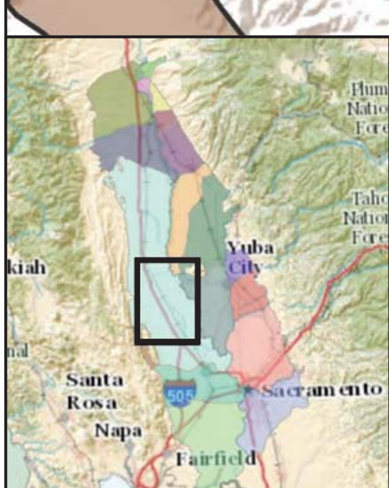

Location of Intermediate Depth Groundwater Monitoring Wells

Colusa Subbasin
Part 3 of 4

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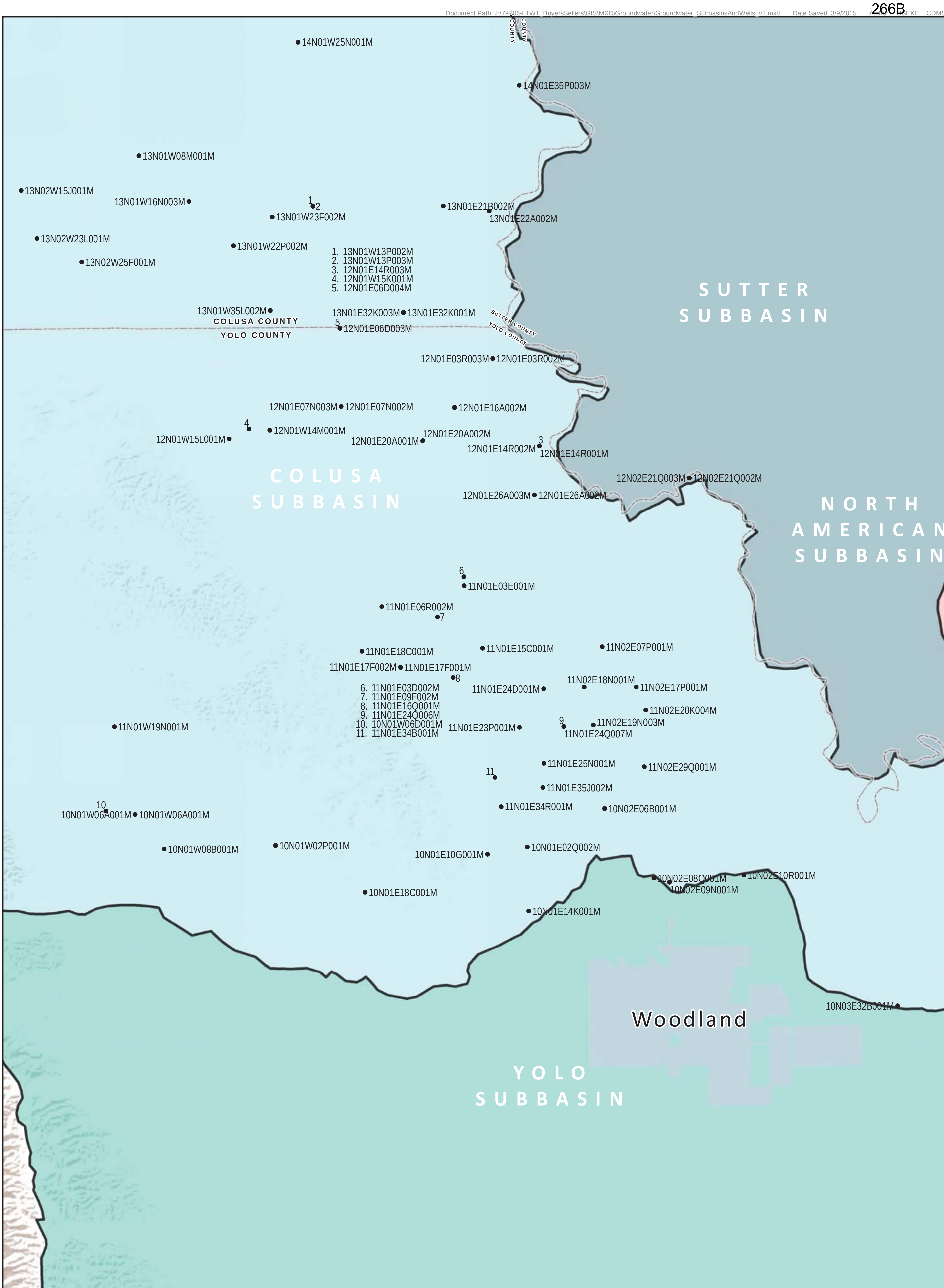

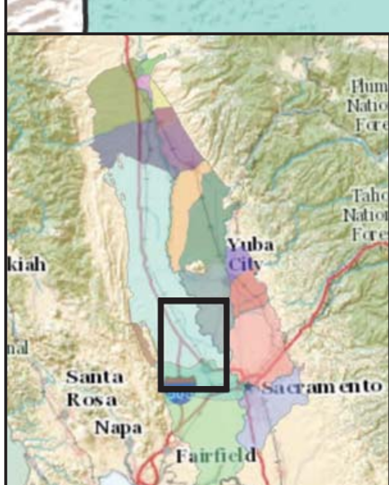

Location of Intermediate Depth Groundwater Monitoring Wells

Colusa Subbasin
Part 4 of 4

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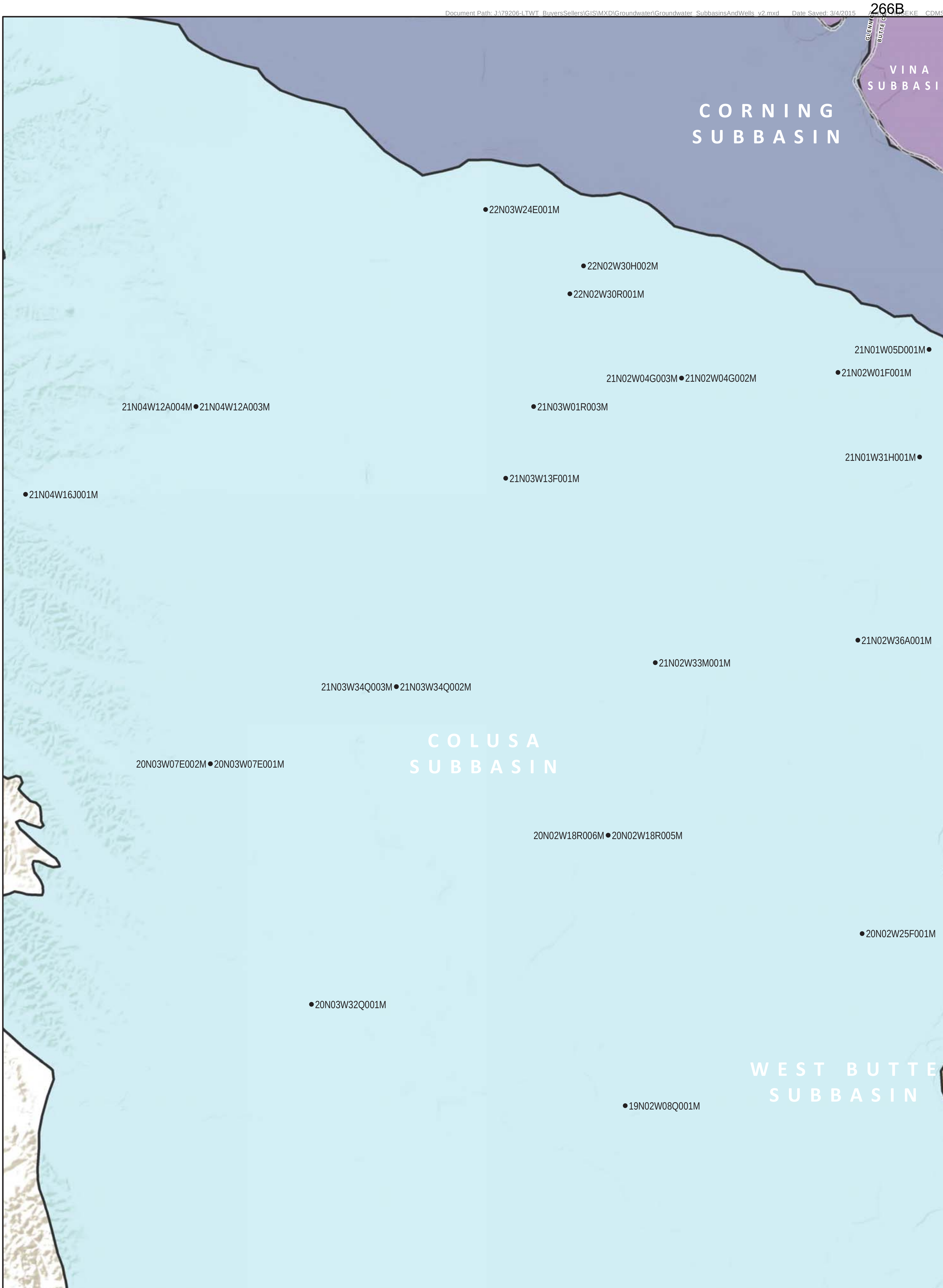

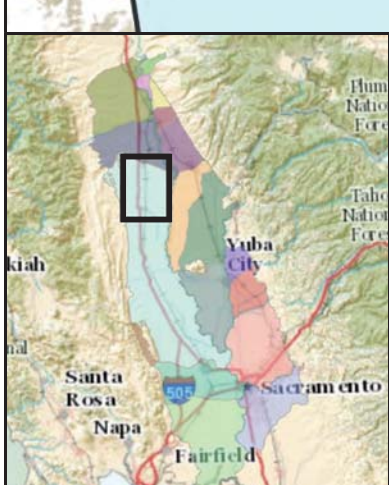

Location of Deep Groundwater Monitoring Wells

Colusa Subbasin

Part 1 of 3

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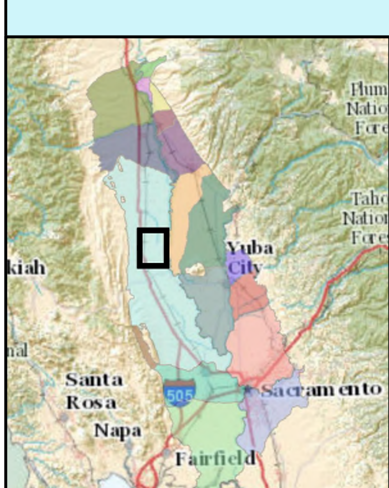

Location of Deep Groundwater Monitoring Wells

Colusa Subbasin

Part 2 of 3

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5

Miles

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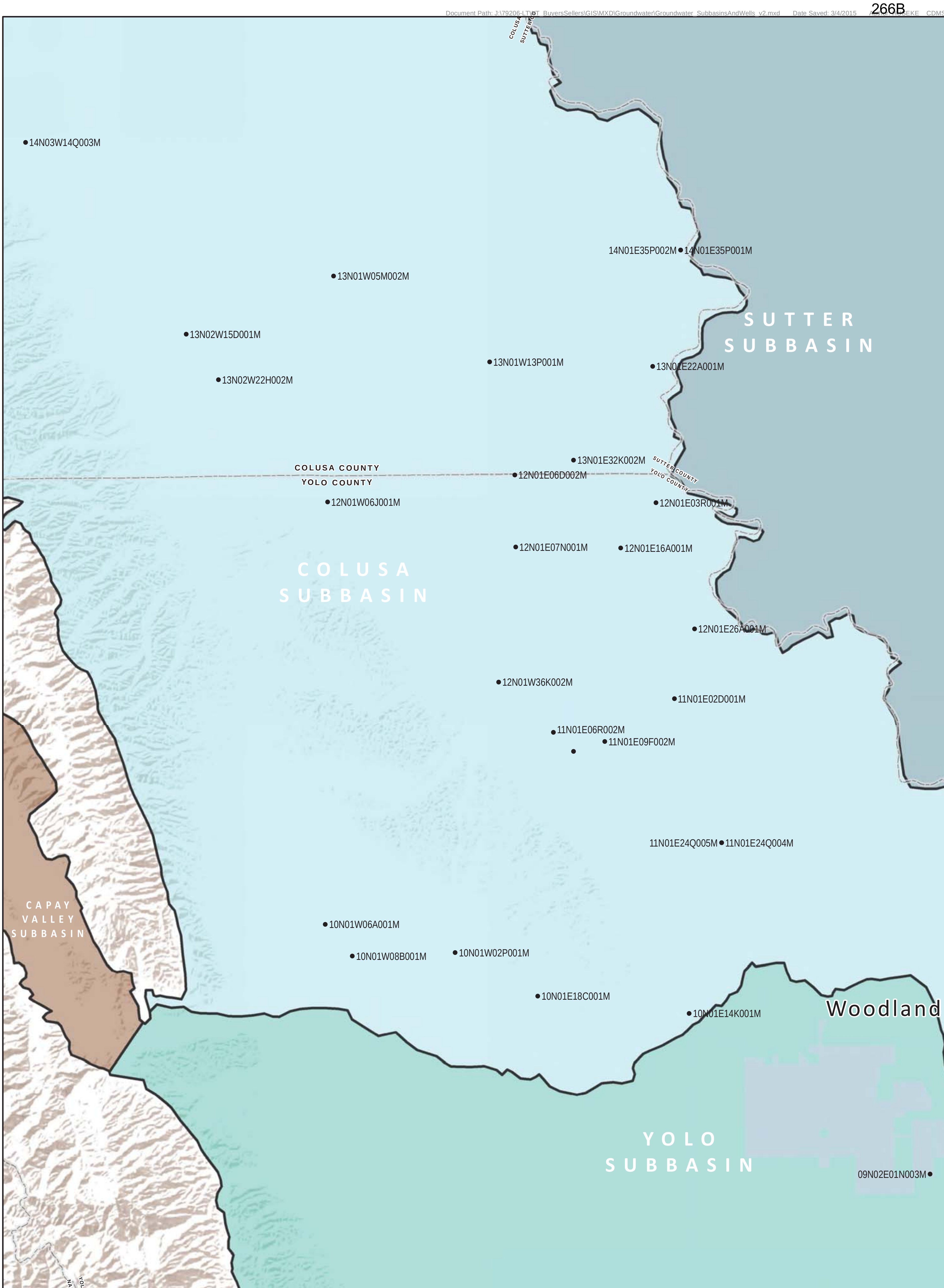
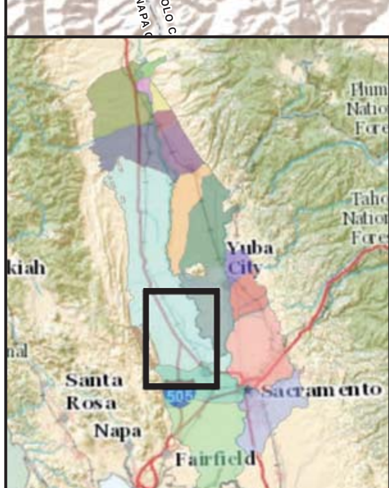
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 CDMSmith





Location of Deep Groundwater Monitoring Wells

Colusa Subbasin

Part 3 of 3

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5

Miles

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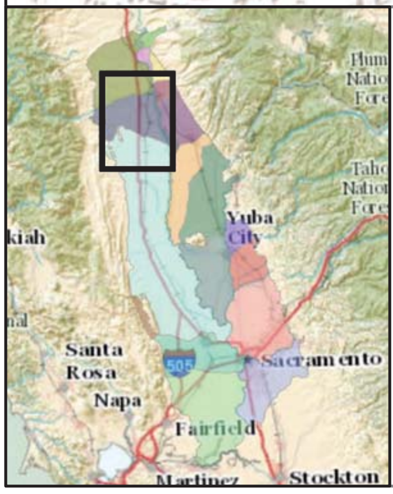

Location of Shallow Groundwater Monitoring Wells

Corning Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5
Miles

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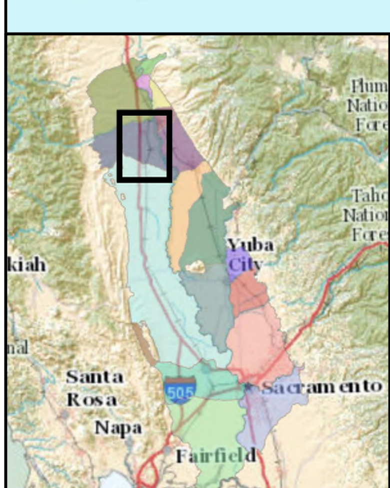
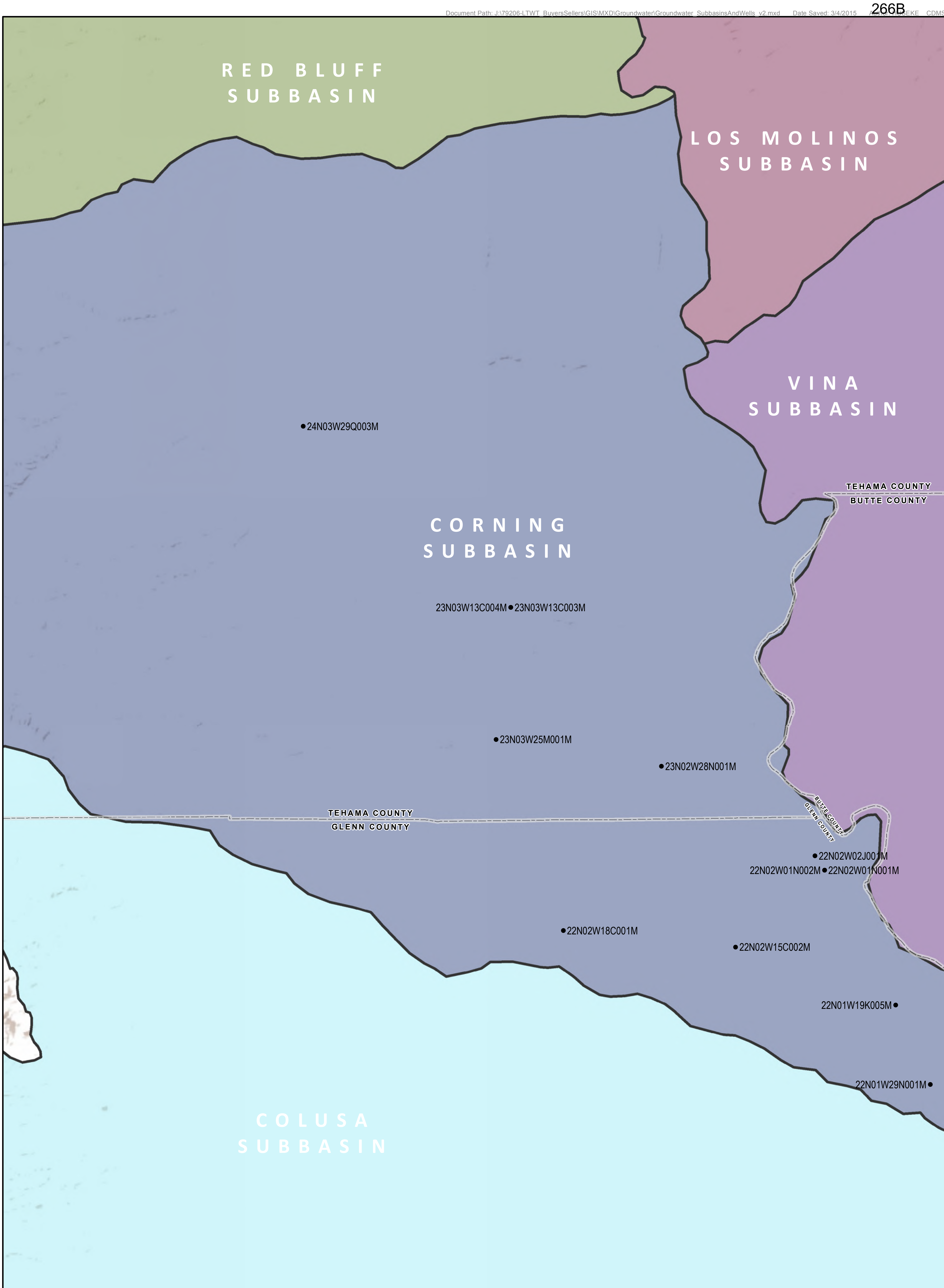
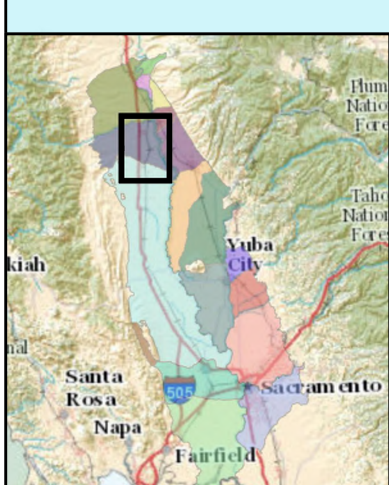


Location of Intermediate Depth Groundwater Monitoring Wells

Corning Subbasin
Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.



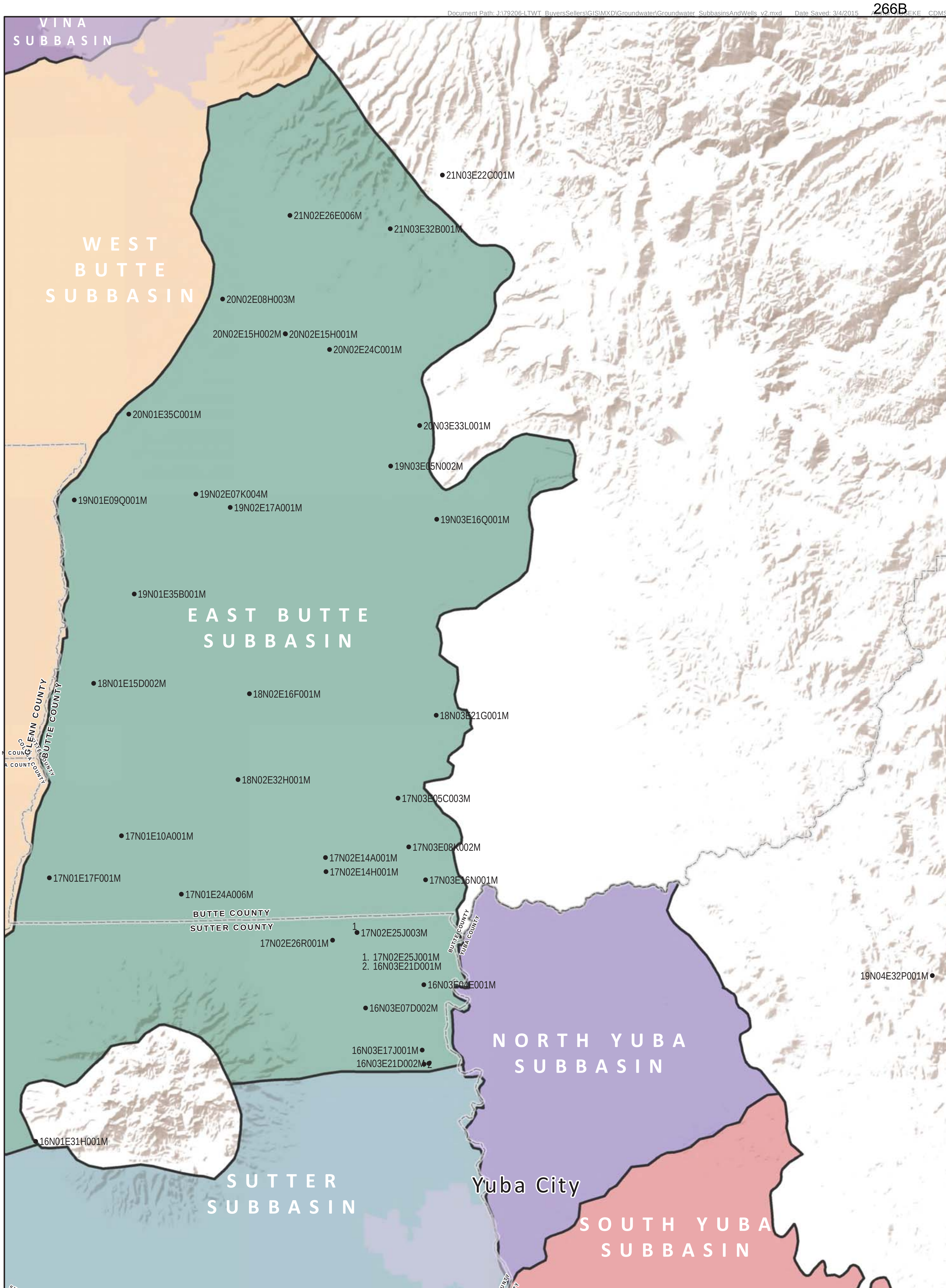


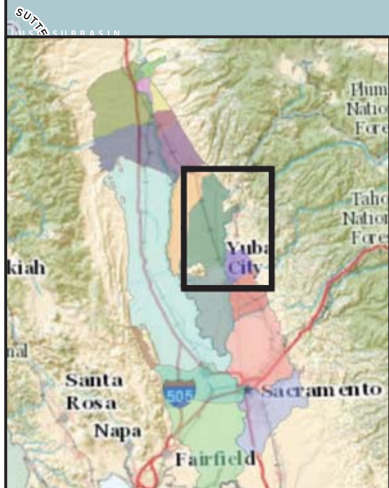
Location of Deep Groundwater Monitoring Wells

Corning Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.



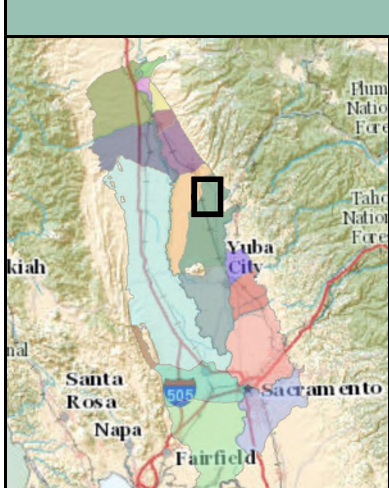


Location of Shallow Groundwater Monitoring Wells

East Butte Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

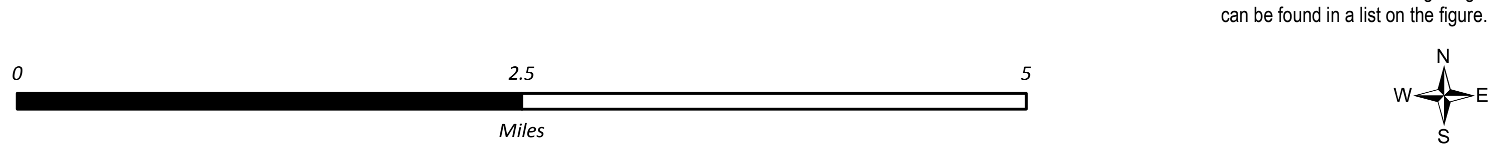


Location of Intermediate Depth Groundwater Monitoring Wells

East Butte Subbasin

Part 1 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.



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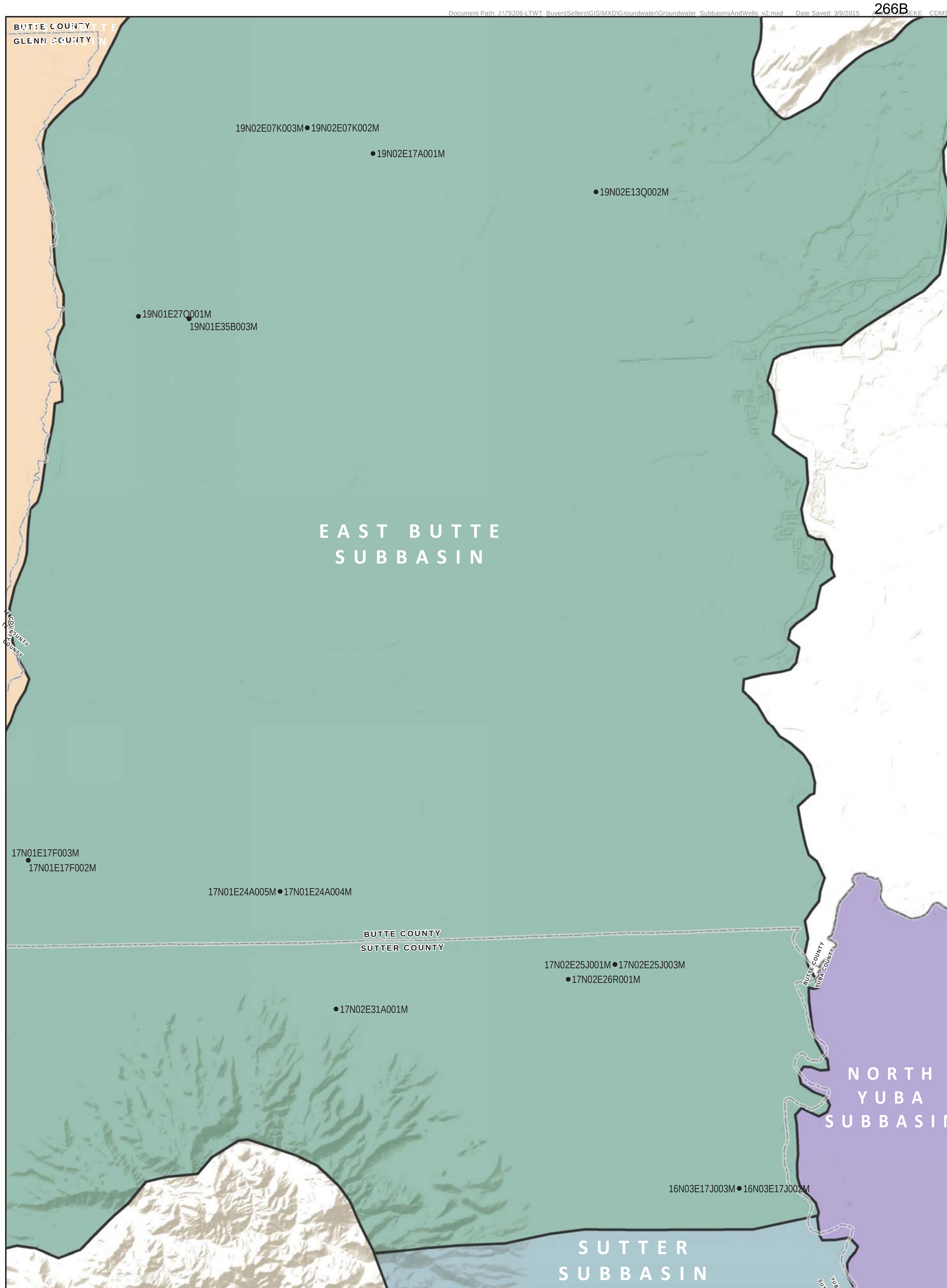

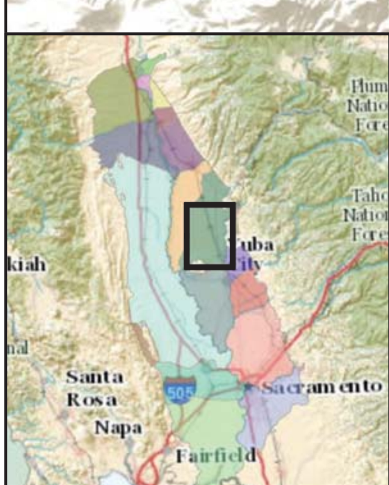

Location of Intermediate Depth Groundwater Monitoring Wells

East Butte Subbasin
Part 2 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5
Miles

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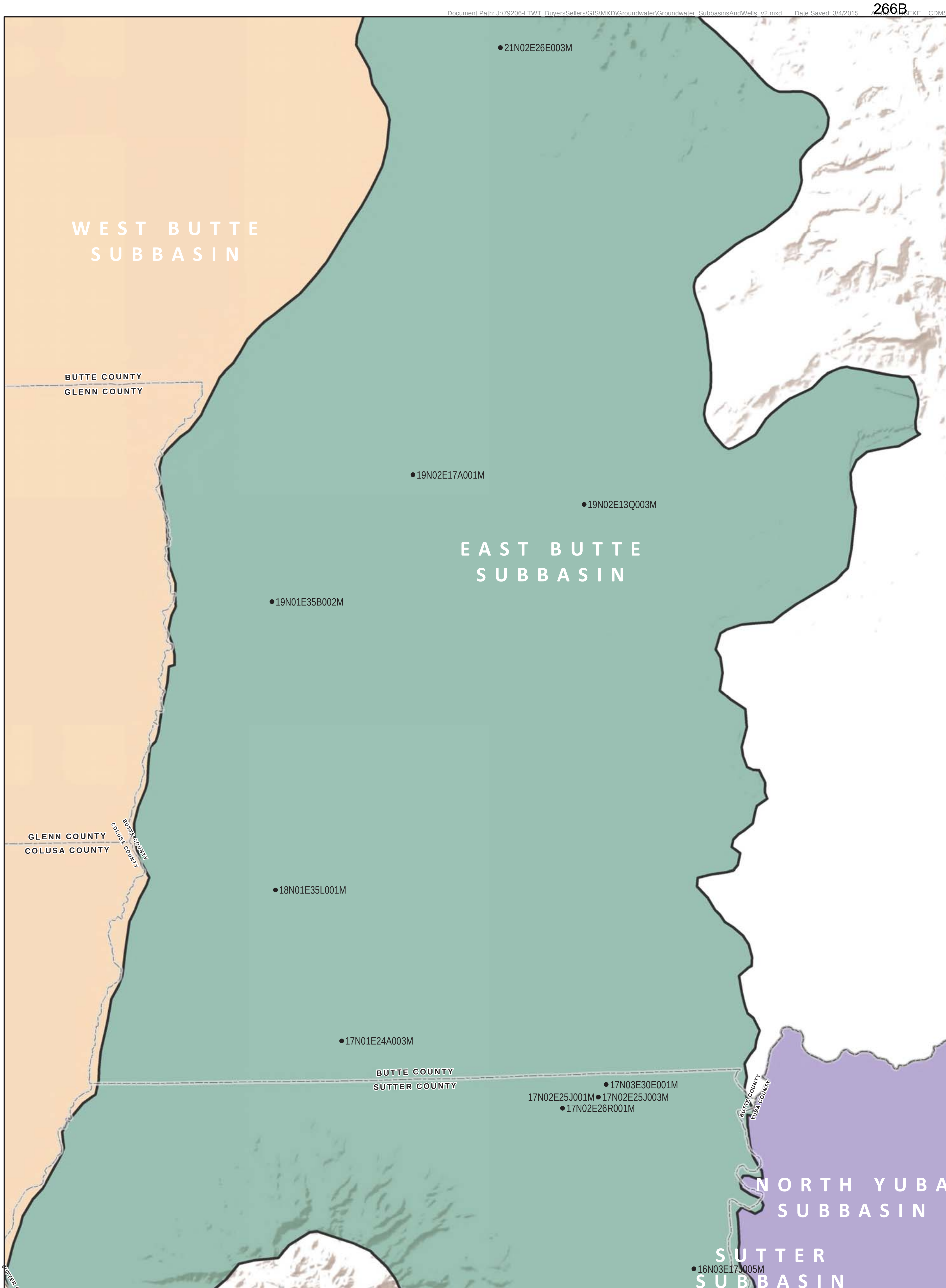
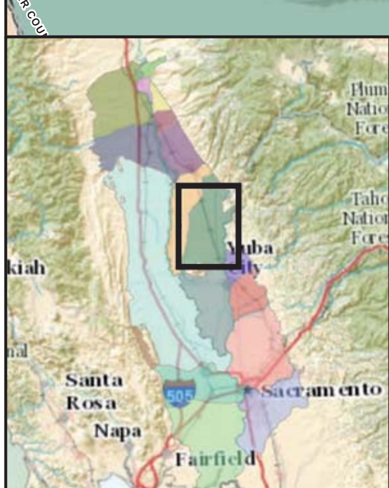
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 CDMSmith





Location of Deep Groundwater Monitoring Wells

East Butte Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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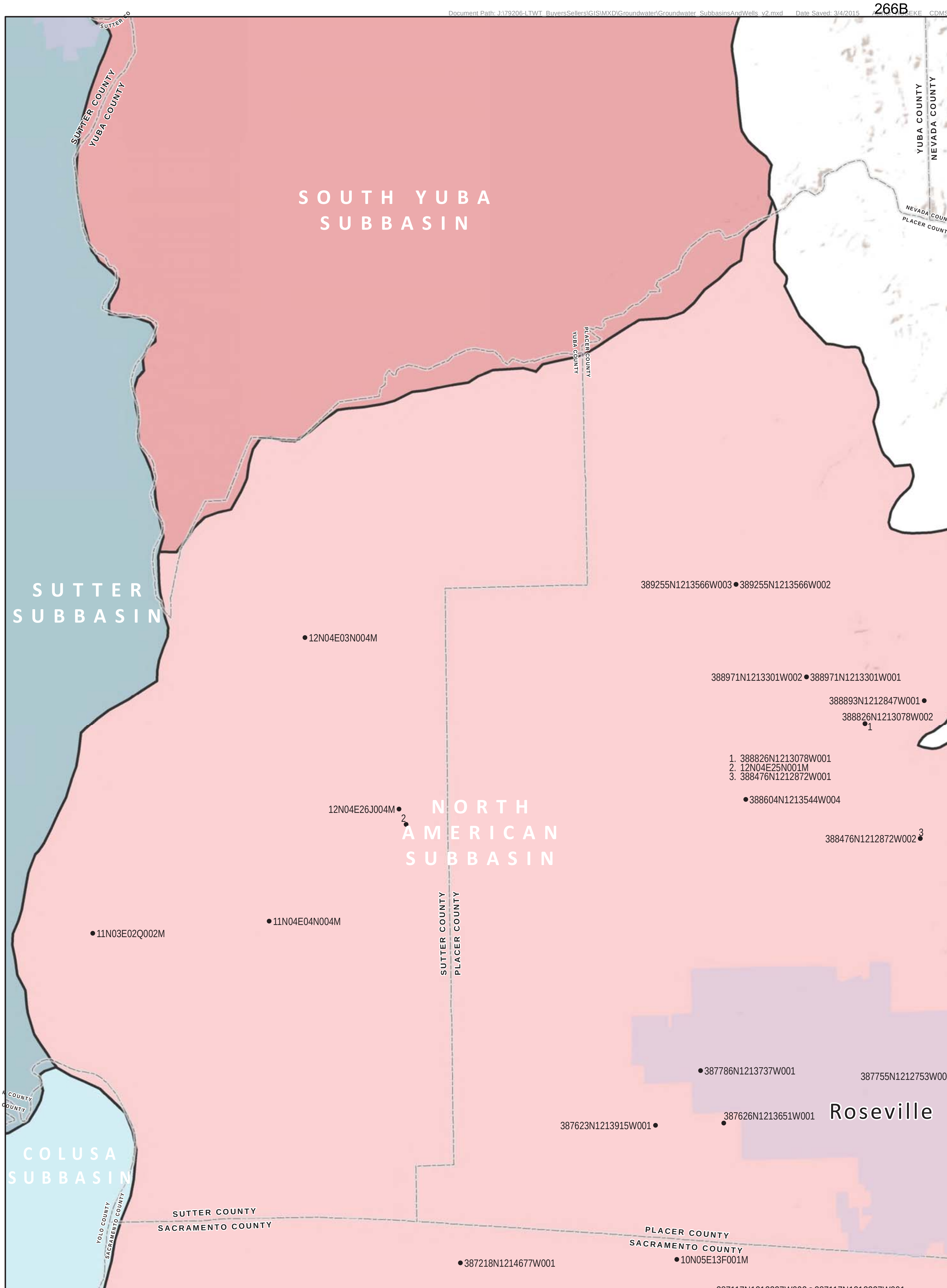
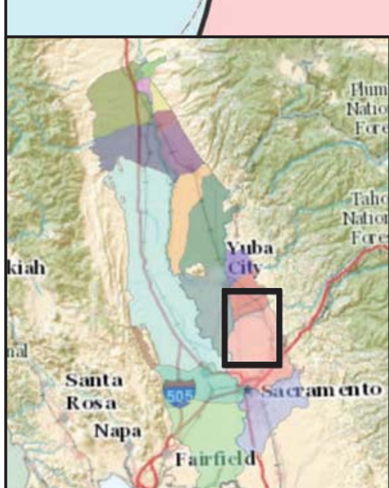


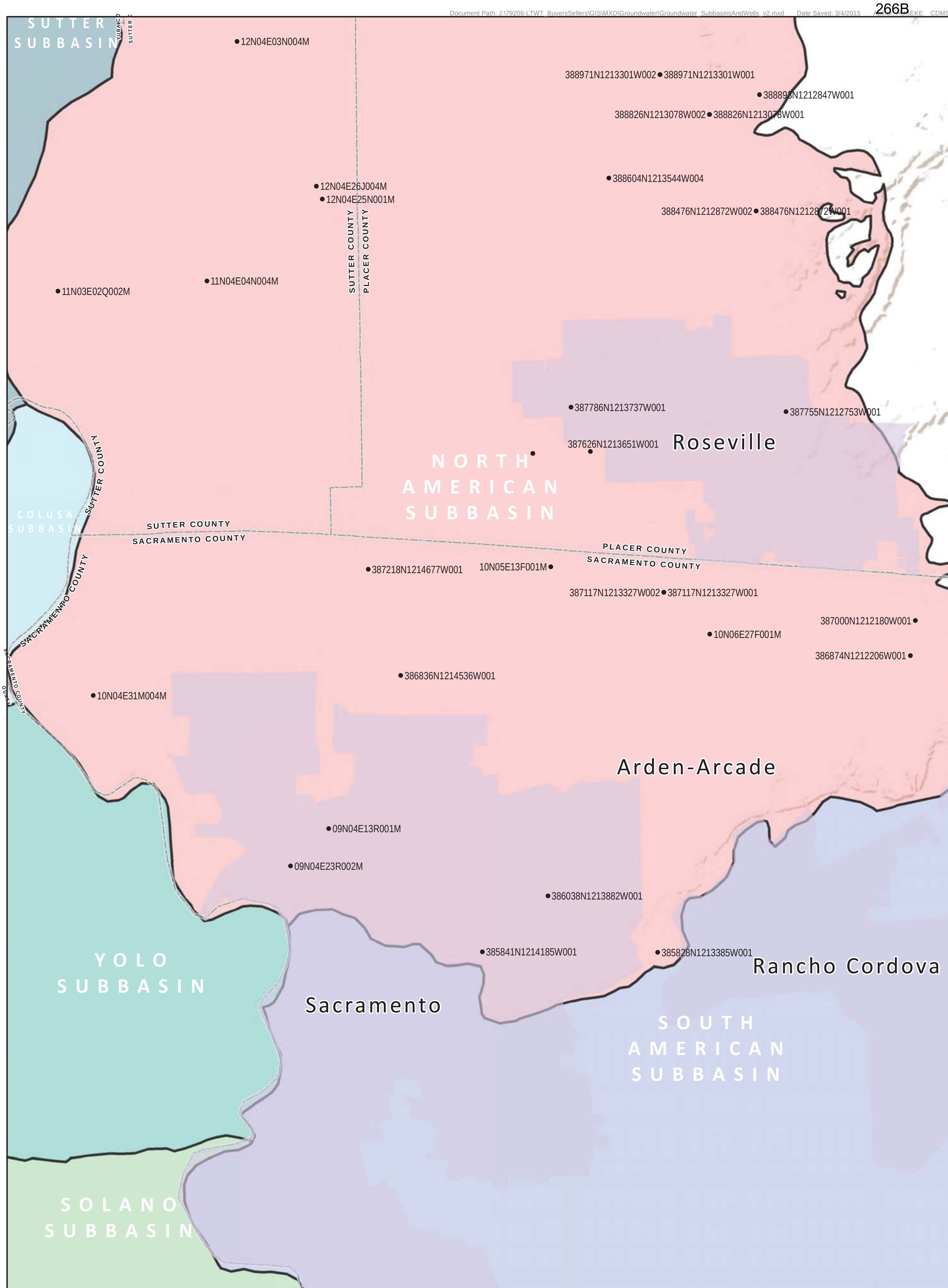


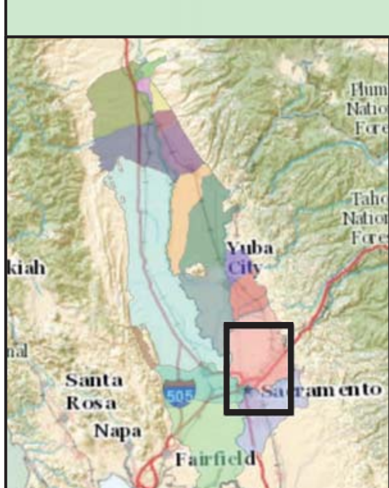
Location of Shallow Groundwater Monitoring Wells

North American Subbasin

Part 1 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.





Location of Shallow Groundwater Monitoring Wells

North American Subbasin

Part 2 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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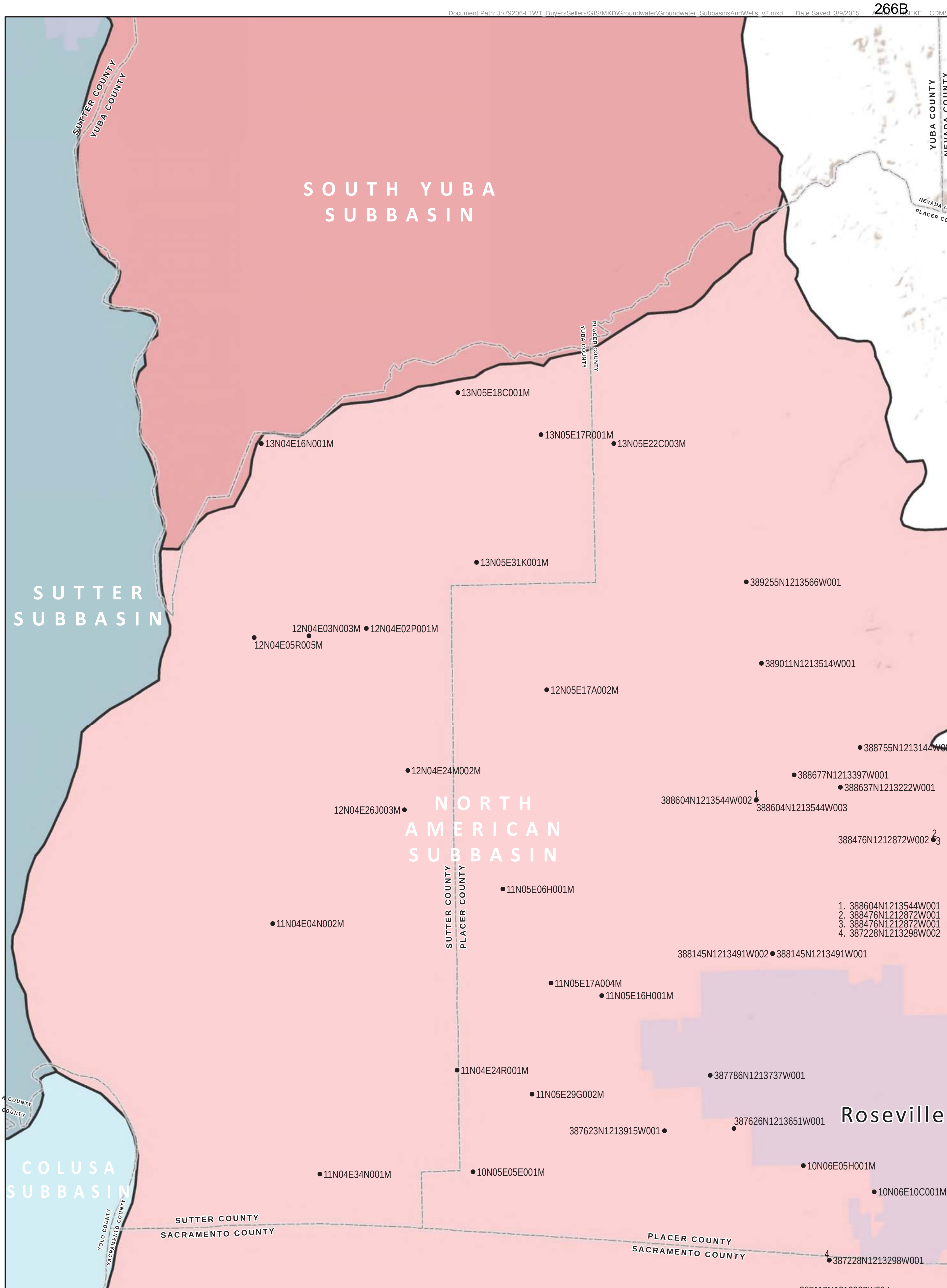
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/9/2015 CDMSmith



Location of Intermediate Depth Groundwater Monitoring Wells

North American Subbasin

Part 1 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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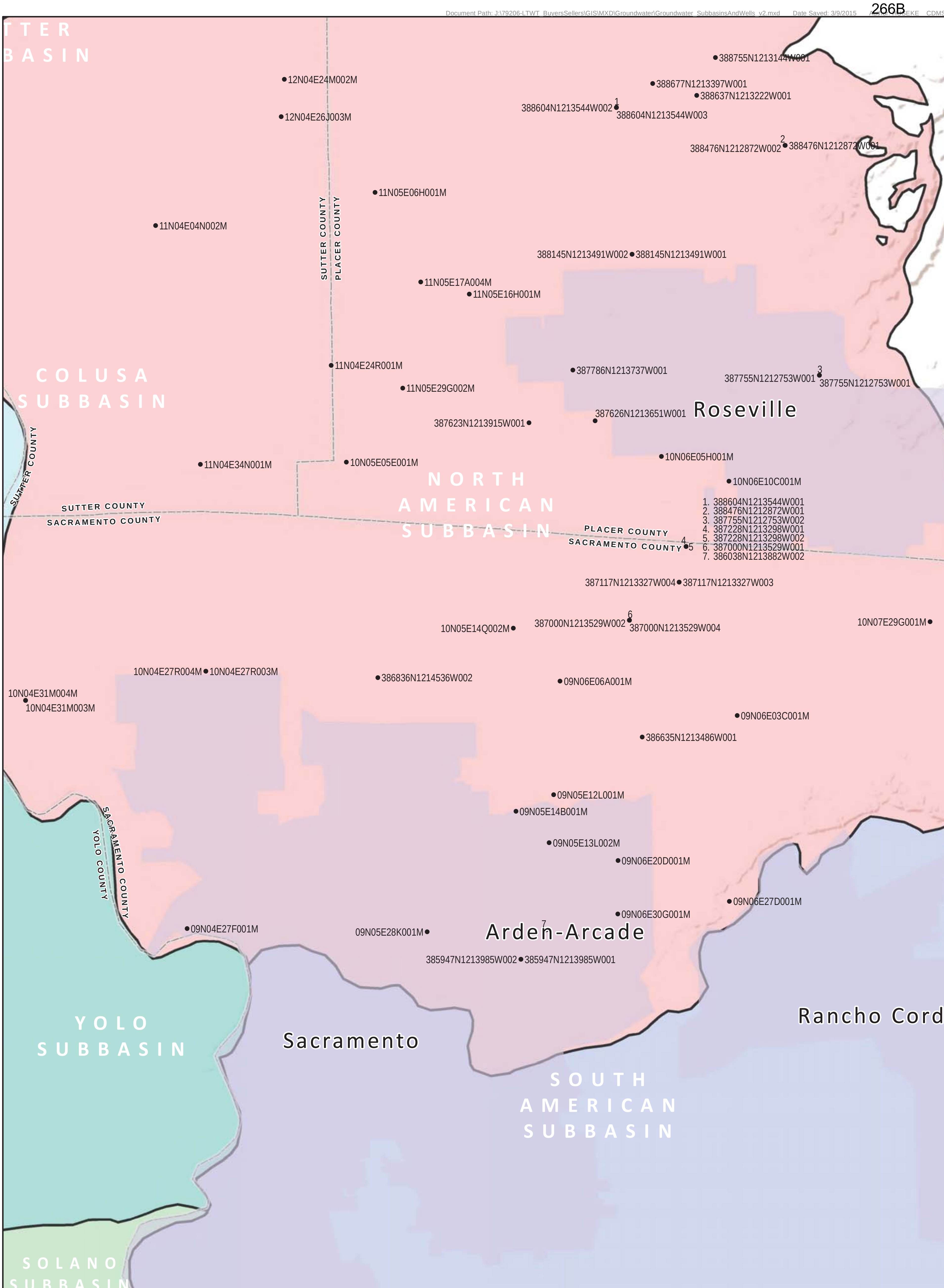
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/9/2015 EKE CDMSmith



Location of Intermediate Depth Groundwater Monitoring Wells

North American Subbasin
Part 2 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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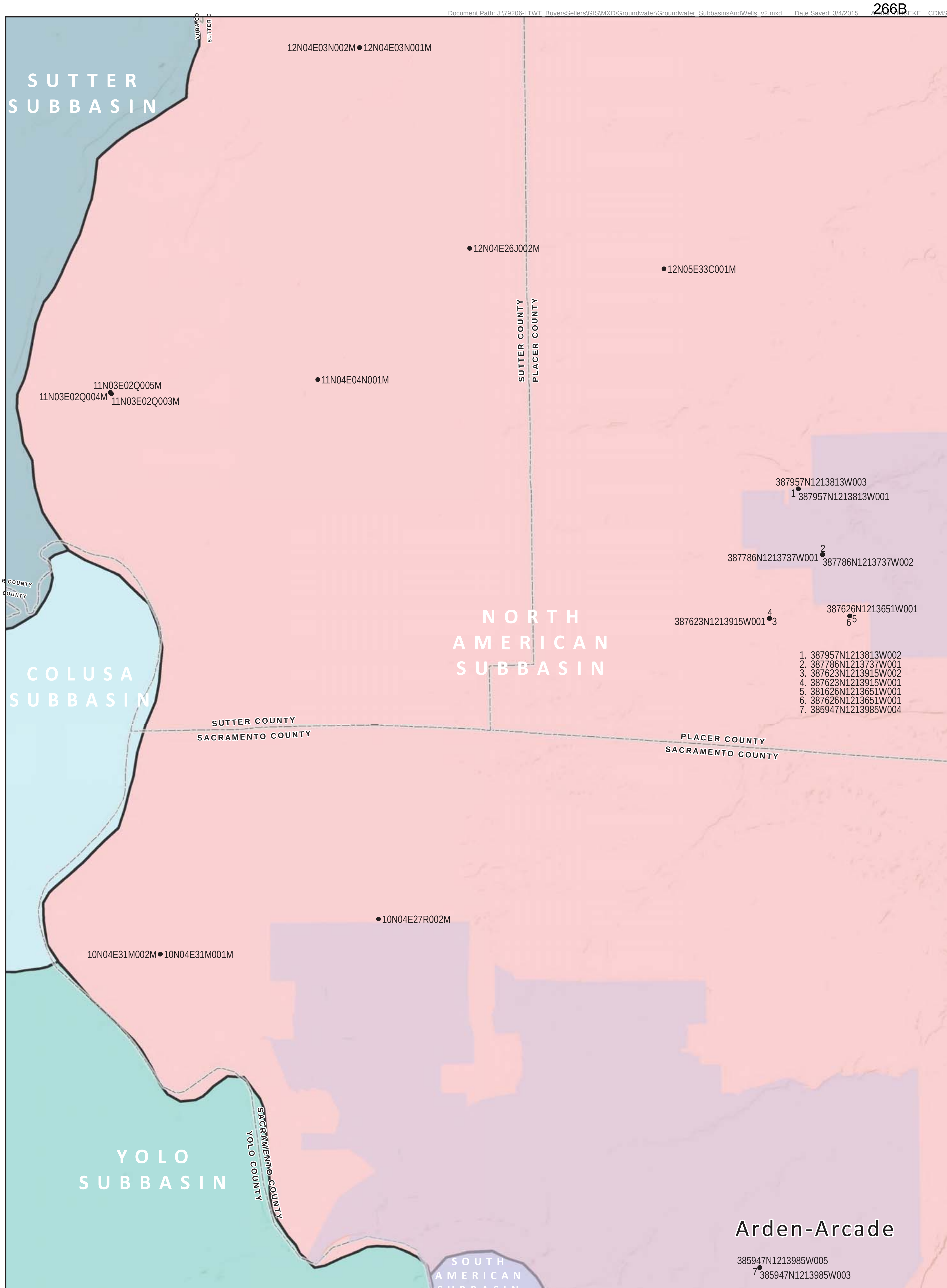
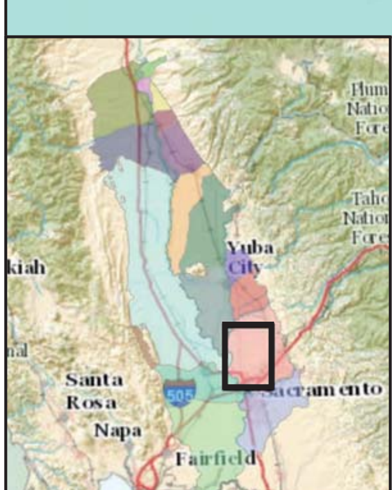
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 Author: HOSEKE CDMSmith

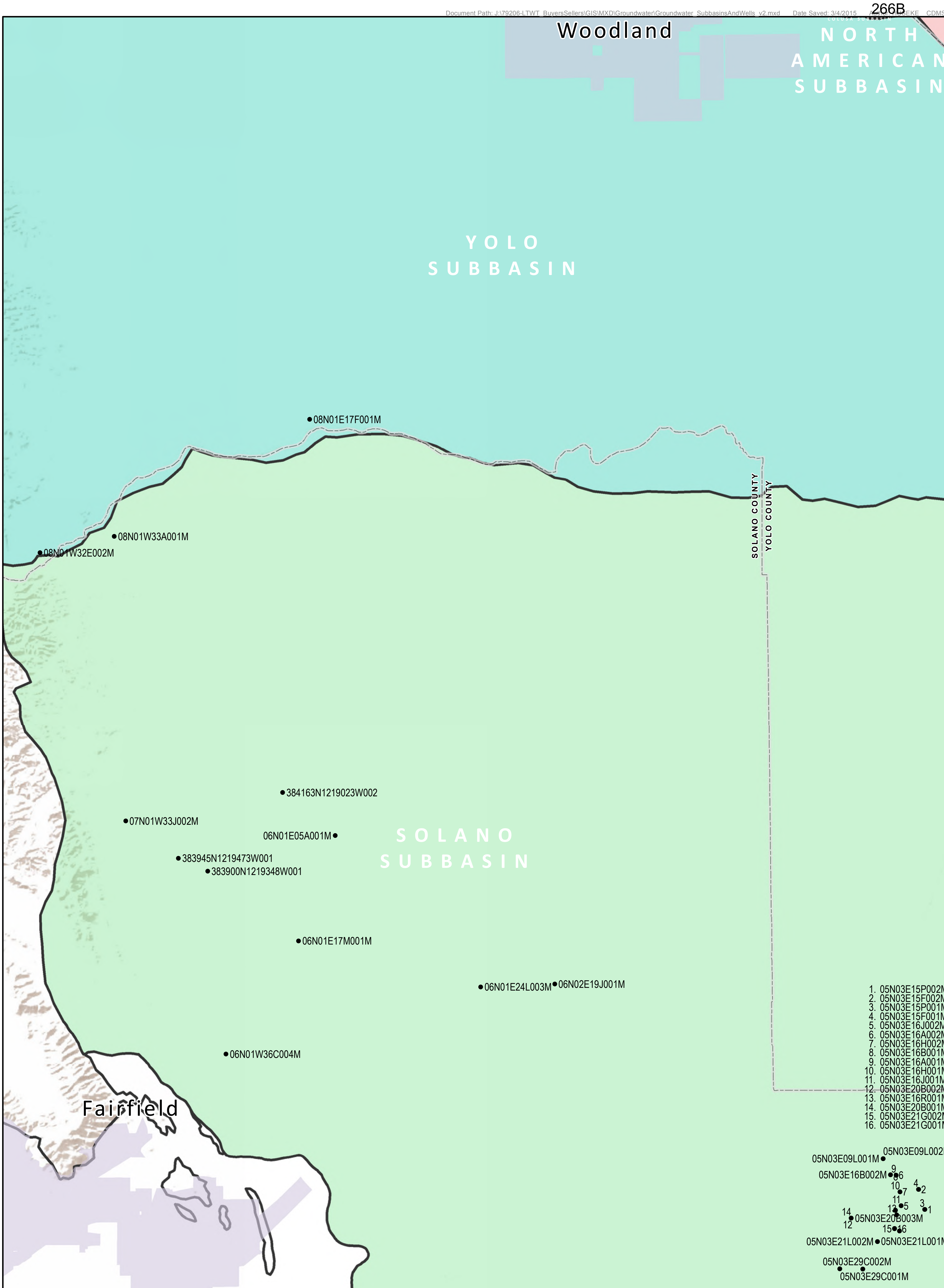


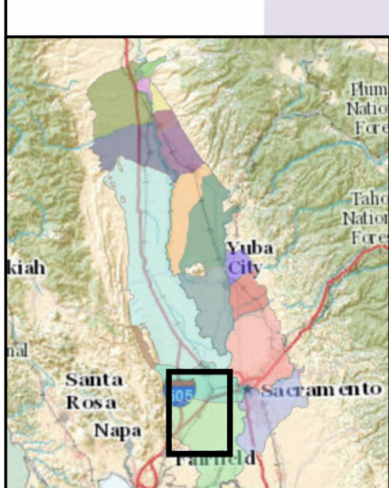


Location of Deep Groundwater Monitoring Wells

North American Subbasin
Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.





Location of Shallow Groundwater Monitoring Wells

Solano Subbasin

Part 1 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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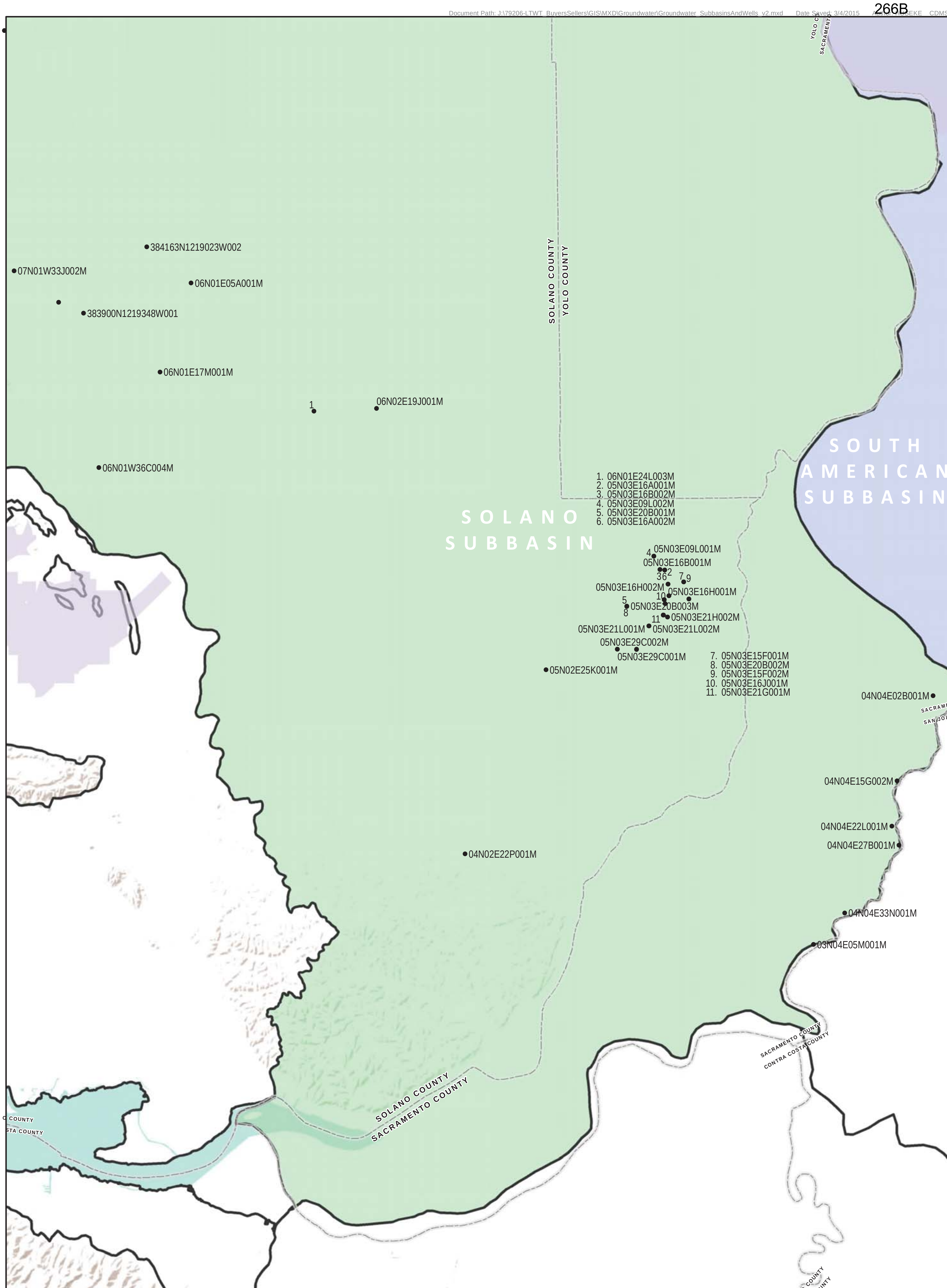
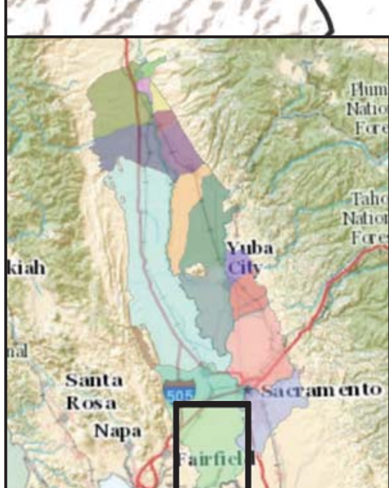
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 CDMSmith





Location of Shallow Groundwater Monitoring Wells
Solano Subbasin
Part 2 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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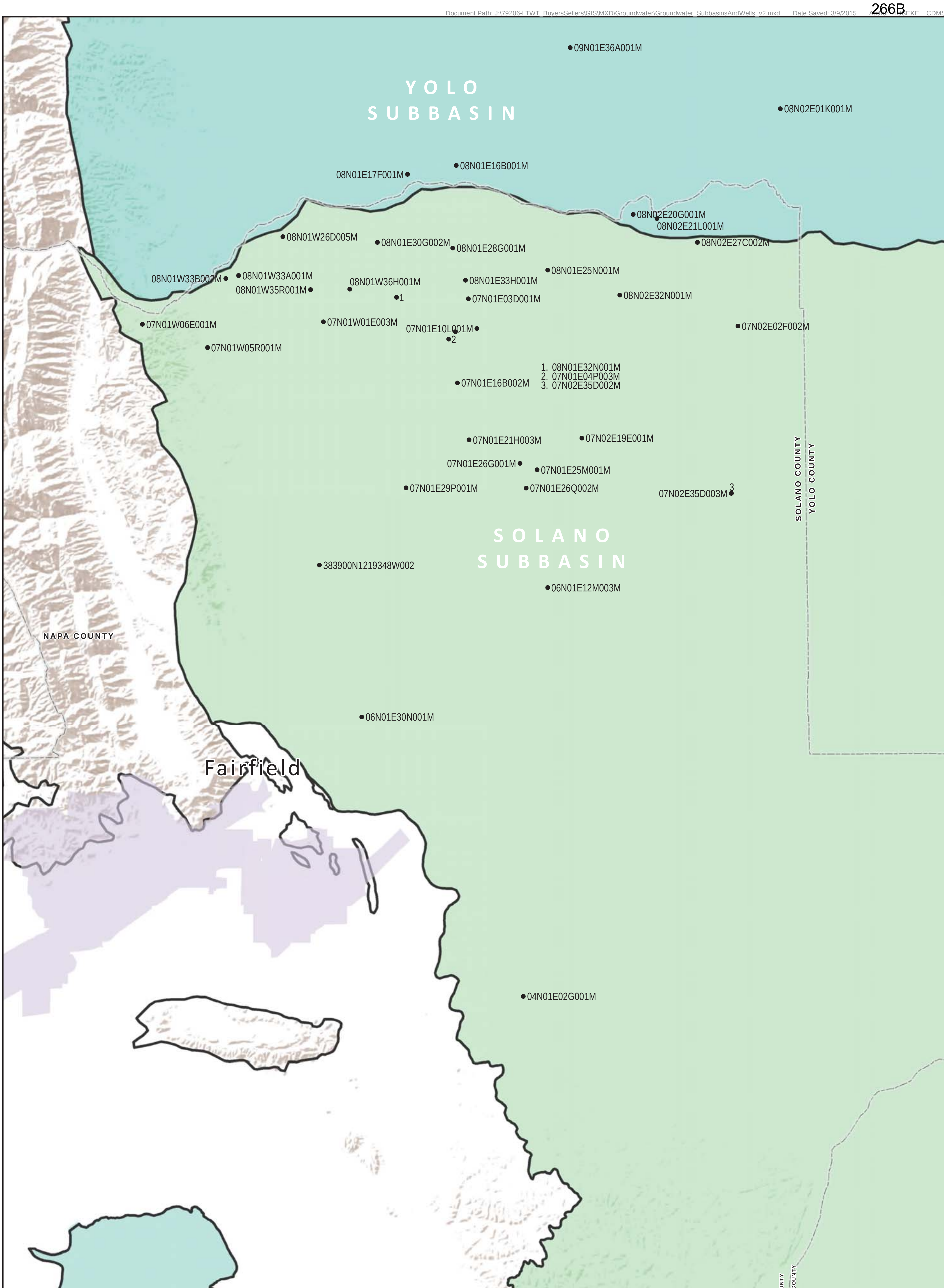
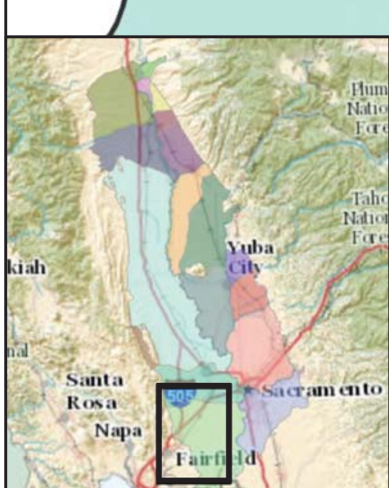
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/9/2015 CDMSmith





Location of Intermediate Depth Groundwater Monitoring Wells

Solano Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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Miles

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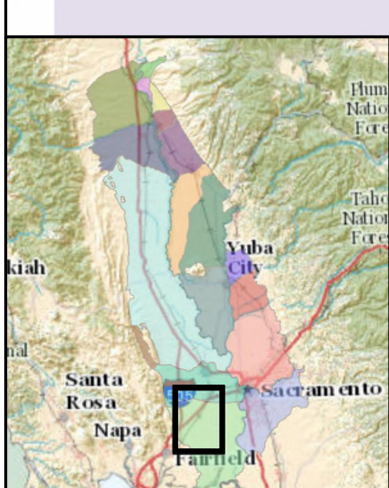

Location of Deep Groundwater Monitoring Wells

Solano Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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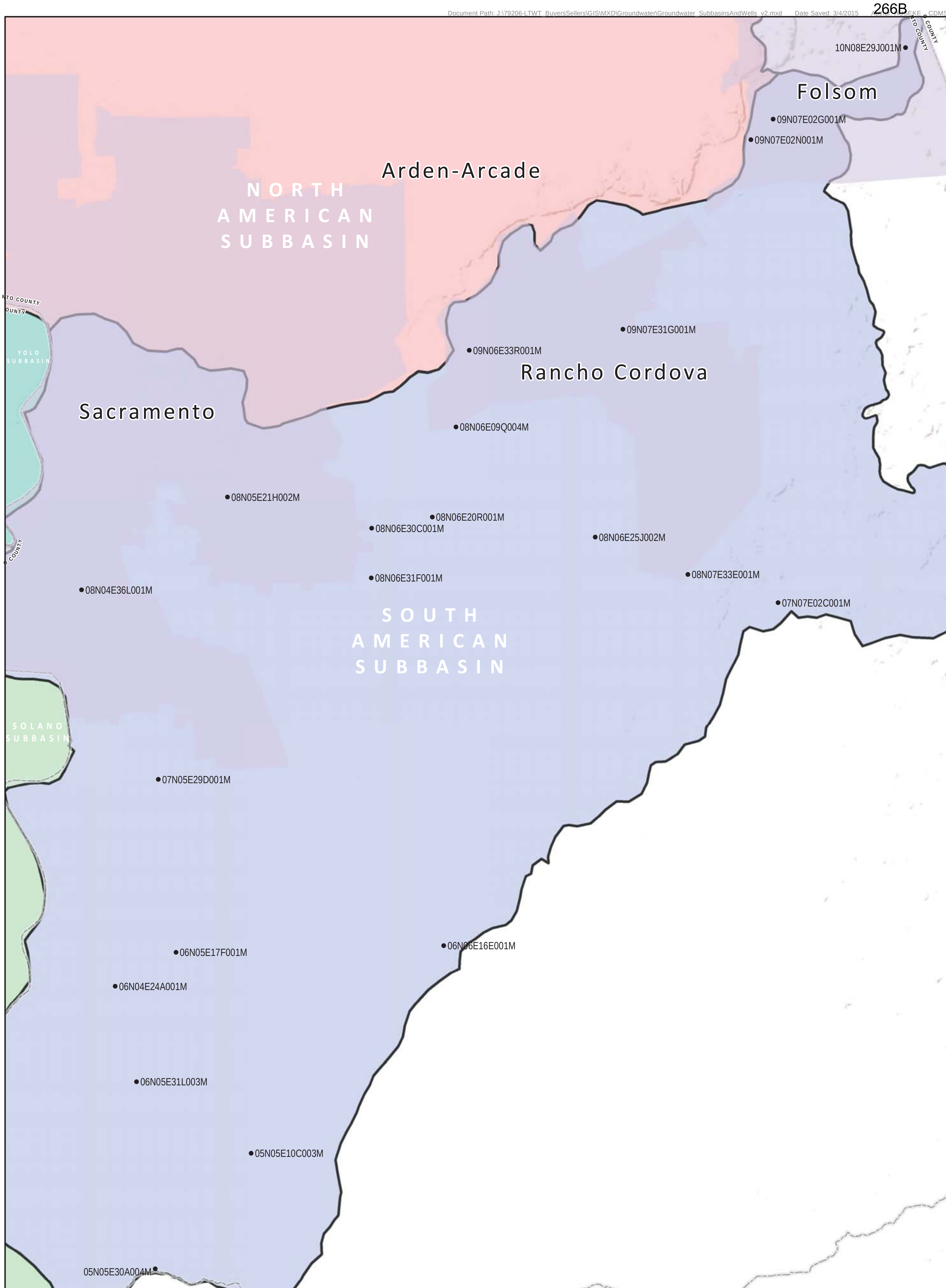
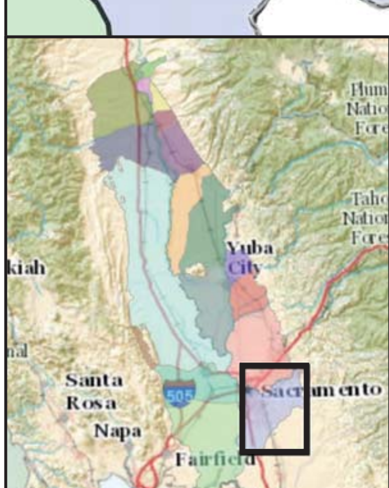
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 CDMSmith





Location of Shallow Groundwater Monitoring Wells

South American Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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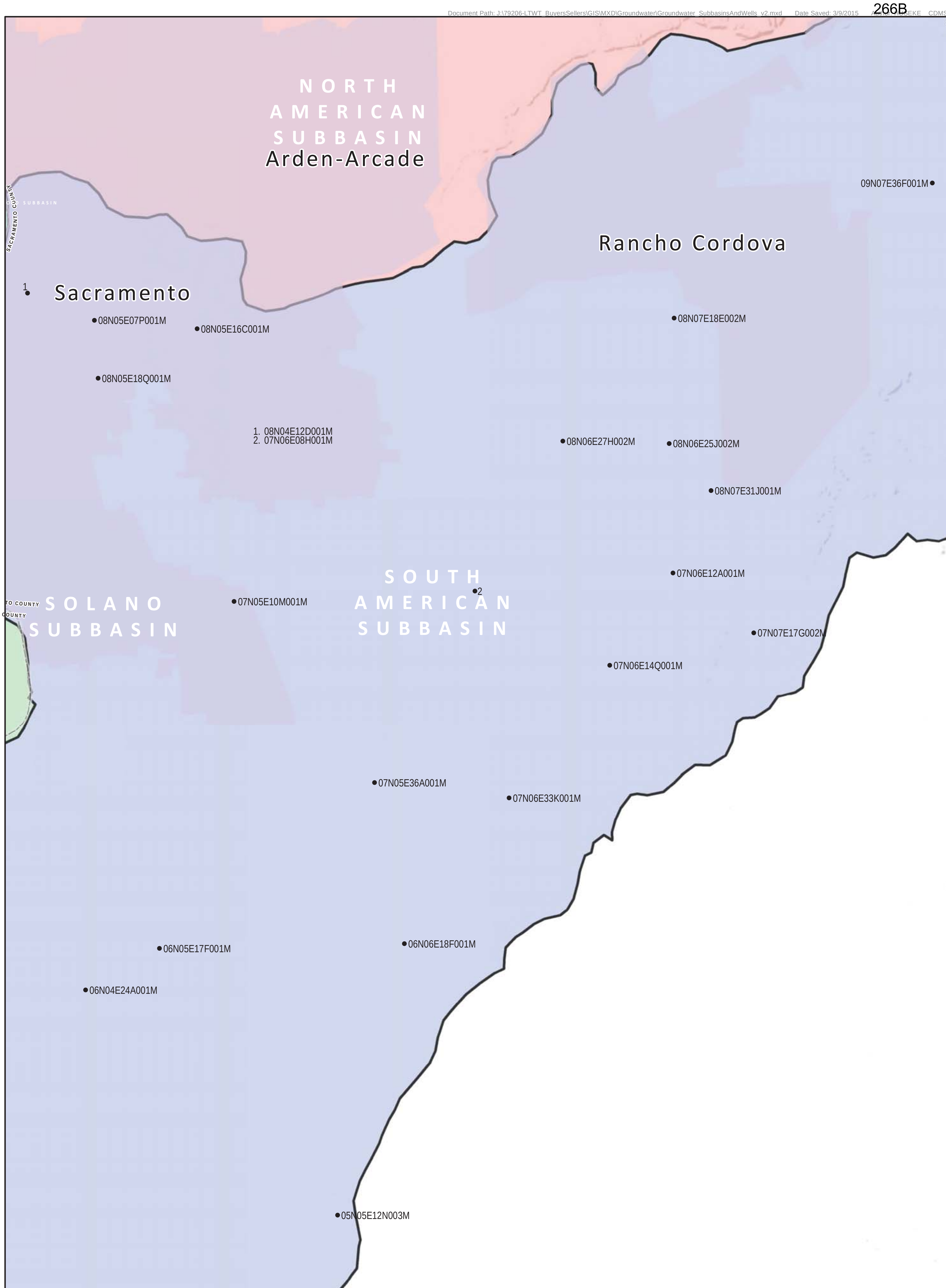
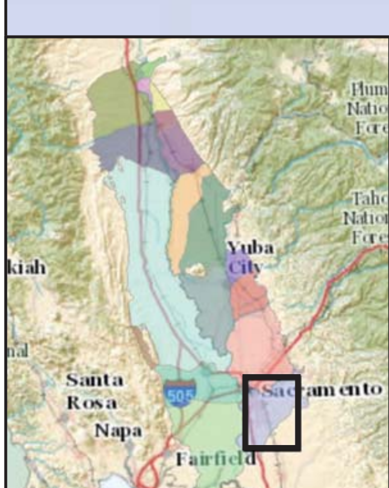
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/9/2015 CDMSmith





Location of Intermediate Depth Groundwater Monitoring Wells

South American Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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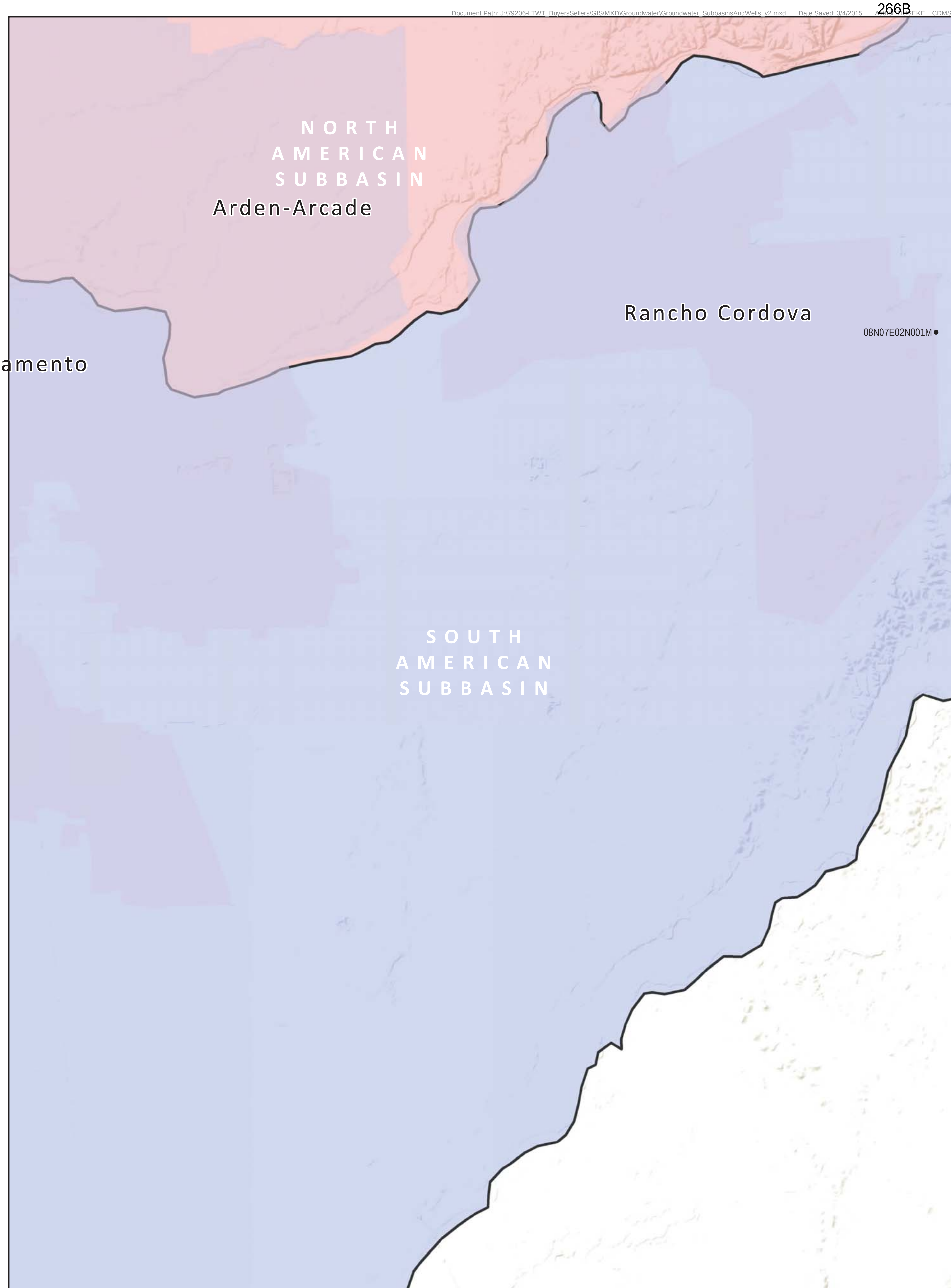
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 Author: [illegible] CDMSmith



Location of Deep Groundwater Monitoring Wells

South American Subbasin

Part 1 of 1

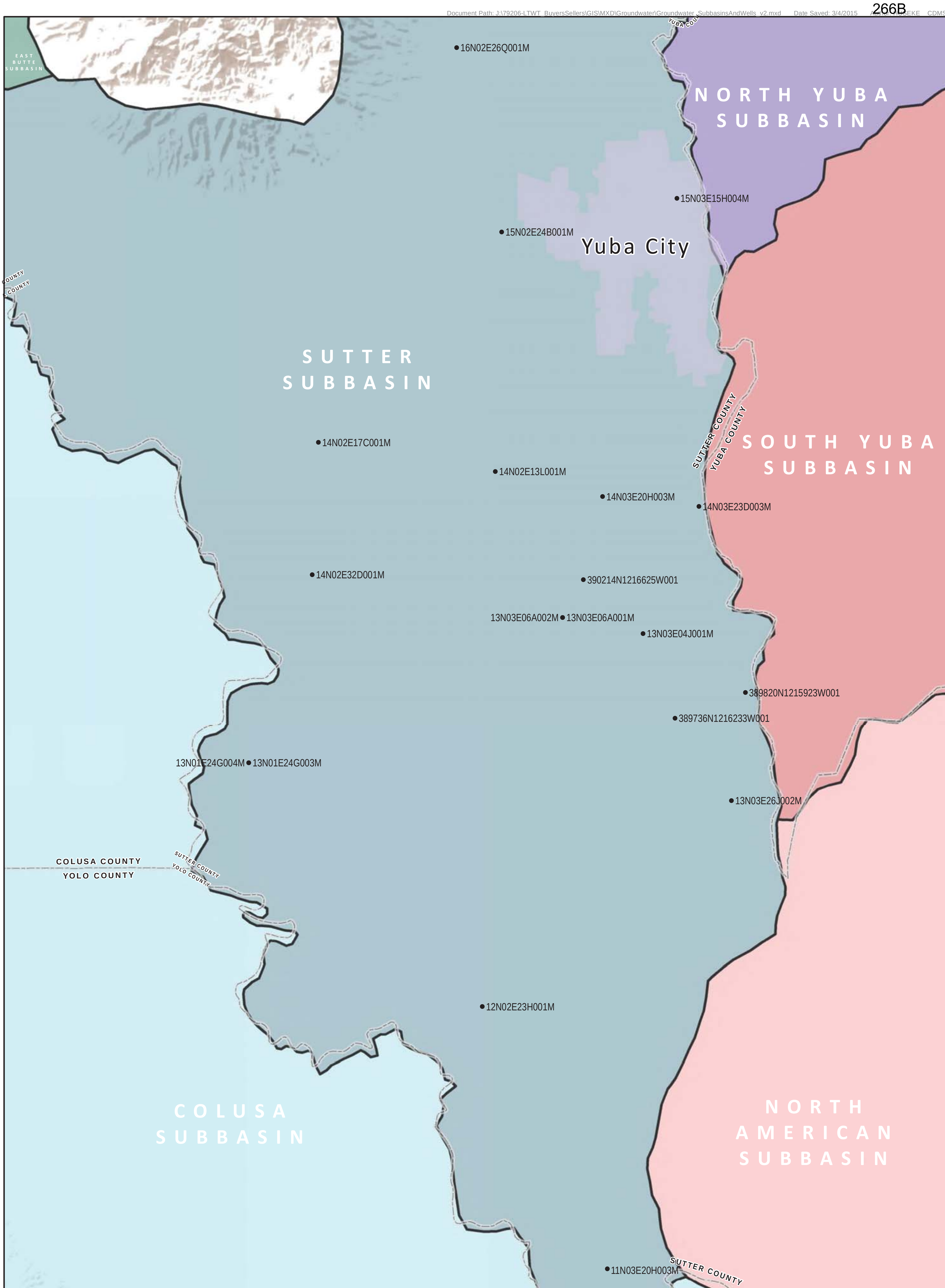
Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

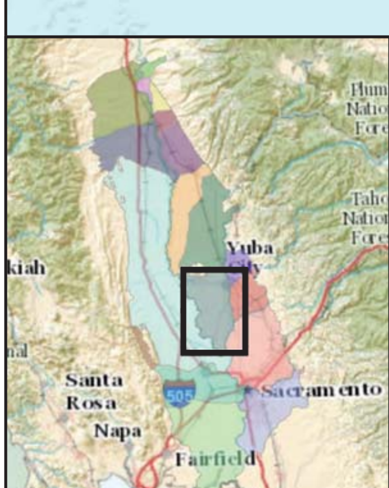
0 2.5 5

Miles

N W E S

Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 CDMSmith





Location of Shallow Groundwater Monitoring Wells

Sutter Subbasin

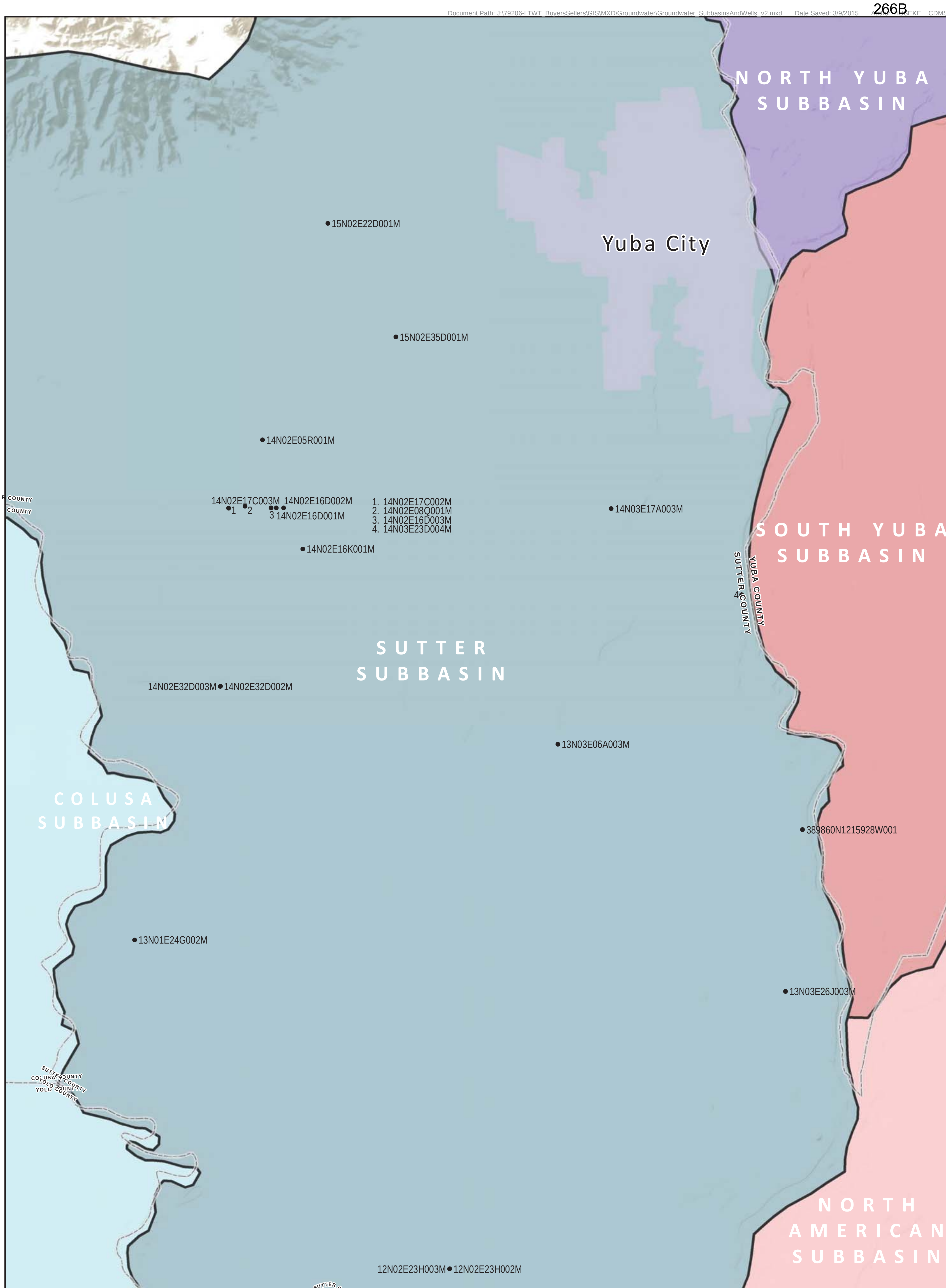
Part 1 of 1

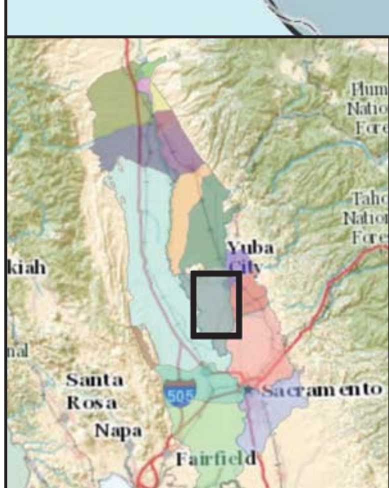
Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5

Miles

N W E S





Location of Intermediate Depth Groundwater Monitoring Wells

Sutter Subbasin
Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5
Miles

N W E S

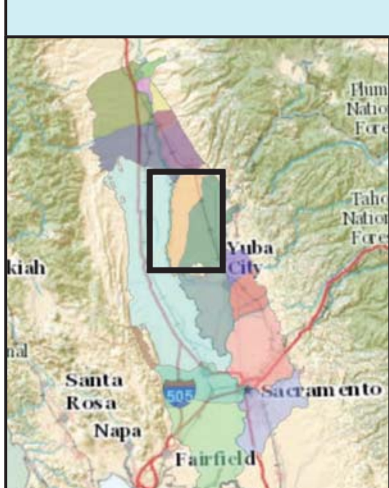
Location of Deep Groundwater Monitoring Wells

Sutter Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/4/2015 CDMSmith



Location of Shallow Groundwater Monitoring Wells

West Butte Subbasin

Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5

Miles

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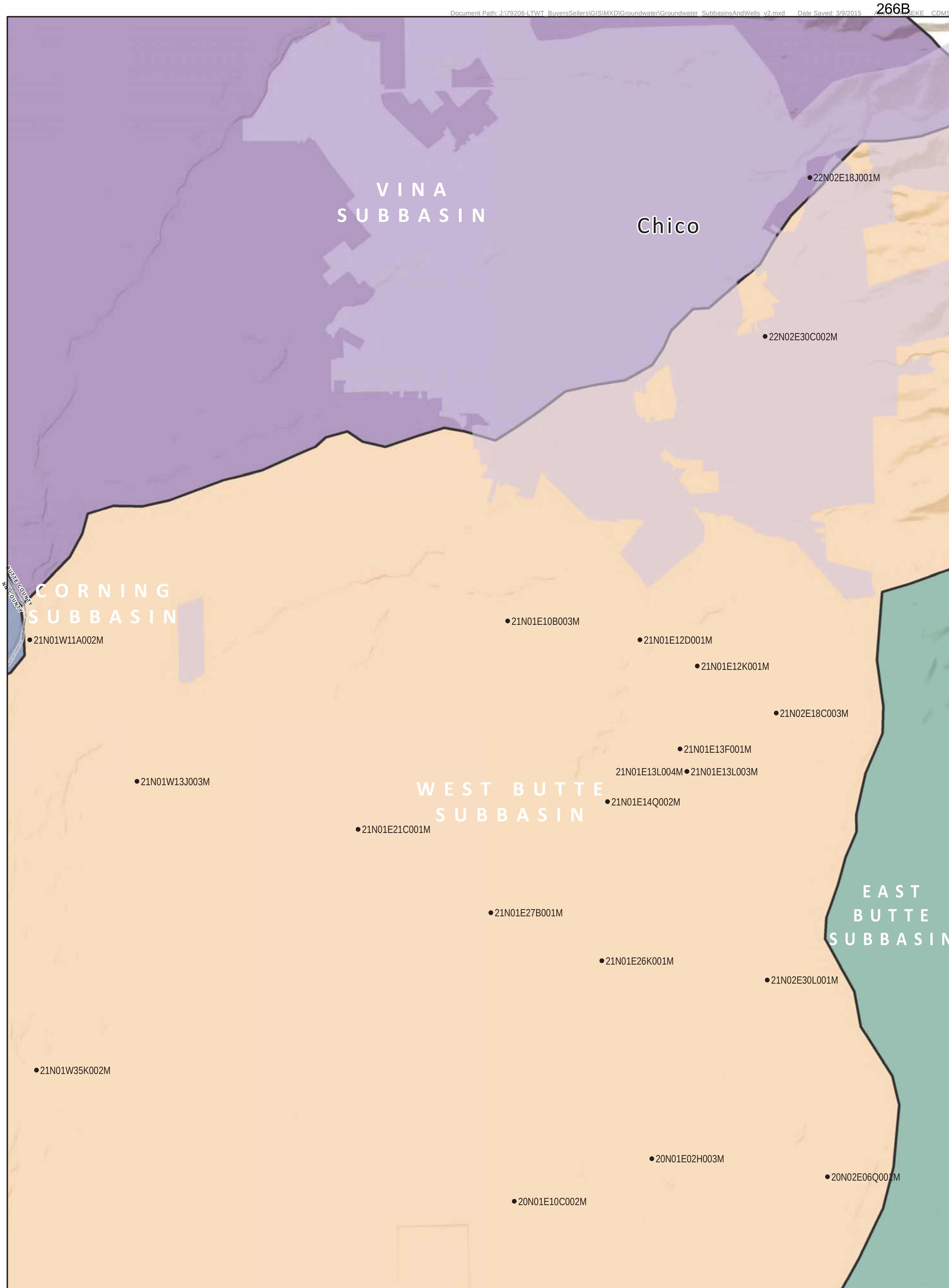
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/9/2015 Author: H...EKE CDMSmith



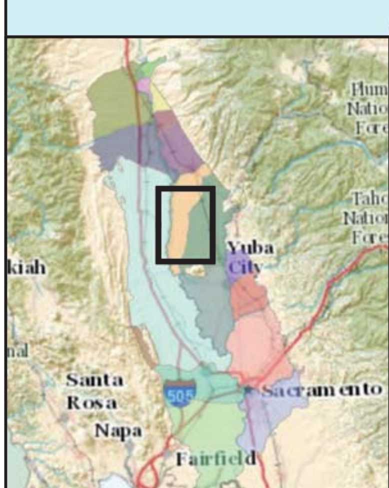
Location of Intermediate Depth Groundwater Monitoring Wells

West Butte Subbasin
Part 1 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5
Miles

N W E S



Location of Intermediate Depth Groundwater Monitoring Wells

West Butte Subbasin
Part 2 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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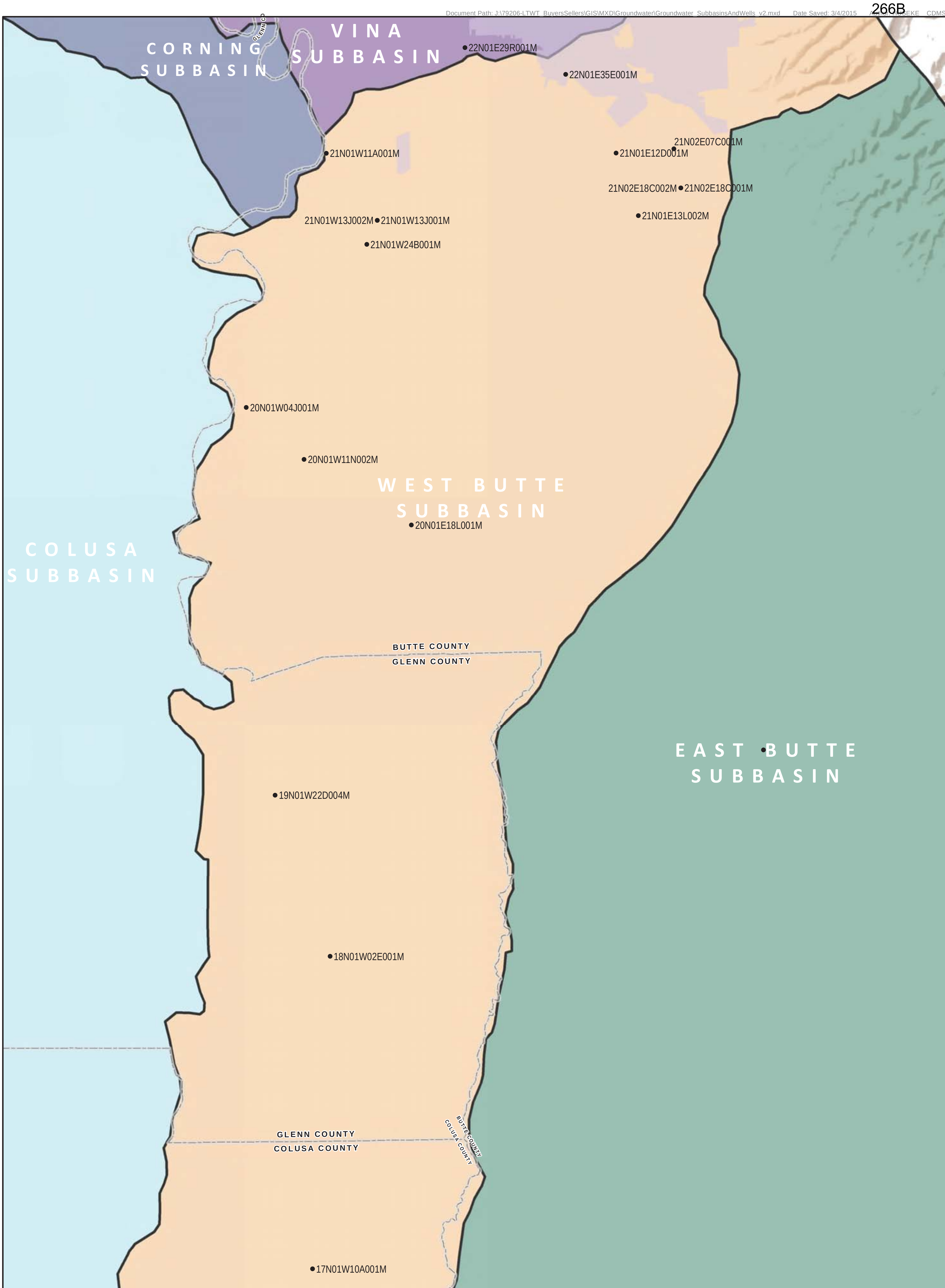
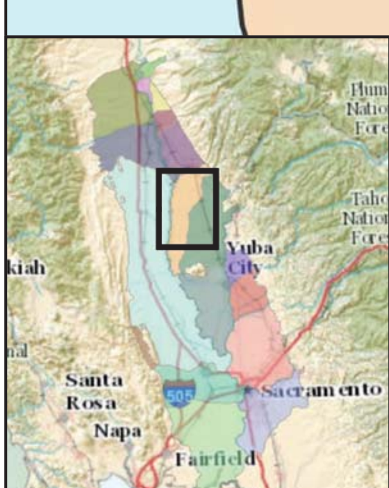




Location of Deep Groundwater Monitoring Wells

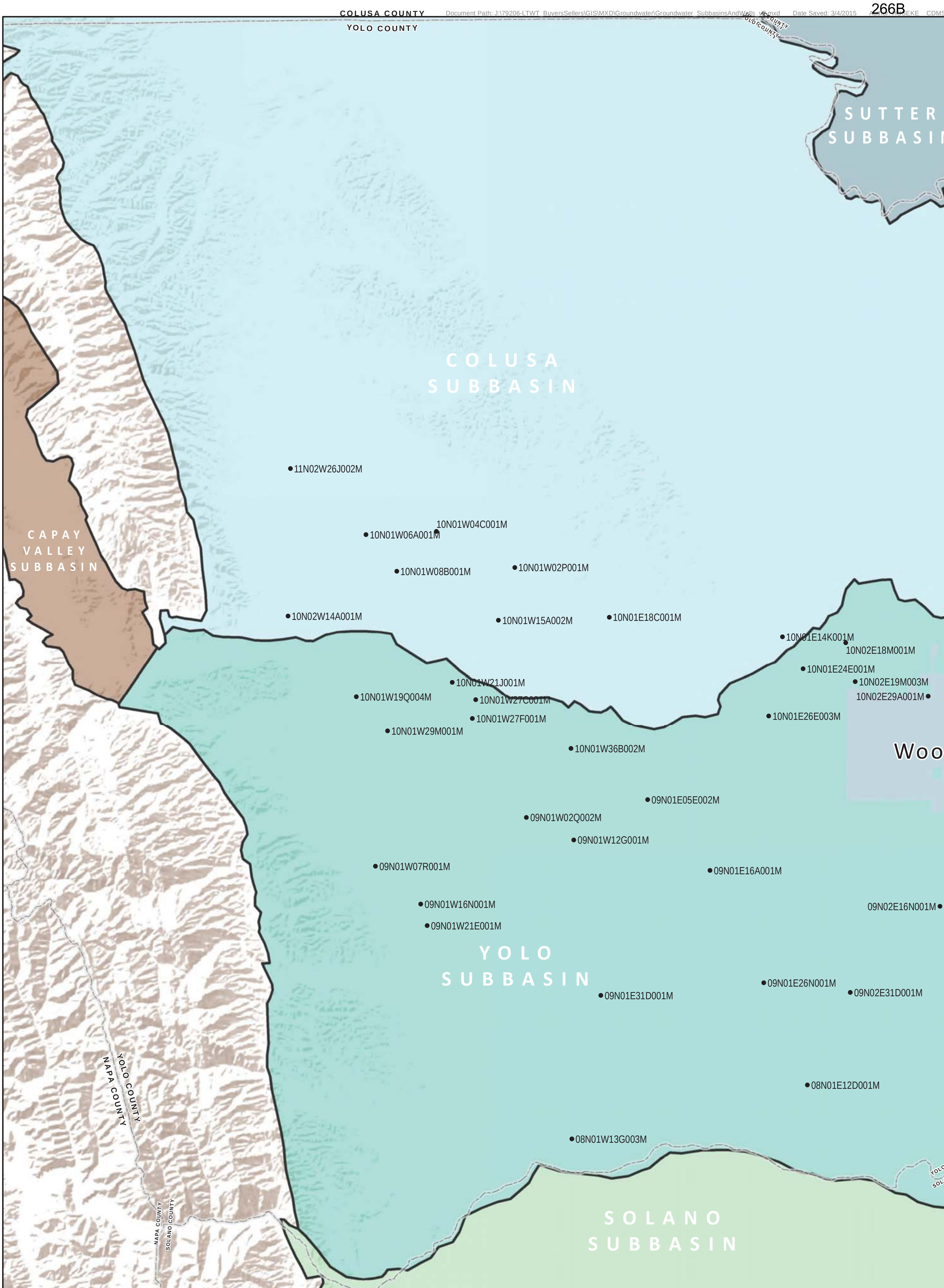
West Butte Subbasin

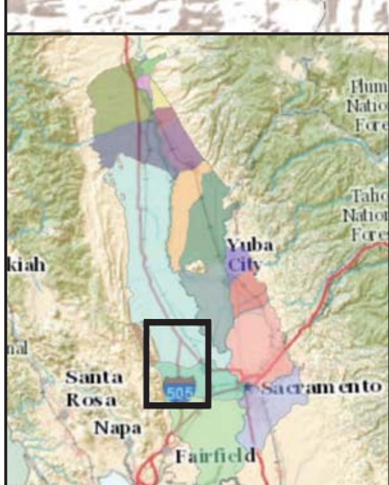
Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5
Miles

N W E S





Location of Shallow Groundwater Monitoring Wells

Yolo Subbasin
Part 1 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

0 2.5 5
Miles

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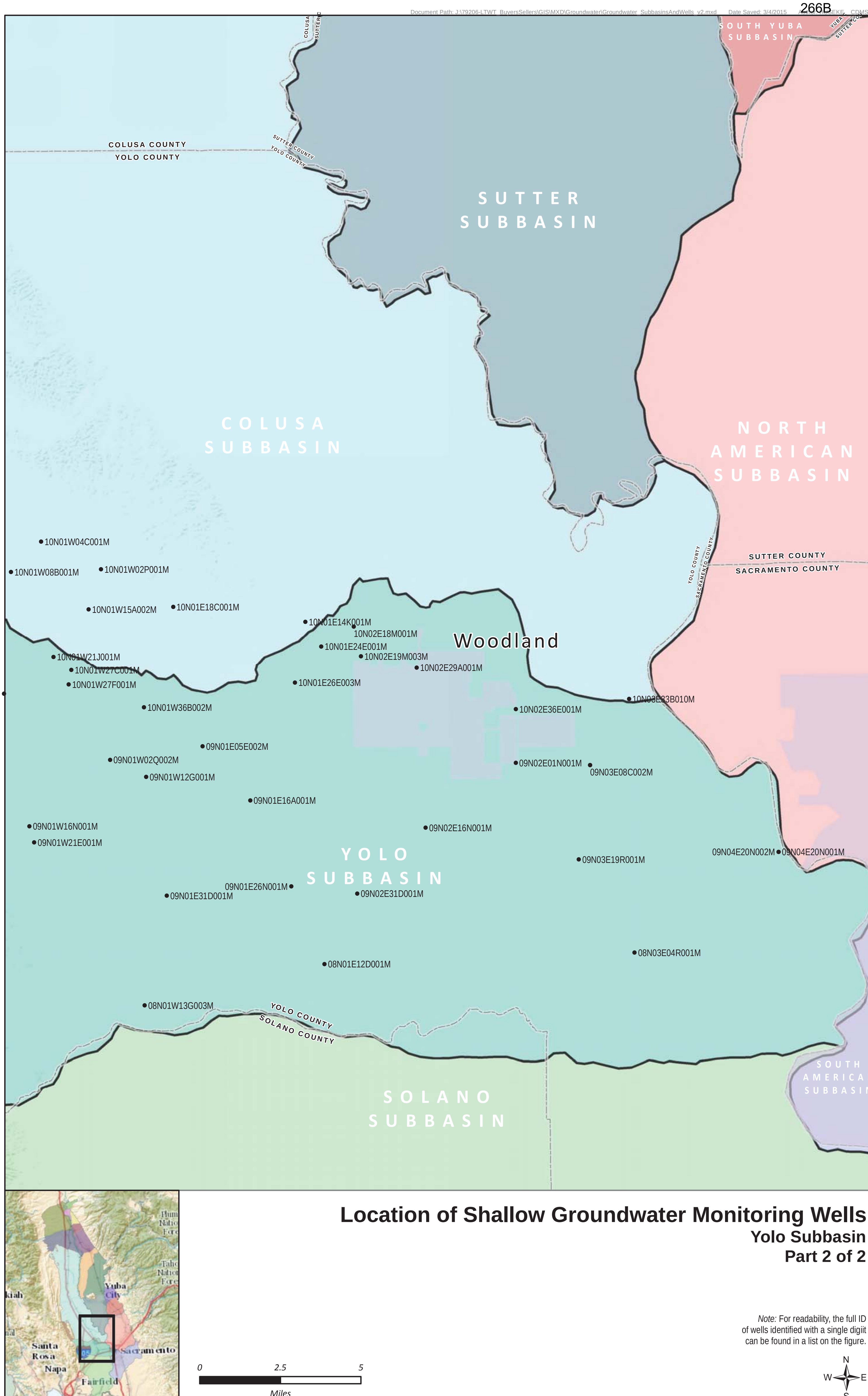
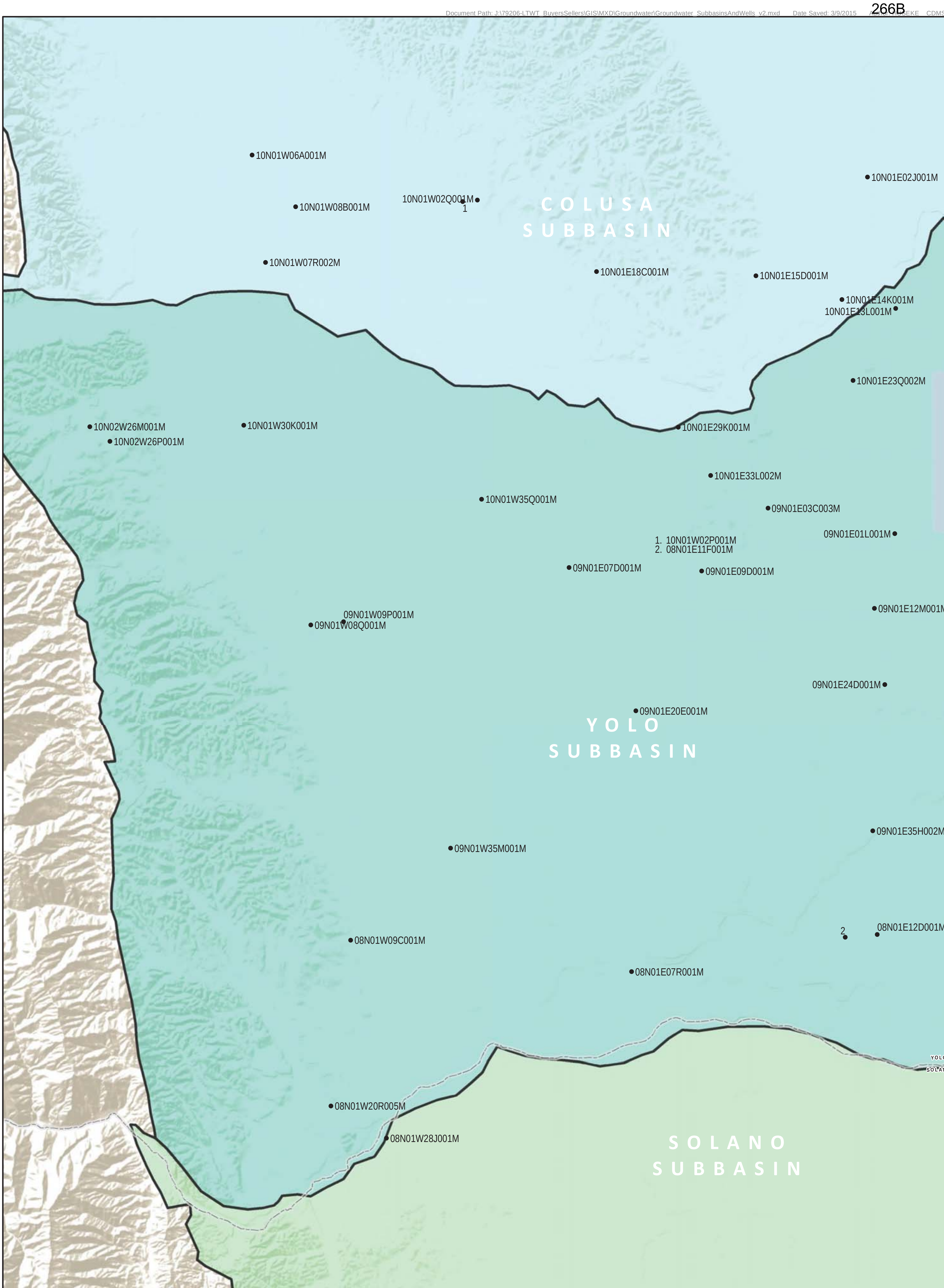


Location of Shallow Groundwater Monitoring Wells

Yolo Subbasin
Part 2 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/9/2015 CDMSmith



Location of Intermediate Depth Groundwater Monitoring Wells

Yolo Subbasin

Part 1 of 2

0 2.5 5

Miles

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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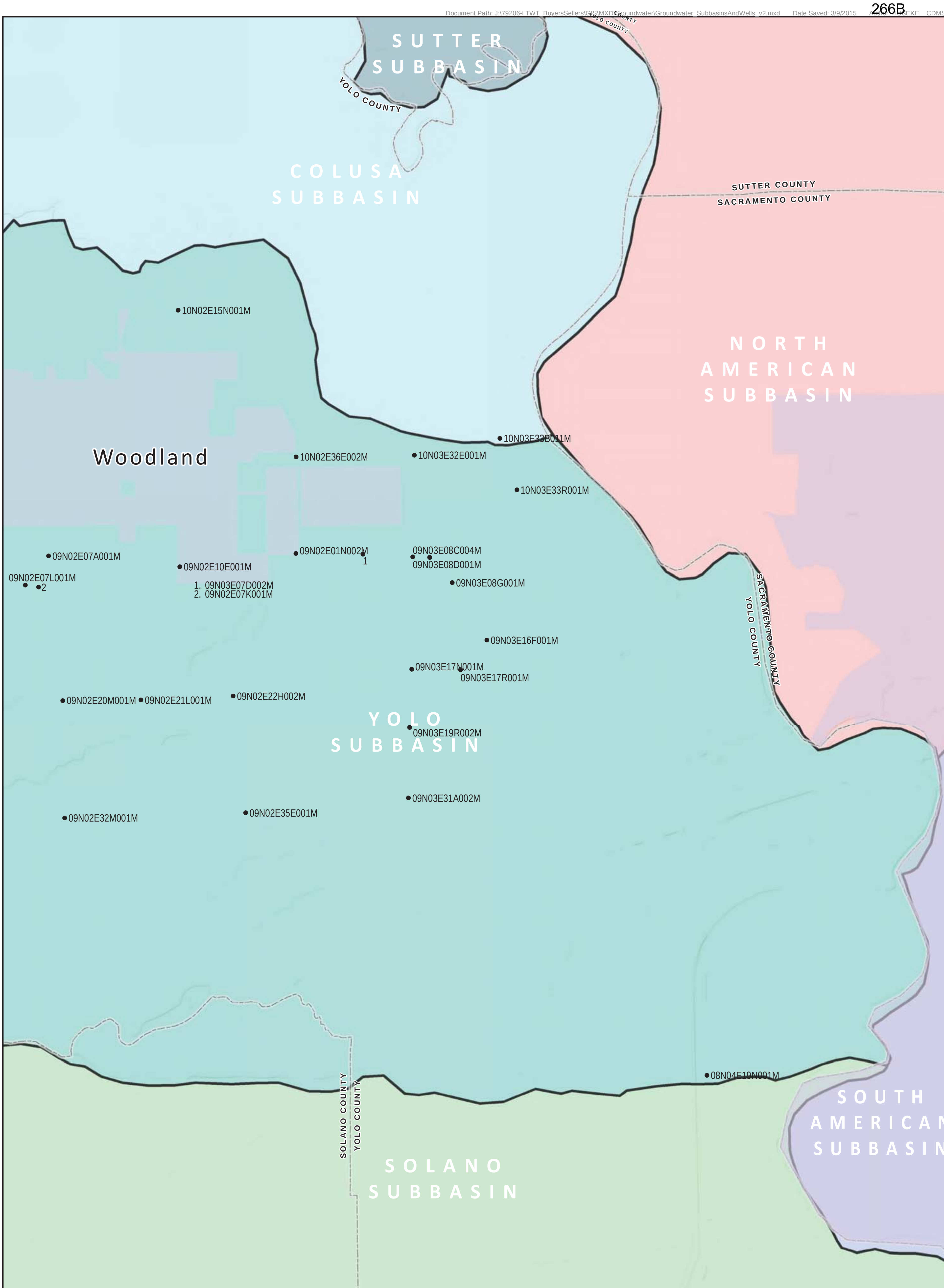
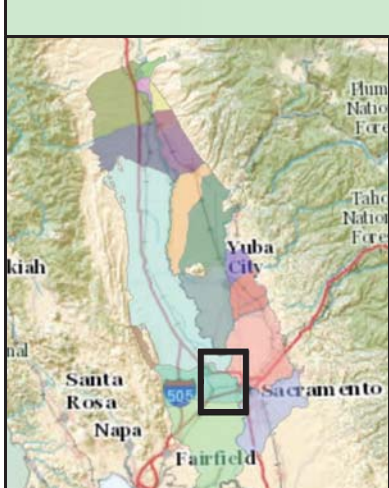
Document Path: J:\79206-LTWT_BuyersSellers\GIS\MXD\Groundwater\Groundwater_SubbasinsAndWells_v2.mxd Date Saved: 3/9/2015 CDMSmith





Location of Intermediate Depth Groundwater Monitoring Wells

Yolo Subbasin
Part 2 of 2

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

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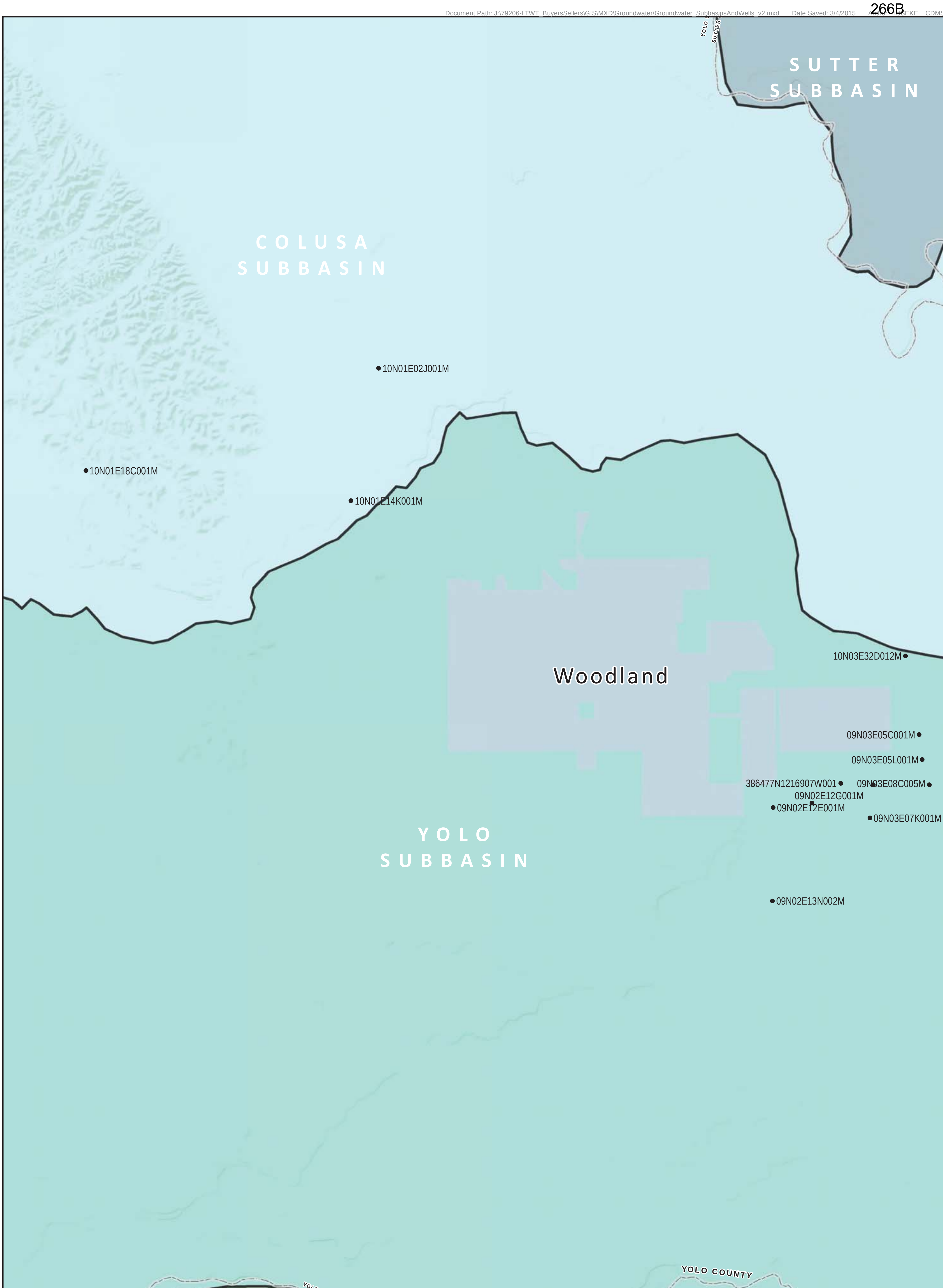

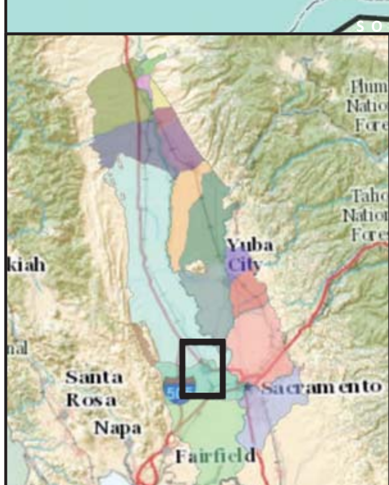

Location of Deep Groundwater Monitoring Wells
Yolo Subbasin
Part 1 of 1

Note: For readability, the full ID of wells identified with a single digiit can be found in a list on the figure.

Shallow Groundwater Monitoring Well Hydrographs- Colusa Subbasin

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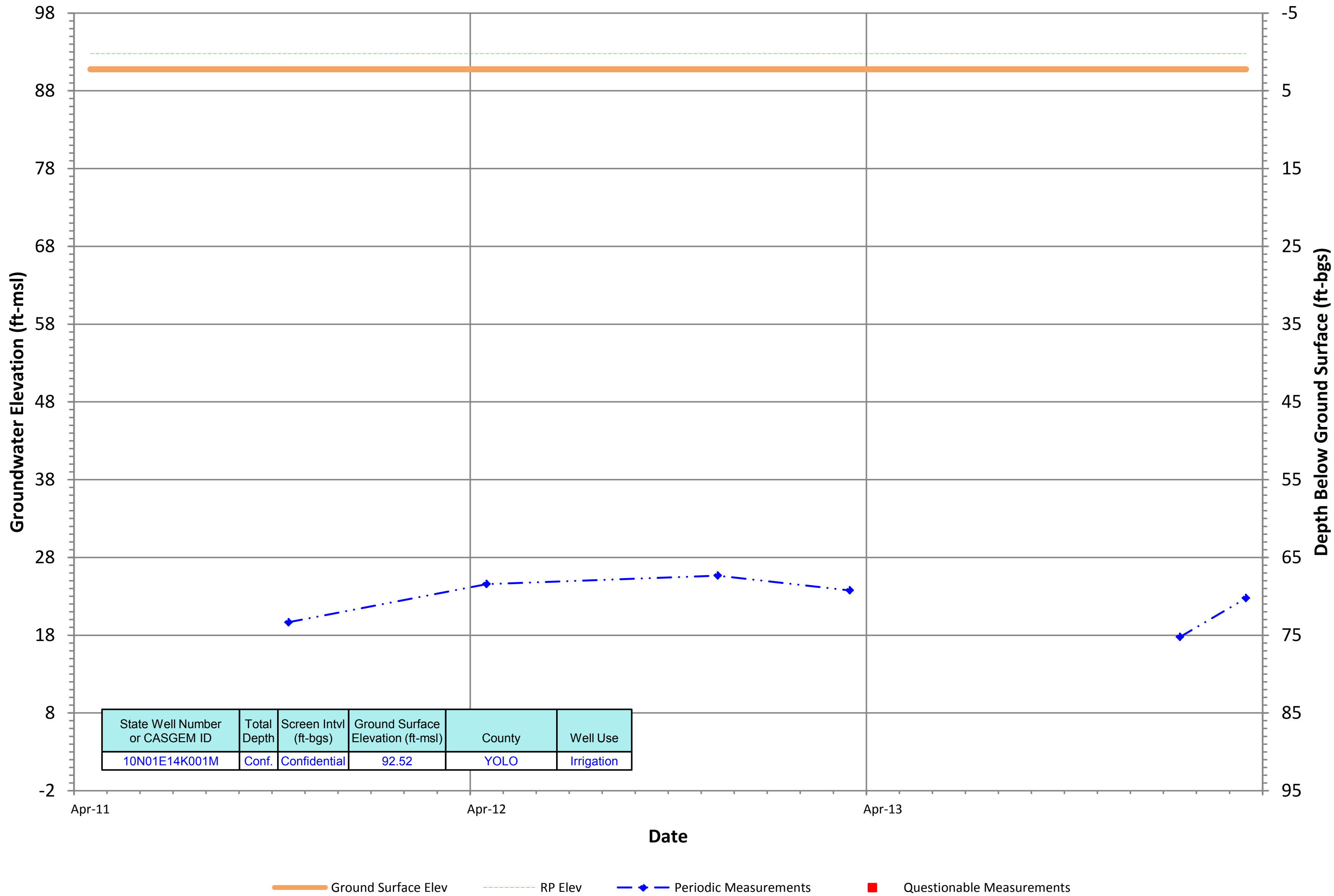
10N01E14K001M
Period Of Record: 04/22/2011 to 03/18/2014

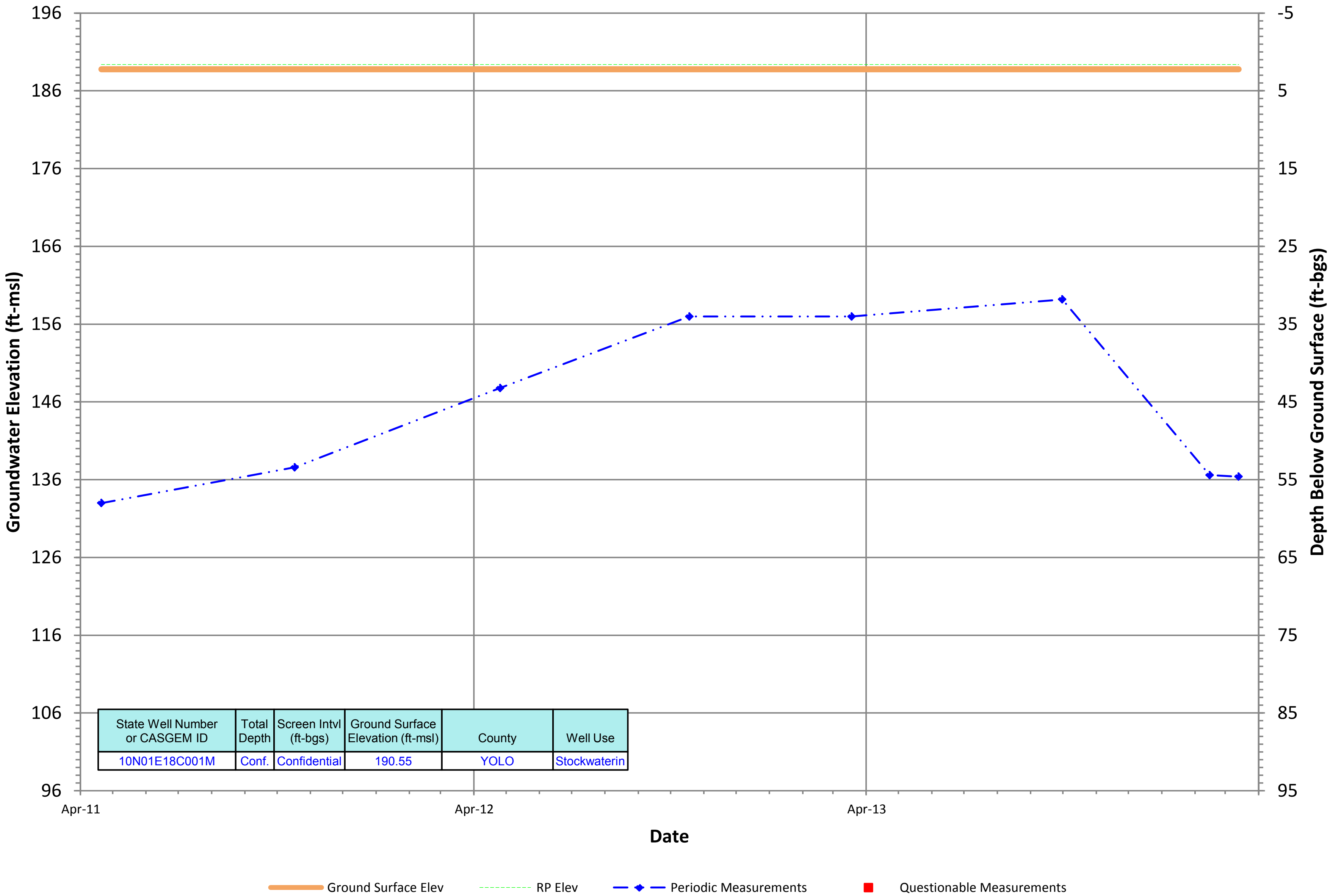
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E14K001M	Conf.	Confidential	92.52	YOLO	Irrigation

10N01E18C001M
Period Of Record: 04/20/2011 to 03/13/2014

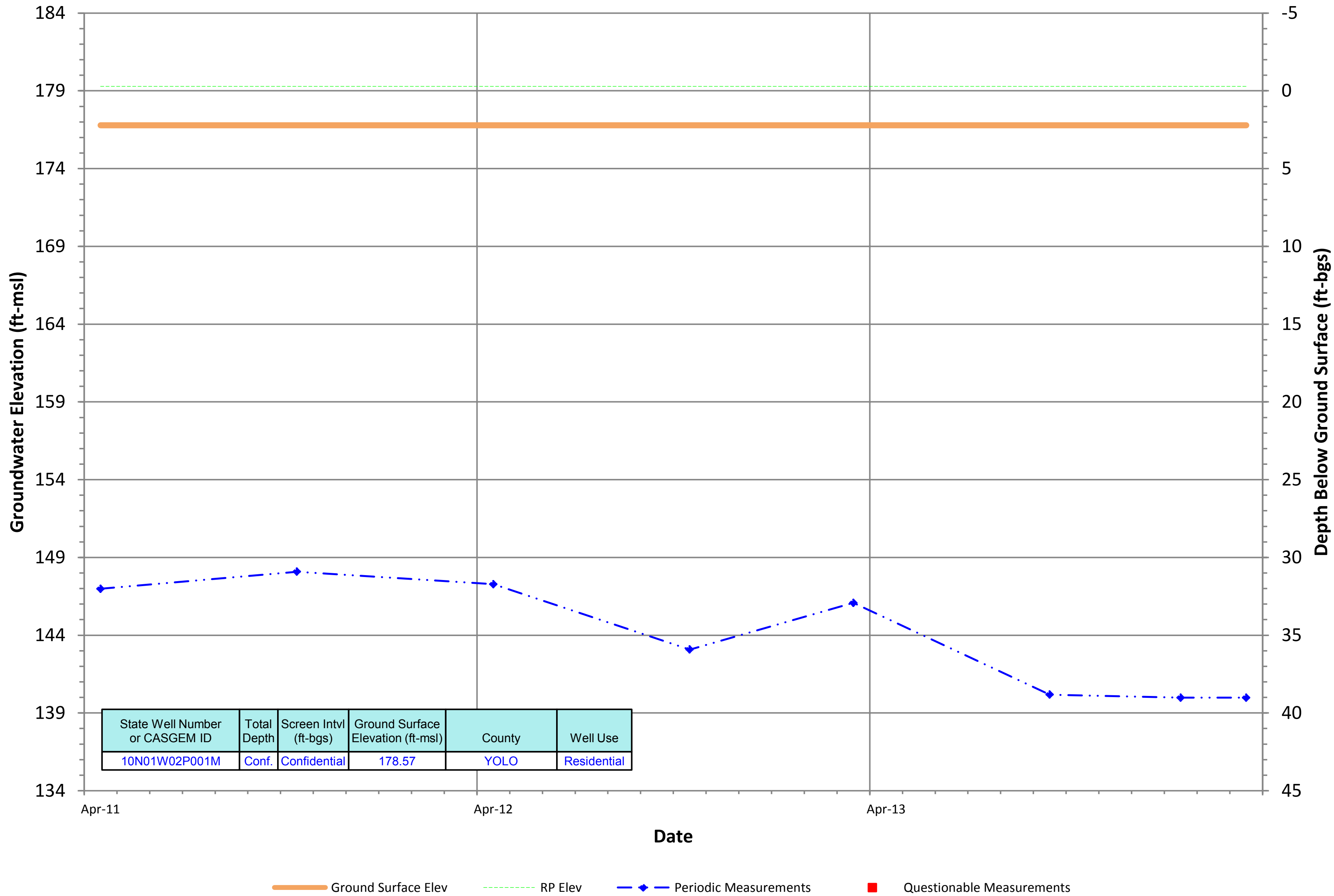
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



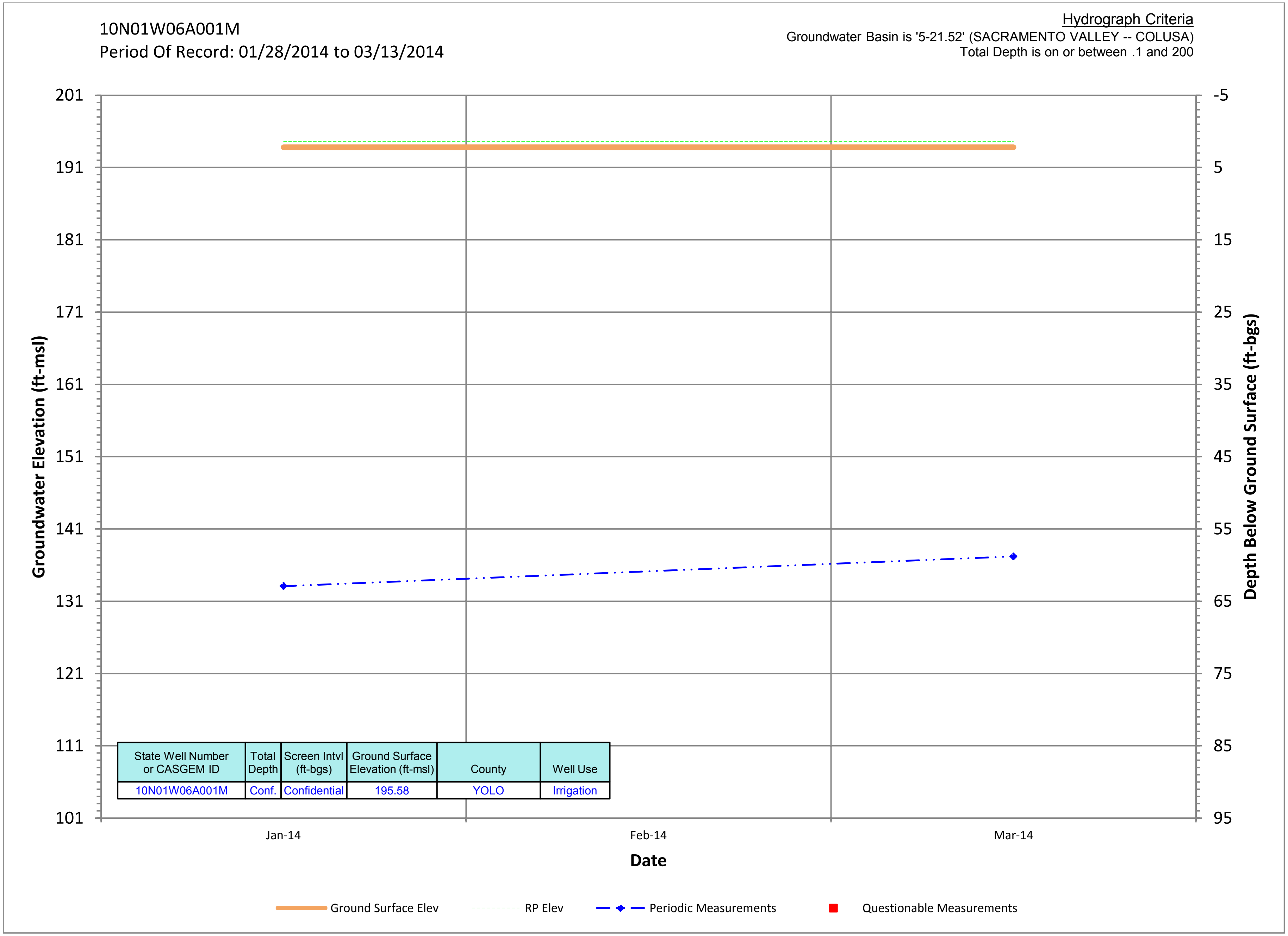
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E18C001M	Conf.	Confidential	190.55	YOLO	Stockwaterin

10N01W02P001M
Period Of Record: 04/20/2011 to 03/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



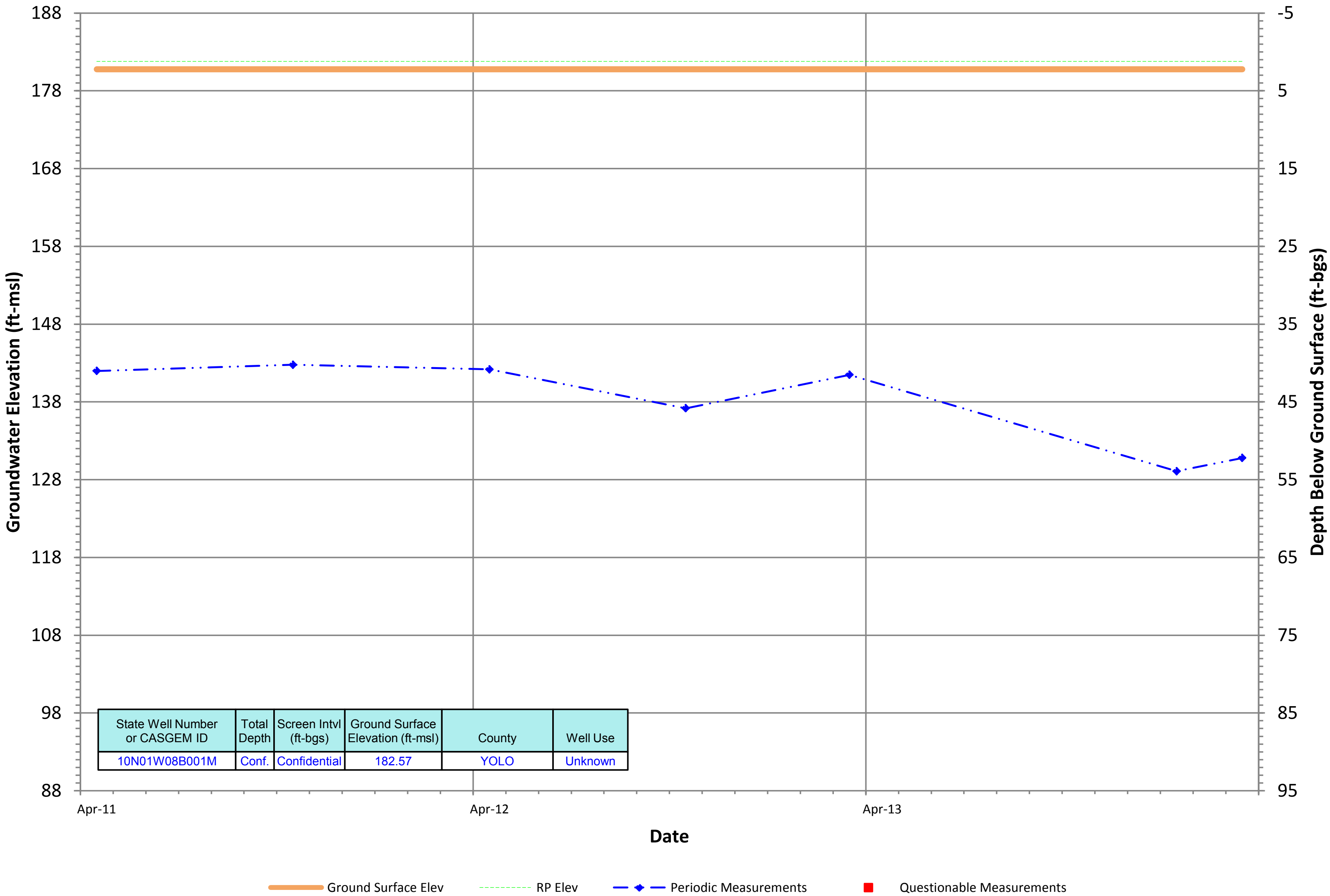
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W02P001M	Conf.	Confidential	178.57	YOLO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W06A001M	Conf.	Confidential	195.58	YOLO	Irrigation

10N01W08B001M
Period Of Record: 04/20/2011 to 03/13/2014

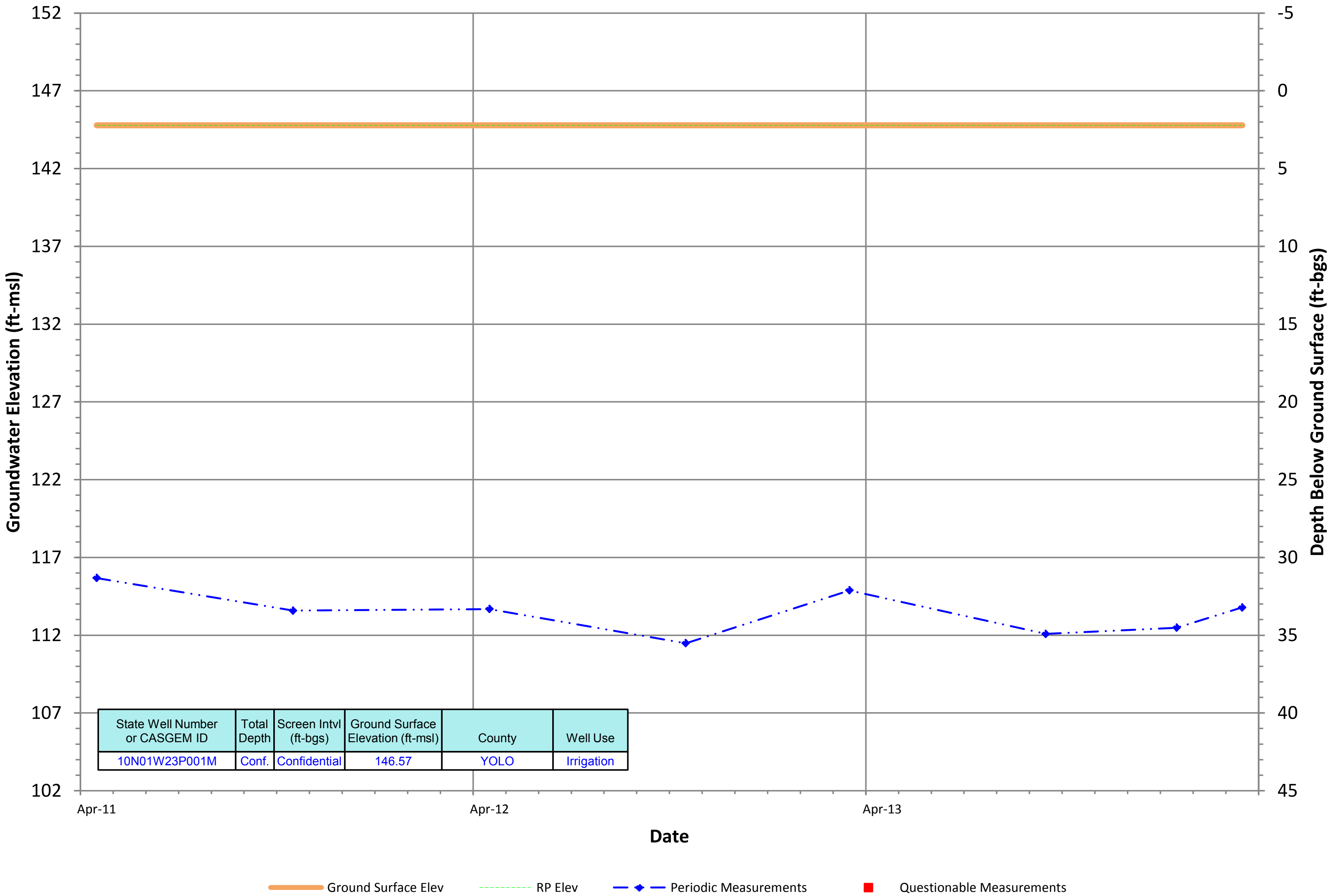
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W08B001M	Conf.	Confidential	182.57	YOLO	Unknown

10N01W23P001M
Period Of Record: 04/21/2011 to 03/14/2014

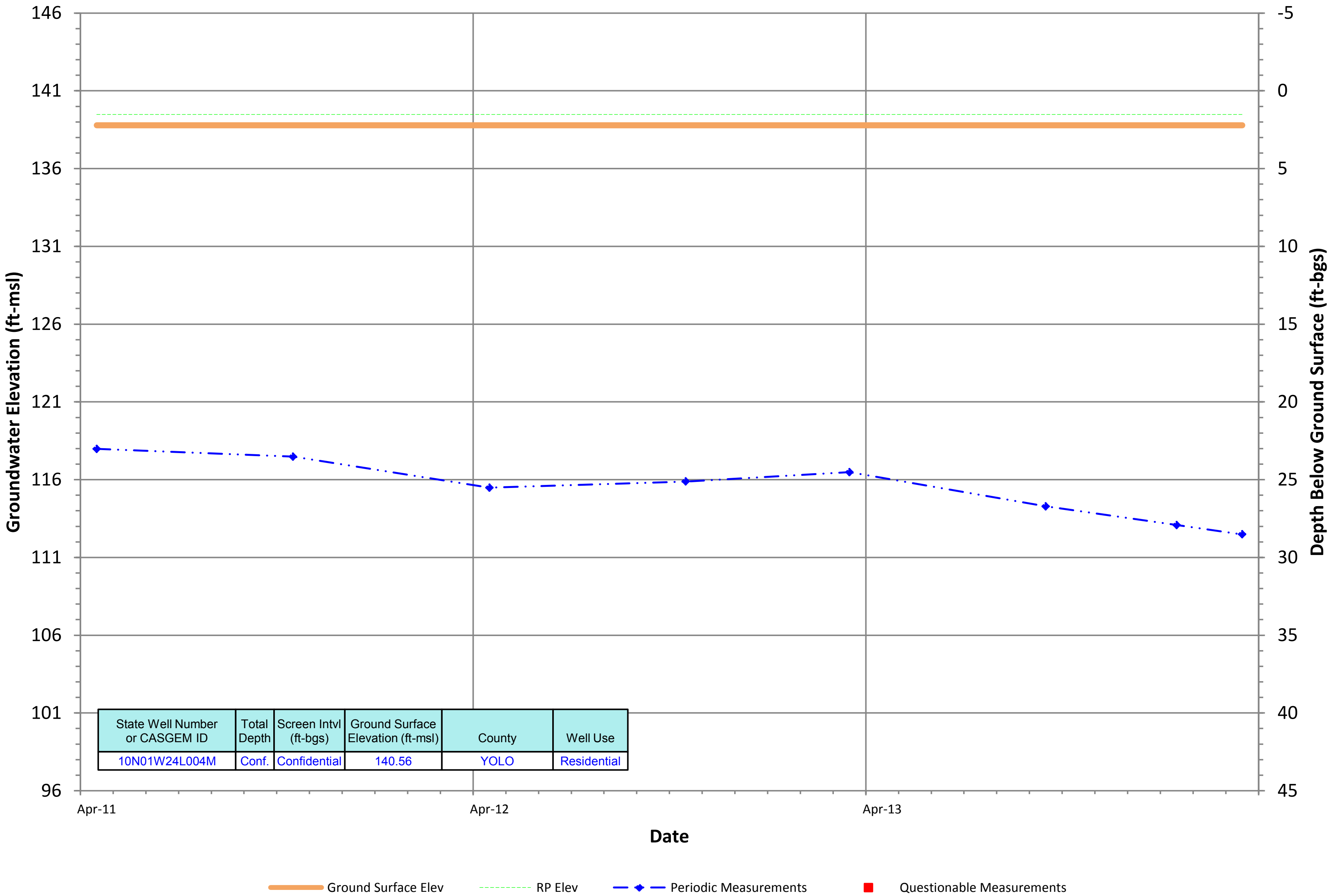
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W23P001M	Conf.	Confidential	146.57	YOLO	Irrigation

10N01W24L004M
Period Of Record: 04/20/2011 to 03/13/2014

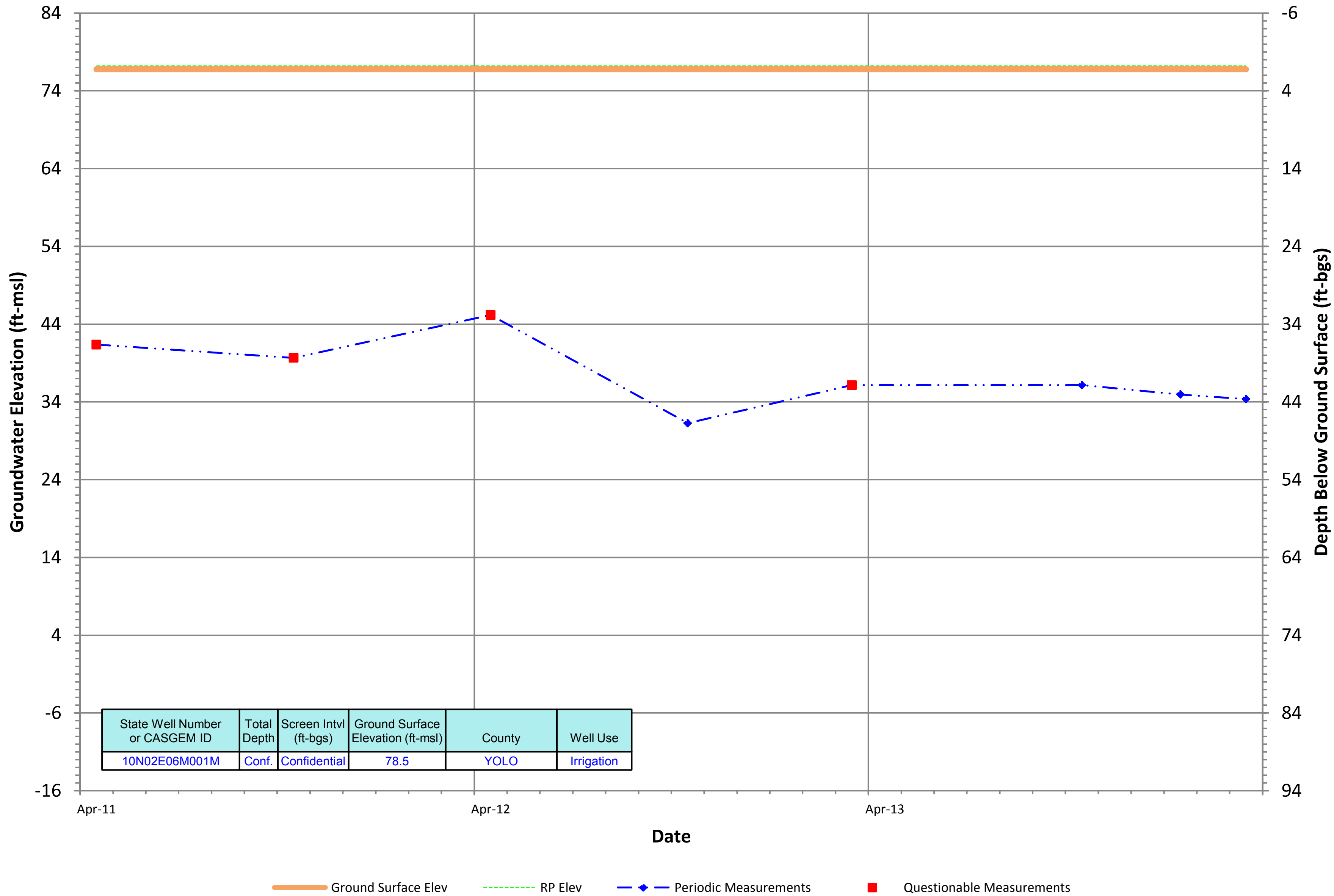
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W24L004M	Conf.	Confidential	140.56	YOLO	Residential

10N02E06M001M
Period Of Record: 04/22/2011 to 03/18/2014

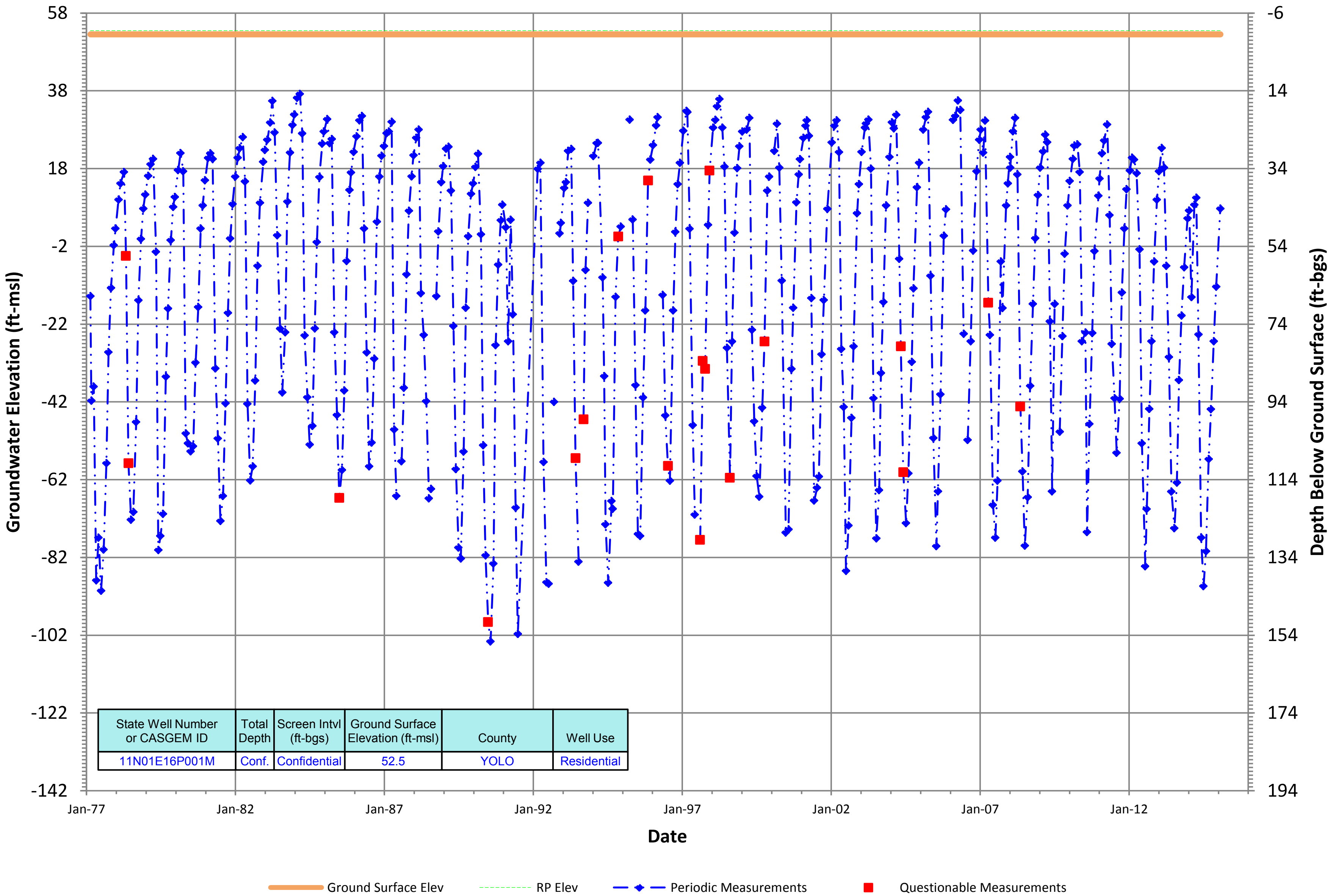
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



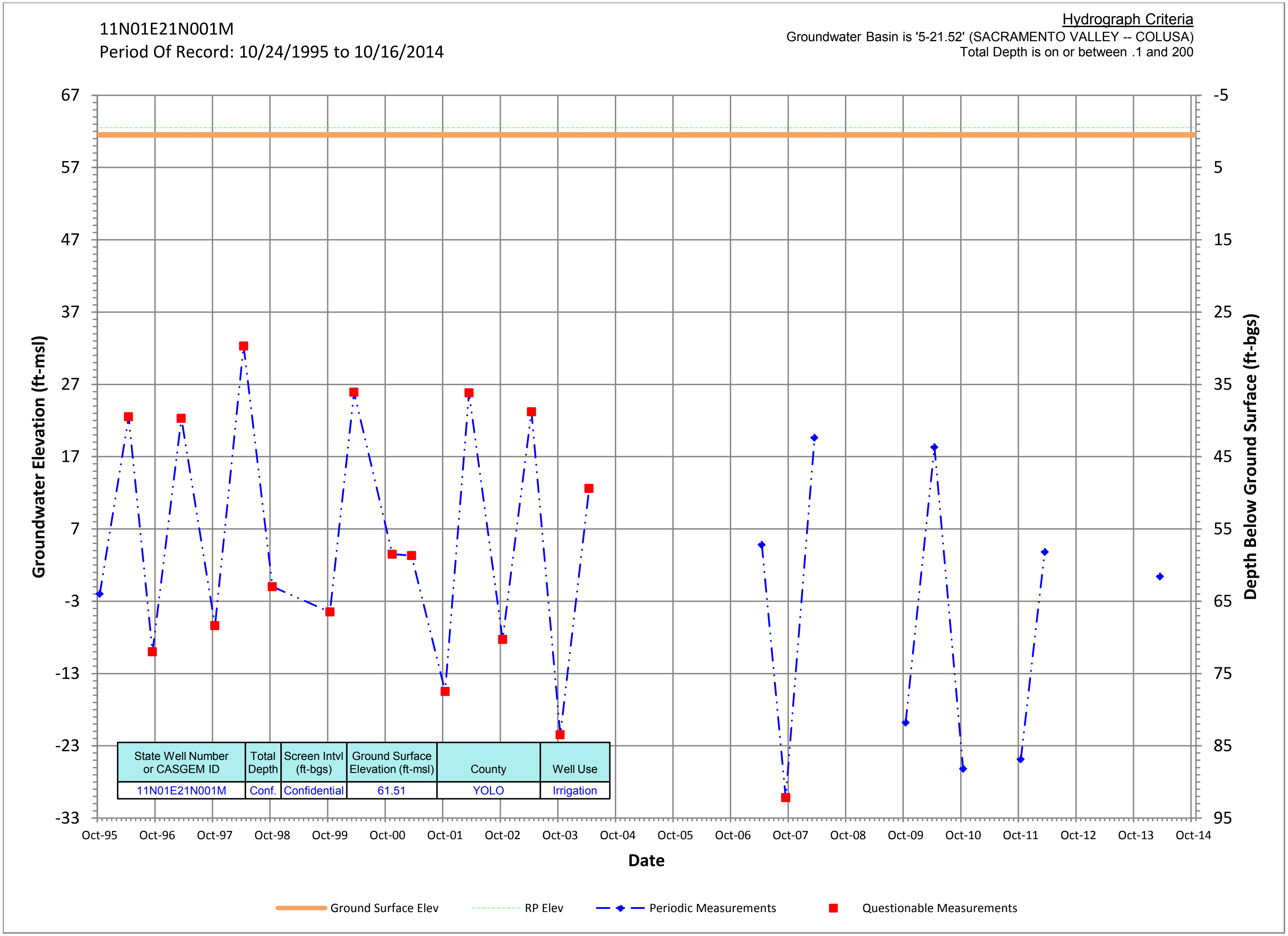
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E06M001M	Conf.	Confidential	78.5	YOLO	Irrigation

11N01E16P001M
Period Of Record: 02/16/1977 to 01/23/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



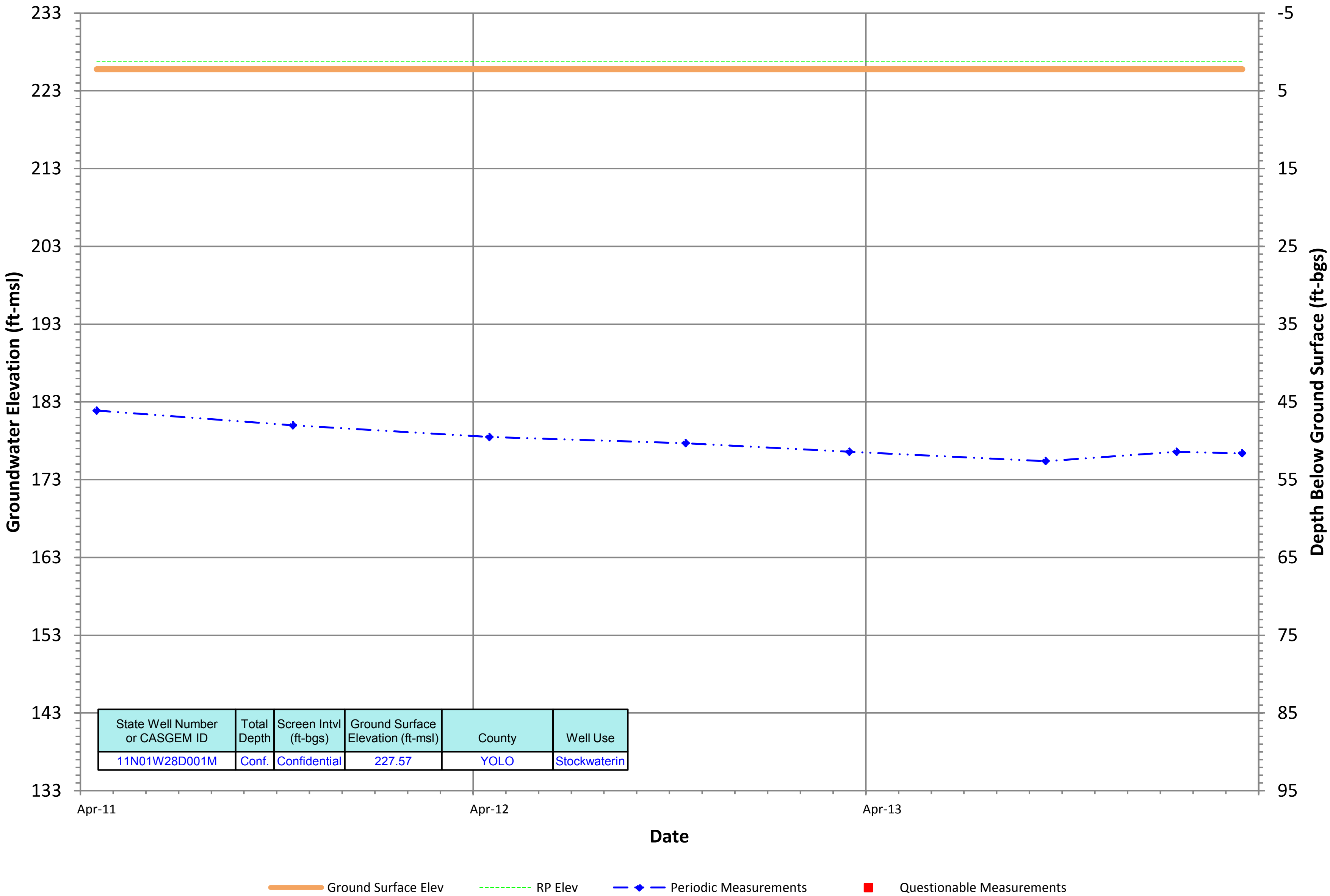
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E16P001M	Conf.	Confidential	52.5	YOLO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E21N001M	Conf.	Confidential	61.51	YOLO	Irrigation

11N01W28D001M
Period Of Record: 04/20/2011 to 03/13/2014

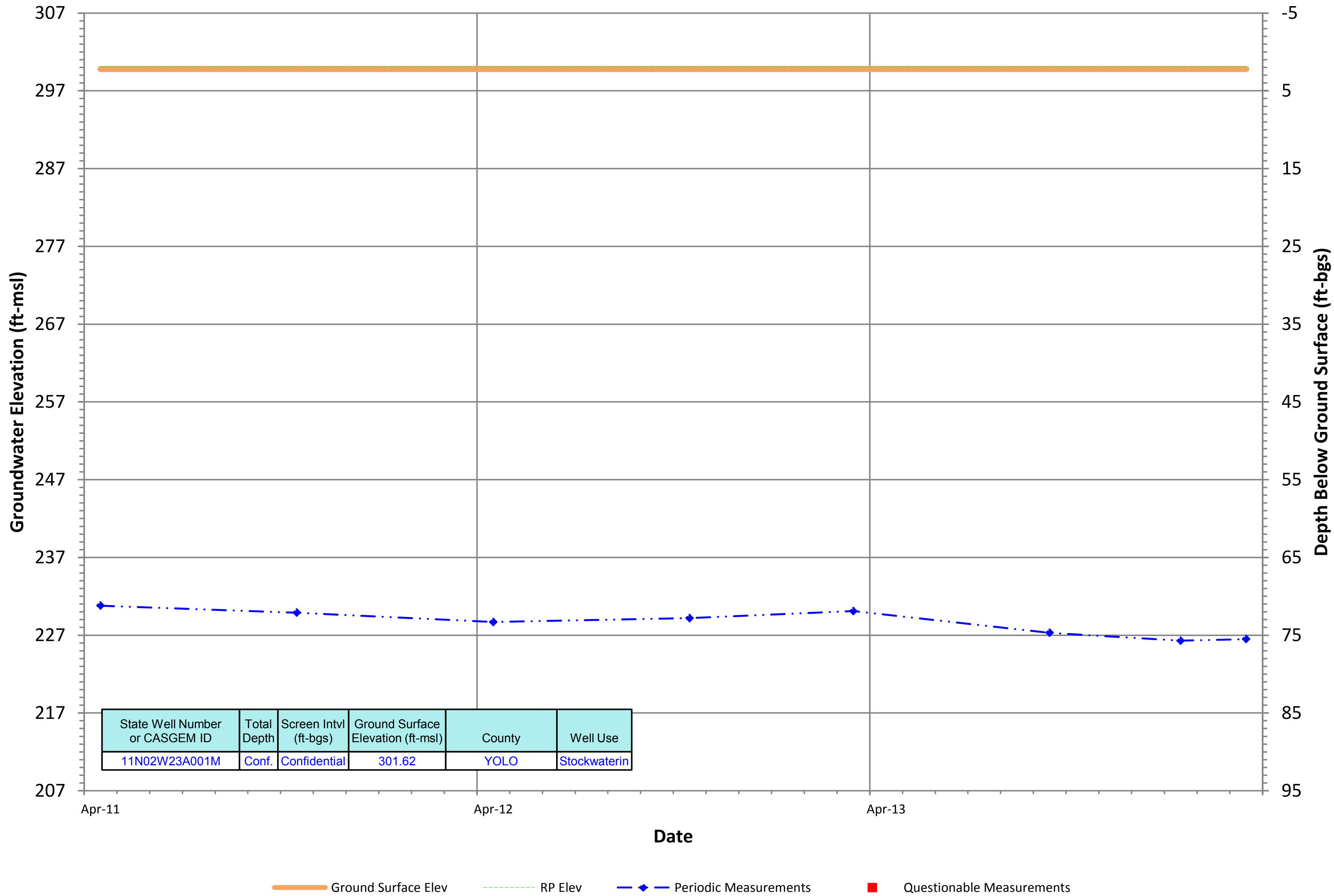
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01W28D001M	Conf.	Confidential	227.57	YOLO	Stockwaterin

11N02W23A001M
Period Of Record: 04/20/2011 to 03/13/2014

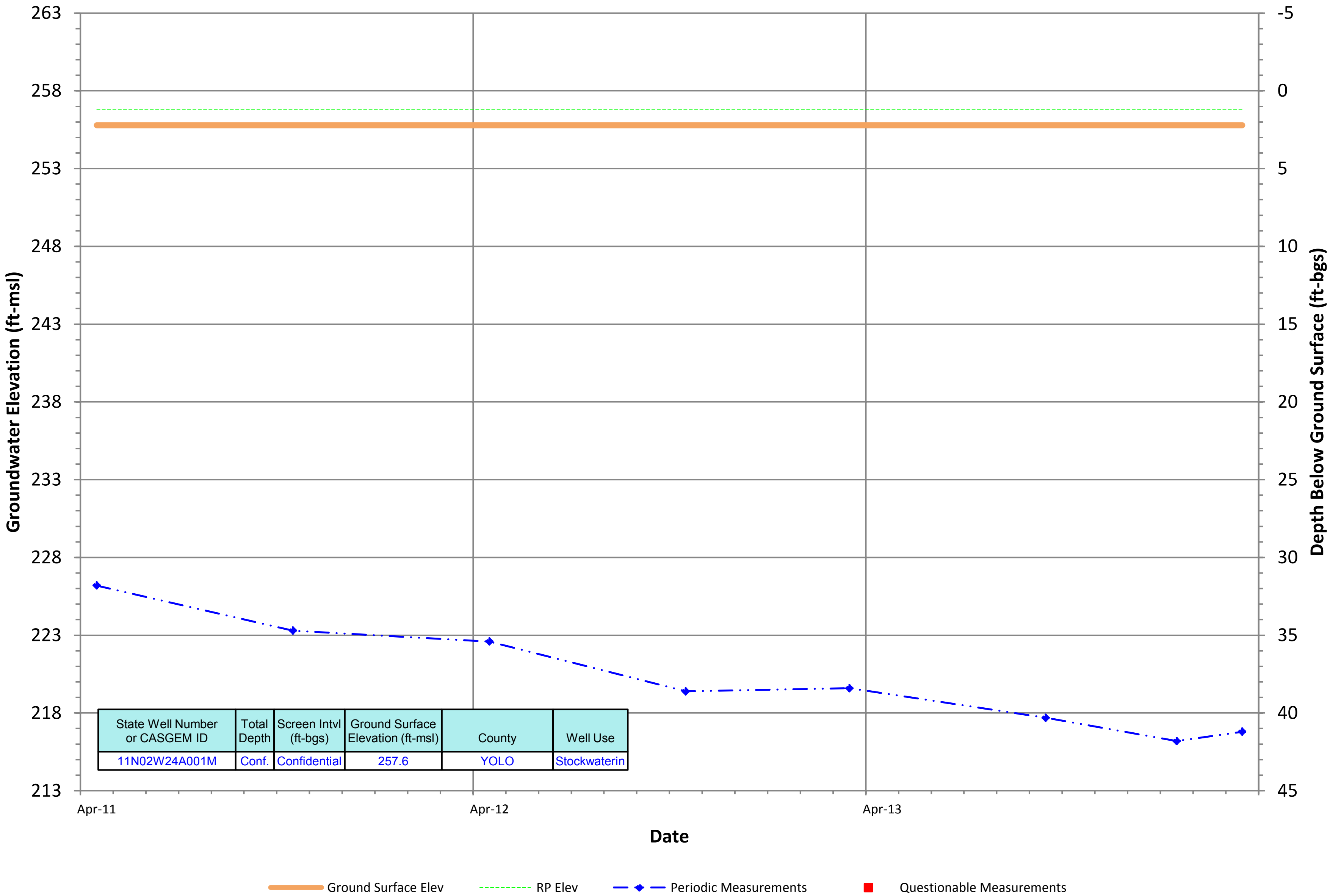
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02W23A001M	Conf.	Confidential	301.62	YOLO	Stockwaterin

11N02W24A001M
Period Of Record: 04/20/2011 to 03/13/2014

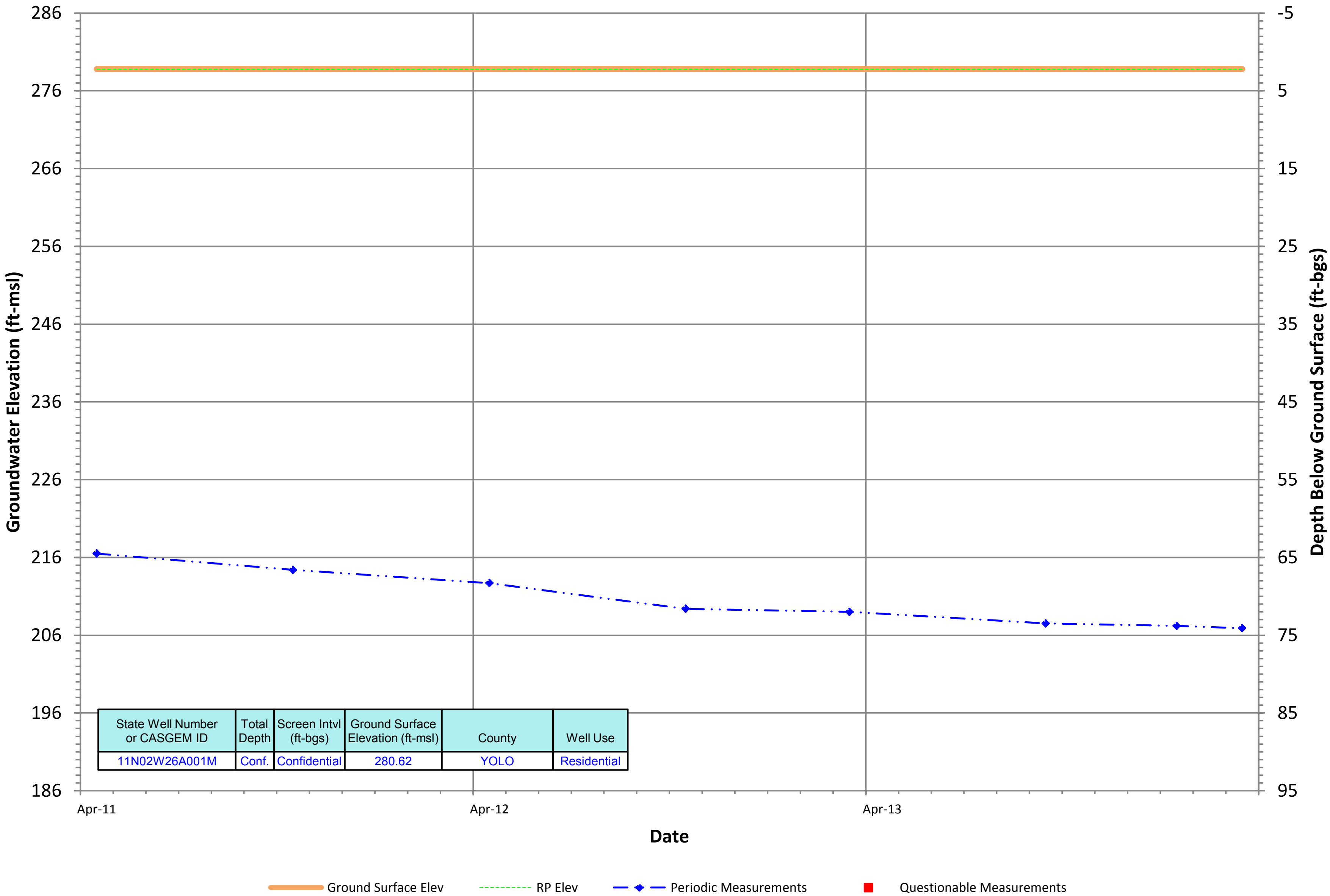
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02W24A001M	Conf.	Confidential	257.6	YOLO	Stockwaterin

11N02W26A001M
Period Of Record: 04/20/2011 to 03/13/2014

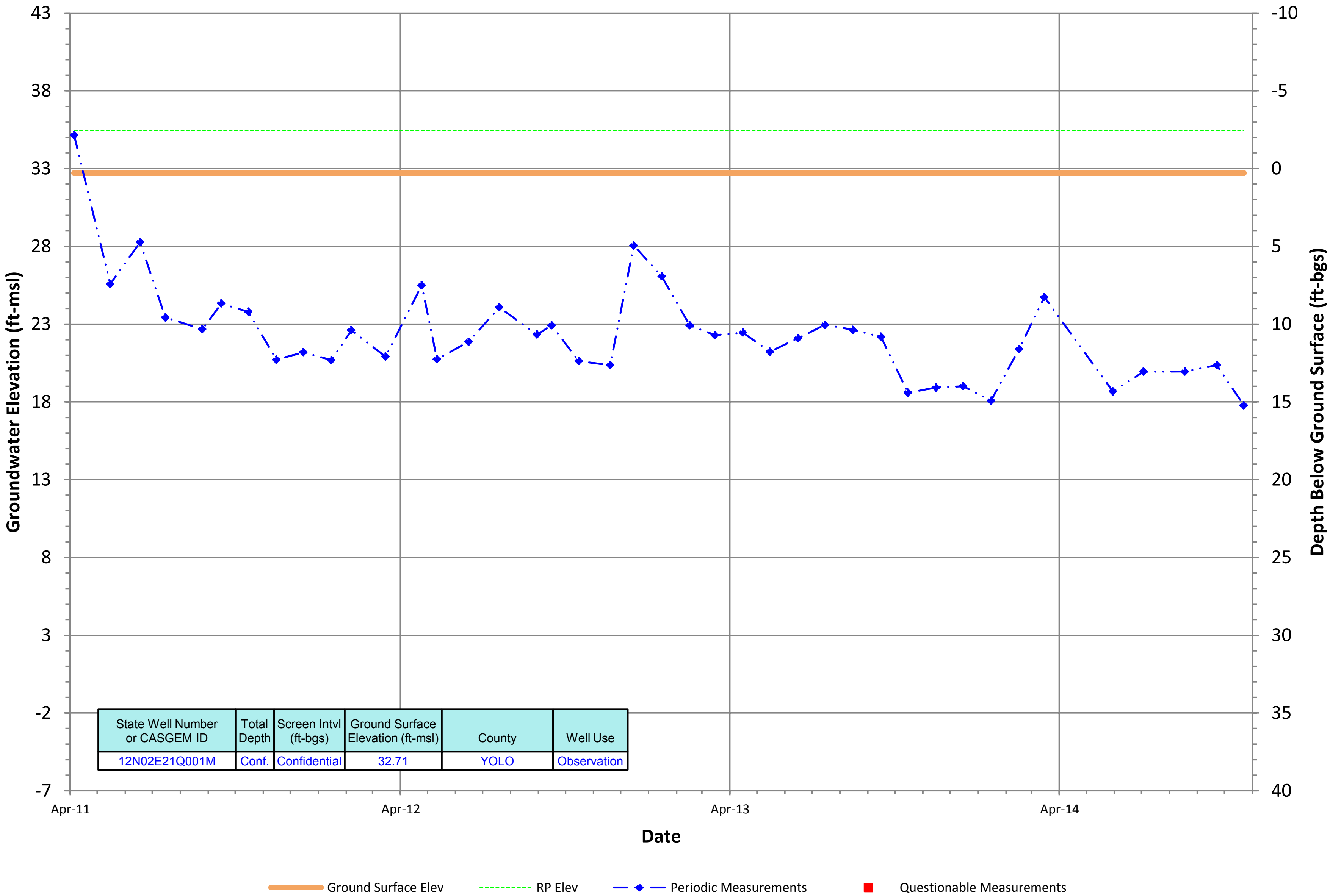
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02W26A001M	Conf.	Confidential	280.62	YOLO	Residential

12N02E21Q001M
Period Of Record: 04/05/2011 to 10/22/2014

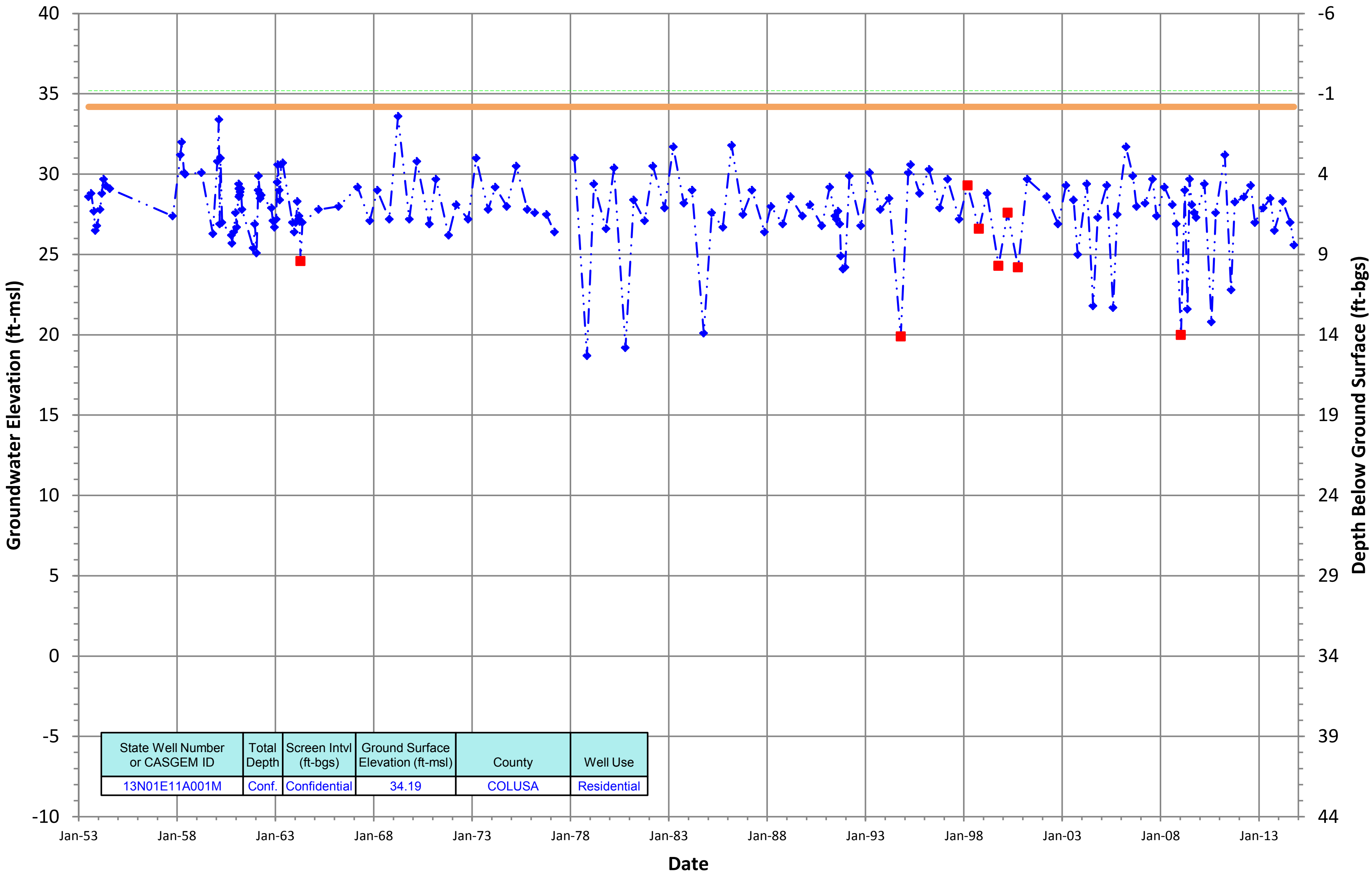
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



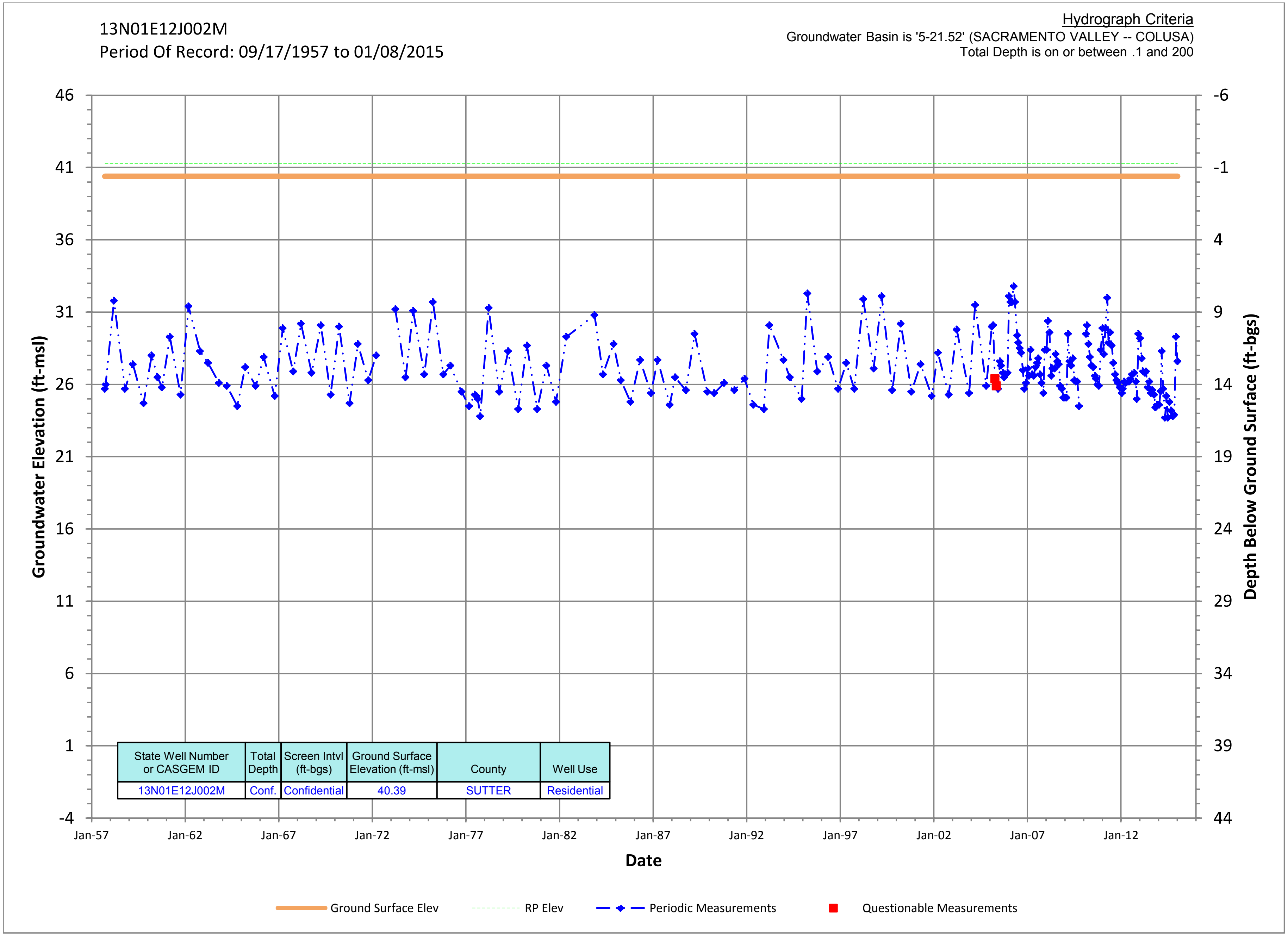
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E21Q001M	Conf.	Confidential	32.71	YOLO	Observation

13N01E11A001M
Period Of Record: 07/01/1953 to 10/14/2014

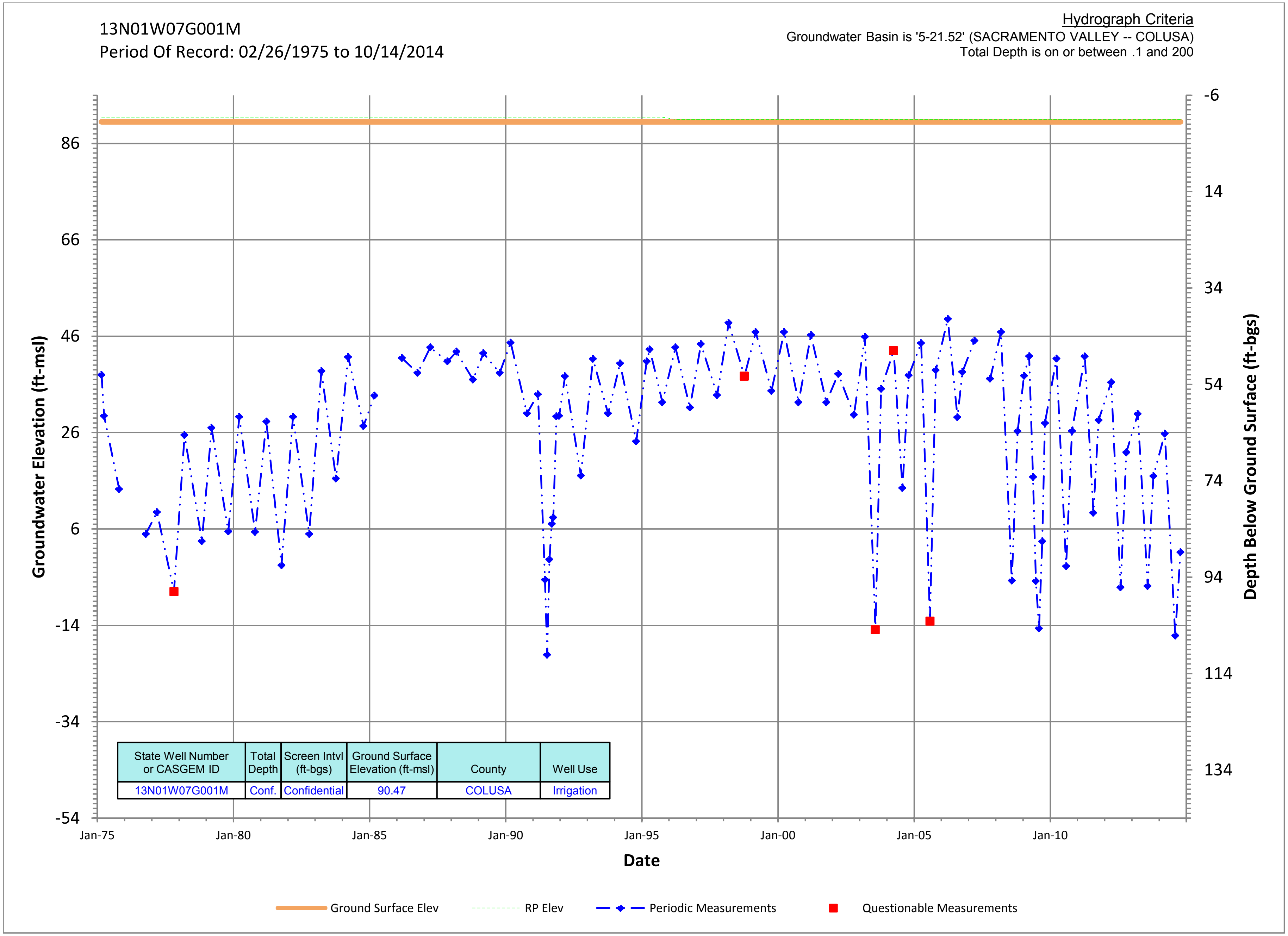
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E11A001M	Conf.	Confidential	34.19	COLUSA	Residential



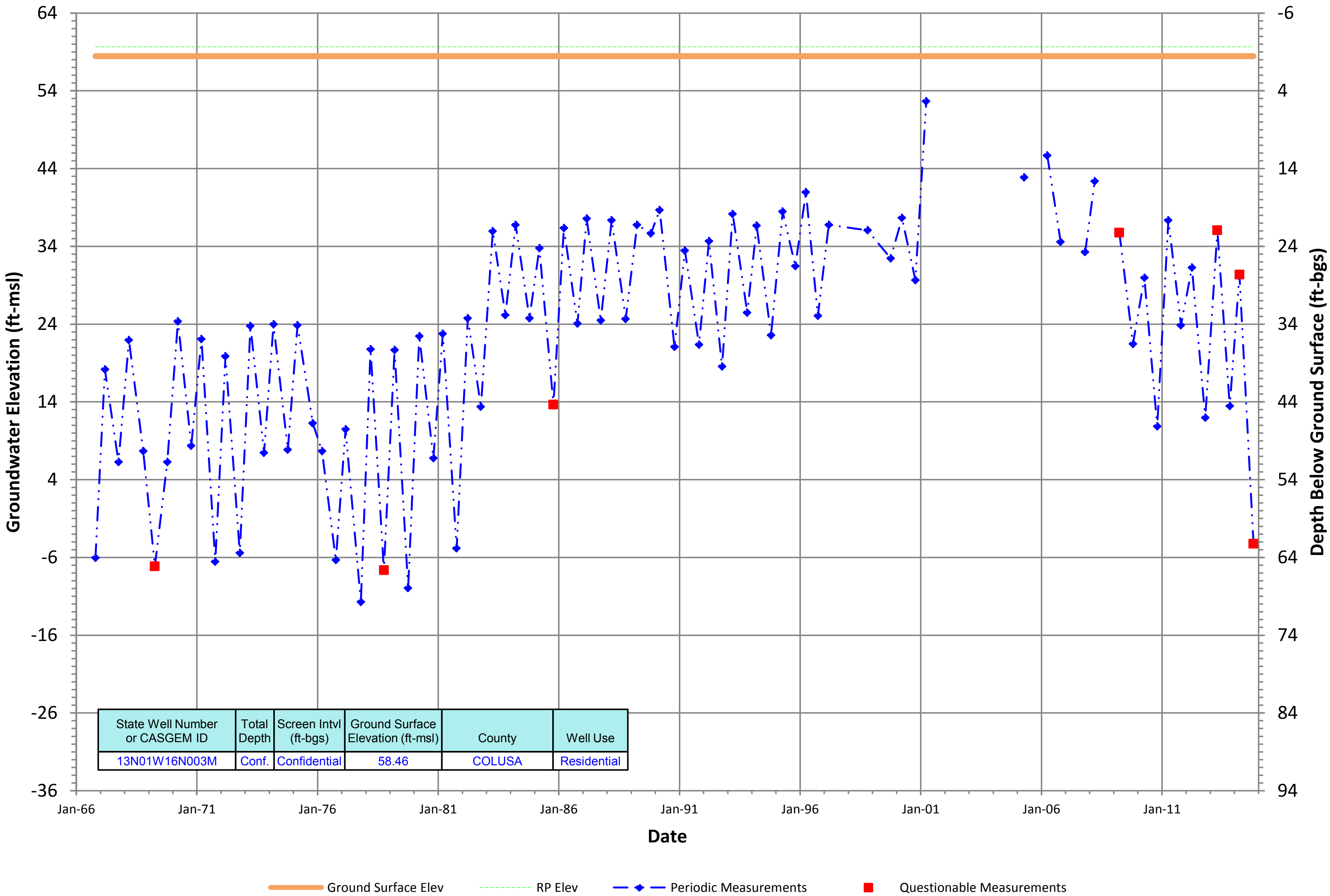
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E12J002M	Conf.	Confidential	40.39	SUTTER	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W07G001M	Conf.	Confidential	90.47	COLUSA	Irrigation

13N01W16N003M
Period Of Record: 10/18/1966 to 10/15/2014

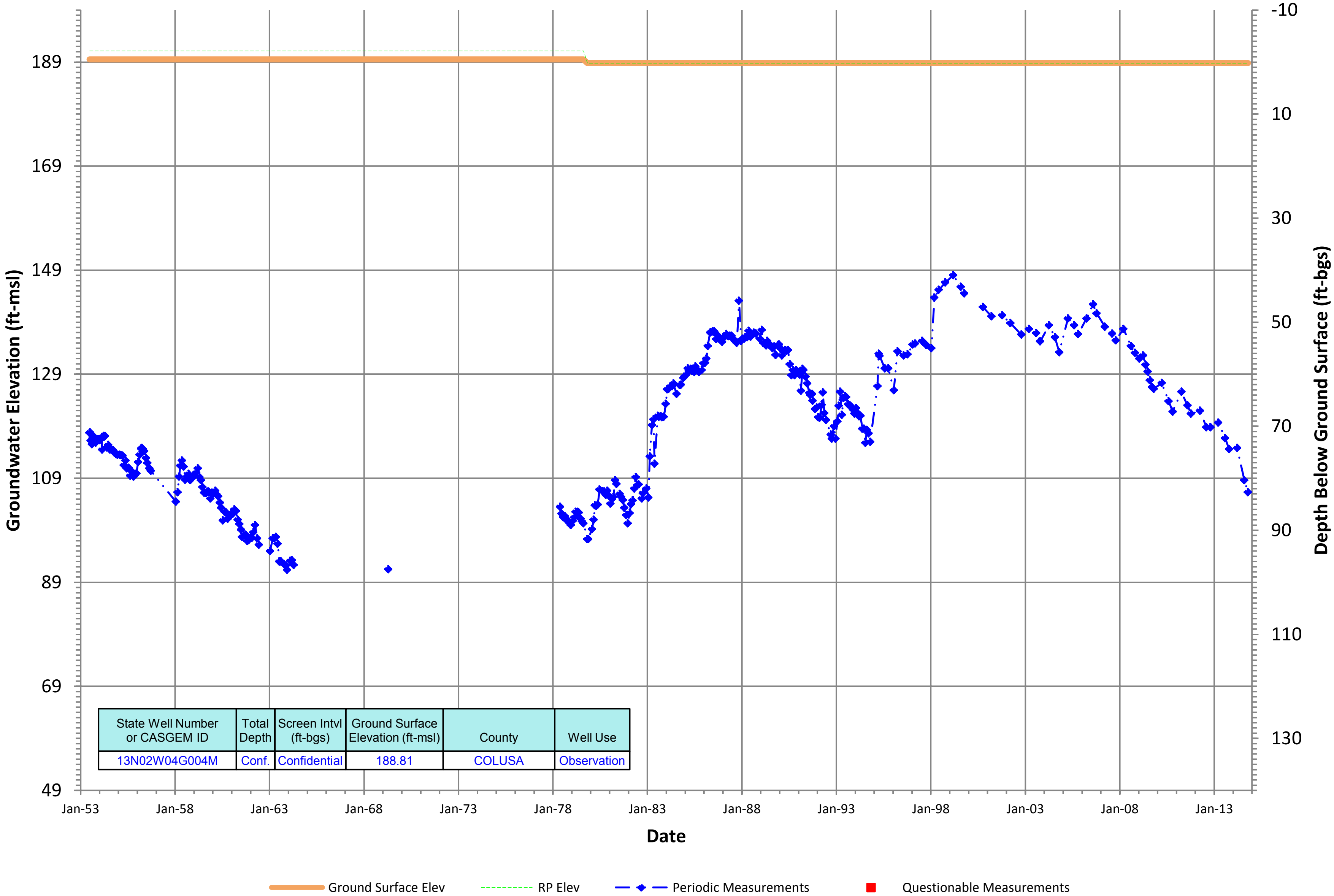
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W16N003M	Conf.	Confidential	58.46	COLUSA	Residential

13N02W04G004M
Period Of Record: 06/23/1953 to 10/14/2014

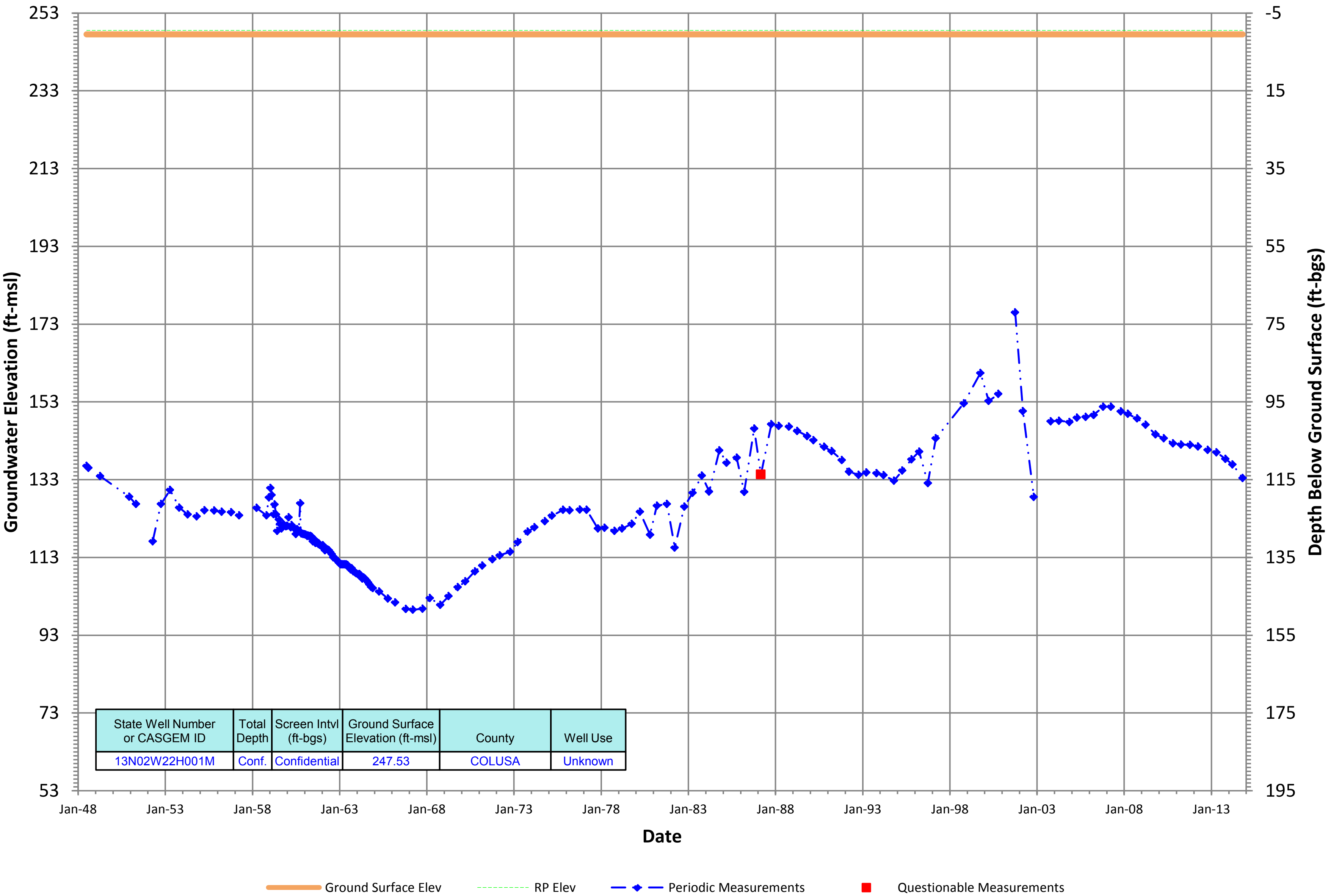
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W04G004M	Conf.	Confidential	188.81	COLUSA	Observation

13N02W22H001M
Period Of Record: 06/25/1948 to 10/15/2014

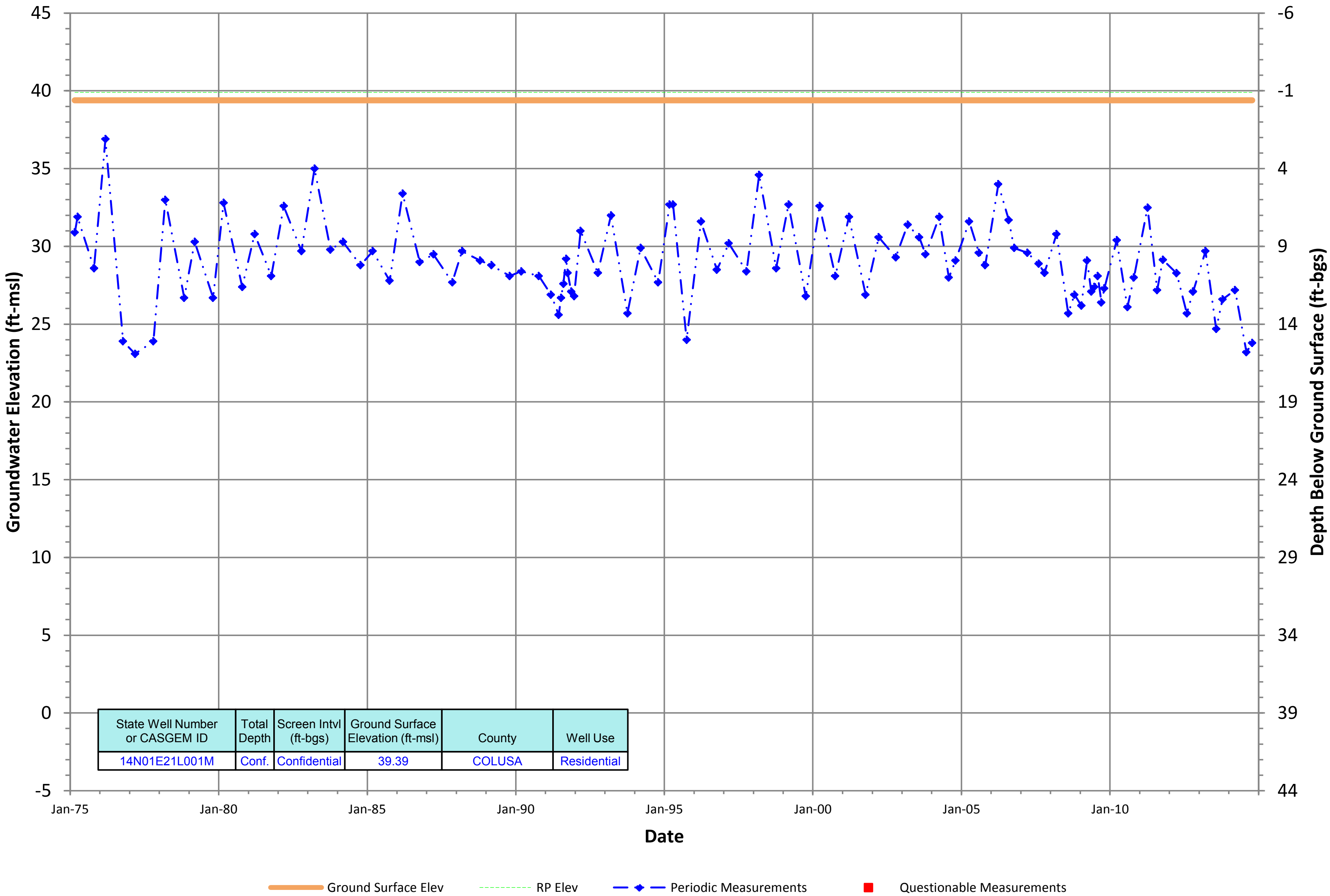
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W22H001M	Conf.	Confidential	247.53	COLUSA	Unknown

14N01E21L001M
Period Of Record: 02/26/1975 to 10/14/2014

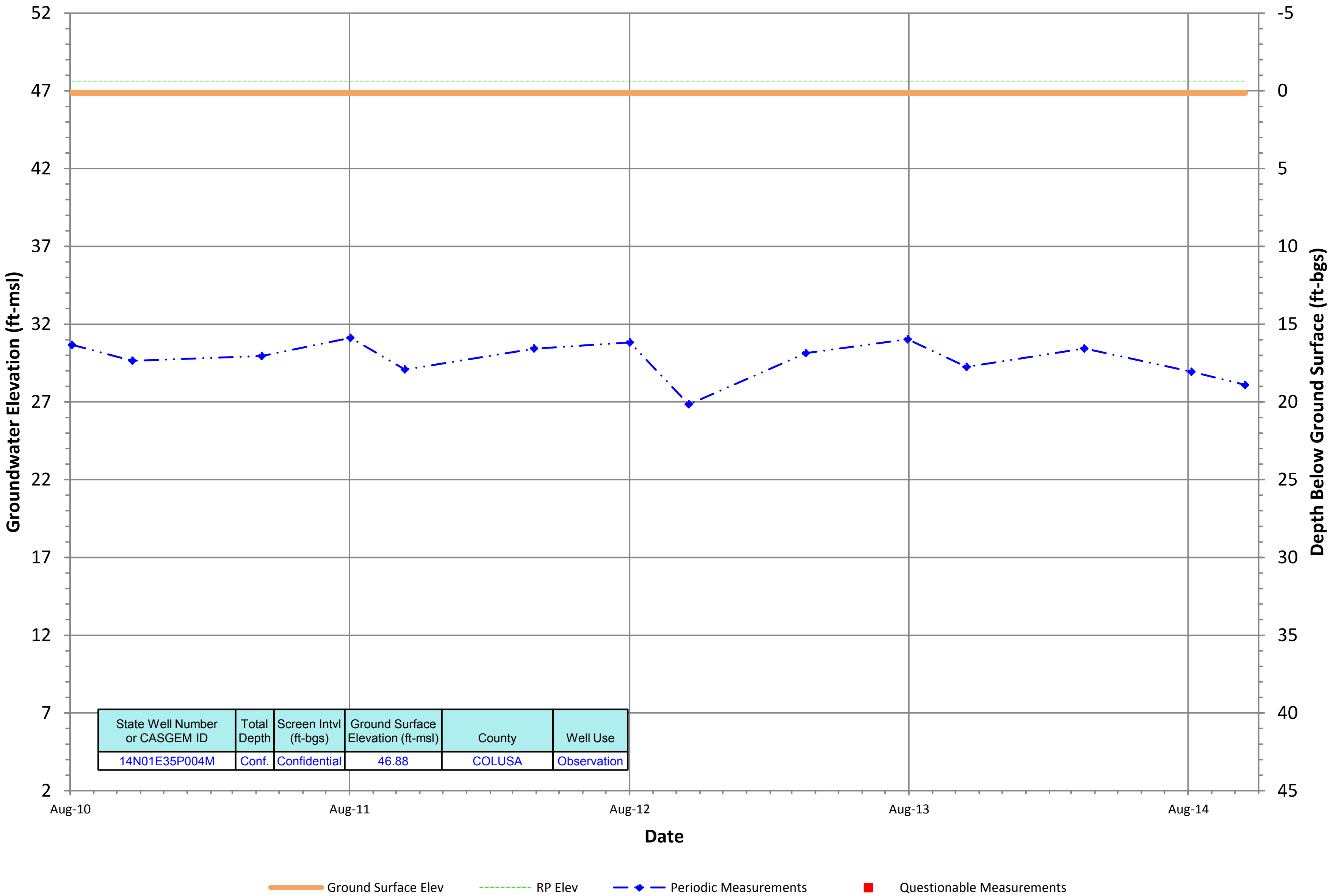
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01E21L001M	Conf.	Confidential	39.39	COLUSA	Residential

14N01E35P004M
Period Of Record: 08/03/2010 to 10/14/2014

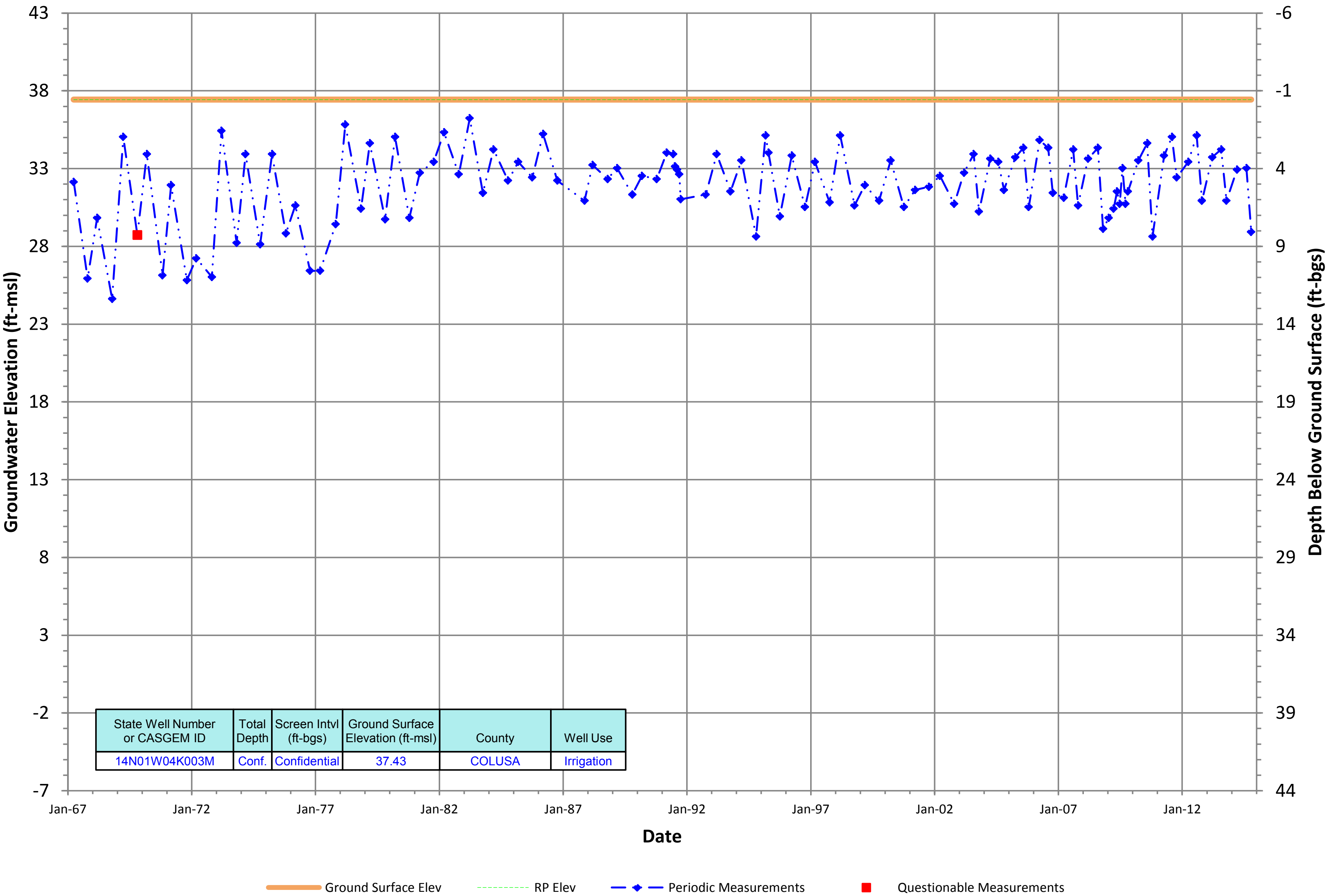
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



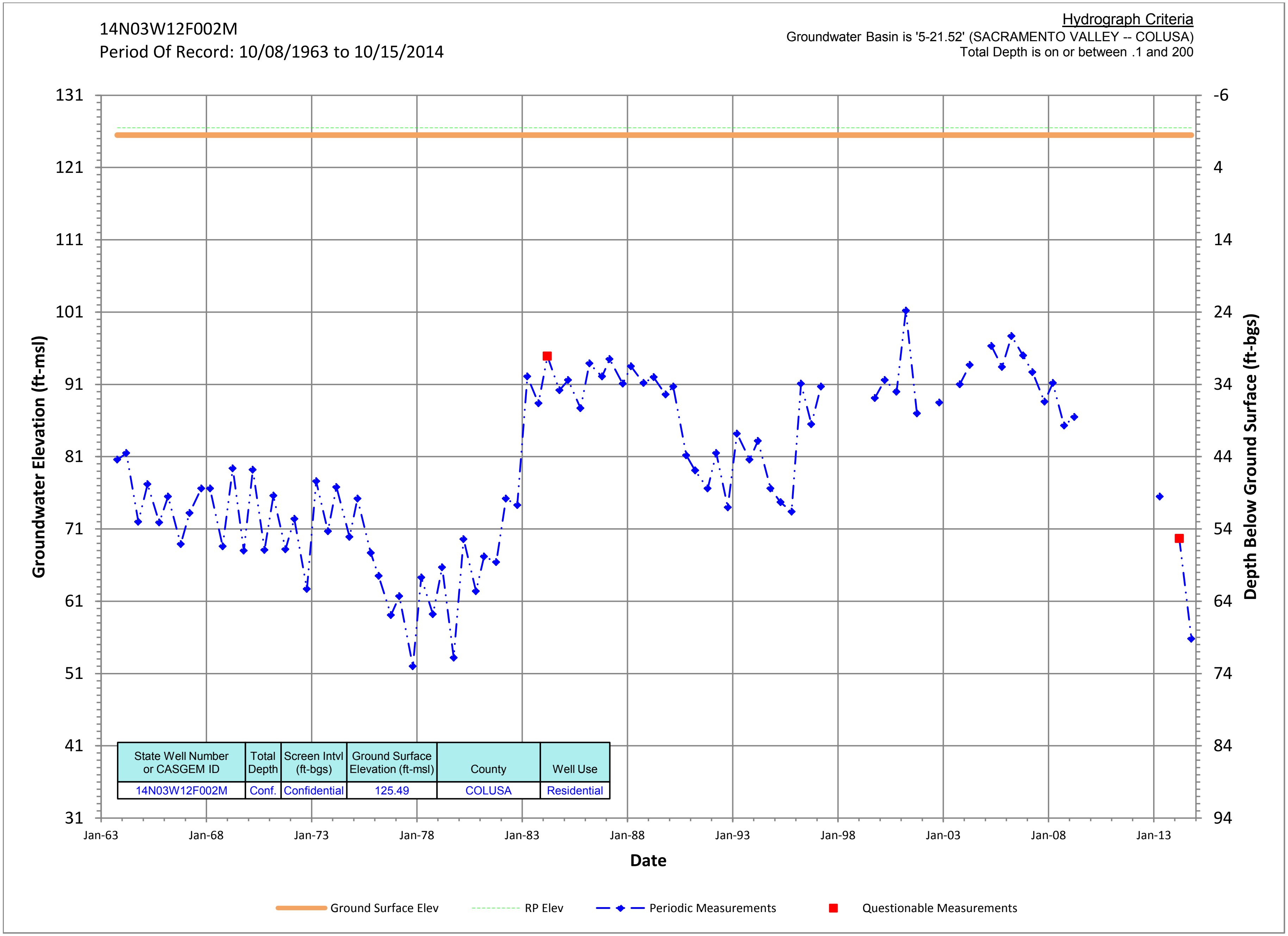
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01E35P004M	Conf.	Confidential	46.88	COLUSA	Observation

14N01W04K003M
Period Of Record: 03/28/1967 to 10/14/2014

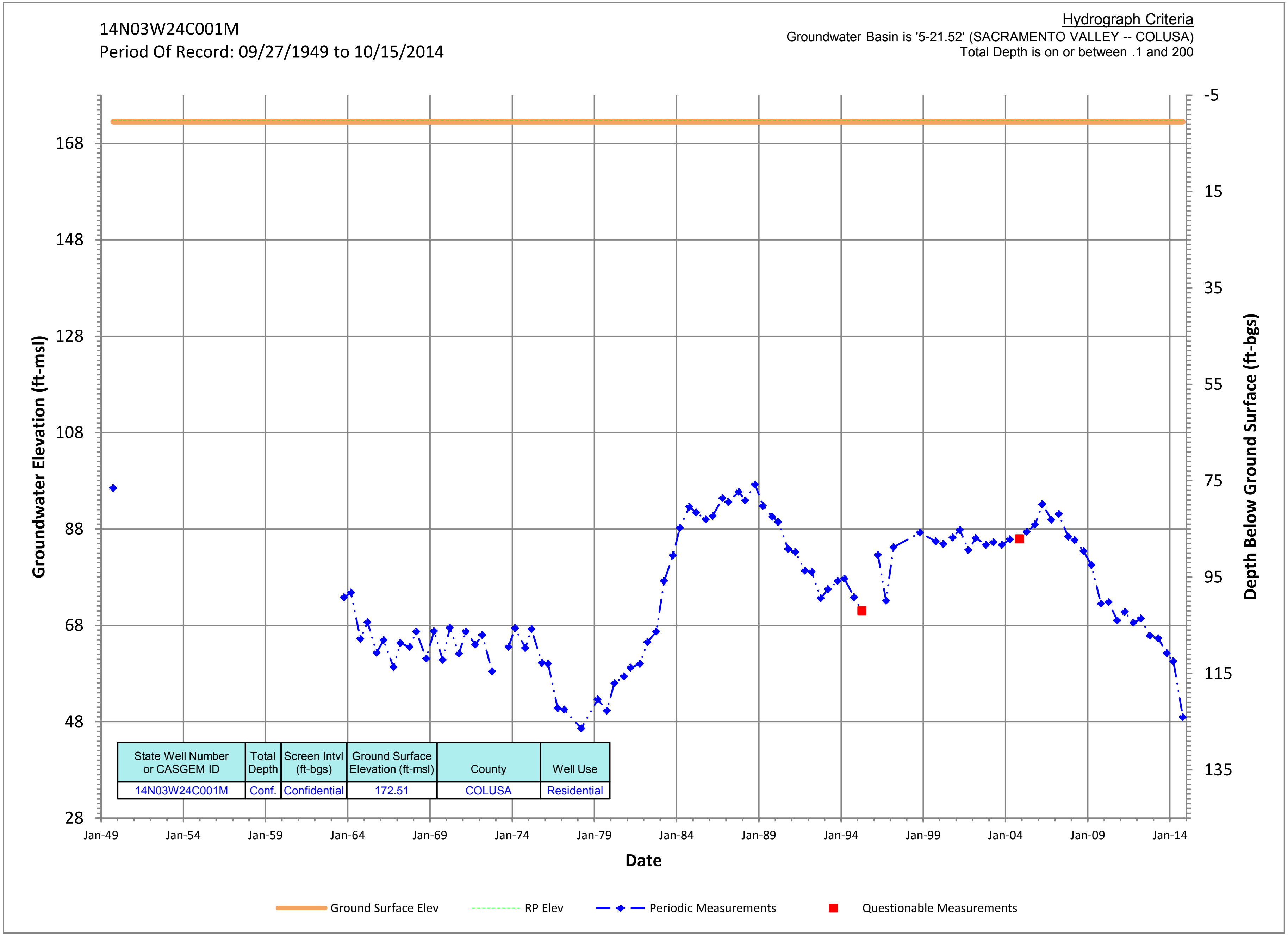
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



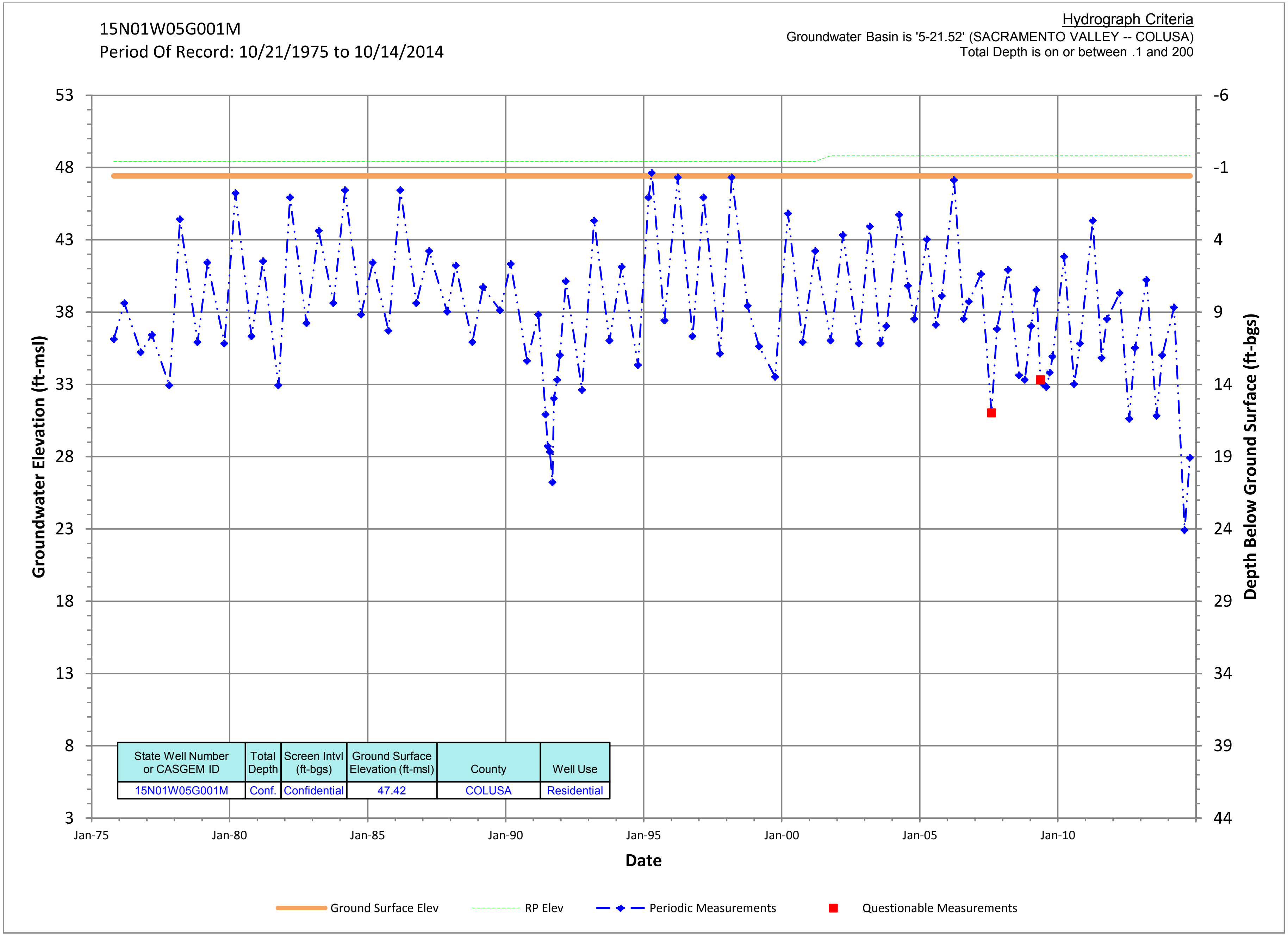
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01W04K003M	Conf.	Confidential	37.43	COLUSA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03W12F002M	Conf.	Confidential	125.49	COLUSA	Residential



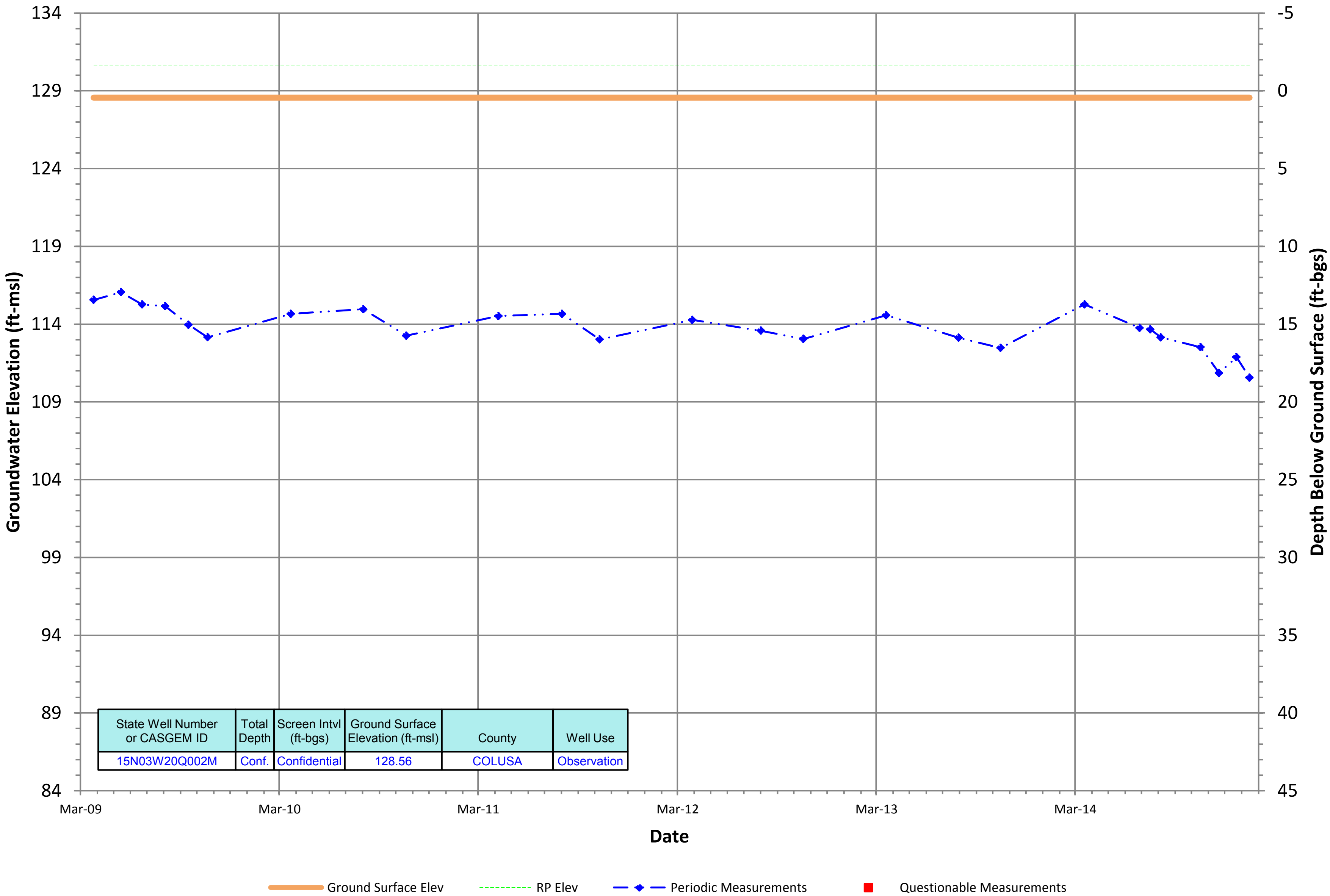
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03W24C001M	Conf.	Confidential	172.51	COLUSA	Residential



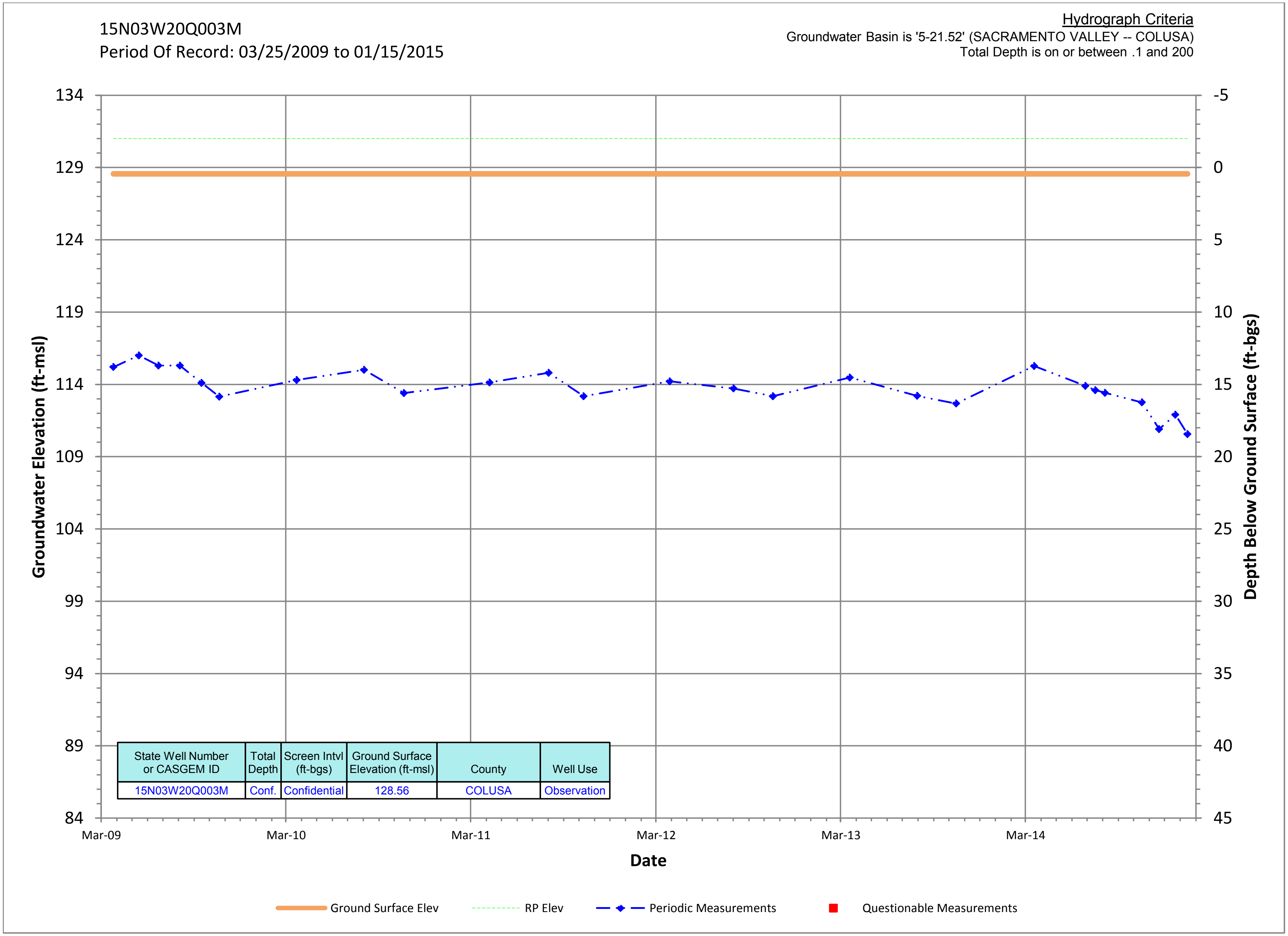
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N01W05G001M	Conf.	Confidential	47.42	COLUSA	Residential

15N03W20Q002M
Period Of Record: 03/25/2009 to 01/15/2015

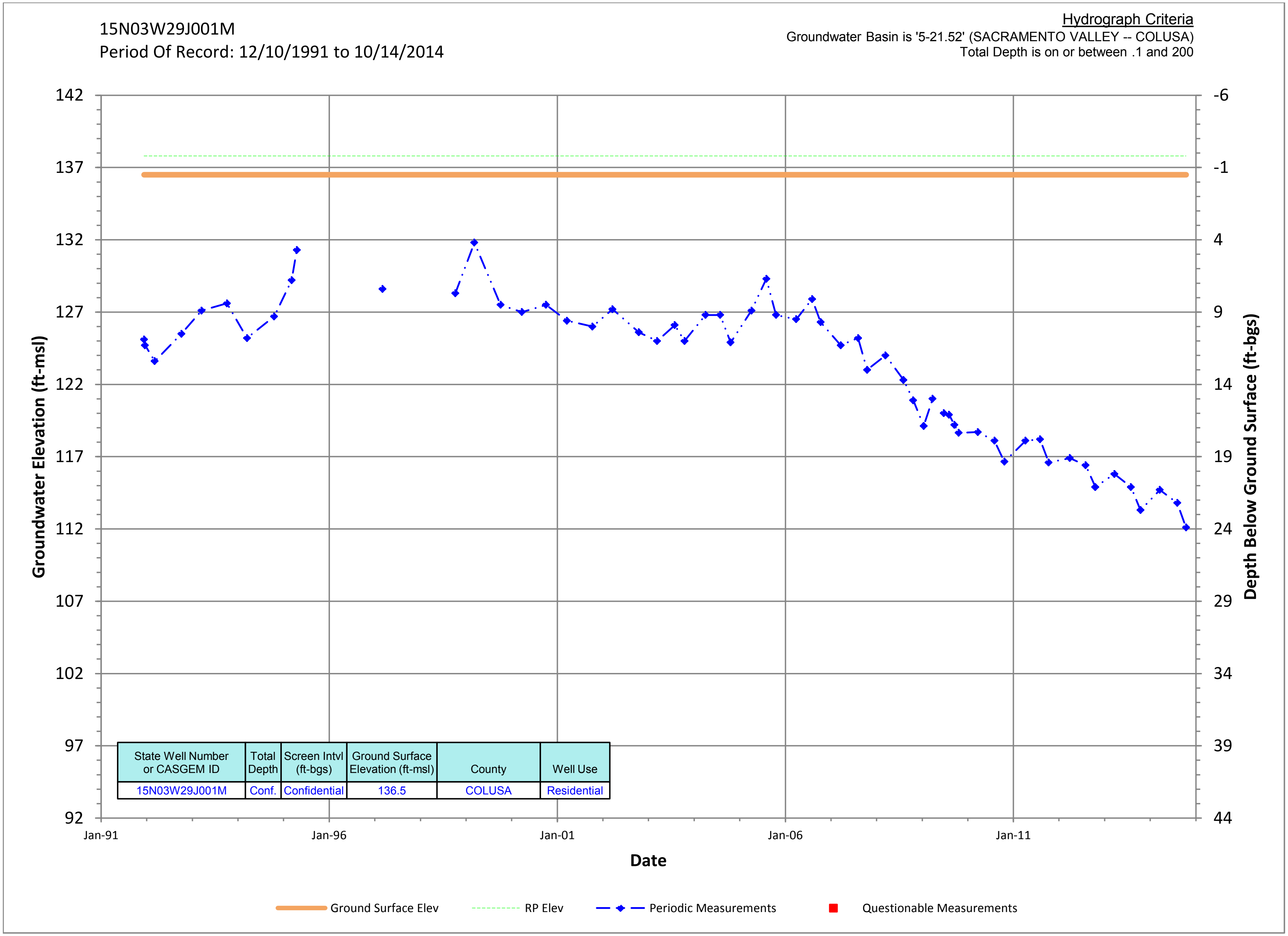
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03W20Q002M	Conf.	Confidential	128.56	COLUSA	Observation



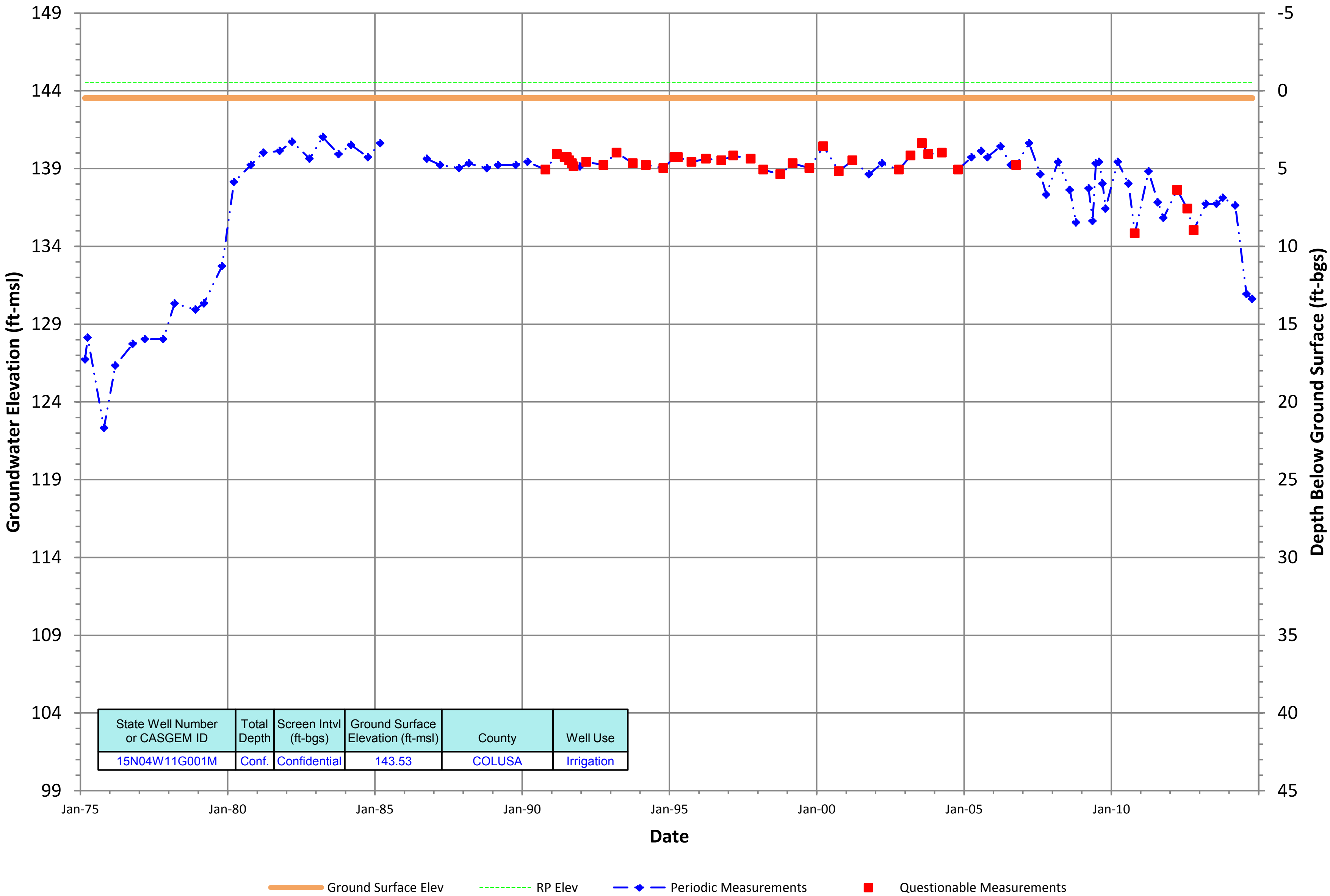
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03W20Q003M	Conf.	Confidential	128.56	COLUSA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03W29J001M	Conf.	Confidential	136.5	COLUSA	Residential

15N04W11G001M
Period Of Record: 02/27/1975 to 10/14/2014

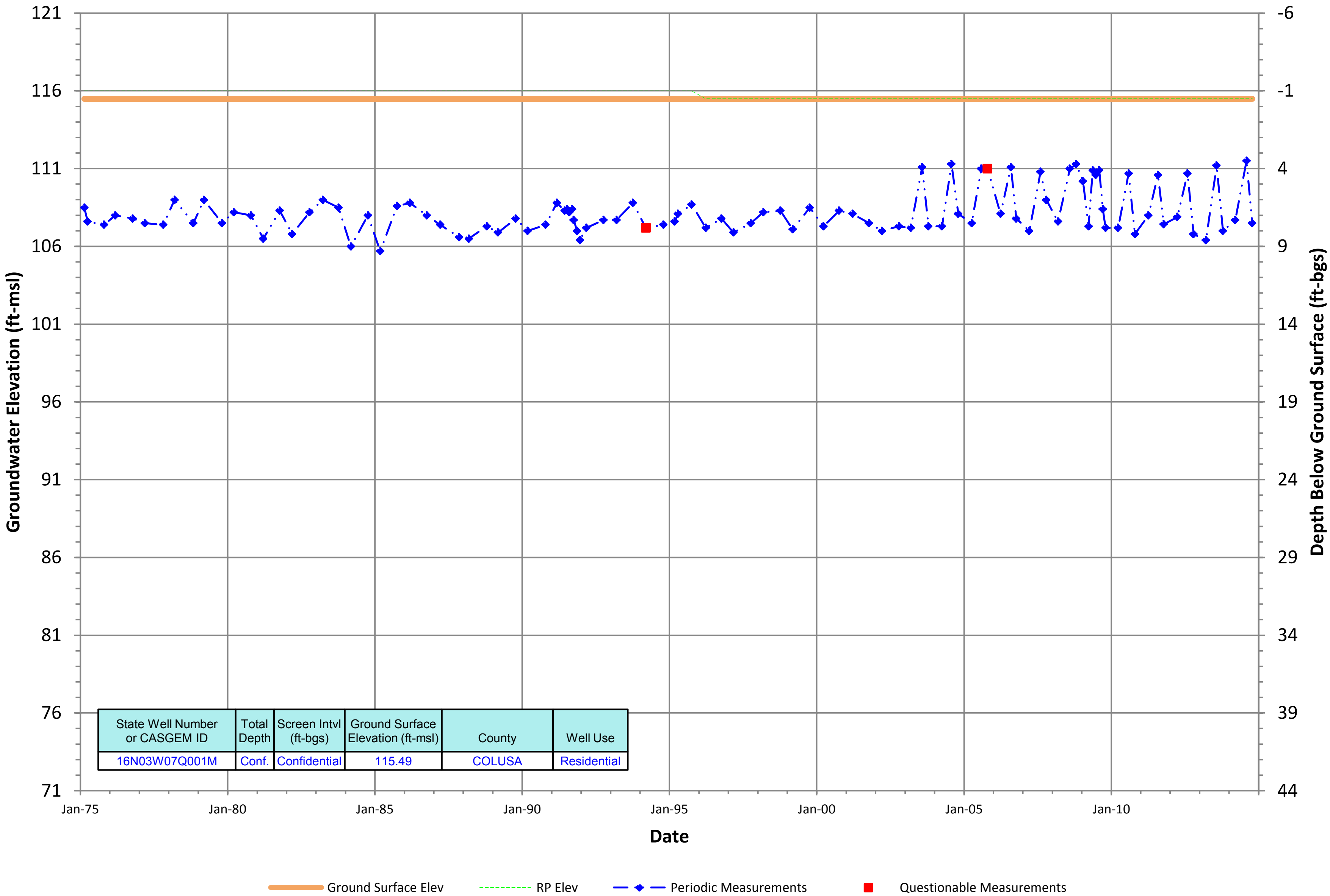
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N04W11G001M	Conf.	Confidential	143.53	COLUSA	Irrigation

16N03W07Q001M
Period Of Record: 02/19/1975 to 10/14/2014

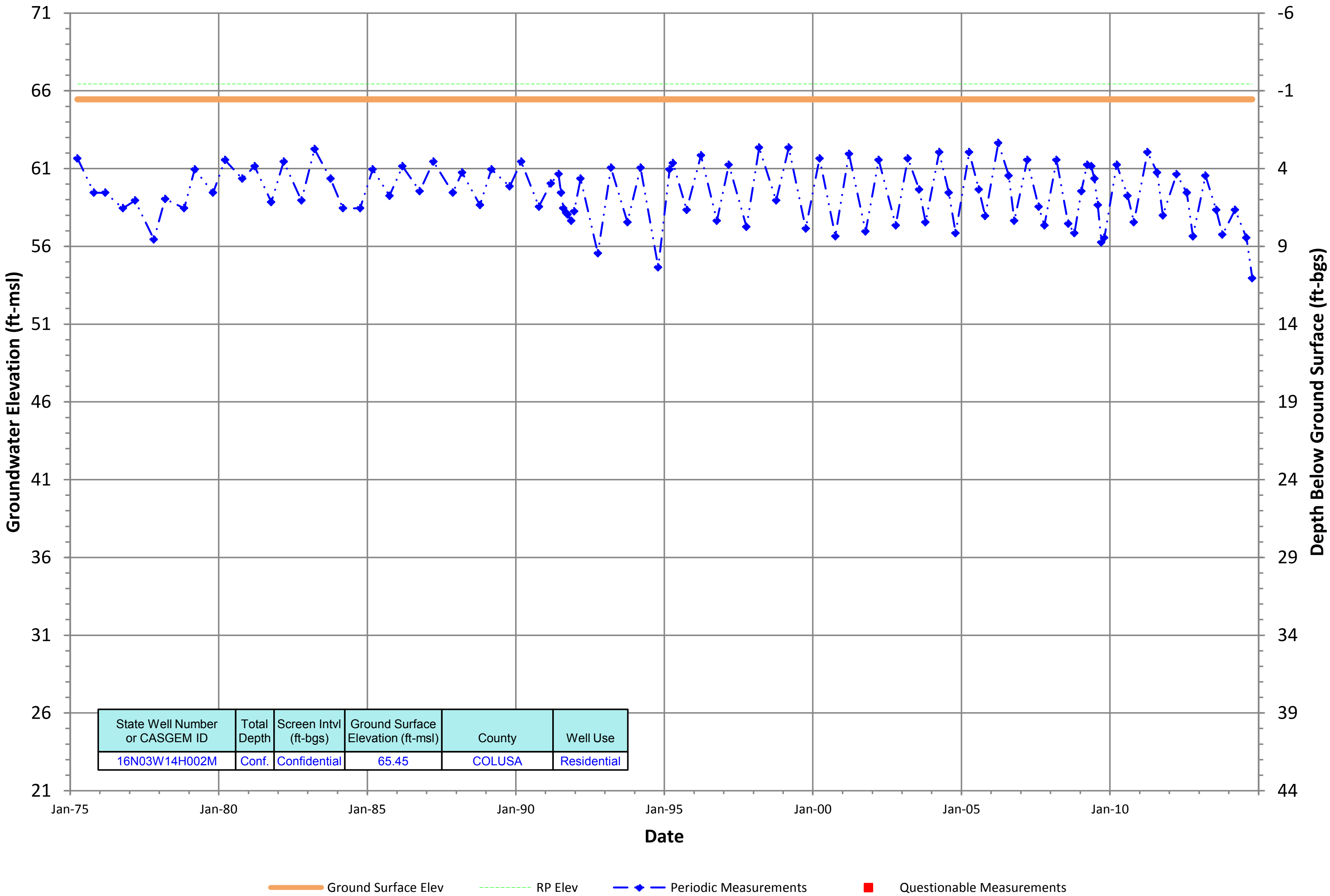
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03W07Q001M	Conf.	Confidential	115.49	COLUSA	Residential

16N03W14H002M
Period Of Record: 03/31/1975 to 10/16/2014

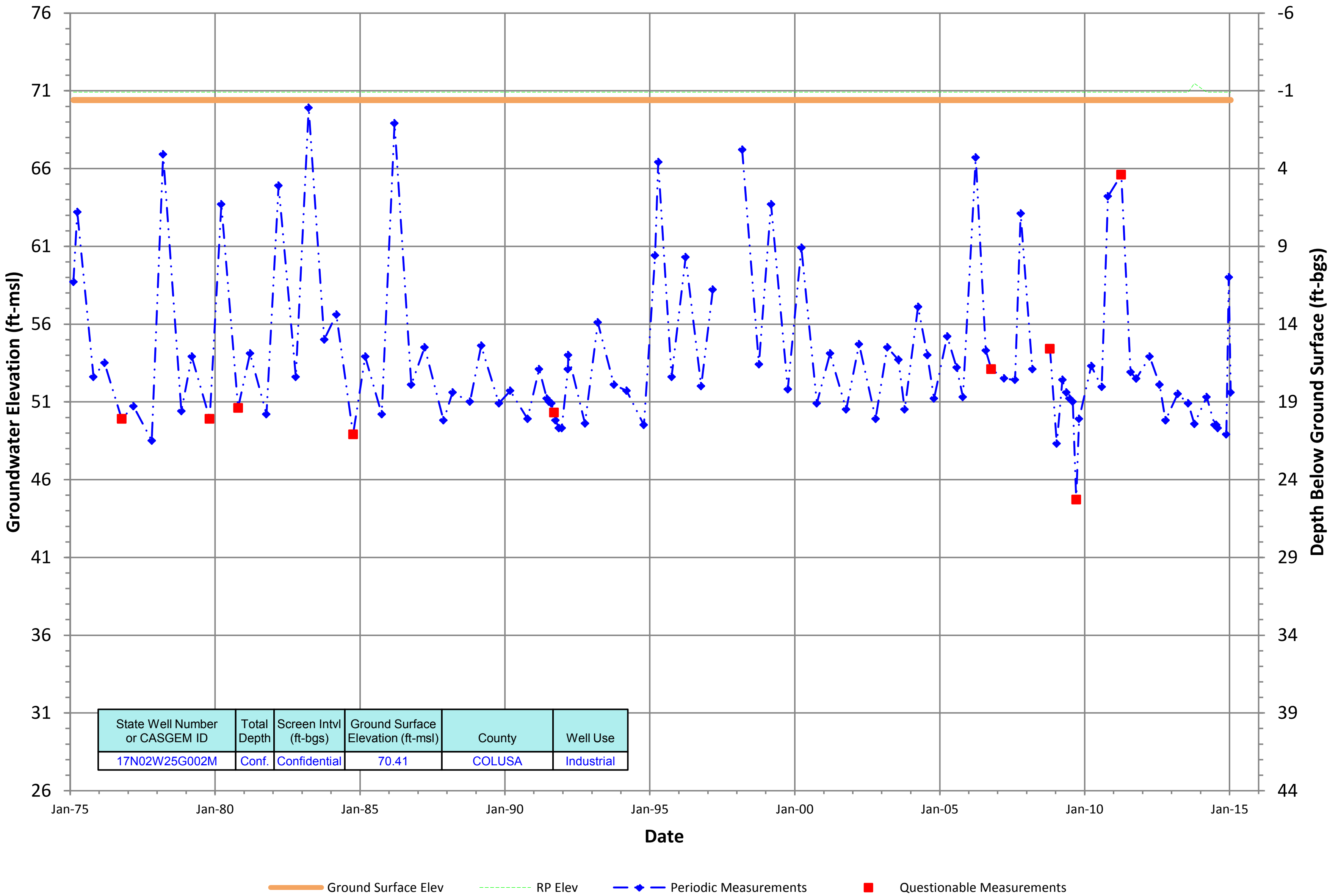
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



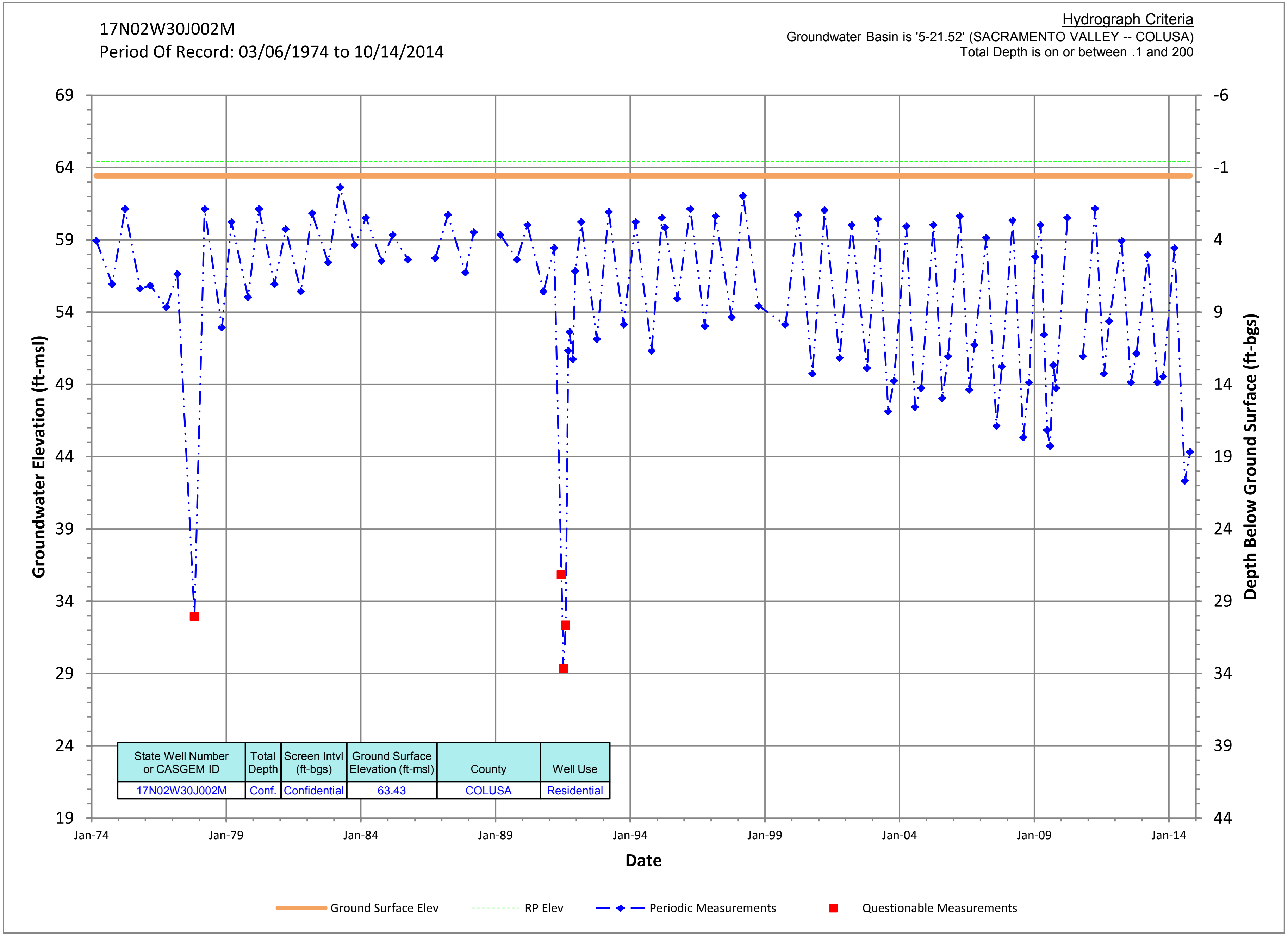
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03W14H002M	Conf.	Confidential	65.45	COLUSA	Residential

17N02W25G002M
Period Of Record: 02/11/1975 to 01/15/2015

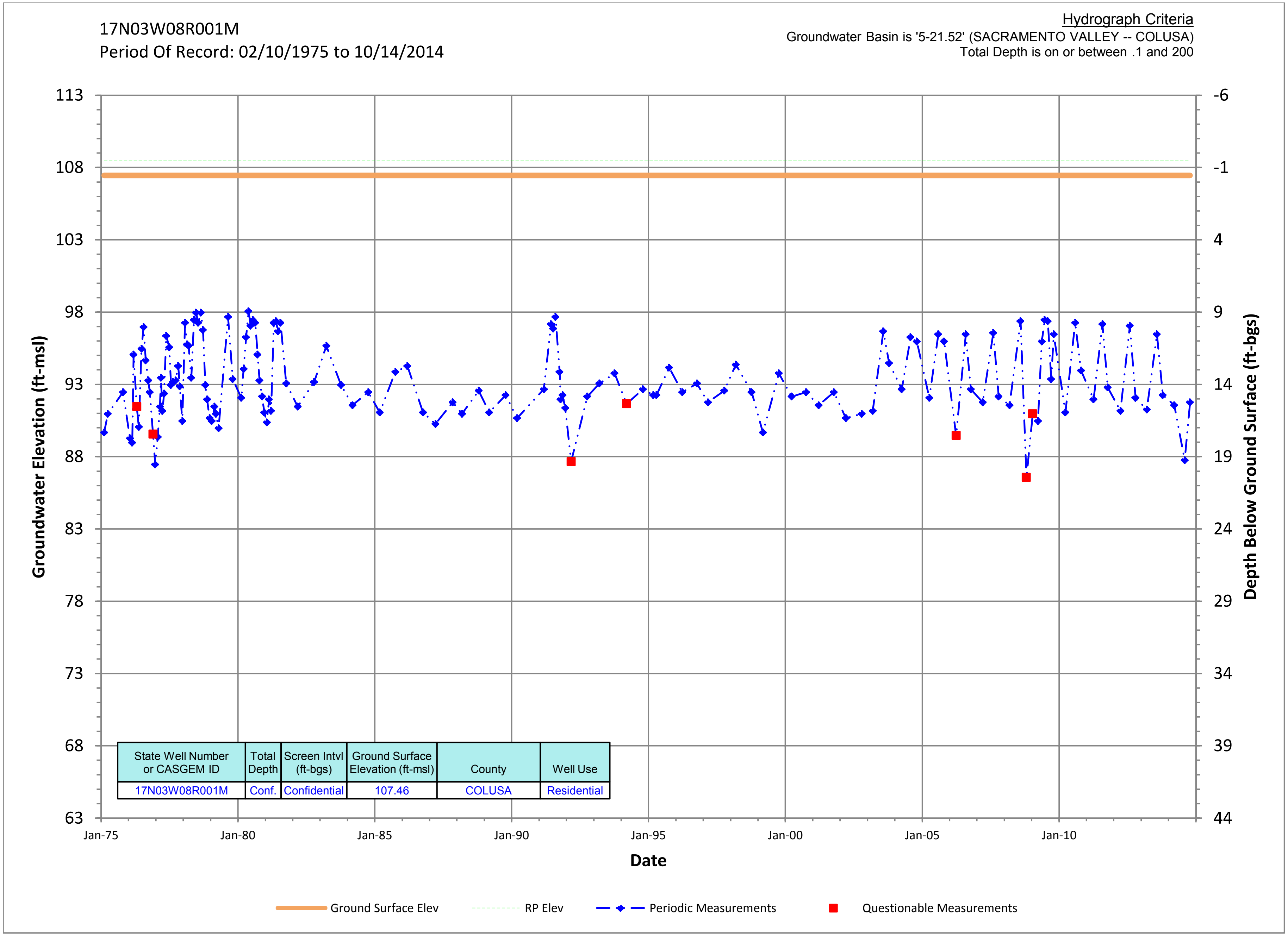
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02W25G002M	Conf.	Confidential	70.41	COLUSA	Industrial

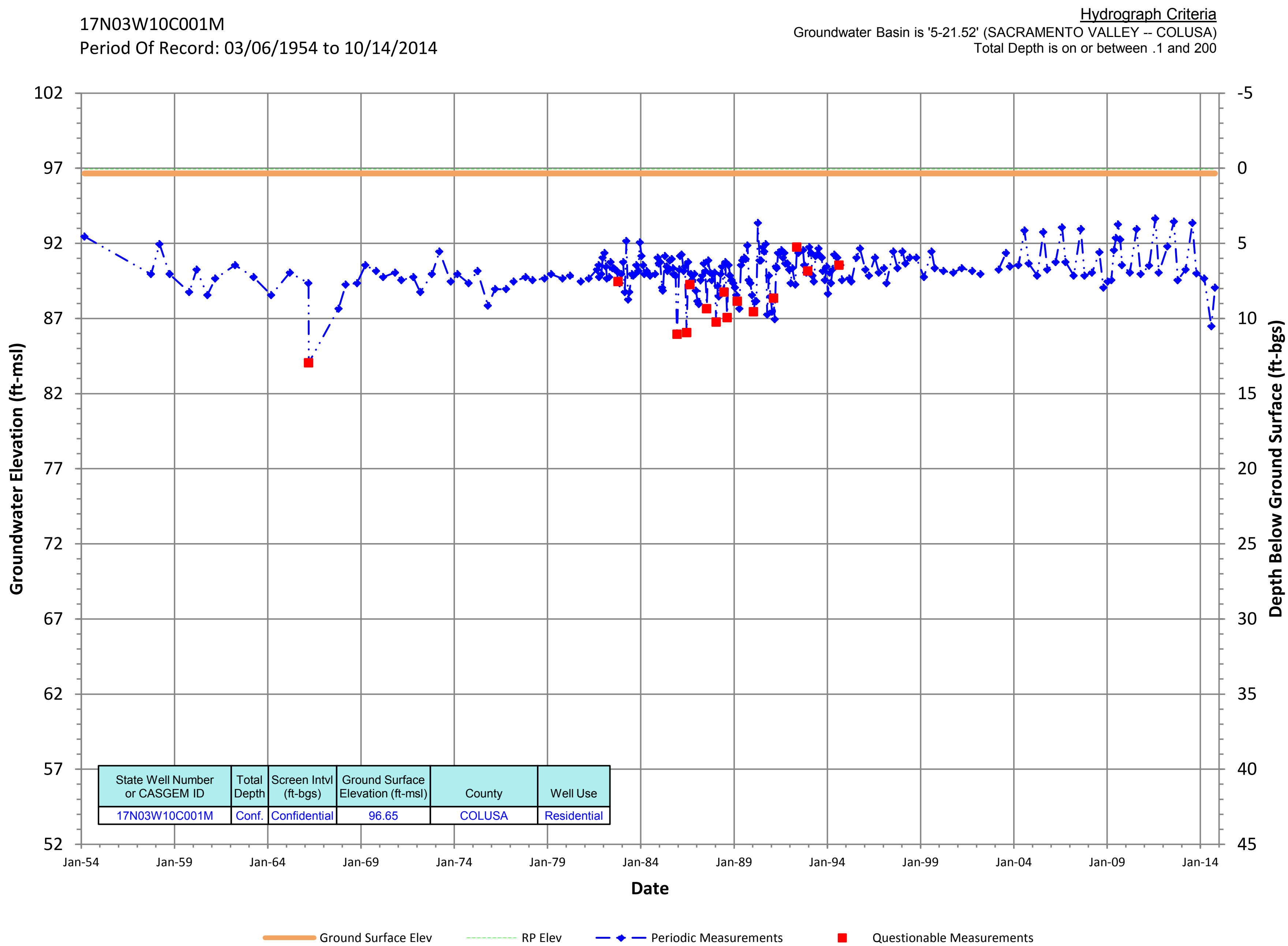


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02W30J002M	Conf.	Confidential	63.43	COLUSA	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N03W08R001M	Conf.	Confidential	107.46	COLUSA	Residential

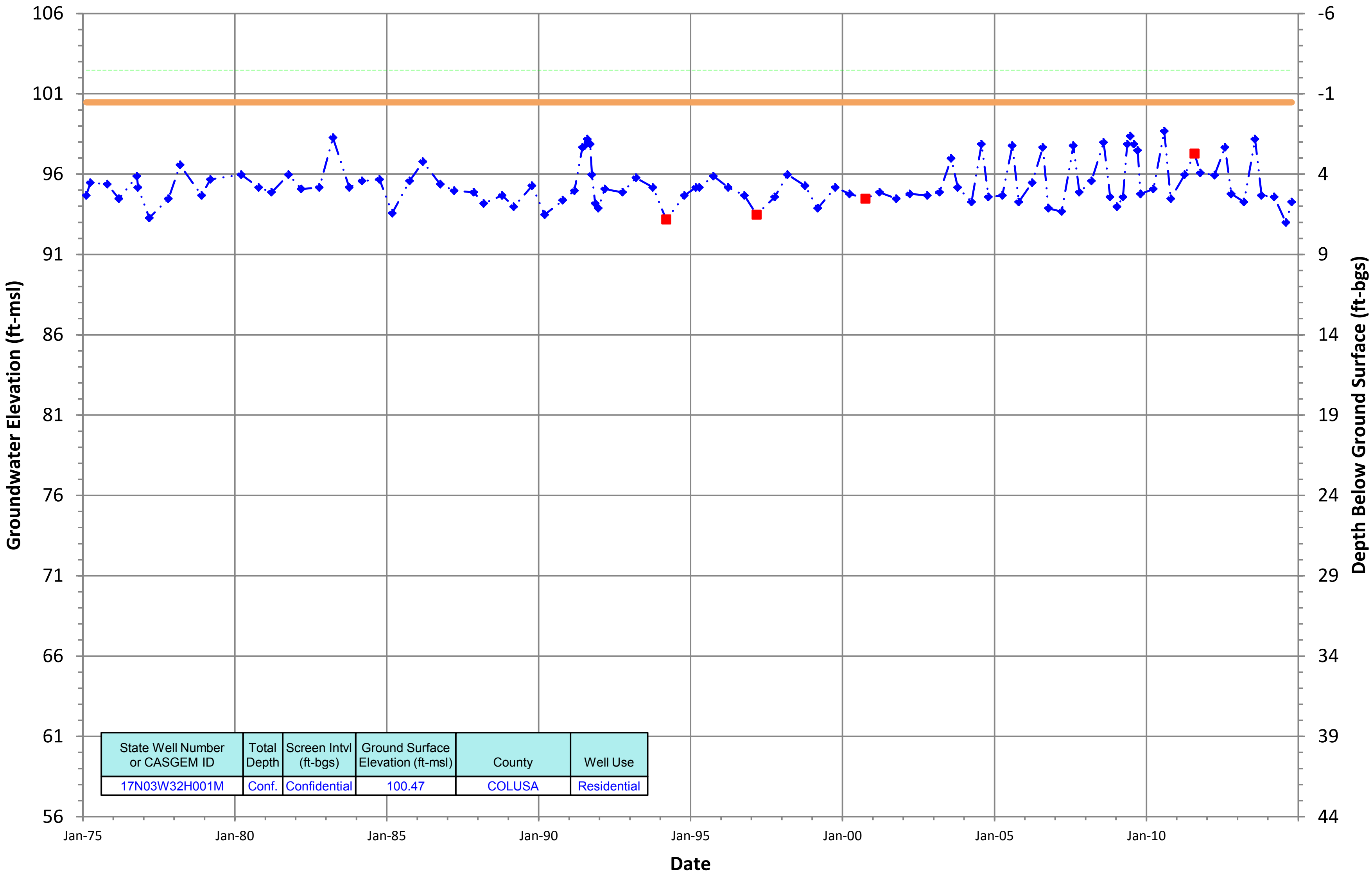
17N03W10C001M
Period Of Record: 03/06/1954 to 10/14/2014



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N03W10C001M	Conf.	Confidential	96.65	COLUSA	Residential

17N03W32H001M
Period Of Record: 02/10/1975 to 10/14/2014

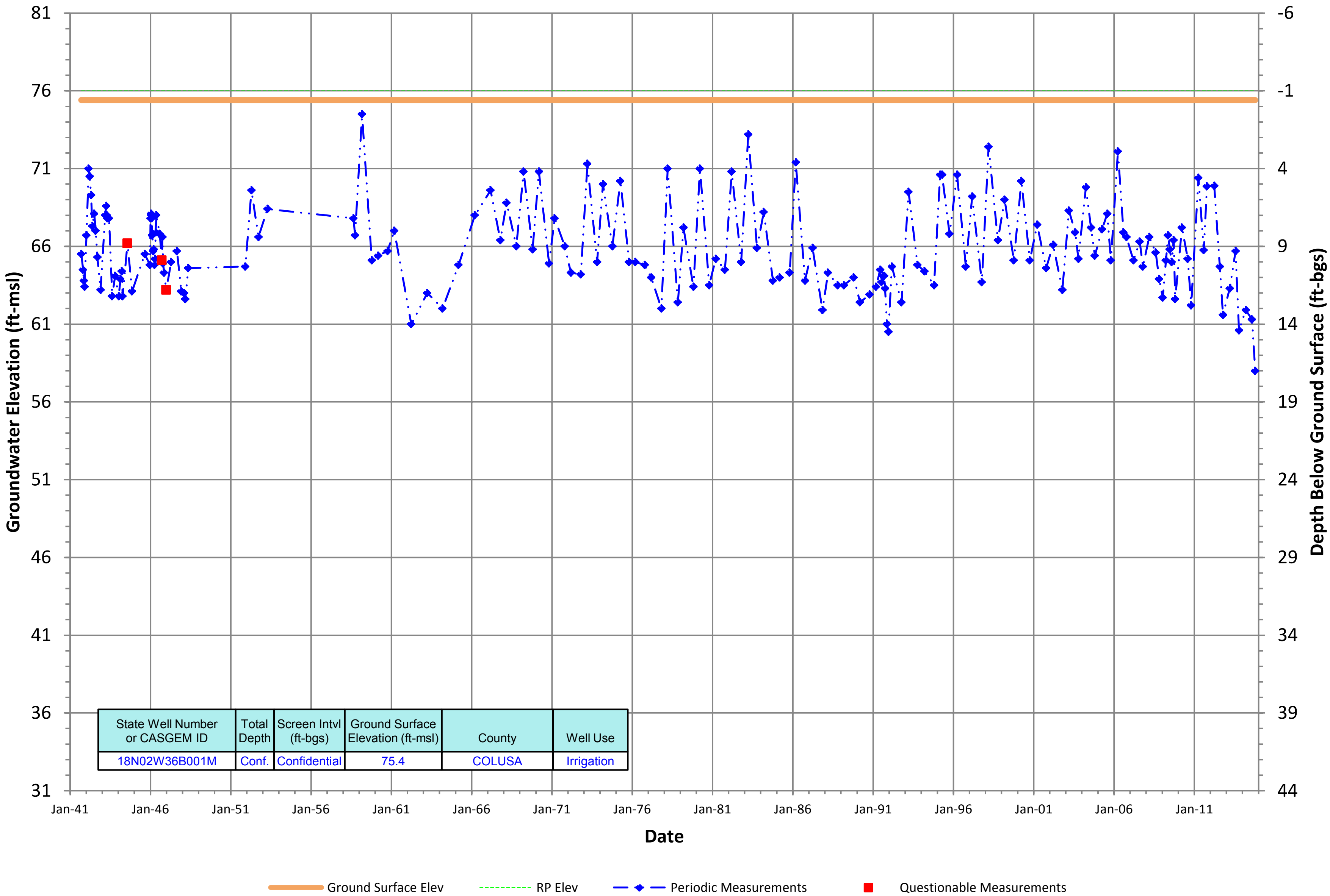
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



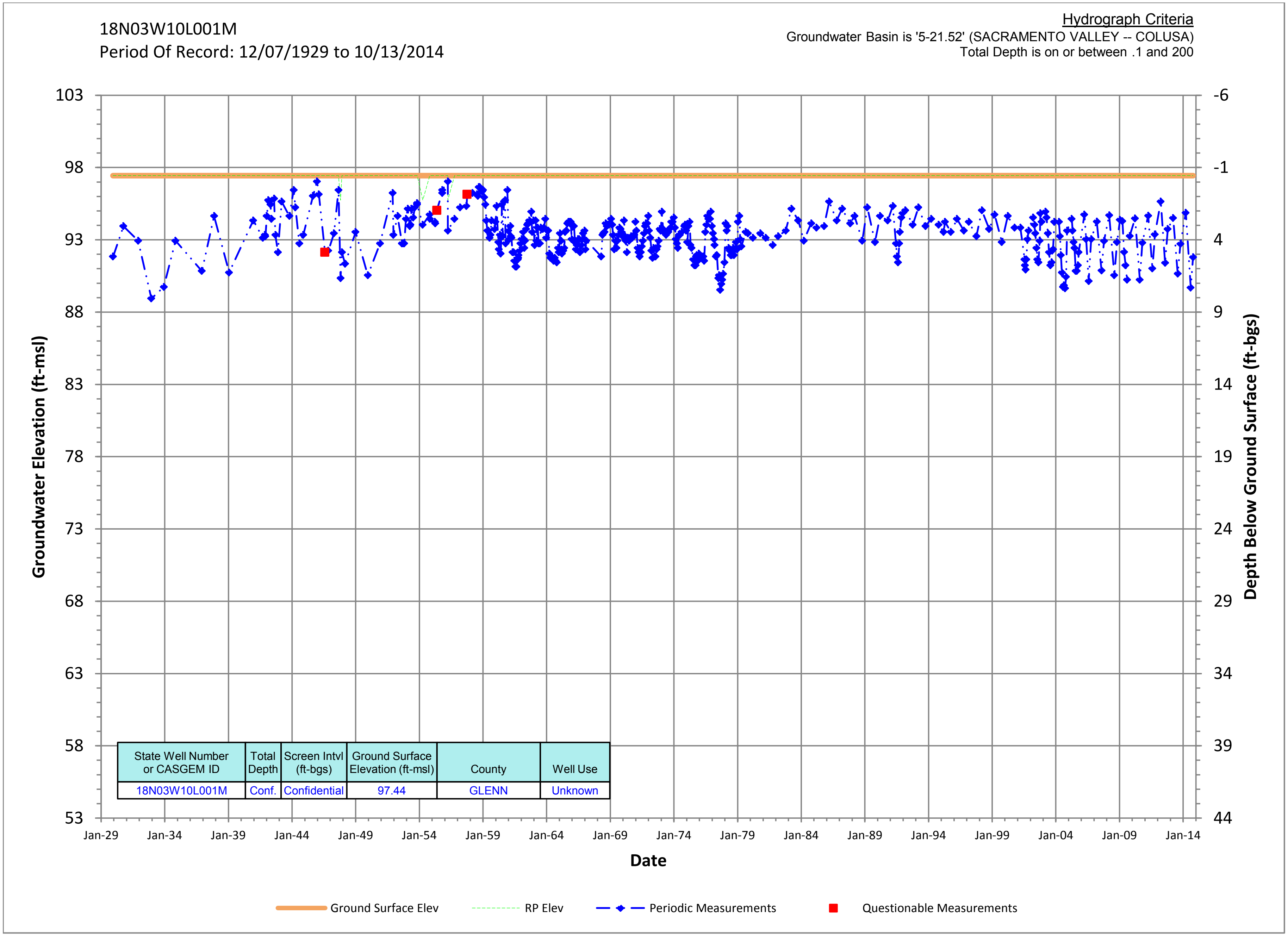
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N03W32H001M	Conf.	Confidential	100.47	COLUSA	Residential

18N02W36B001M
Period Of Record: 09/11/1941 to 10/16/2014

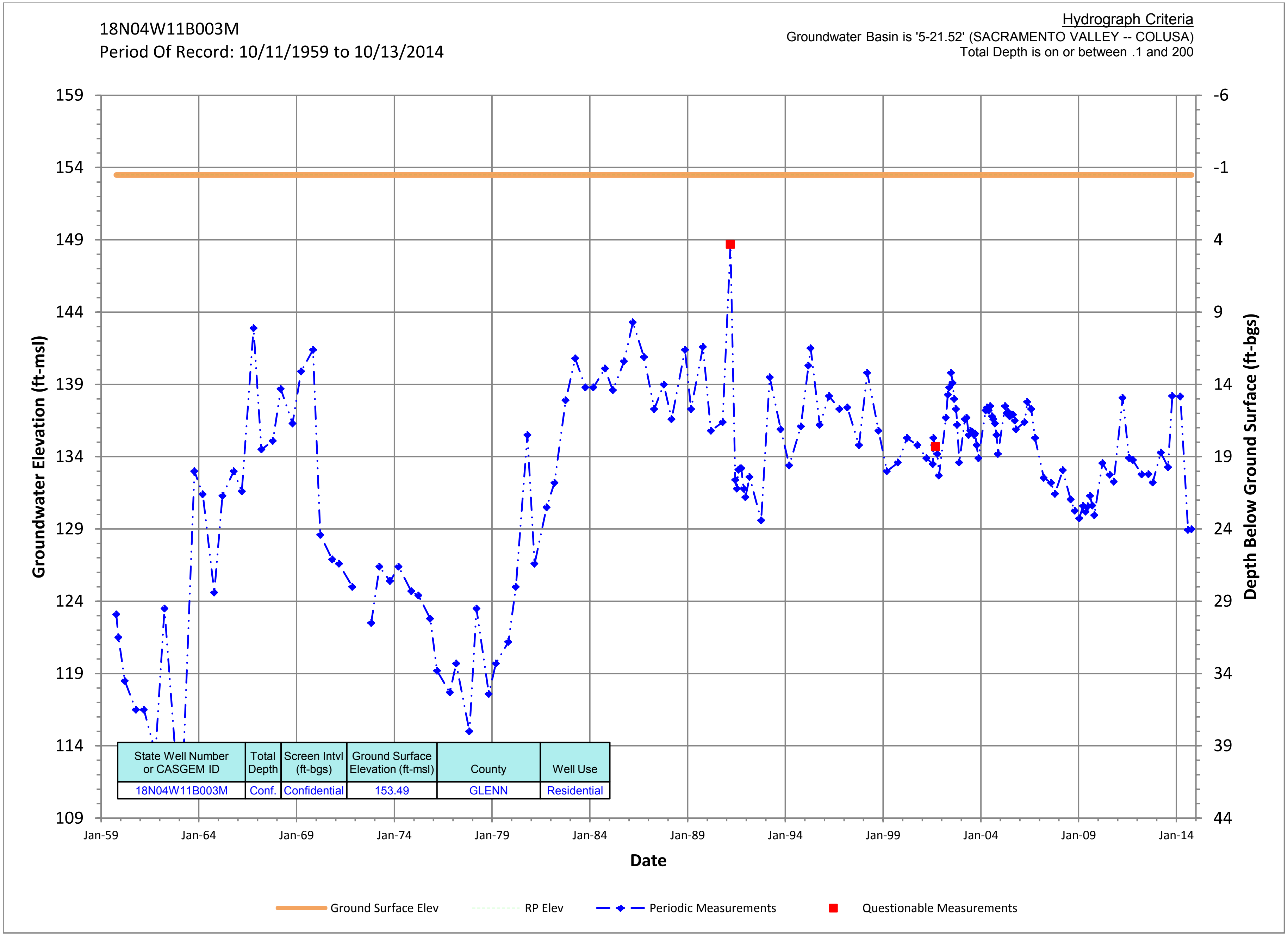
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



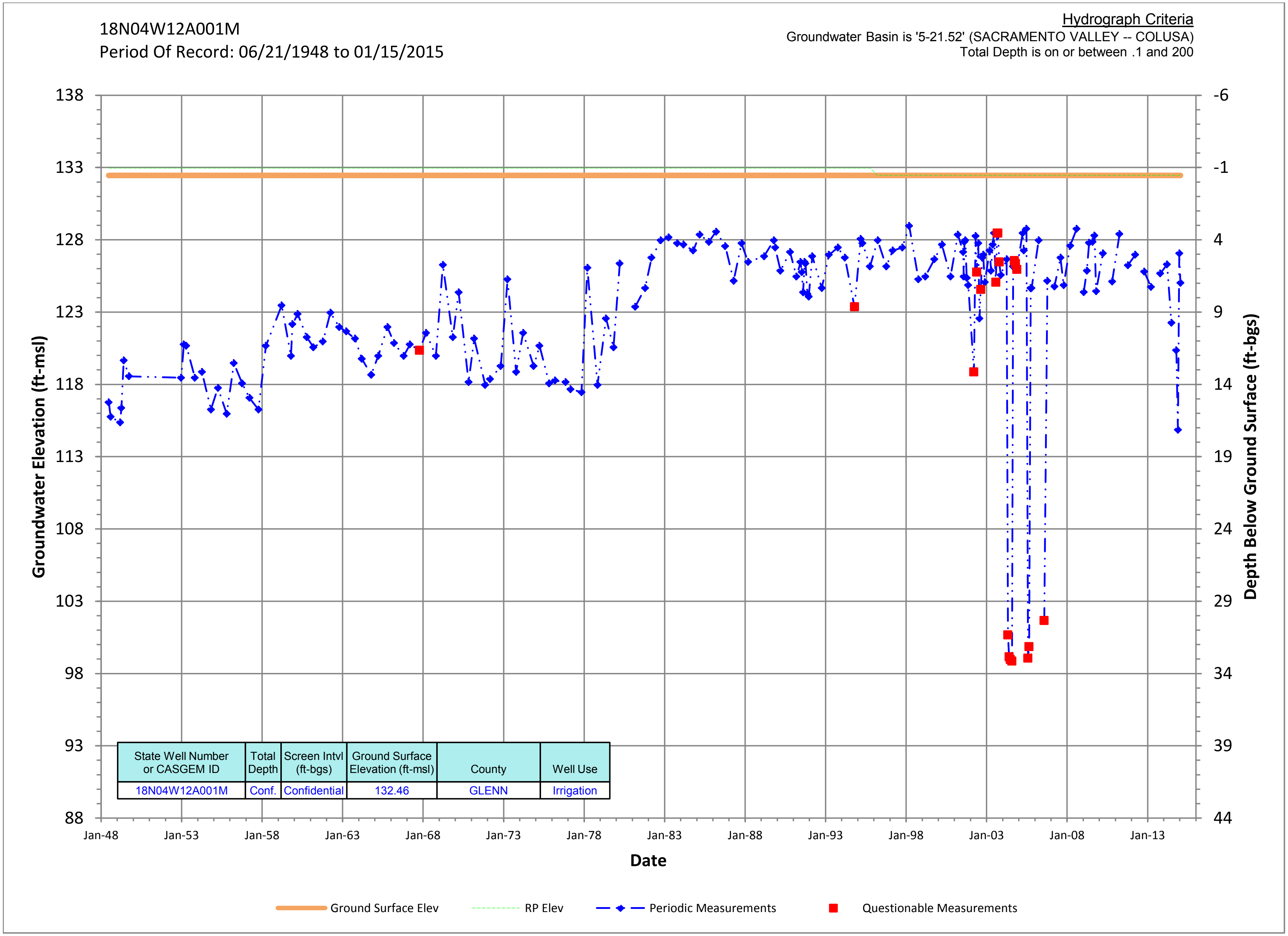
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02W36B001M	Conf.	Confidential	75.4	COLUSA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N03W10L001M	Conf.	Confidential	97.44	GLENN	Unknown

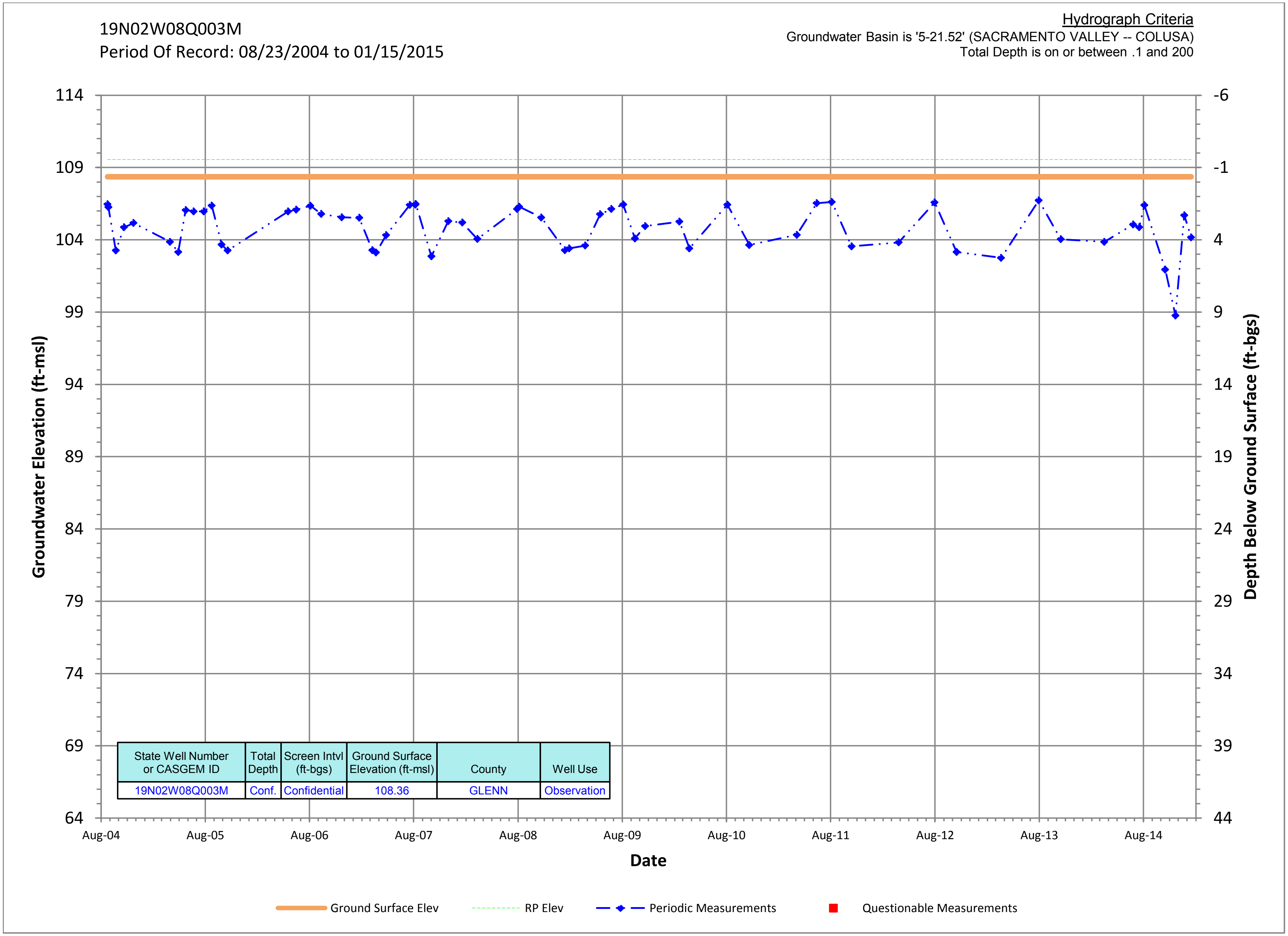


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N04W11B003M	Conf.	Confidential	153.49	GLENN	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N04W12A001M	Conf.	Confidential	132.46	GLENN	Irrigation

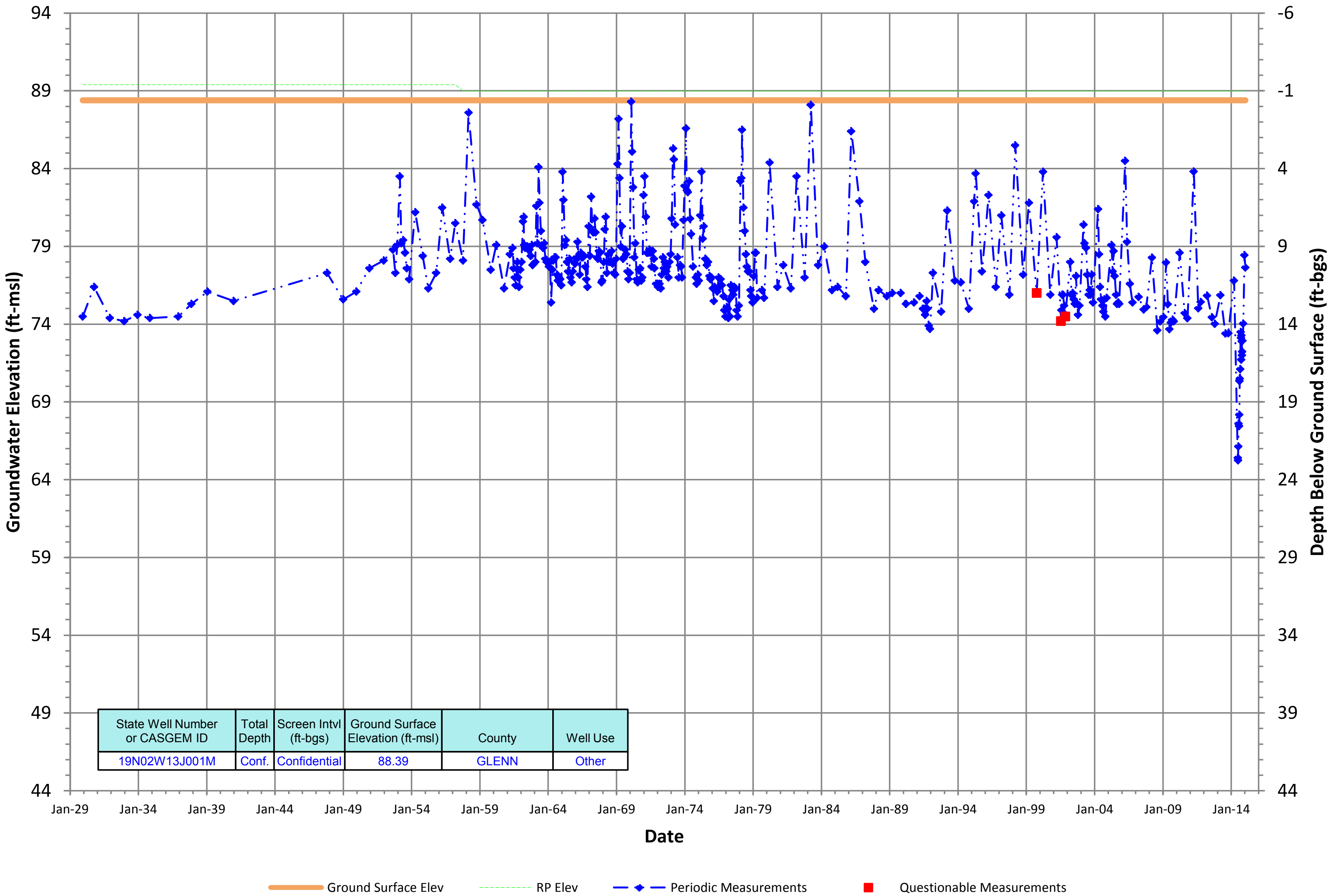
19N02W08Q003M
Period Of Record: 08/23/2004 to 01/15/2015



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W08Q003M	Conf.	Confidential	108.36	GLENN	Observation

19N02W13J001M
Period Of Record: 12/04/1929 to 01/14/2015

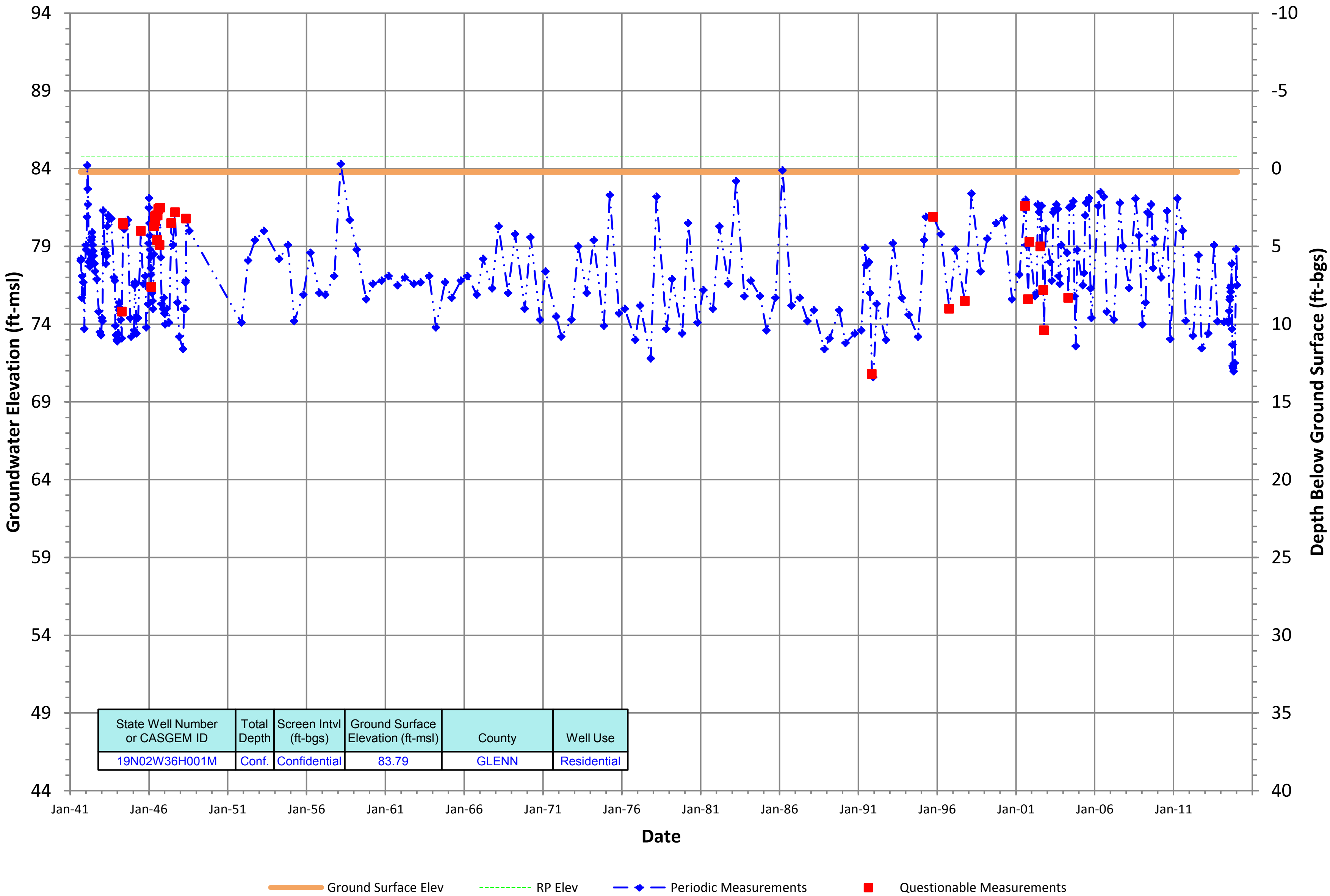
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



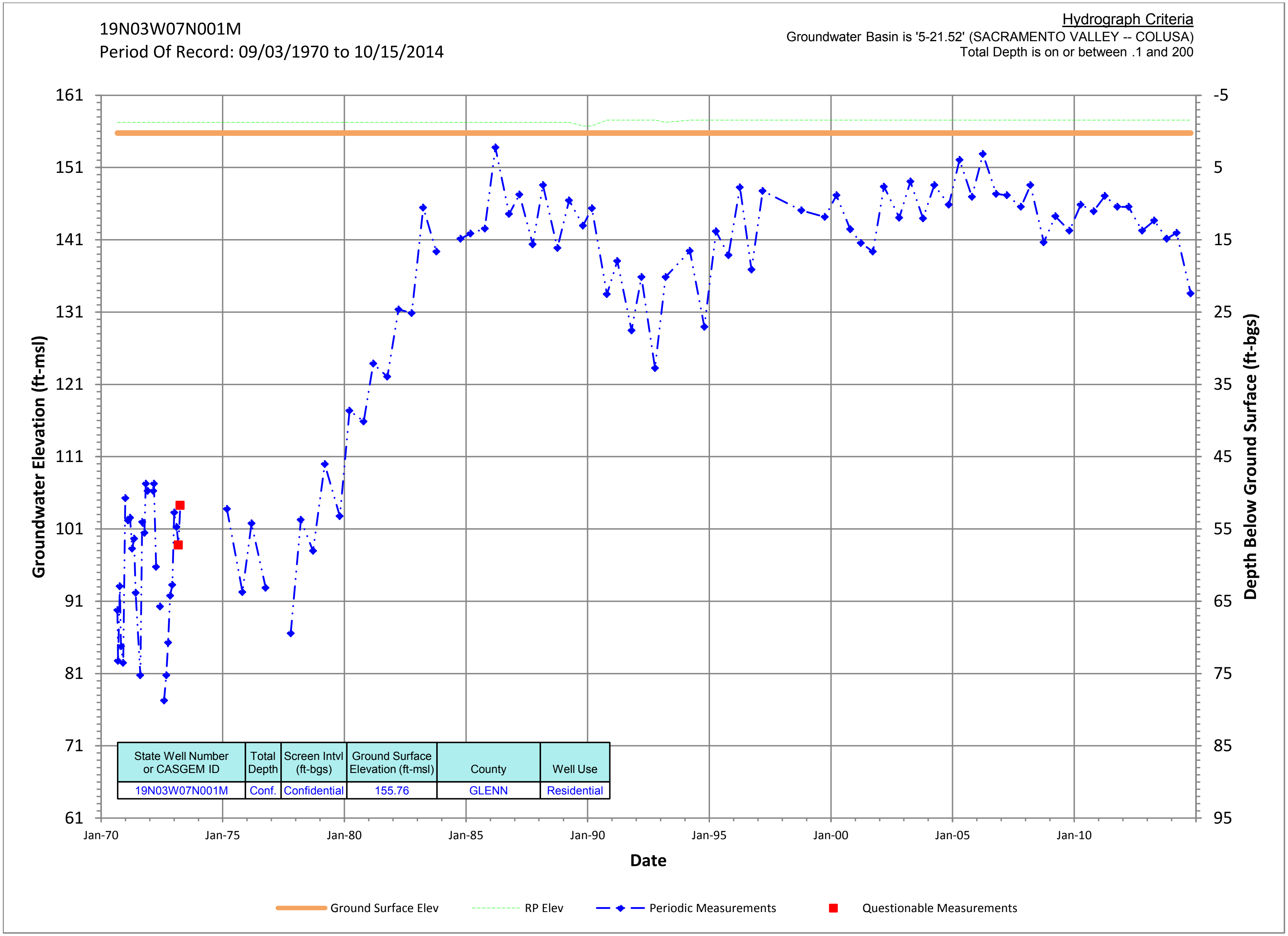
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W13J001M	Conf.	Confidential	88.39	GLENN	Other

19N02W36H001M
Period Of Record: 09/04/1941 to 01/14/2015

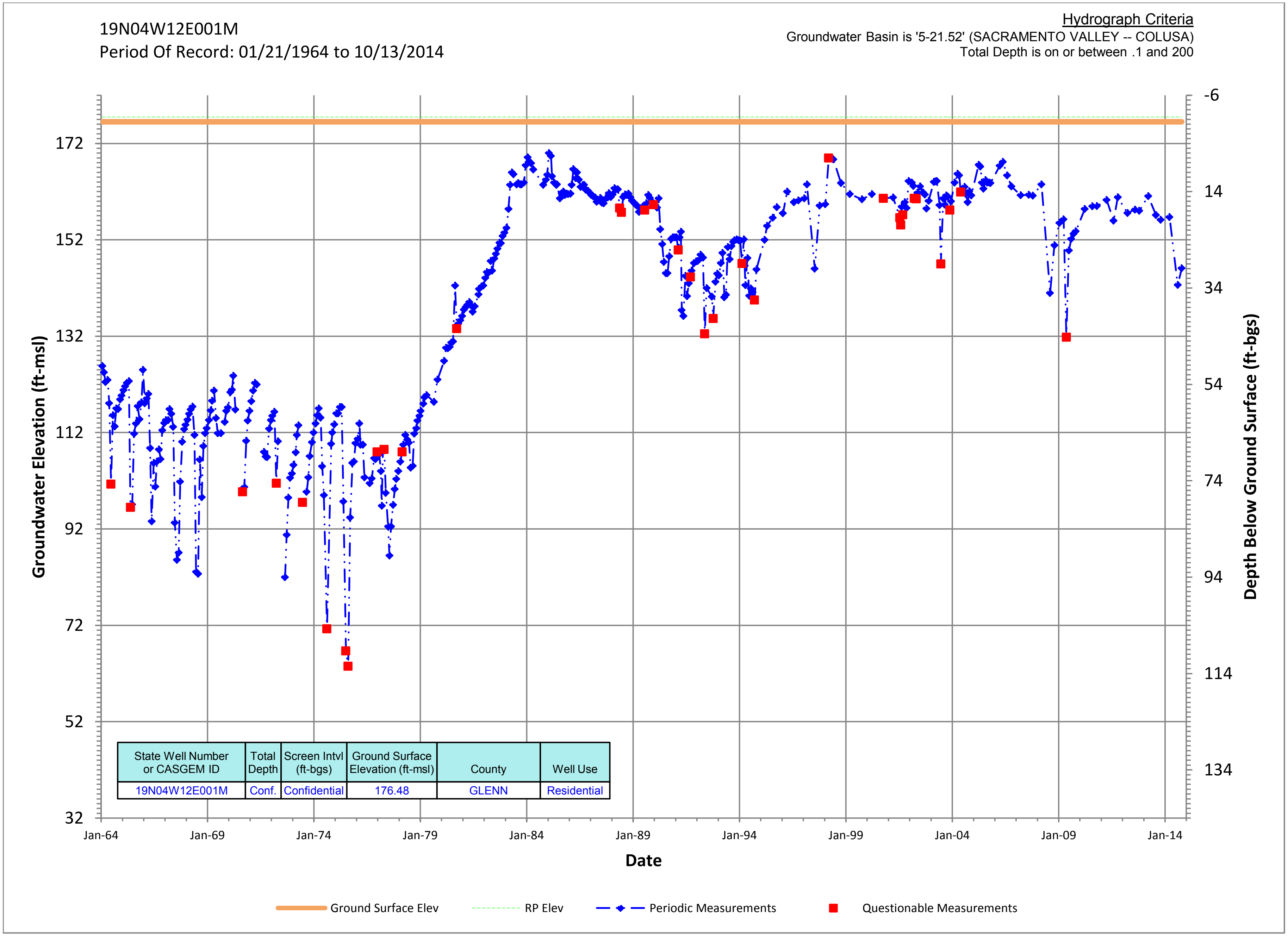
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W36H001M	Conf.	Confidential	83.79	GLENN	Residential



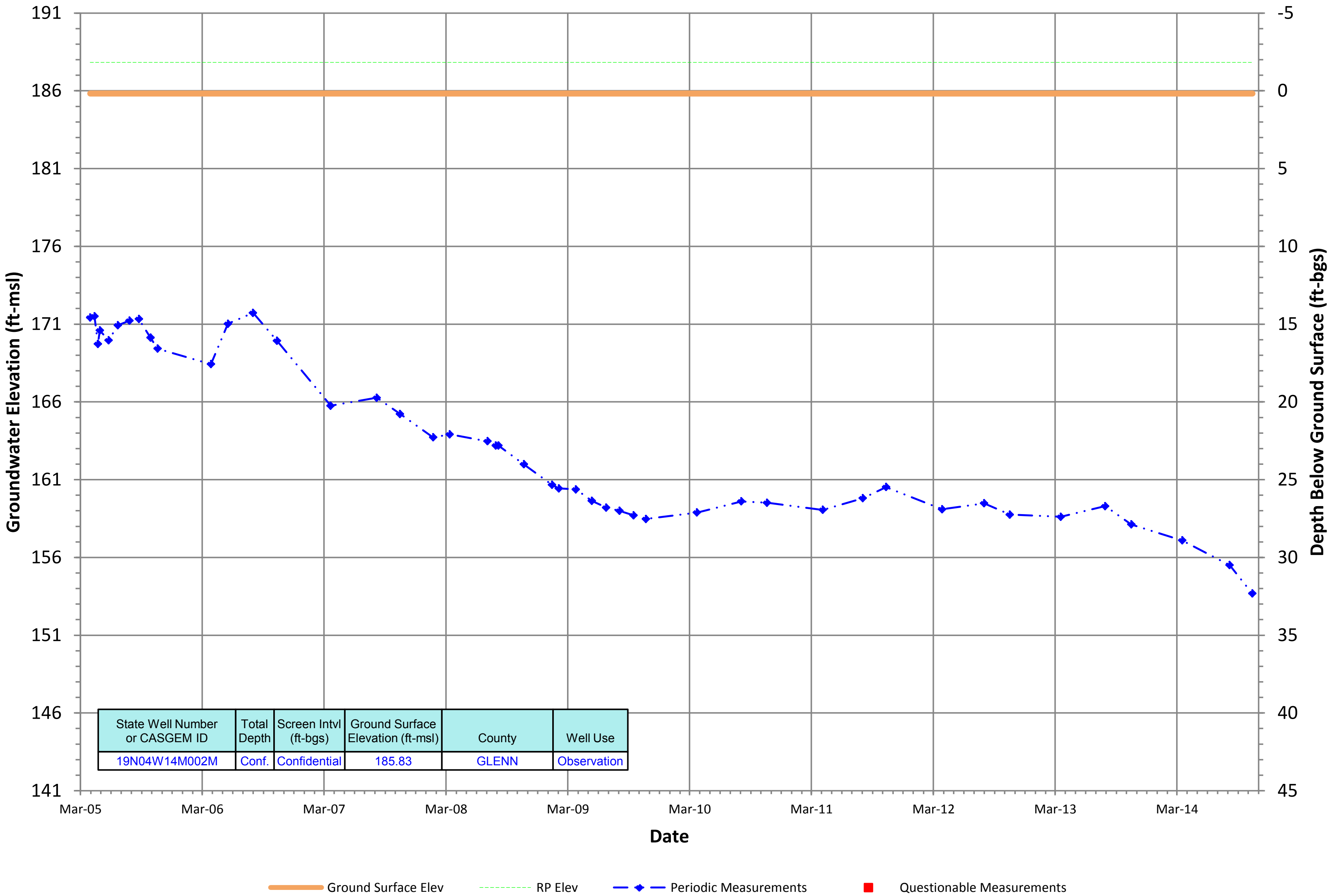
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N03W07N001M	Conf.	Confidential	155.76	GLENN	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N04W12E001M	Conf.	Confidential	176.48	GLENN	Residential

19N04W14M002M
Period Of Record: 03/30/2005 to 10/13/2014

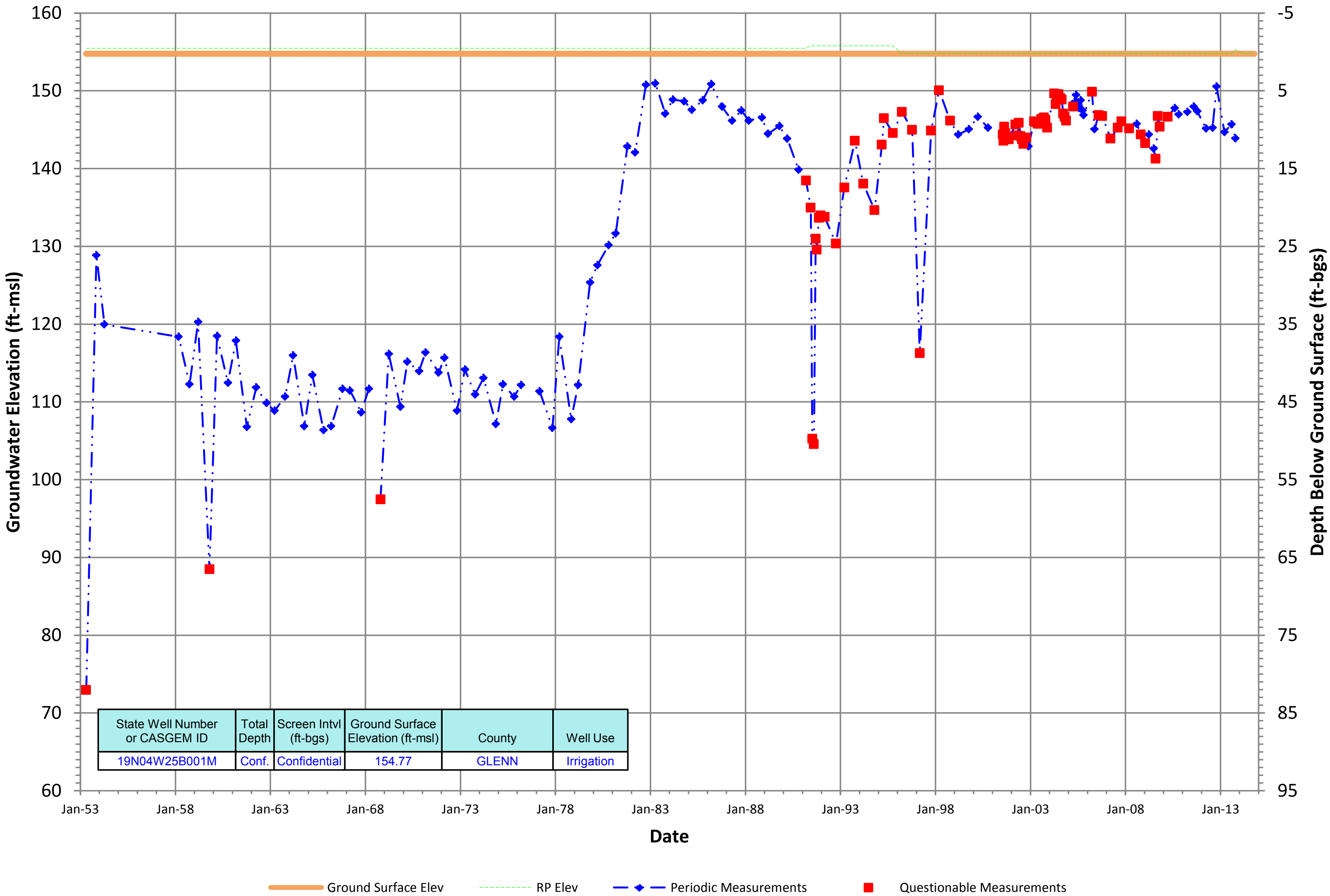
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



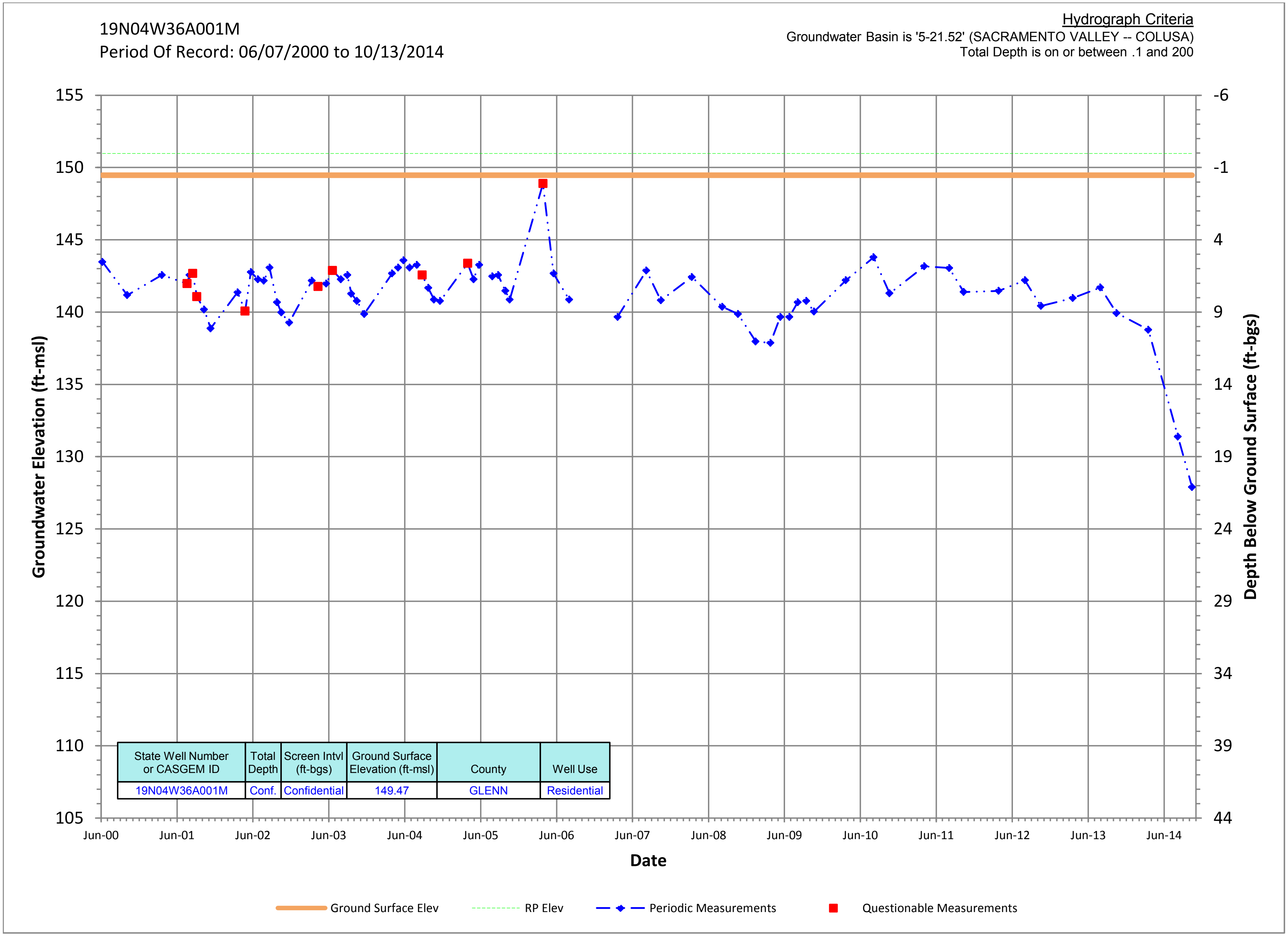
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N04W14M002M	Conf.	Confidential	185.83	GLENN	Observation

19N04W25B001M
Period Of Record: 04/21/1953 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



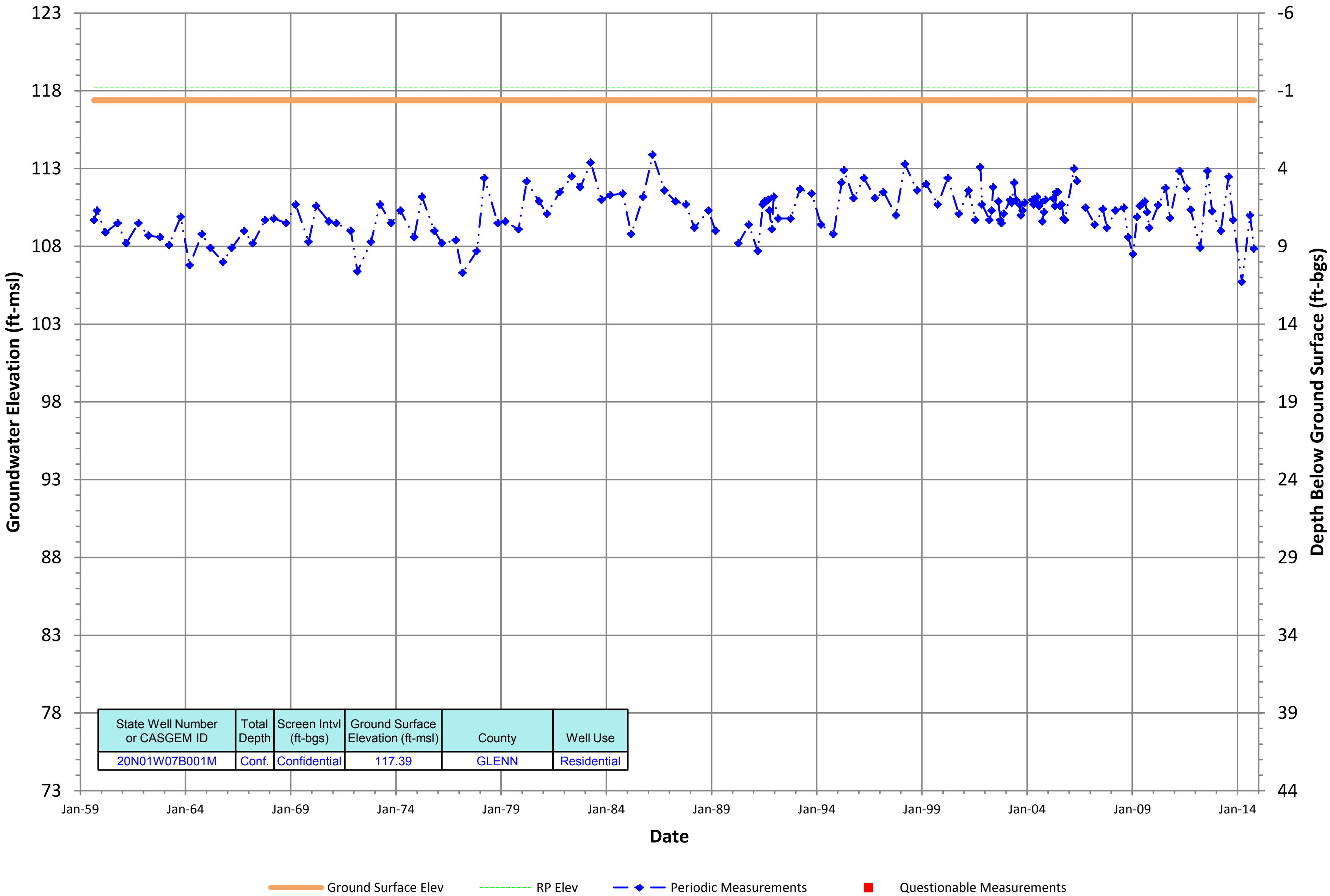
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N04W25B001M	Conf.	Confidential	154.77	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N04W36A001M	Conf.	Confidential	149.47	GLENN	Residential

20N01W07B001M
Period Of Record: 08/25/1959 to 10/13/2014

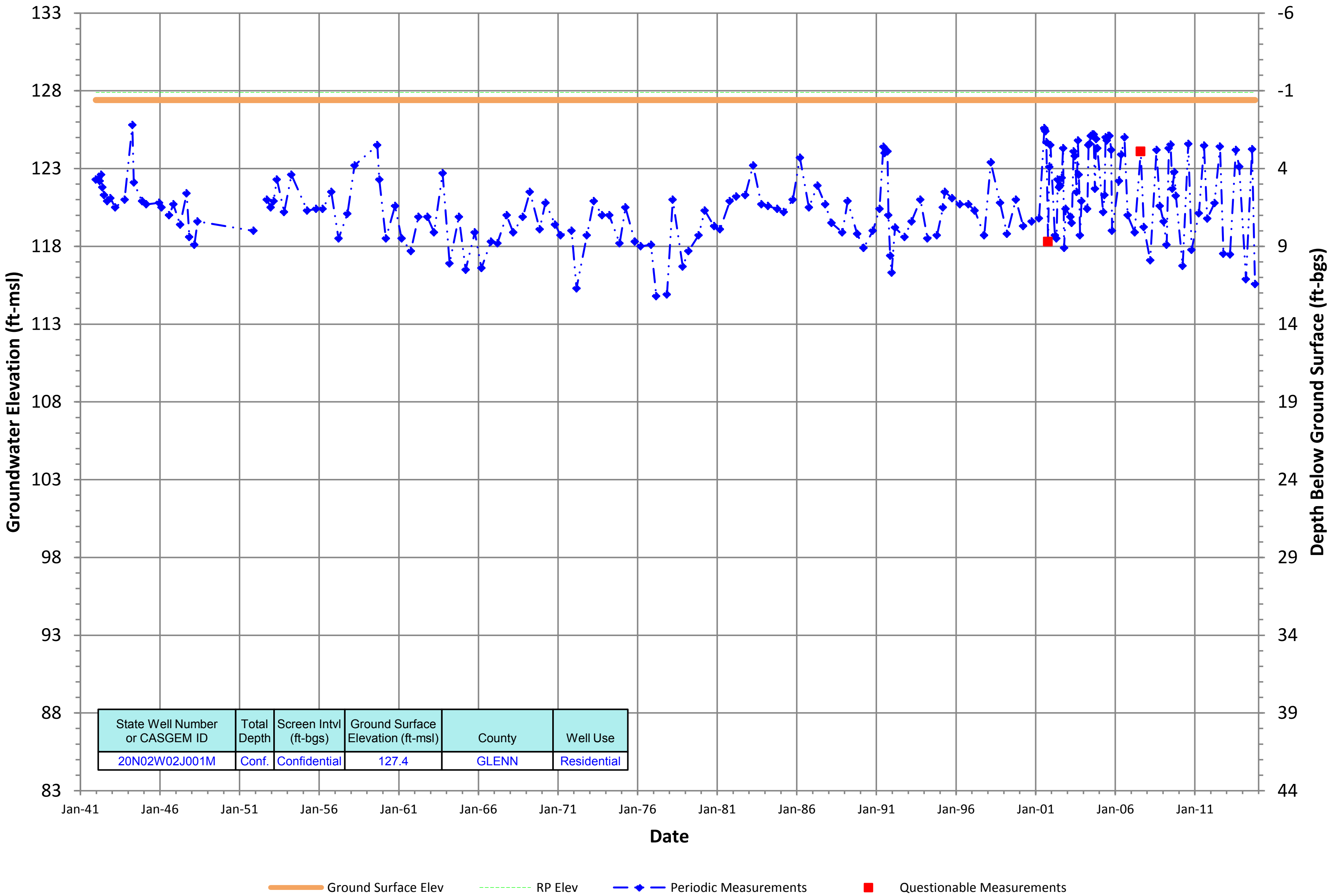
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



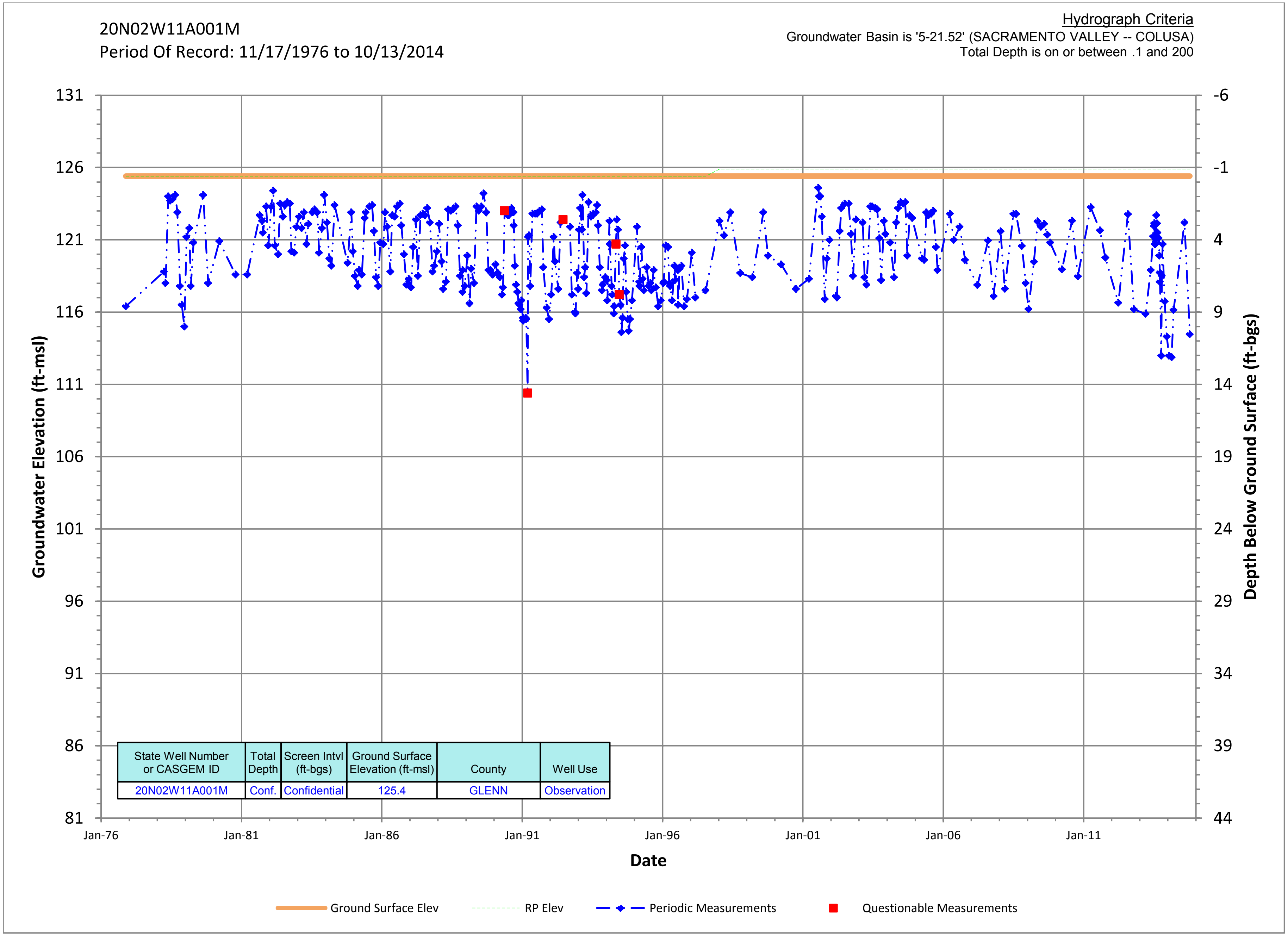
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01W07B001M	Conf.	Confidential	117.39	GLENN	Residential

20N02W02J001M
Period Of Record: 12/22/1941 to 10/13/2014

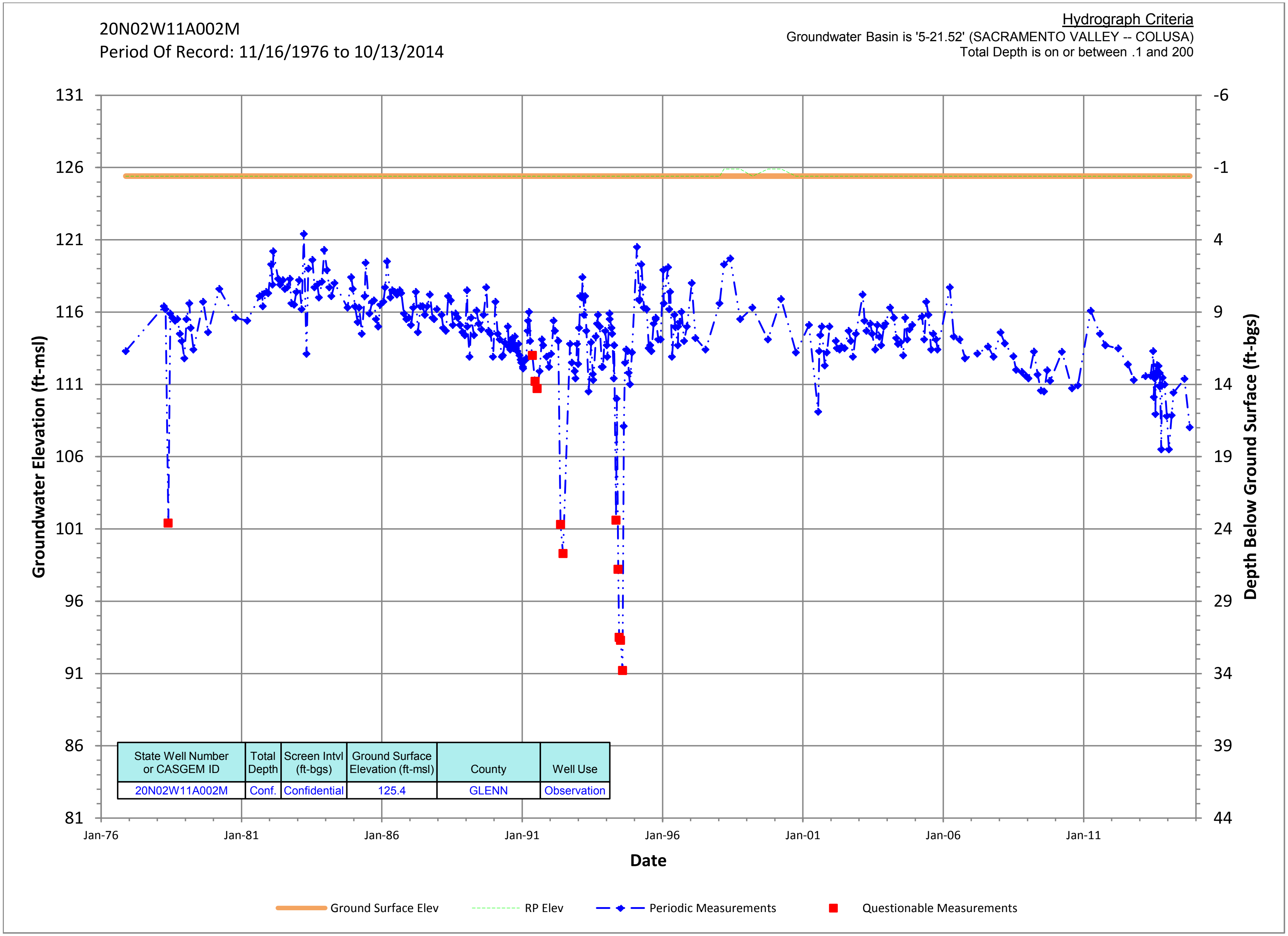
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



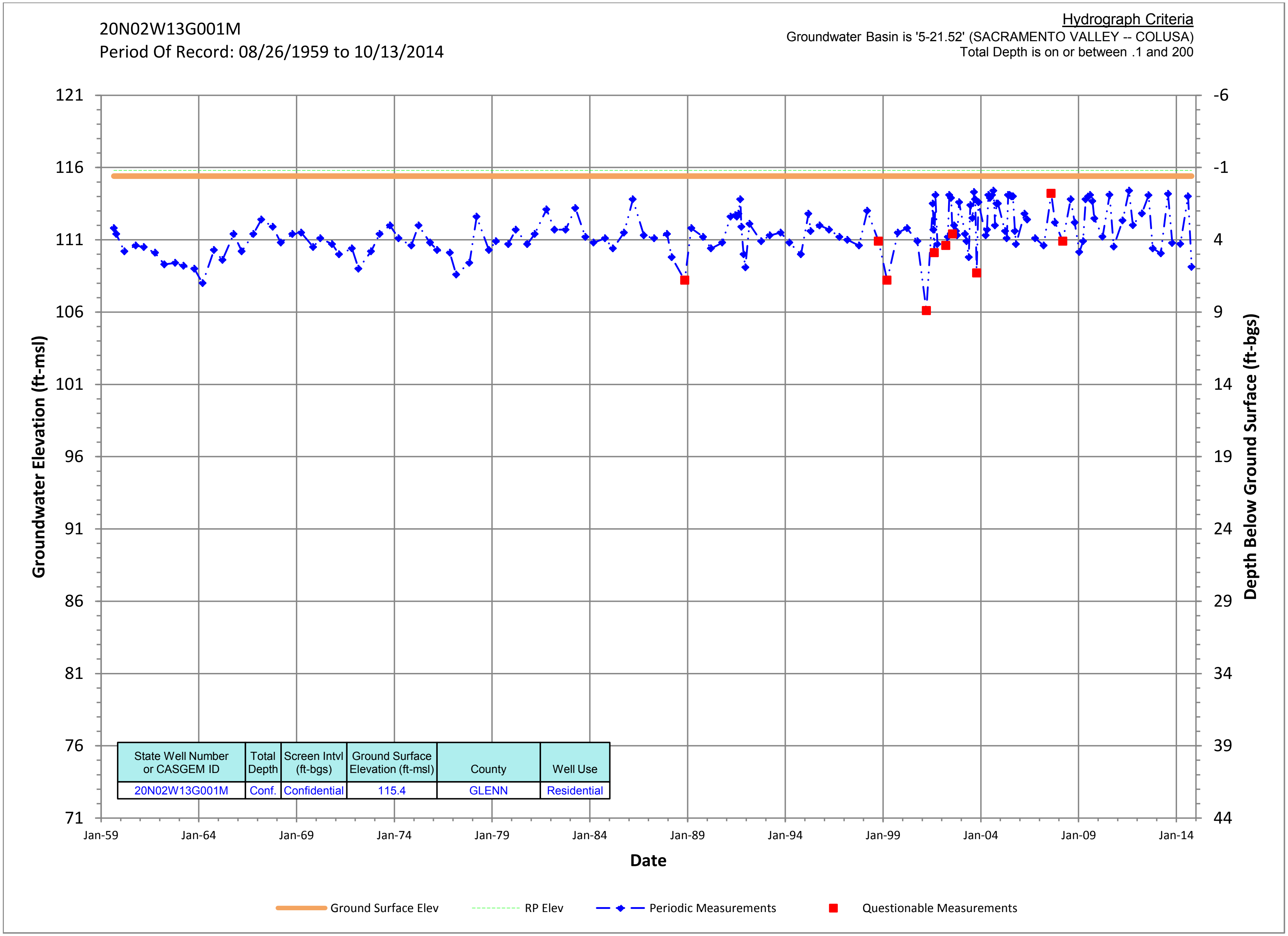
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W02J001M	Conf.	Confidential	127.4	GLENN	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W11A001M	Conf.	Confidential	125.4	GLENN	Observation



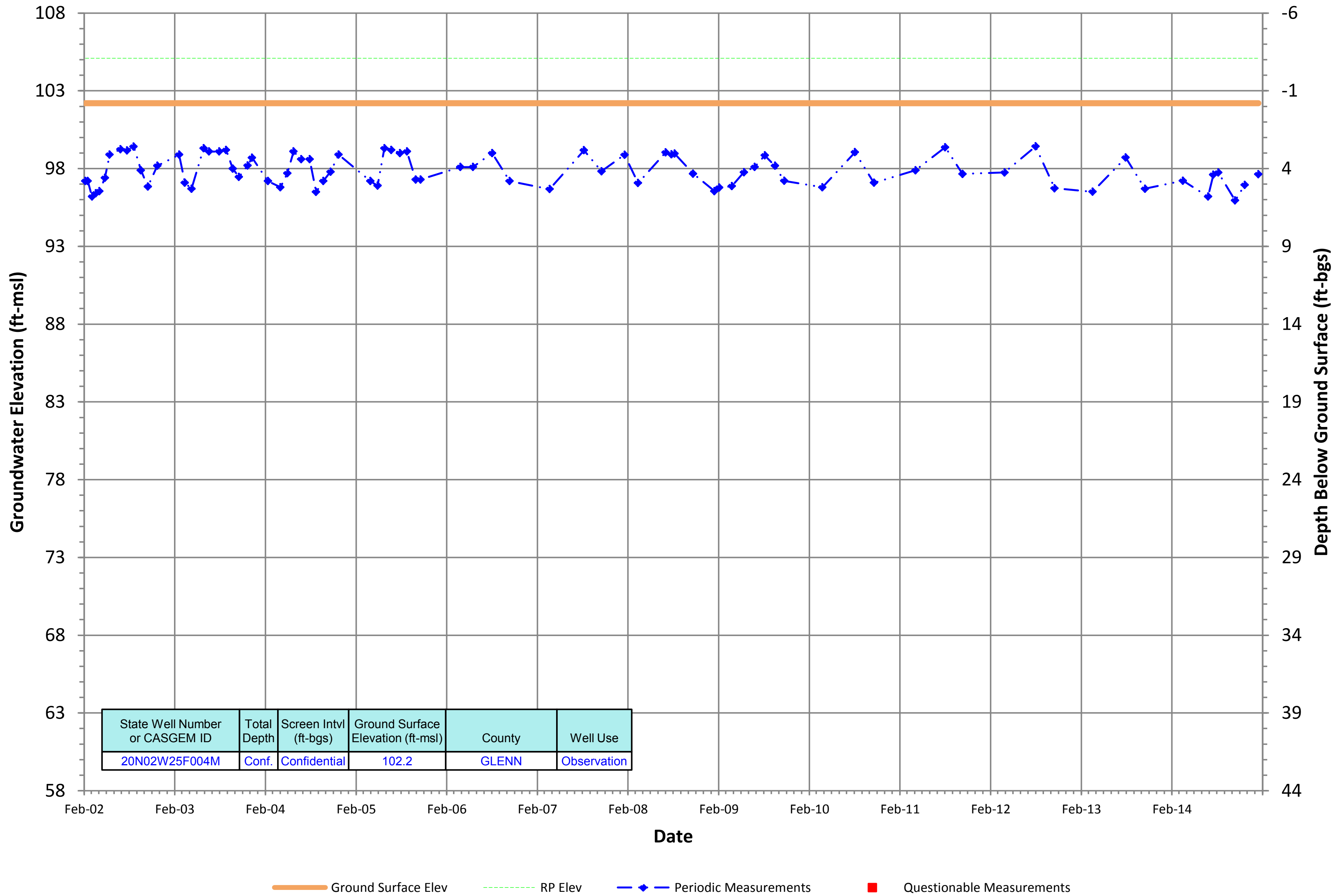
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W11A002M	Conf.	Confidential	125.4	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W13G001M	Conf.	Confidential	115.4	GLENN	Residential

20N02W25F004M
Period Of Record: 02/05/2002 to 01/15/2015

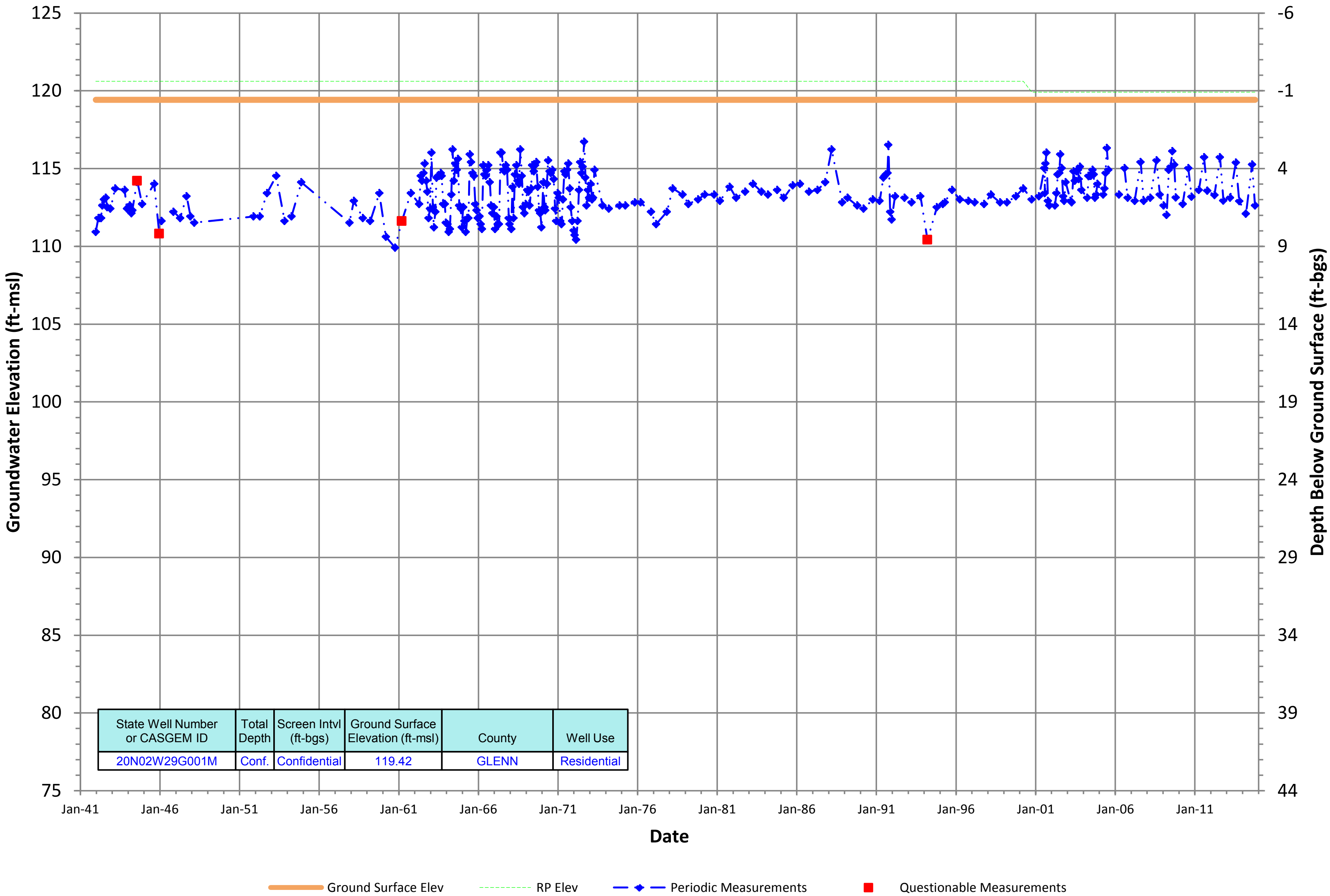
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



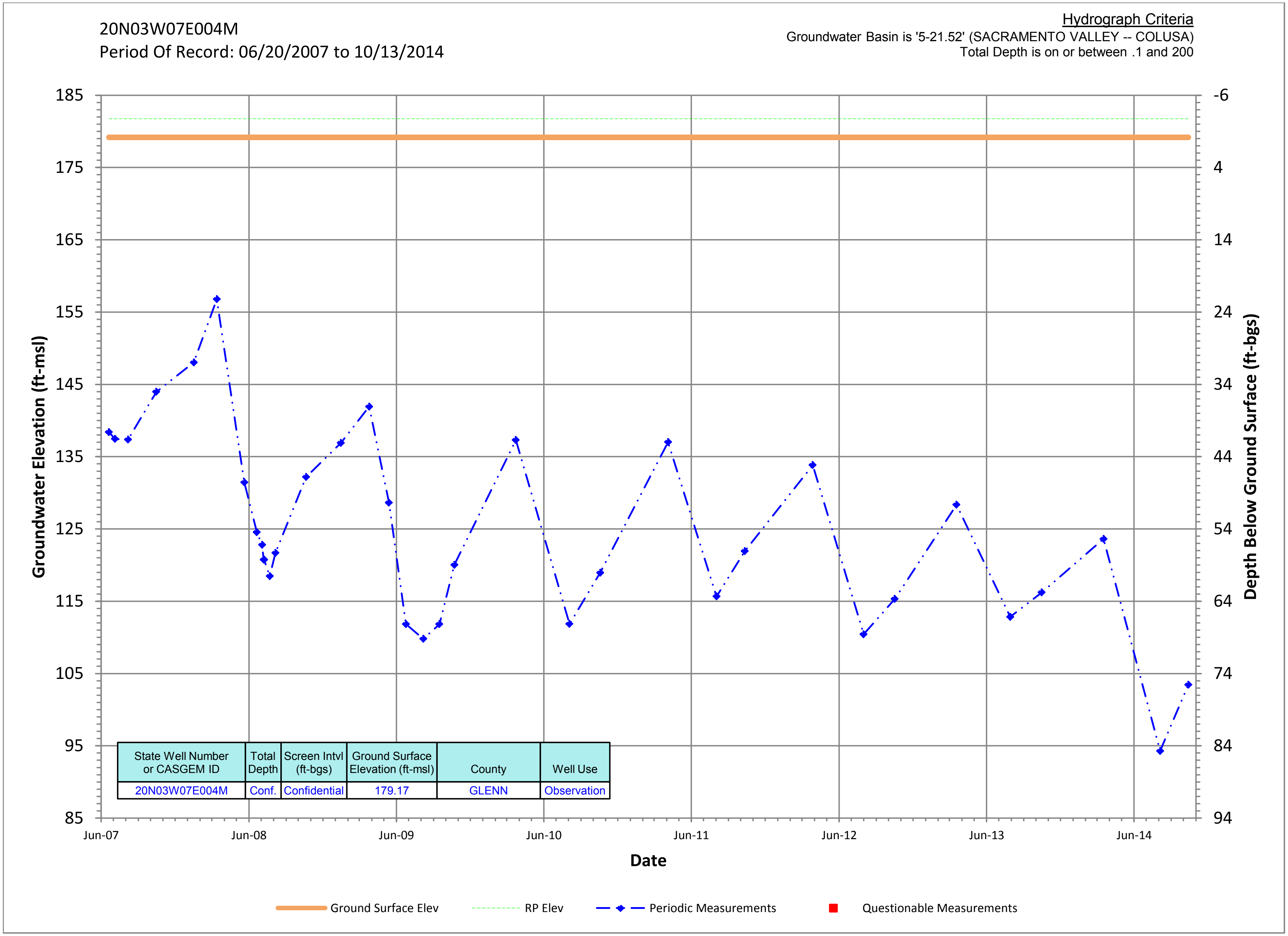
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W25F004M	Conf.	Confidential	102.2	GLENN	Observation

20N02W29G001M
Period Of Record: 12/20/1941 to 10/13/2014

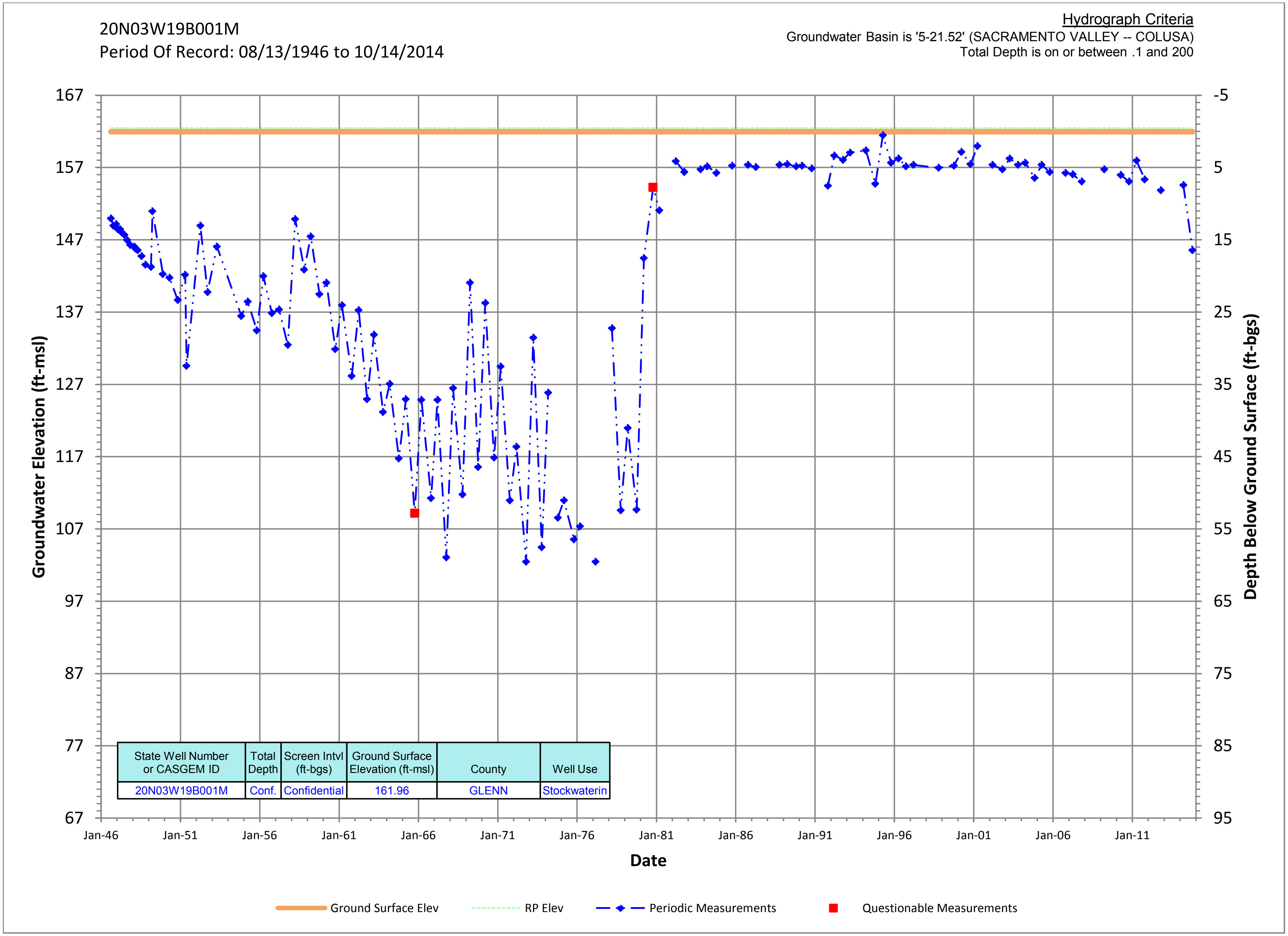
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W29G001M	Conf.	Confidential	119.42	GLENN	Residential



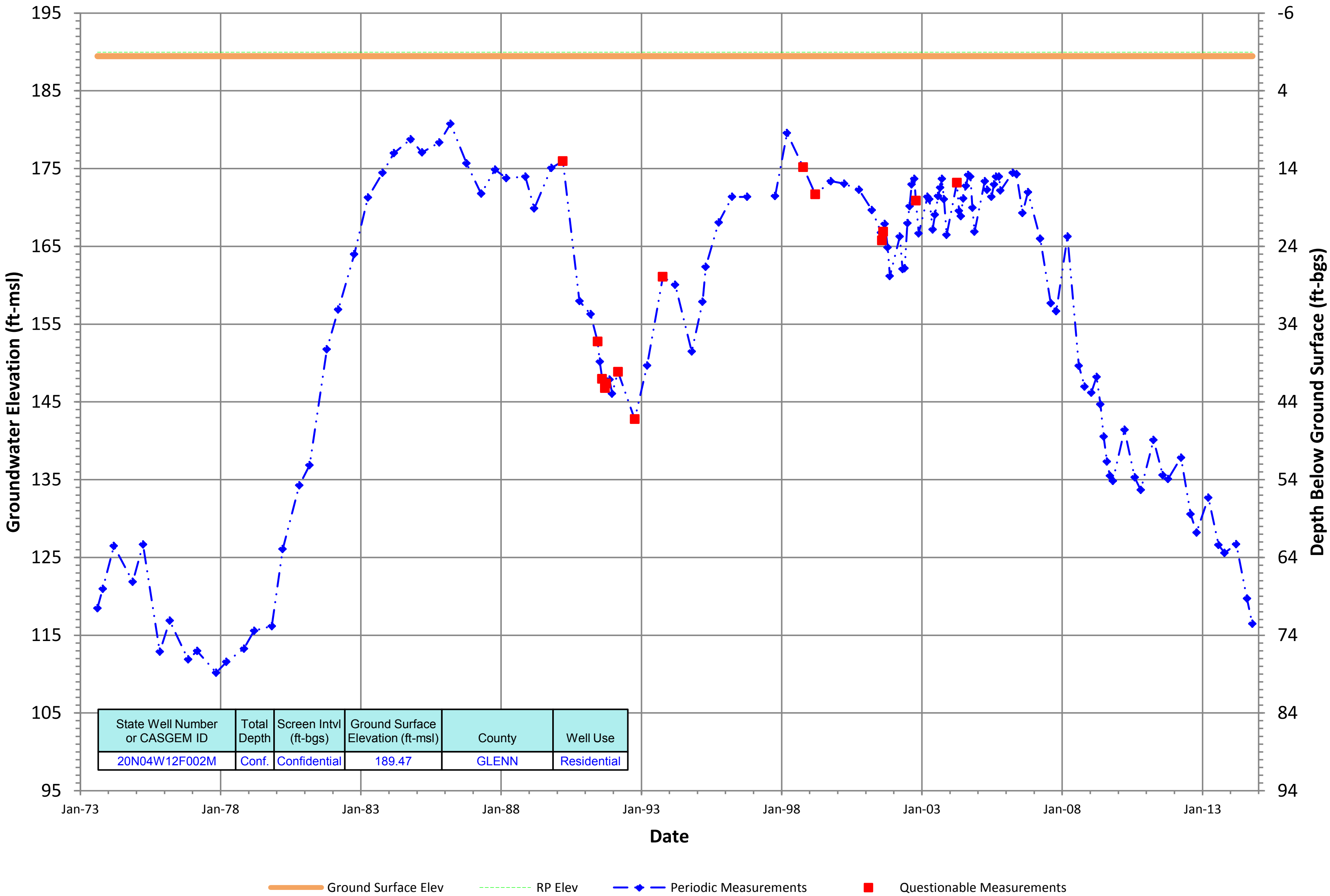
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W07E004M	Conf.	Confidential	179.17	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W19B001M	Conf.	Confidential	161.96	GLENN	Stockwaterin

20N04W12F002M
Period Of Record: 08/10/1973 to 10/13/2014

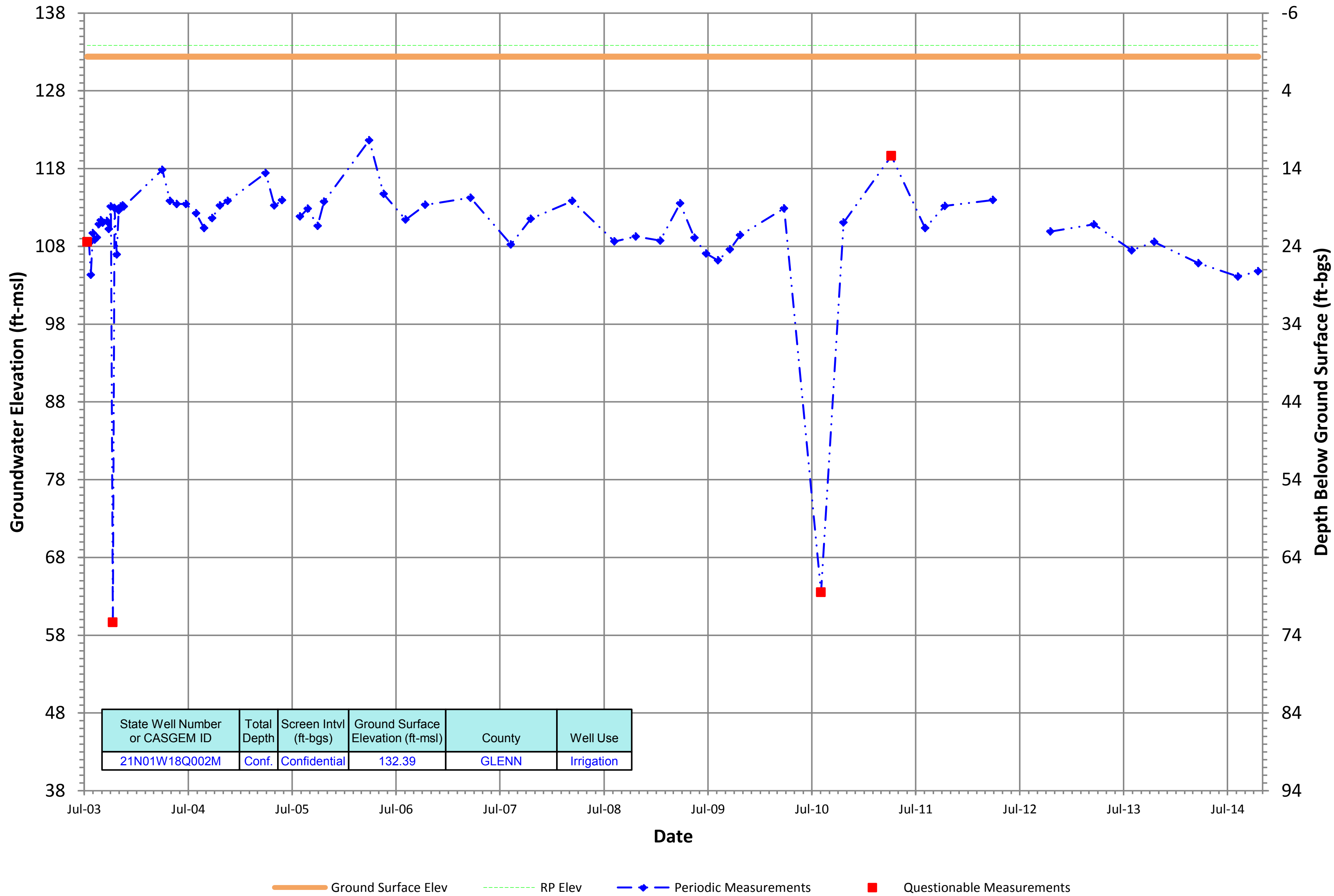
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



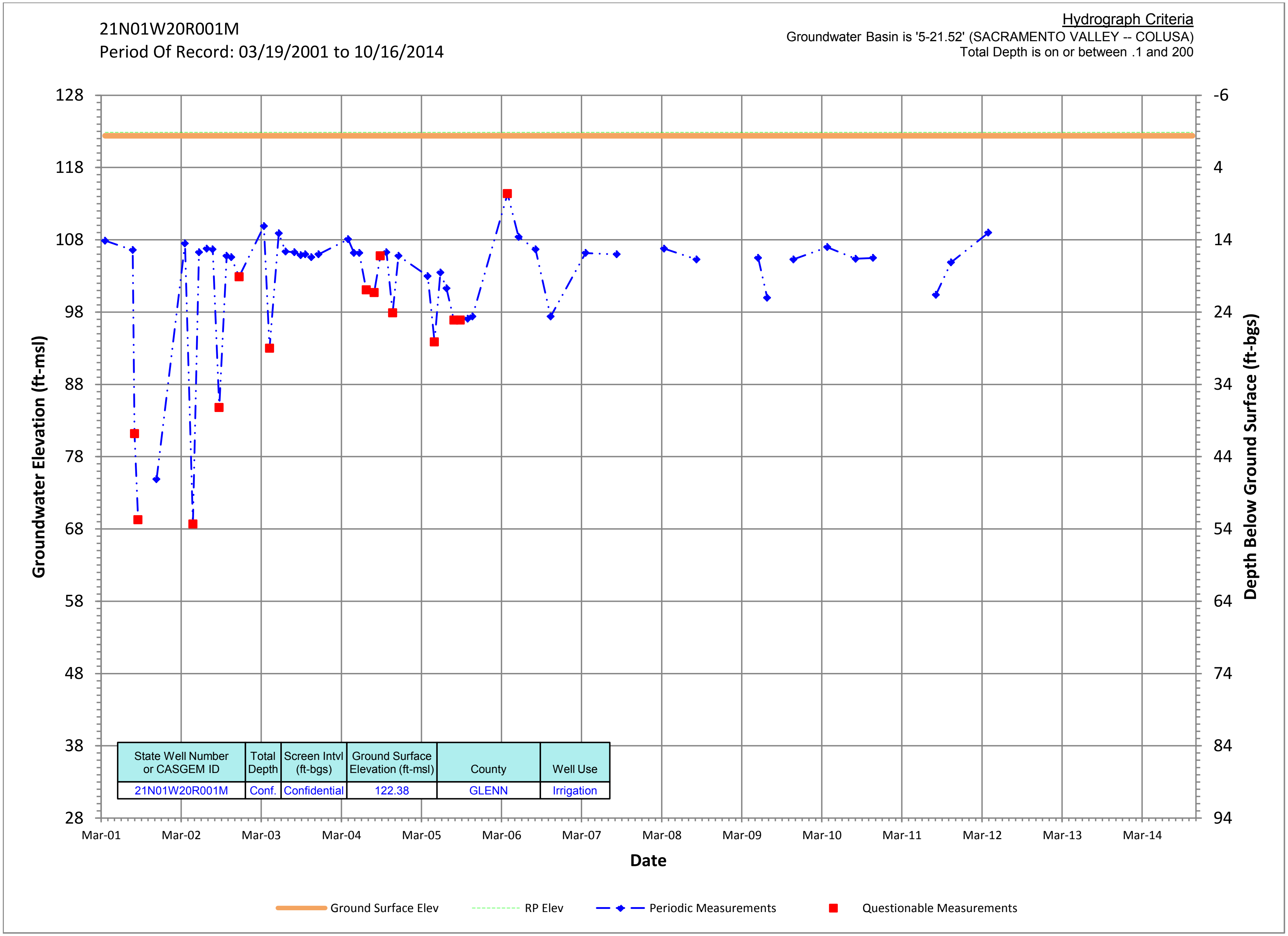
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N04W12F002M	Conf.	Confidential	189.47	GLENN	Residential

21N01W18Q002M
Period Of Record: 07/11/2003 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



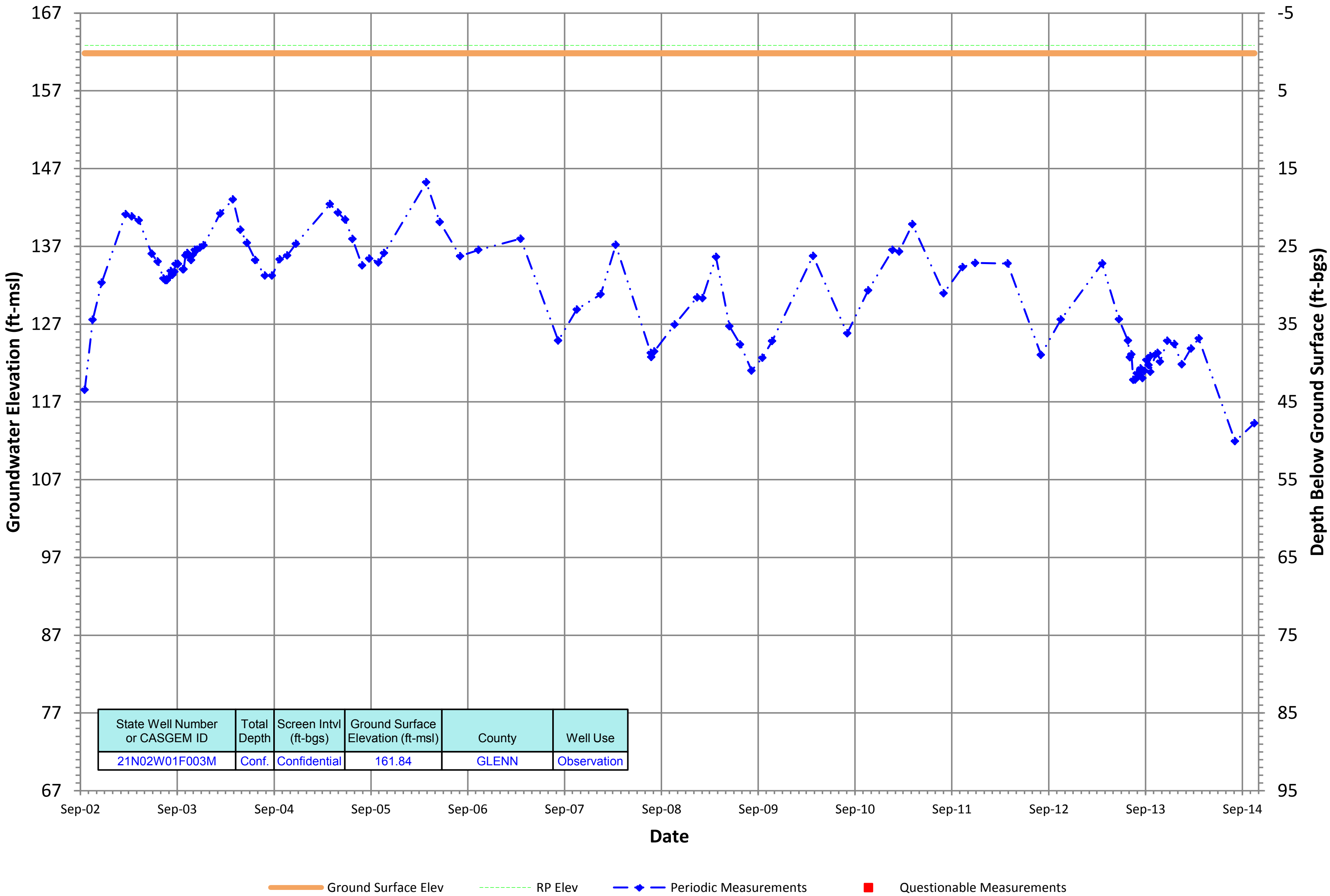
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W18Q002M	Conf.	Confidential	132.39	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W20R001M	Conf.	Confidential	122.38	GLENN	Irrigation

21N02W01F003M
Period Of Record: 09/17/2002 to 10/16/2014

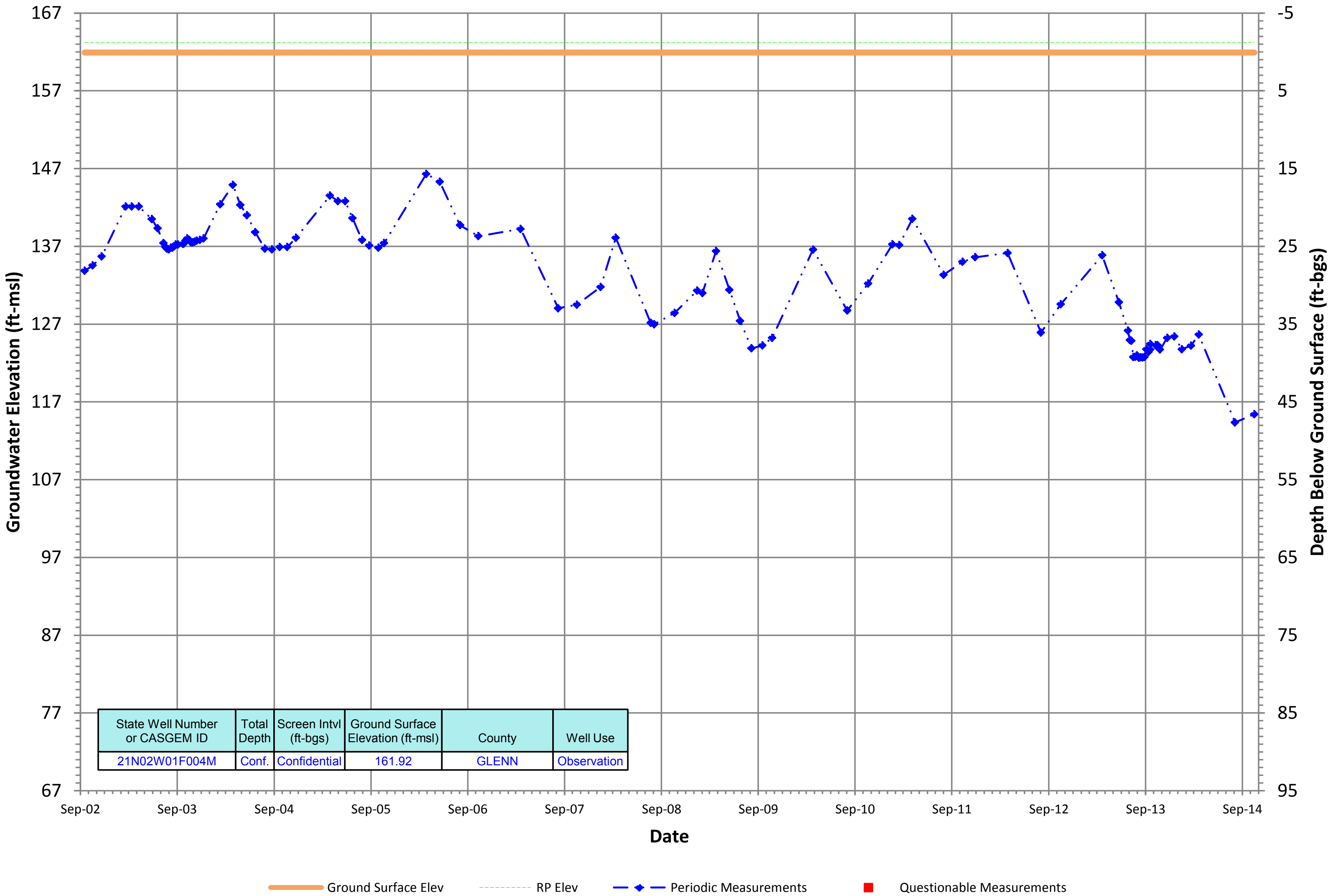
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W01F003M	Conf.	Confidential	161.84	GLENN	Observation

21N02W01F004M
Period Of Record: 09/17/2002 to 10/16/2014

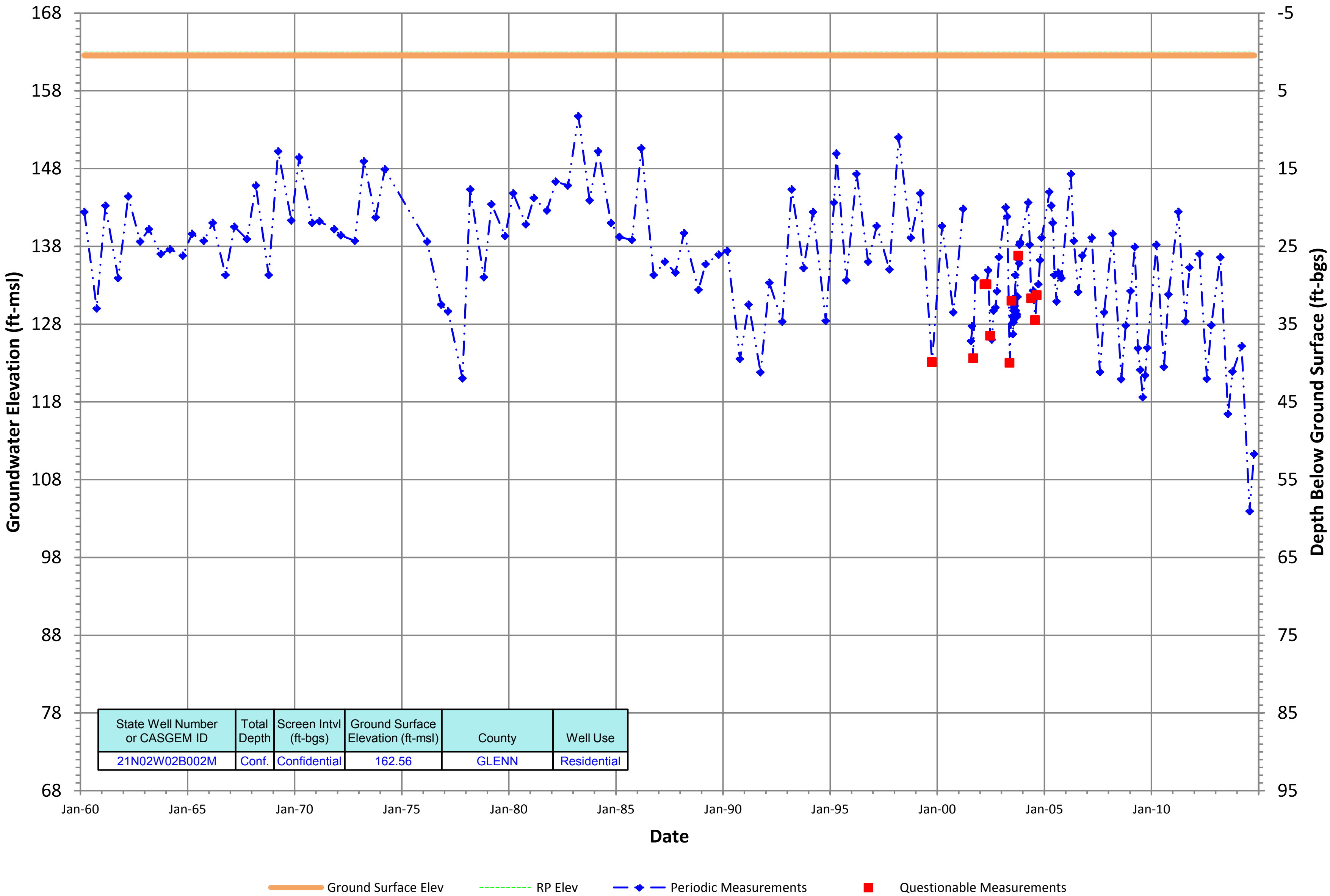
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W01F004M	Conf.	Confidential	161.92	GLENN	Observation

21N02W02B002M
Period Of Record: 03/09/1960 to 10/16/2014

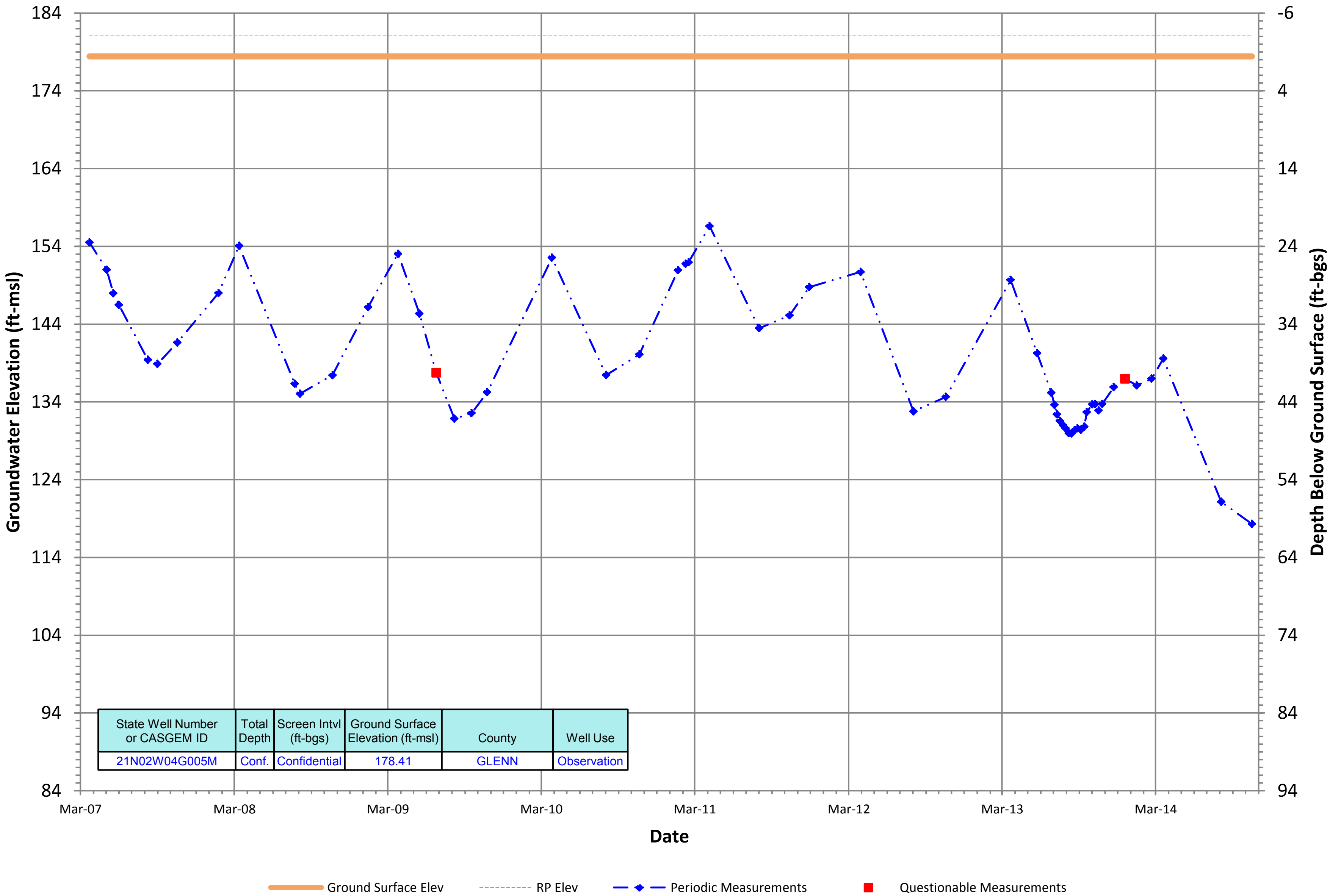
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



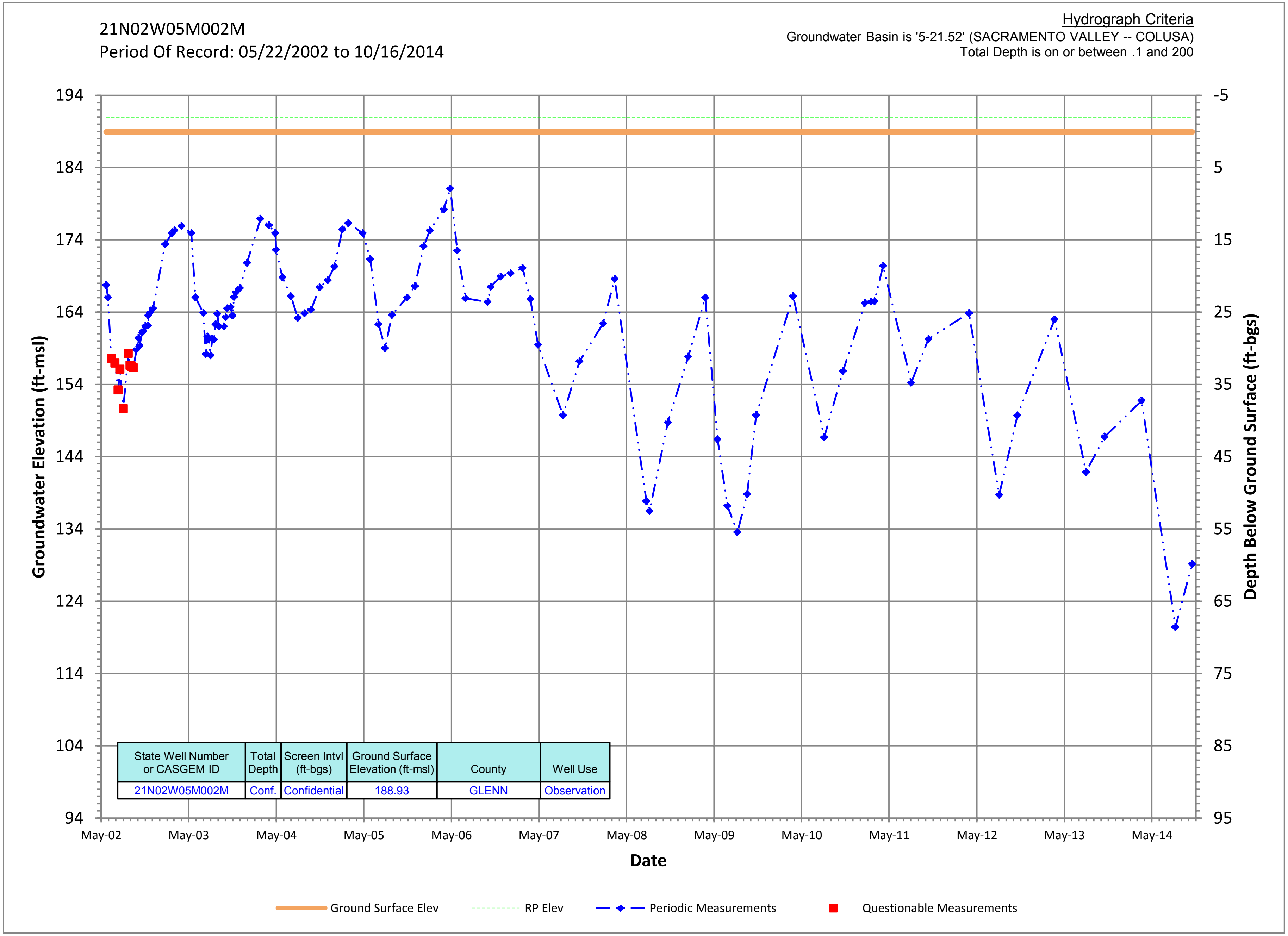
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W02B002M	Conf.	Confidential	162.56	GLENN	Residential

21N02W04G005M
Period Of Record: 03/22/2007 to 10/16/2014

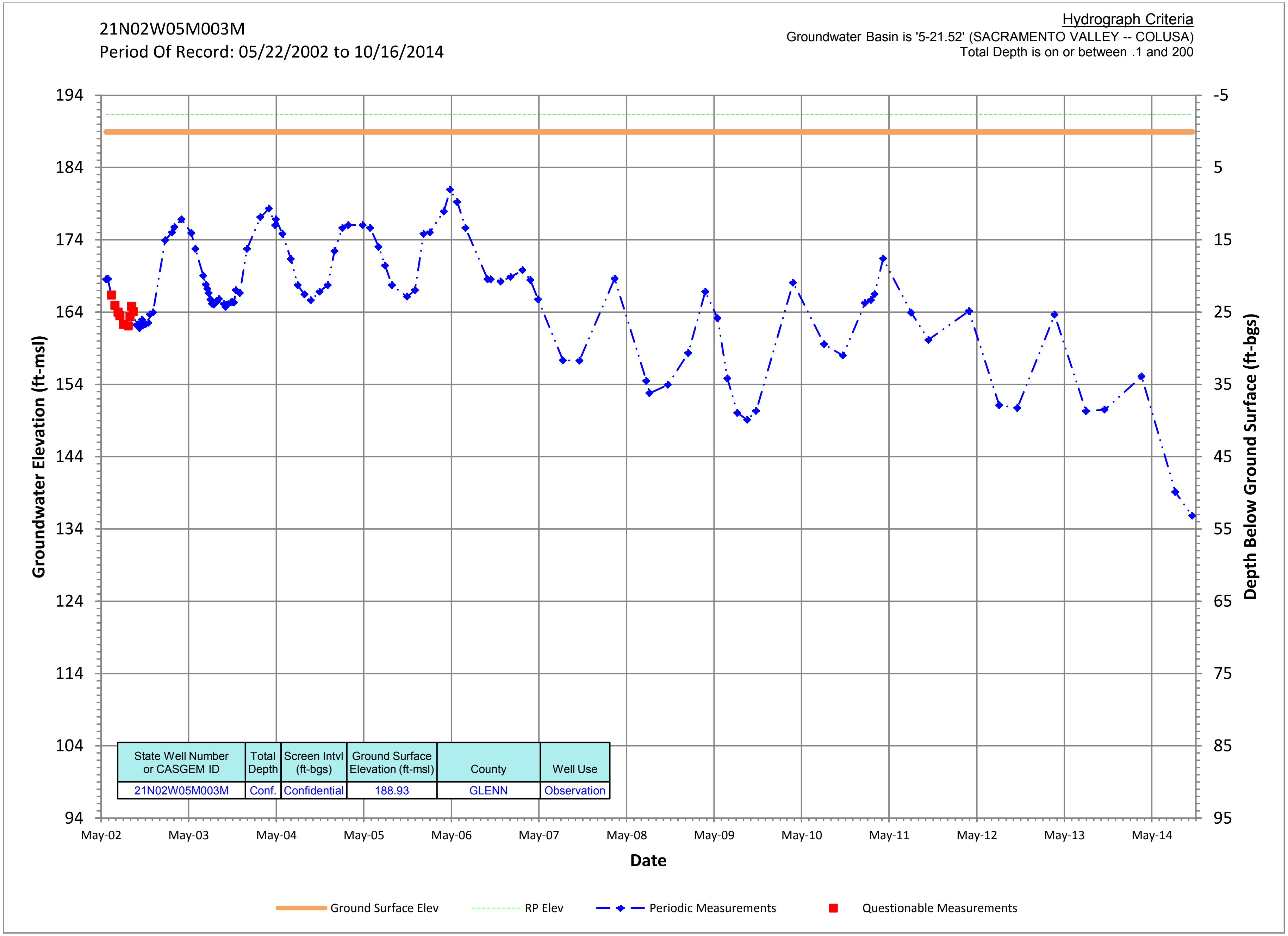
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



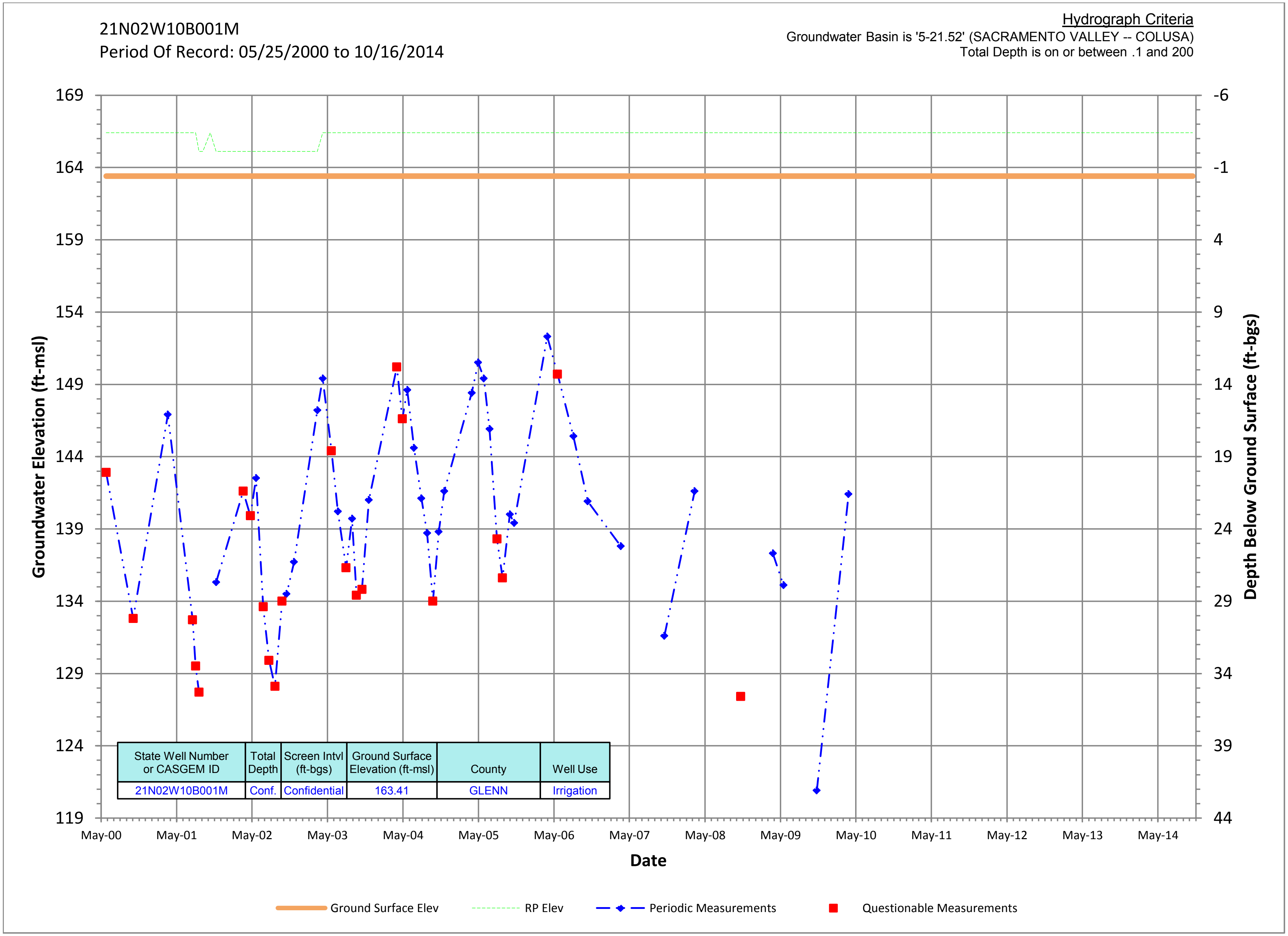
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W04G005M	Conf.	Confidential	178.41	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W05M002M	Conf.	Confidential	188.93	GLENN	Observation

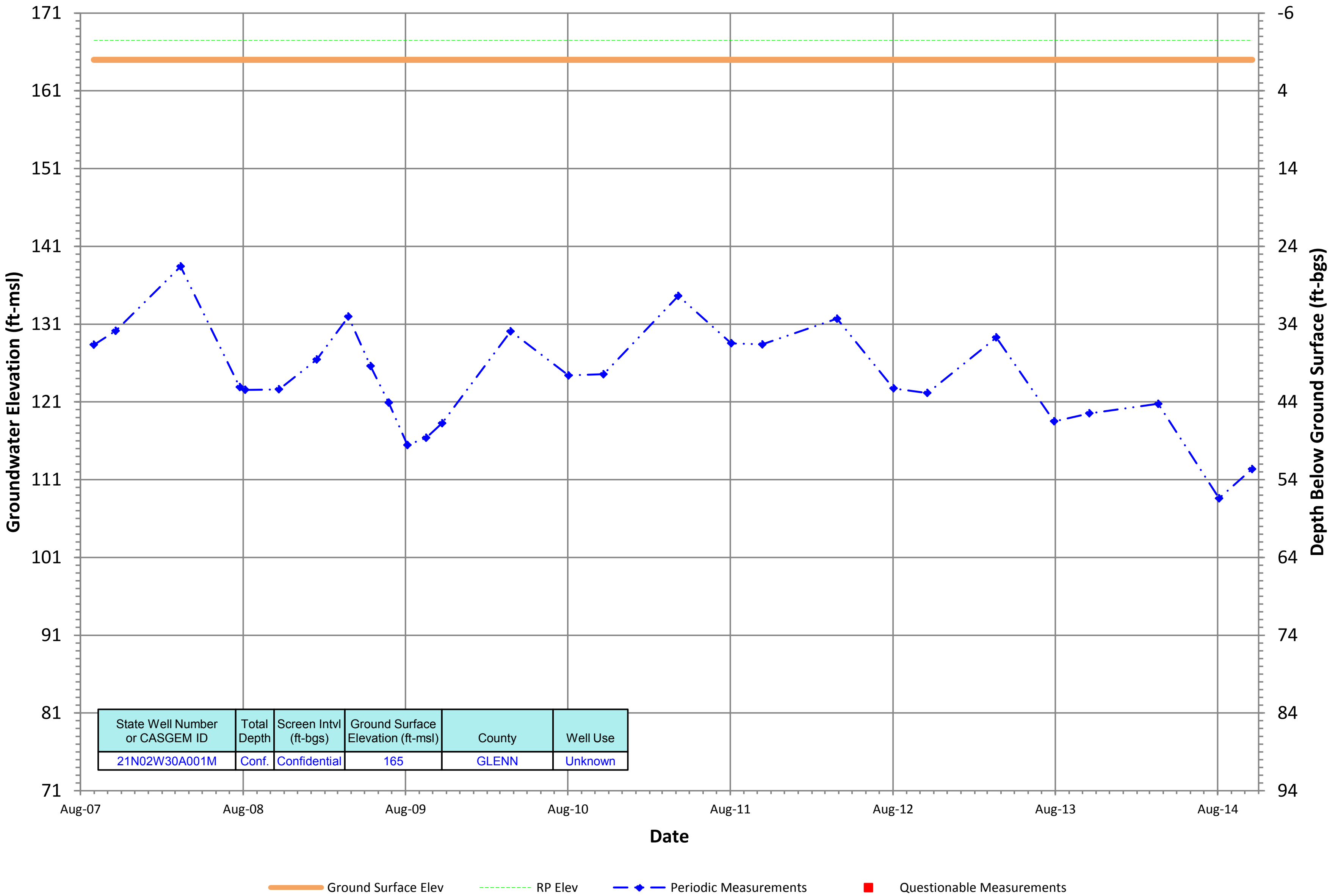


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W05M003M	Conf.	Confidential	188.93	GLENN	Observation

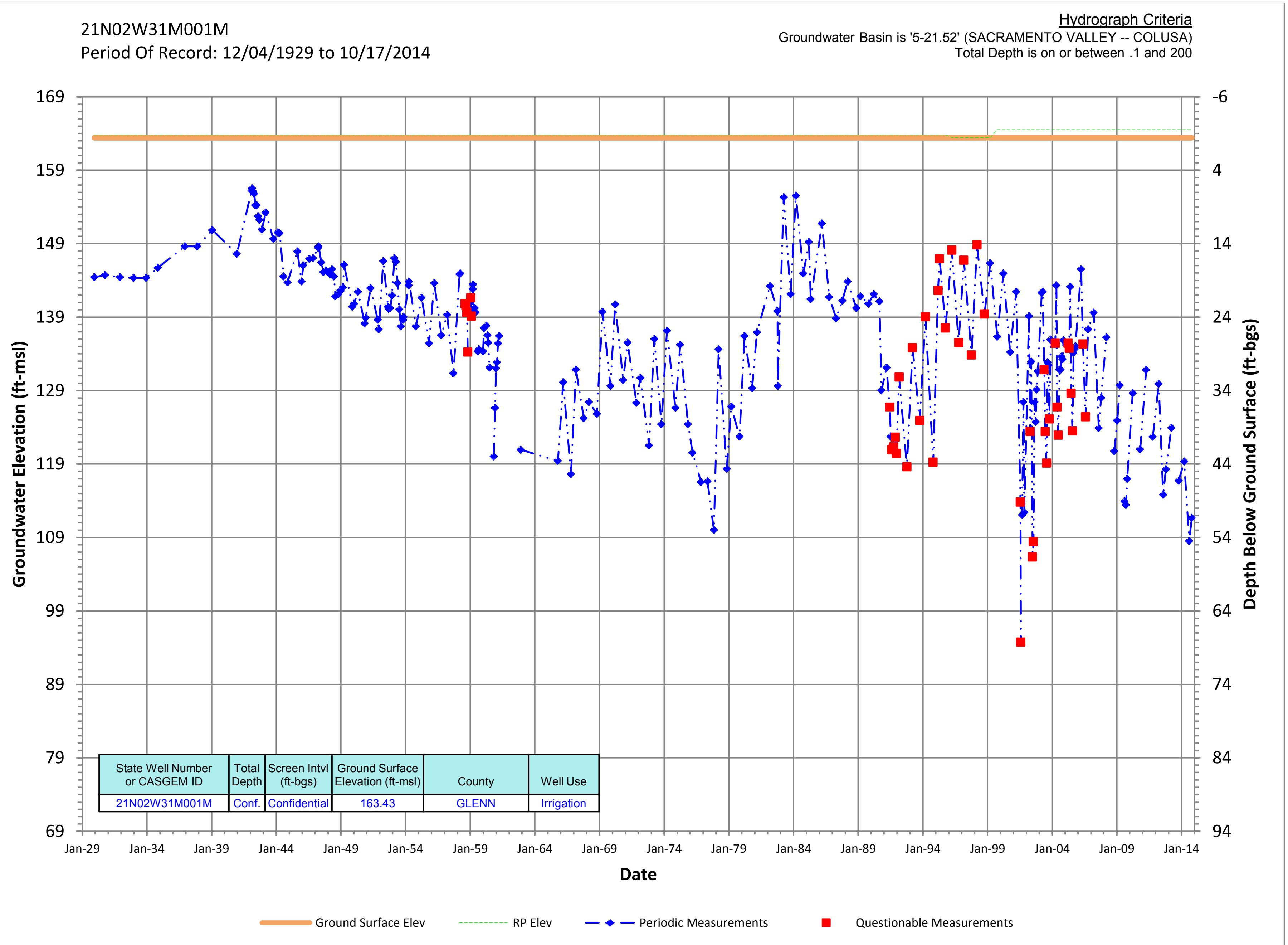

21N02W10B001M
Period Of Record: 05/25/2000 to 10/16/2014
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
169
164
159
154
149
144
139
134
129
124
119
-6
-1
4
9
14
19
24
29
34
39
44
May-00
May-01
May-02
May-03
May-04
May-05
May-06
May-07
May-08
May-09
May-10
May-11
May-12
May-13
May-14
Date
State Well Number or CASGEM ID | Total Depth | Screen Intvl (ft-bgs) | Ground Surface Elevation (ft-msl) | County | Well Use
21N02W10B001M | Conf. | Confidential | 163.41 | GLENN | Irrigation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

21N02W30A001M
Period Of Record: 08/31/2007 to 10/17/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



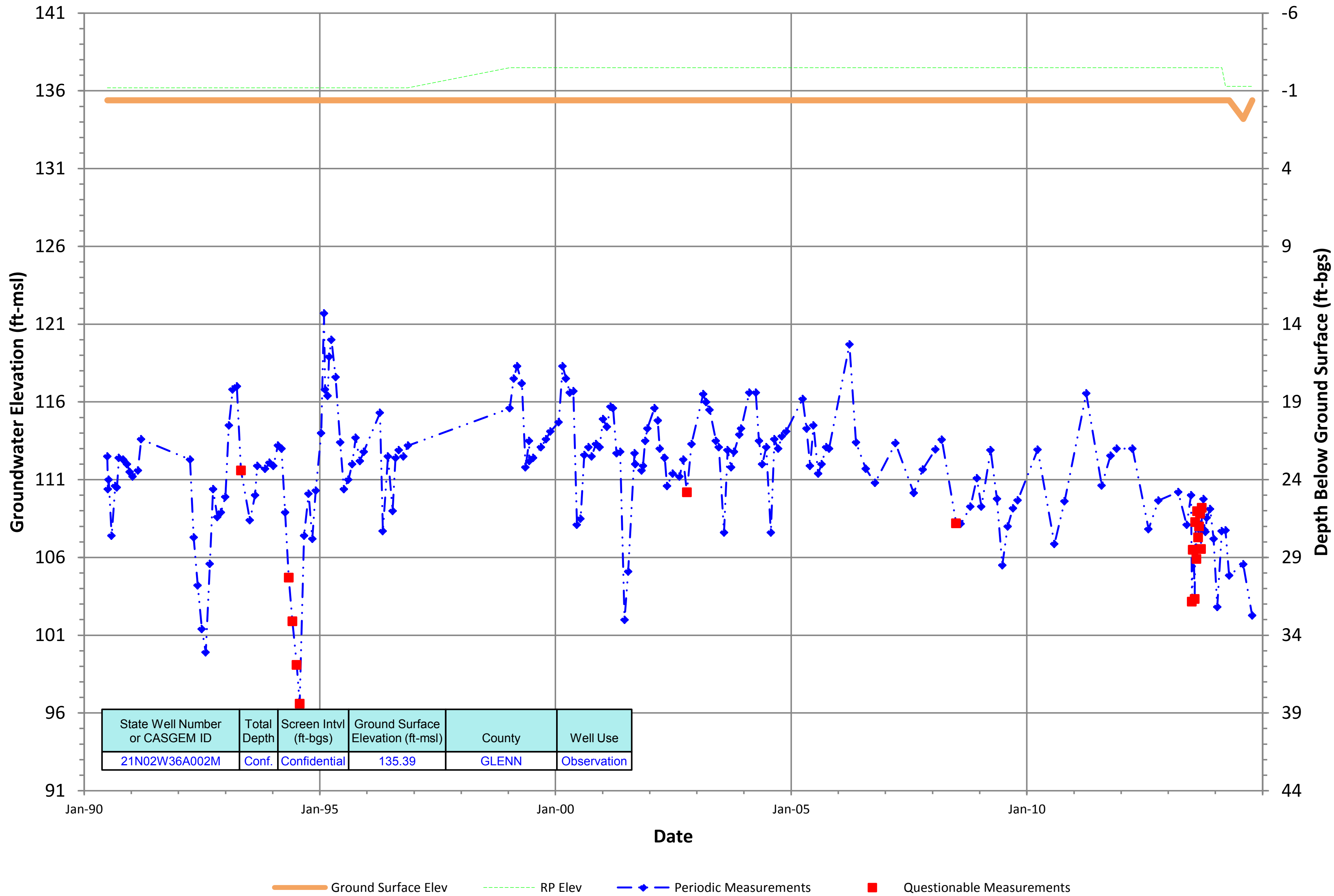
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W30A001M	Conf.	Confidential	165	GLENN	Unknown



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W31M001M	Conf.	Confidential	163.43	GLENN	Irrigation

21N02W36A002M
Period Of Record: 06/29/1990 to 10/13/2014

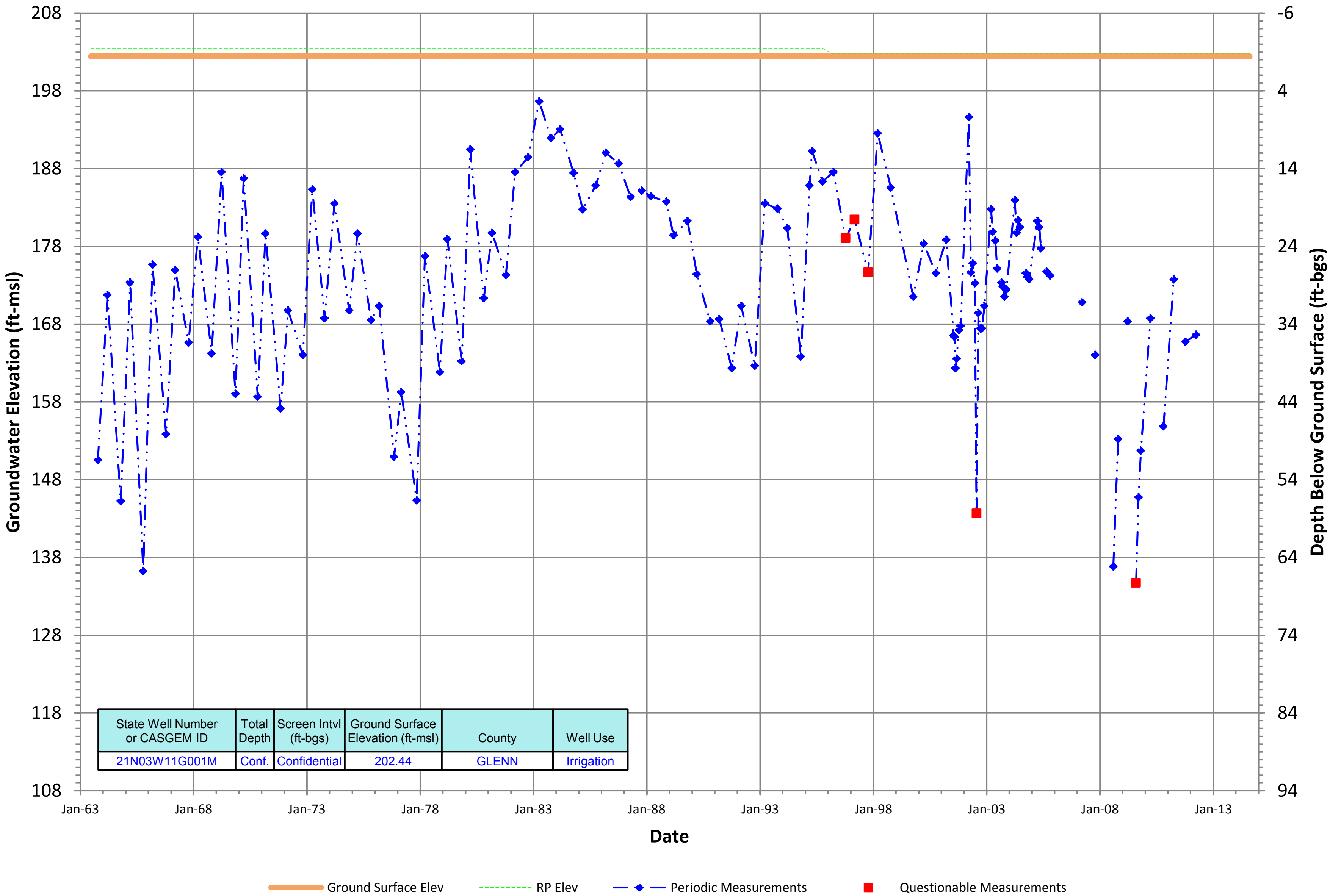
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



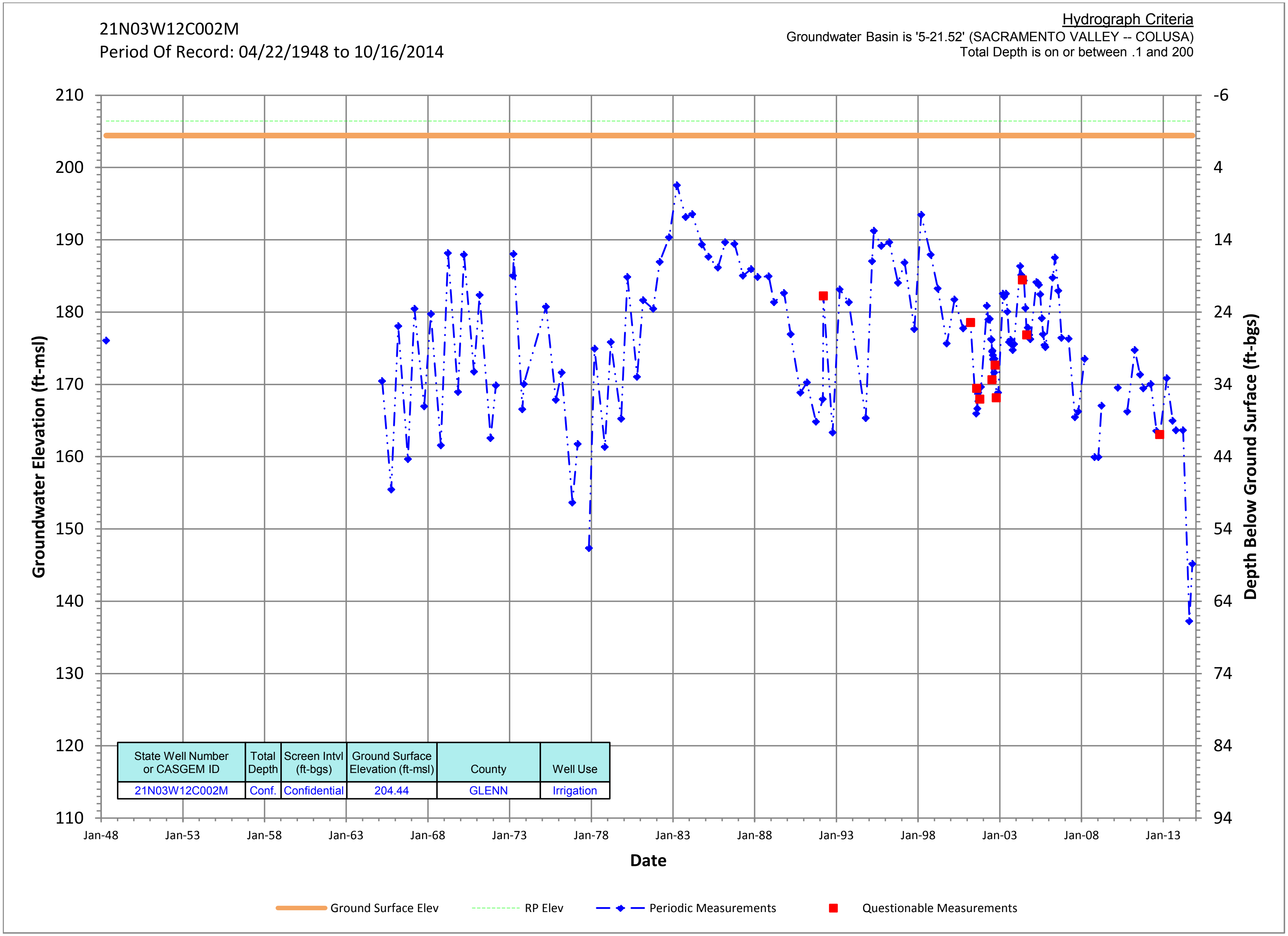
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W36A002M	Conf.	Confidential	135.39	GLENN	Observation

21N03W11G001M
Period Of Record: 06/19/1963 to 08/07/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



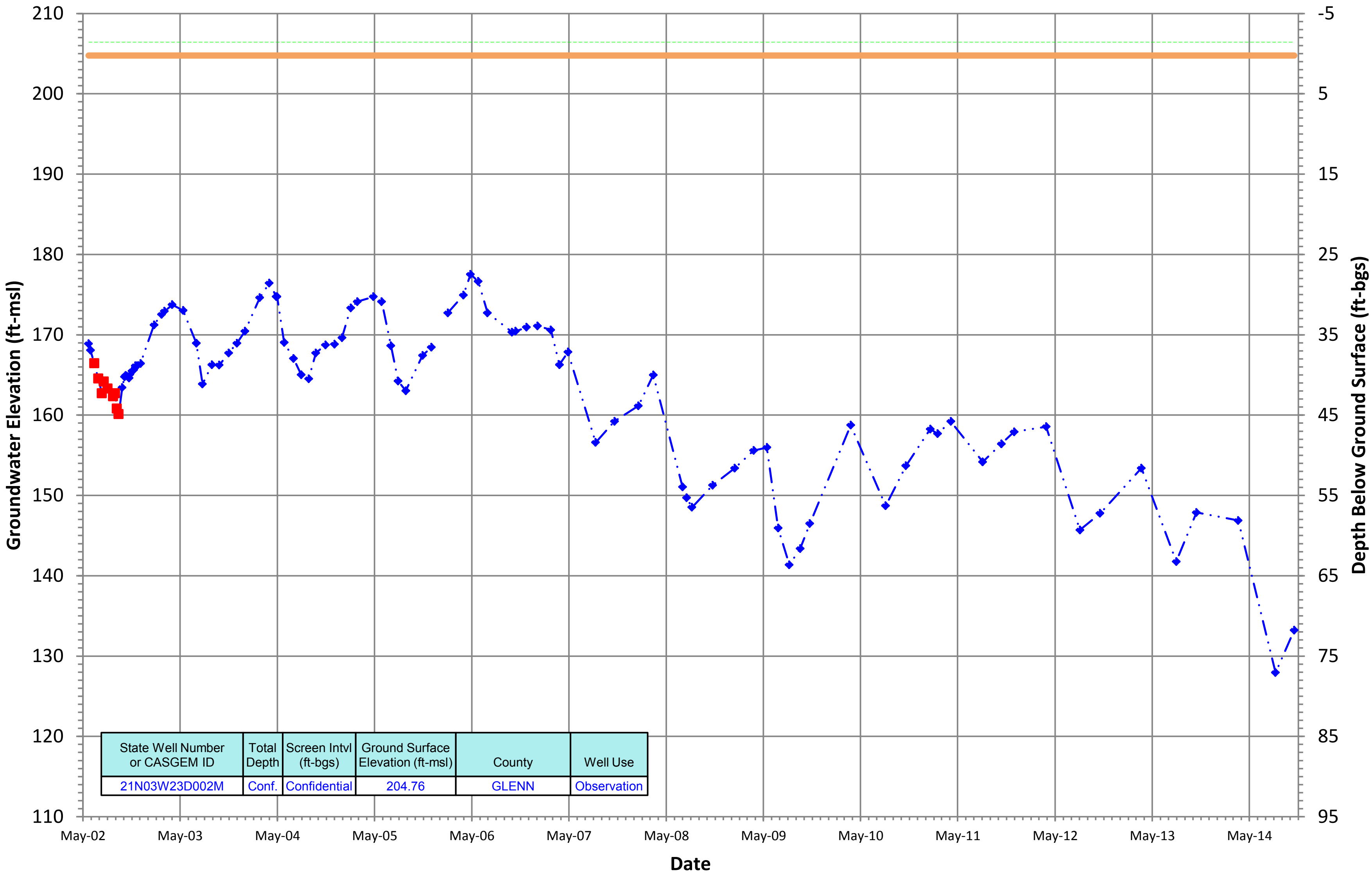
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W11G001M	Conf.	Confidential	202.44	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W12C002M	Conf.	Confidential	204.44	GLENN	Irrigation

21N03W23D002M
Period Of Record: 05/22/2002 to 10/16/2014

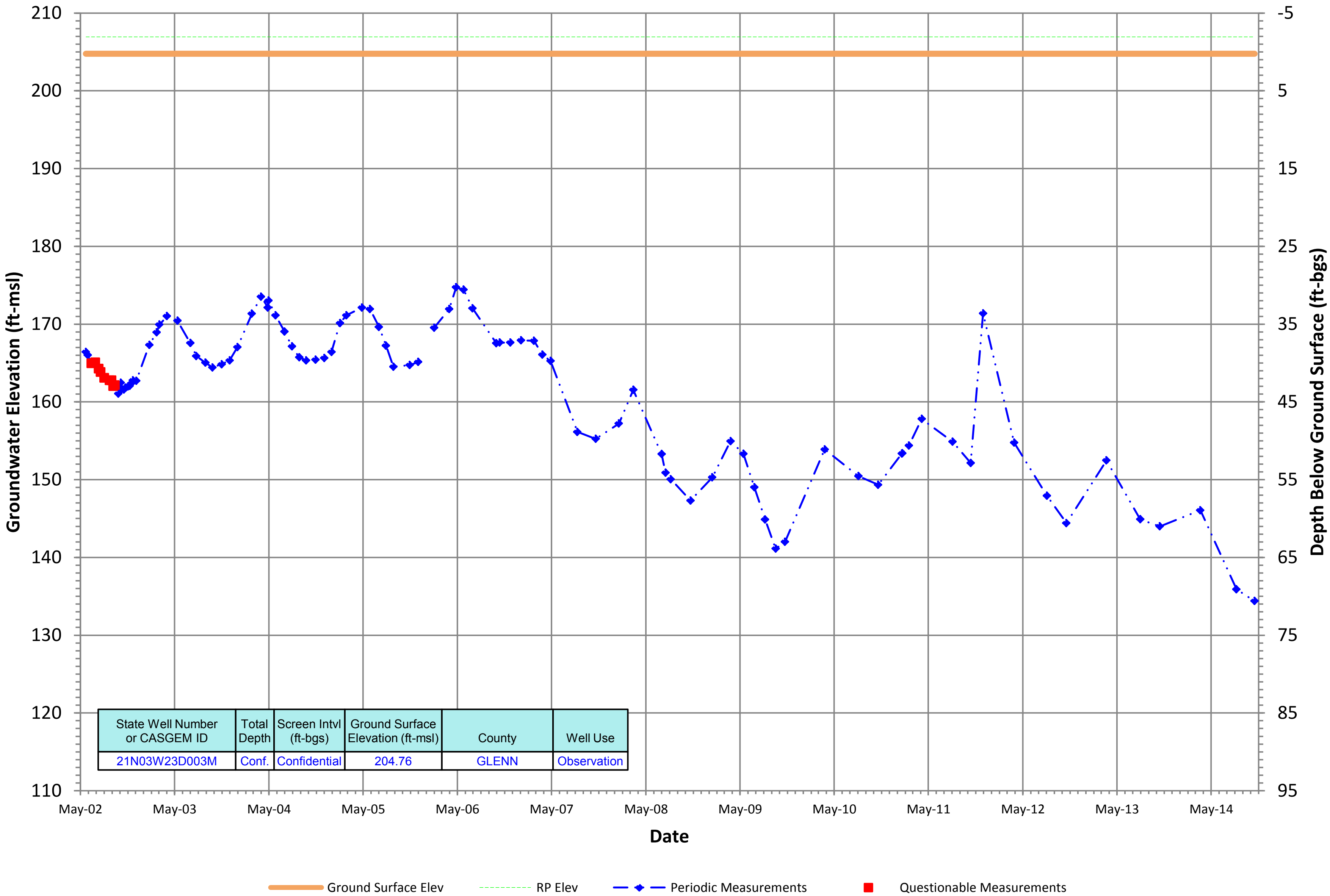
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W23D002M	Conf.	Confidential	204.76	GLENN	Observation

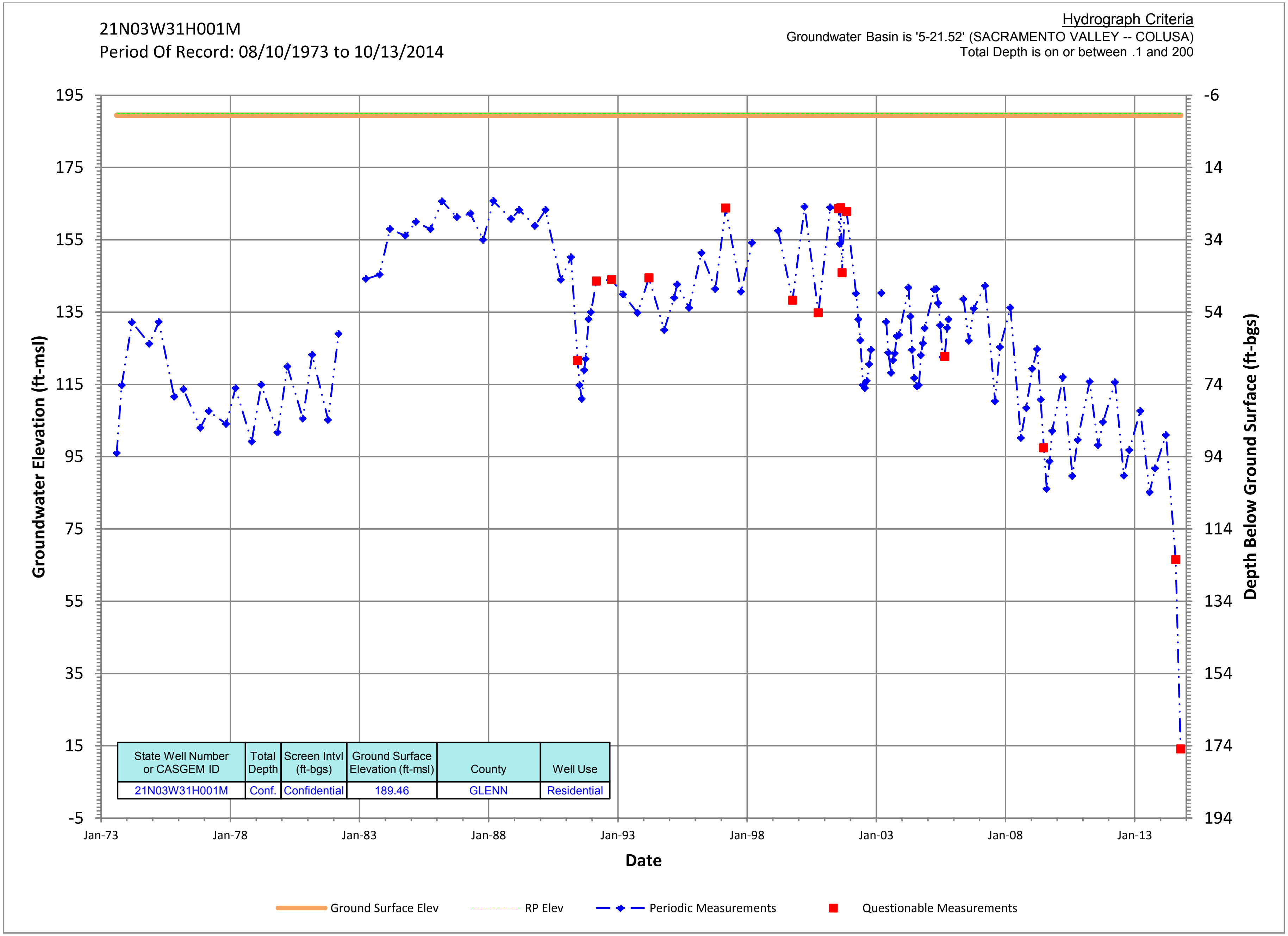
21N03W23D003M
Period Of Record: 05/22/2002 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200

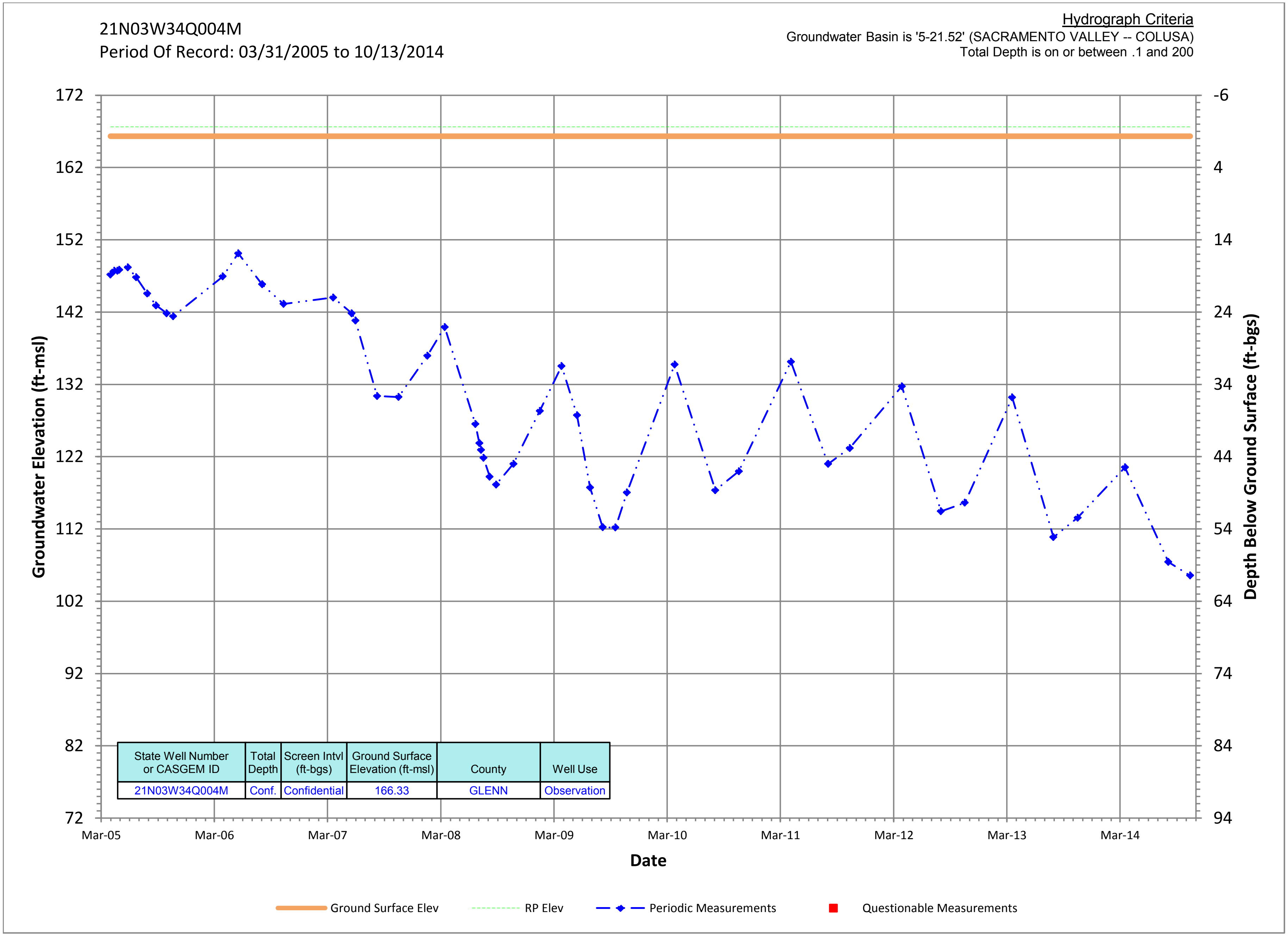


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W23D003M	Conf.	Confidential	204.76	GLENN	Observation

21N03W31H001M
Period Of Record: 08/10/1973 to 10/13/2014



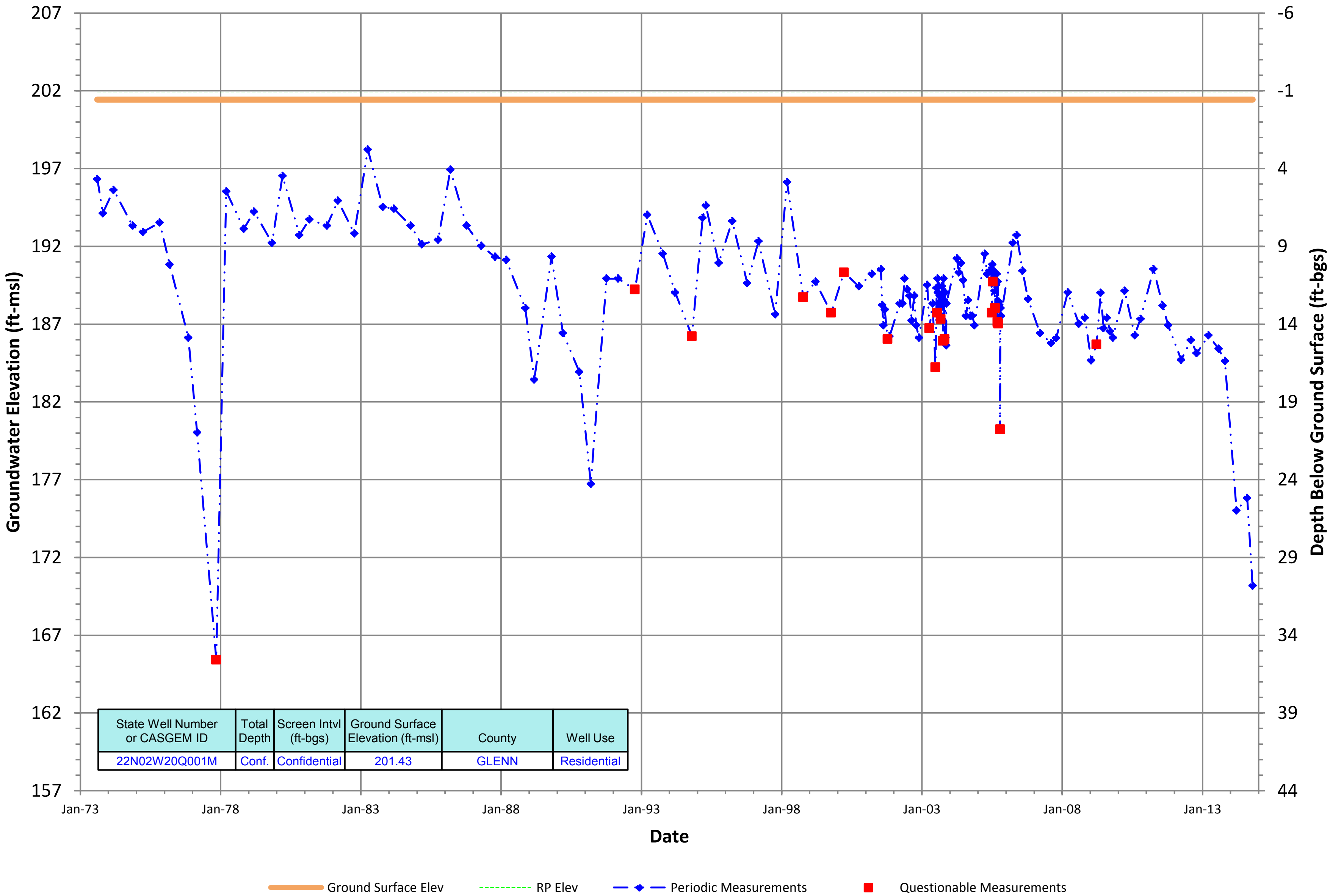
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W31H001M	Conf.	Confidential	189.46	GLENN	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W34Q004M	Conf.	Confidential	166.33	GLENN	Observation

22N02W20Q001M
Period Of Record: 08/09/1973 to 10/16/2014

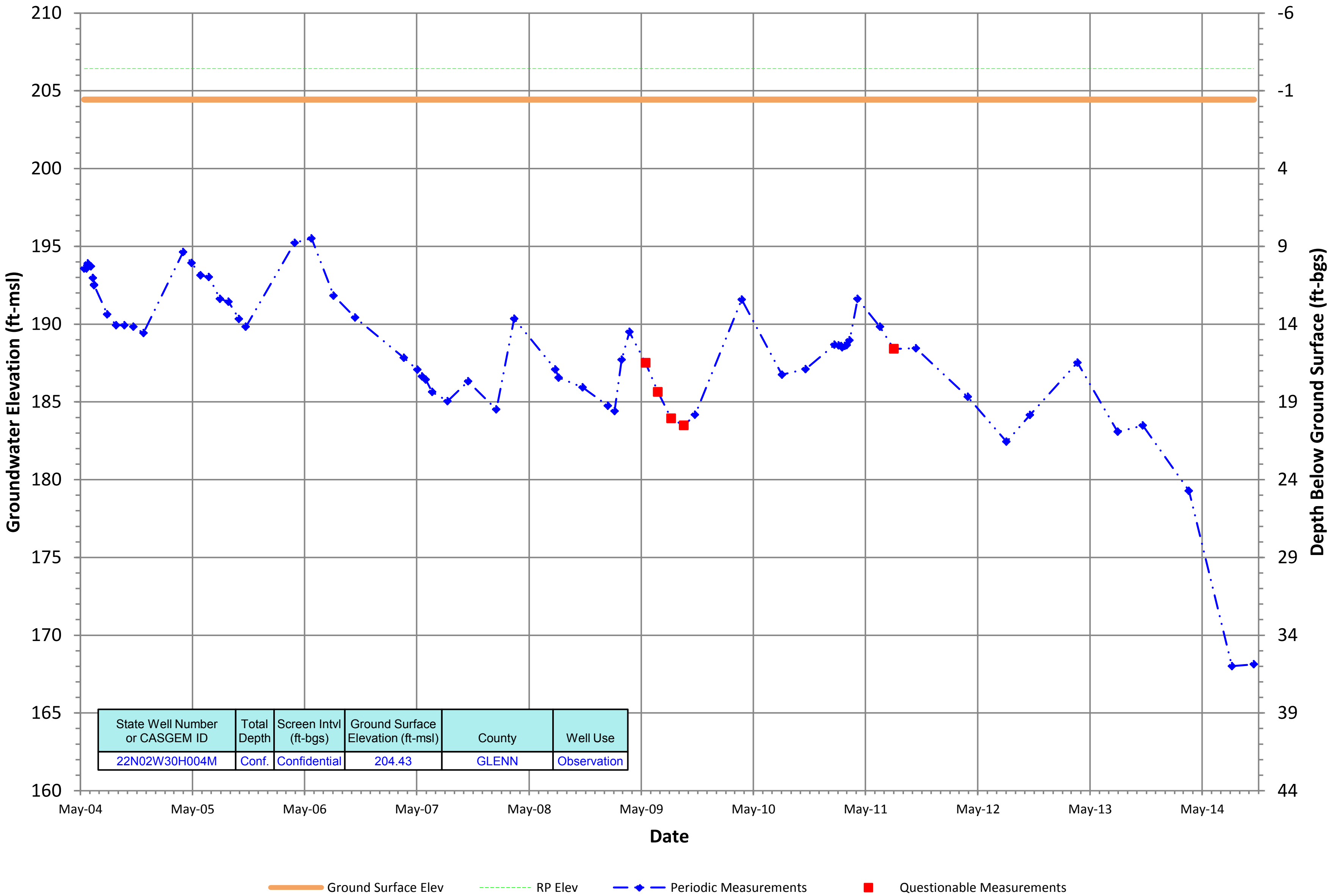
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W20Q001M	Conf.	Confidential	201.43	GLENN	Residential

22N02W30H004M
Period Of Record: 05/13/2004 to 10/16/2014

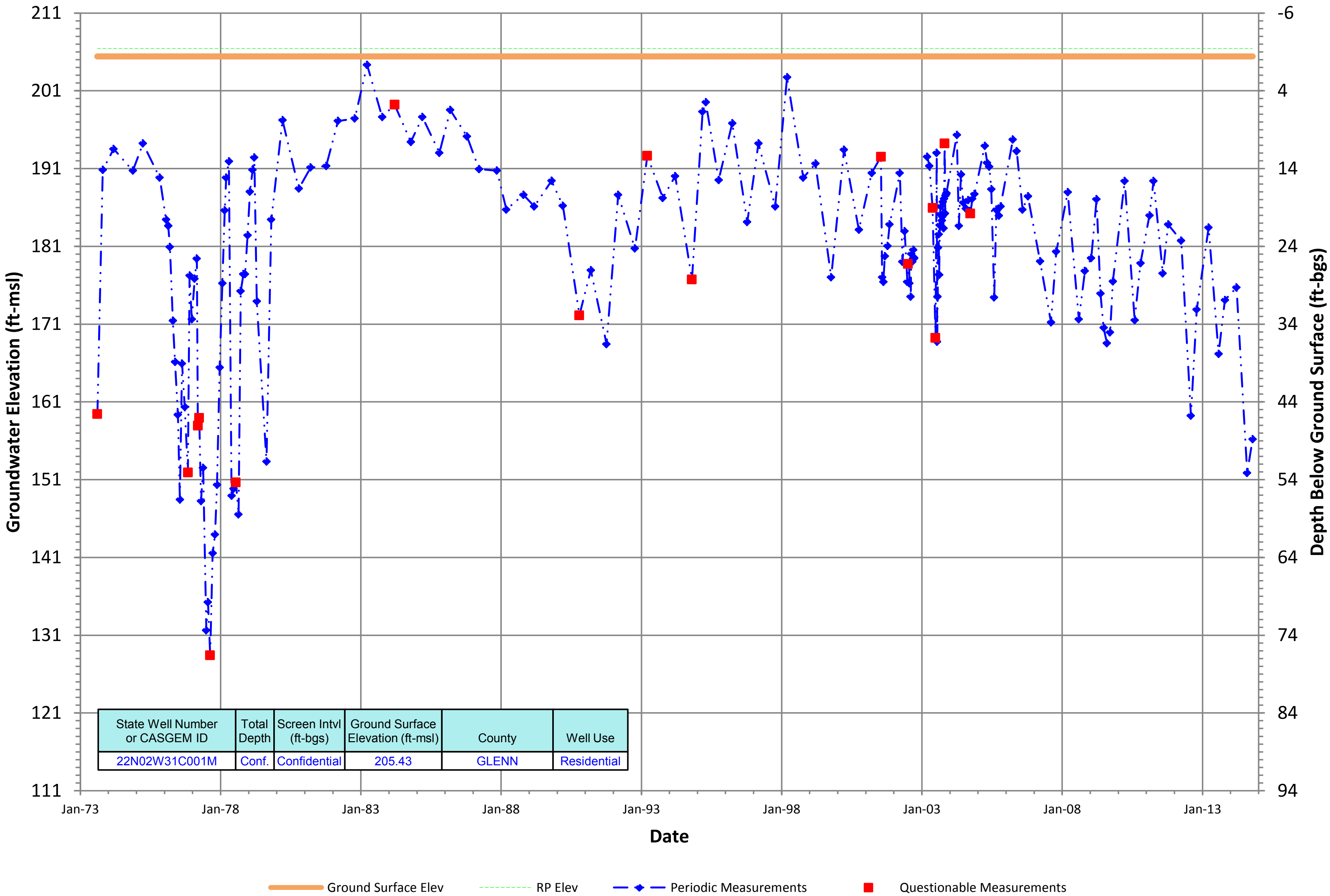
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200

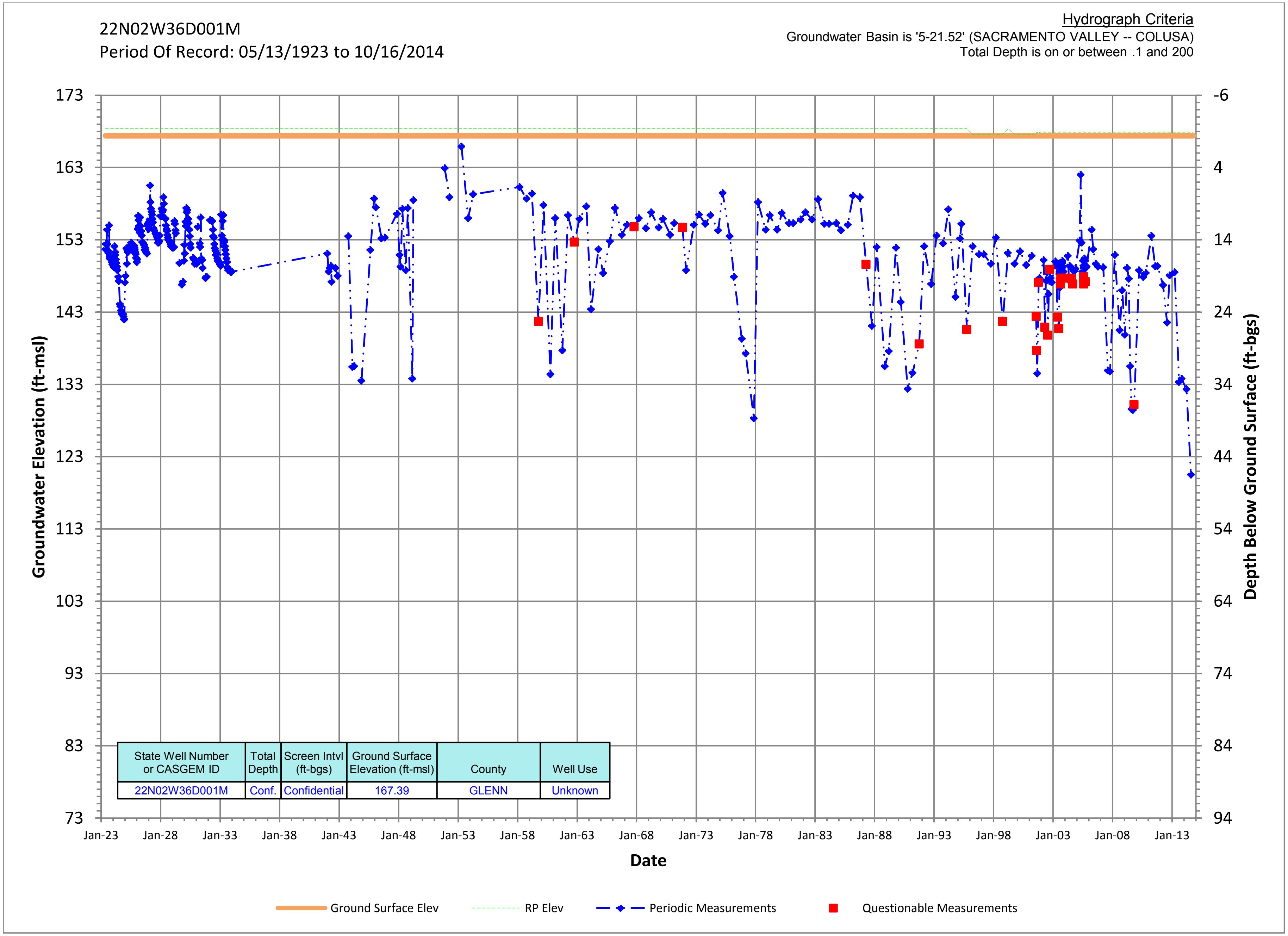


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W30H004M	Conf.	Confidential	204.43	GLENN	Observation

22N02W31C001M
Period Of Record: 08/09/1973 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200

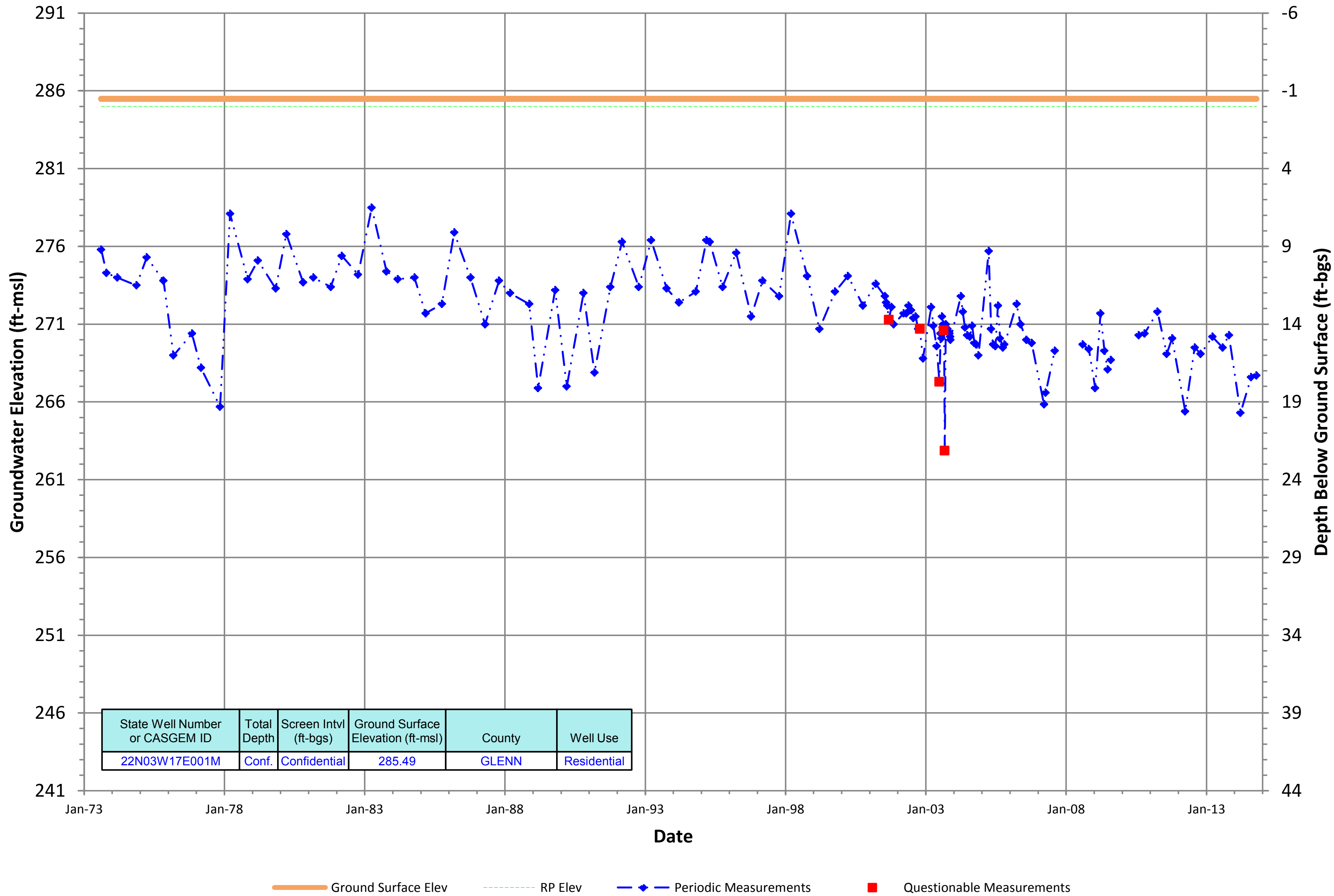




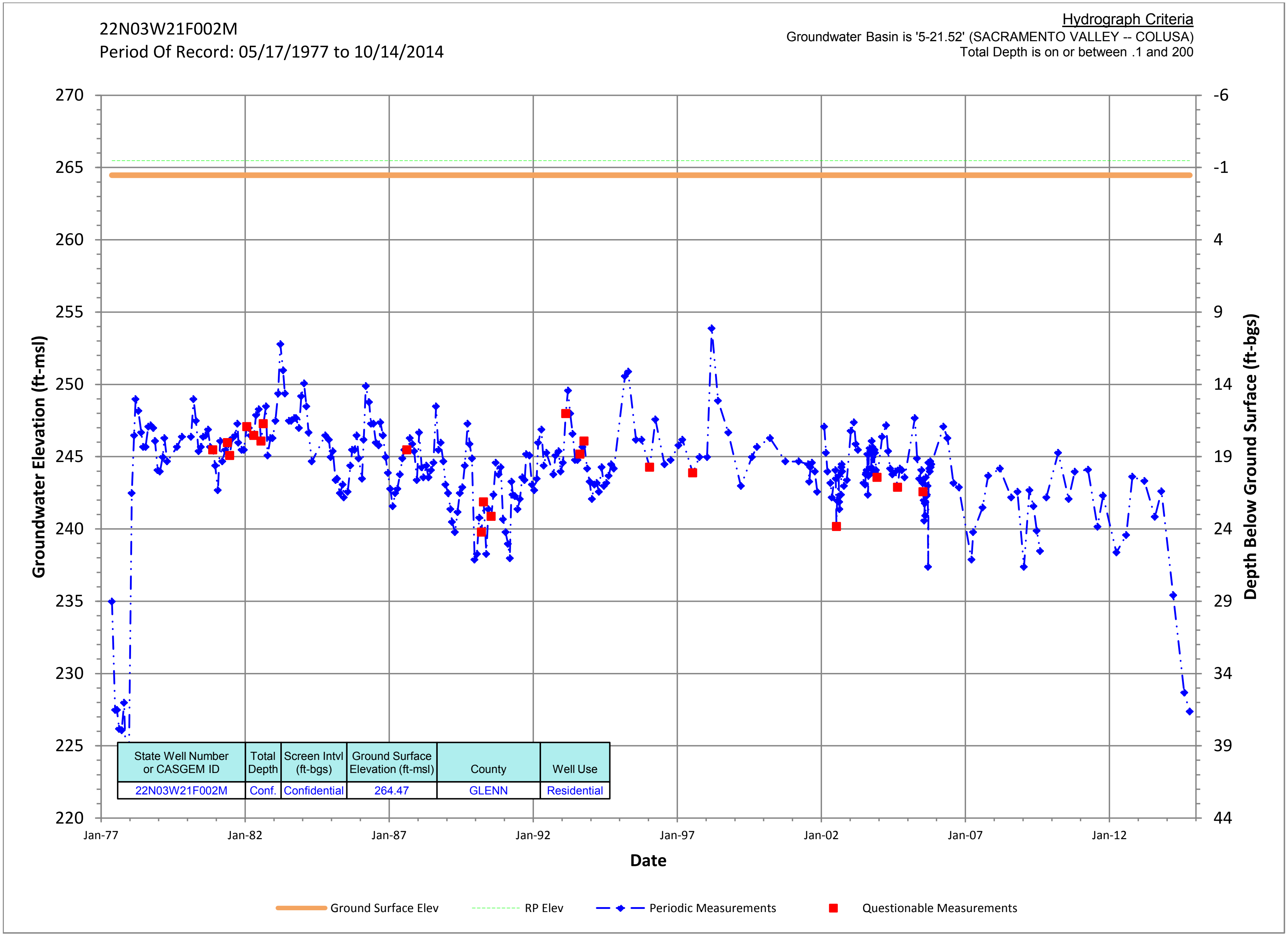
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W36D001M	Conf.	Confidential	167.39	GLENN	Unknown

22N03W17E001M
Period Of Record: 08/09/1973 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



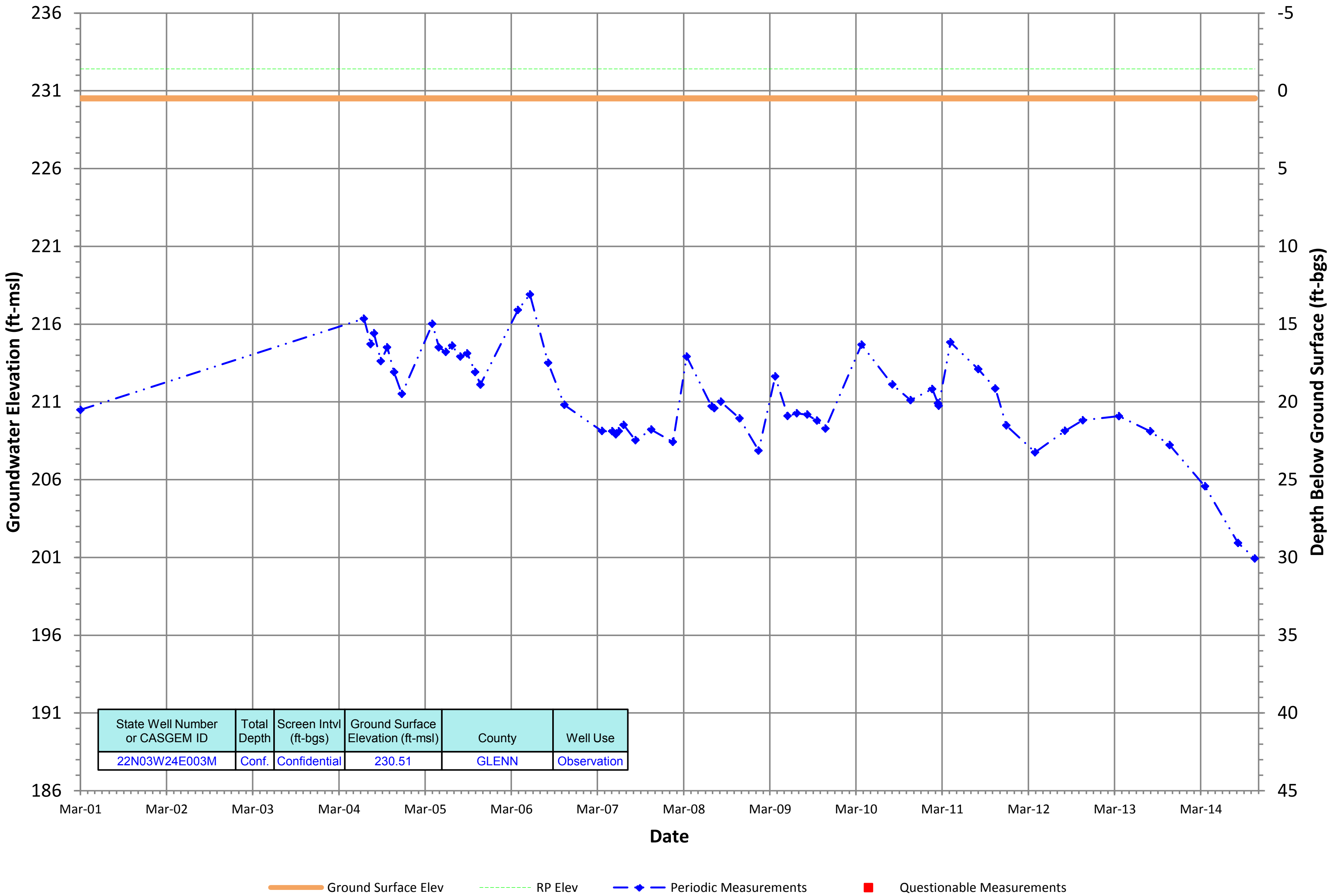
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W17E001M	Conf.	Confidential	285.49	GLENN	Residential



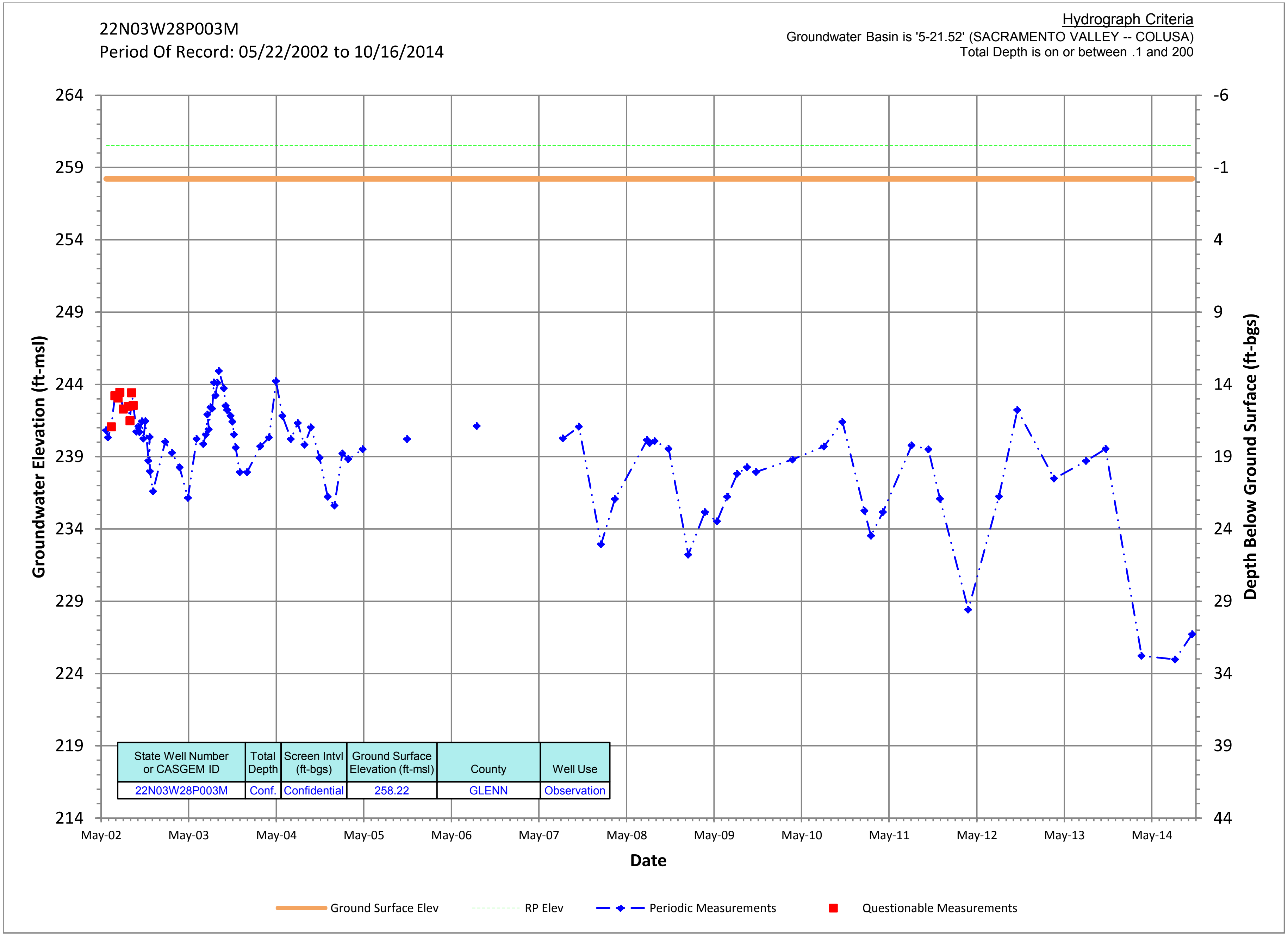
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W21F002M	Conf.	Confidential	264.47	GLENN	Residential

22N03W24E003M
Period Of Record: 03/01/2001 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



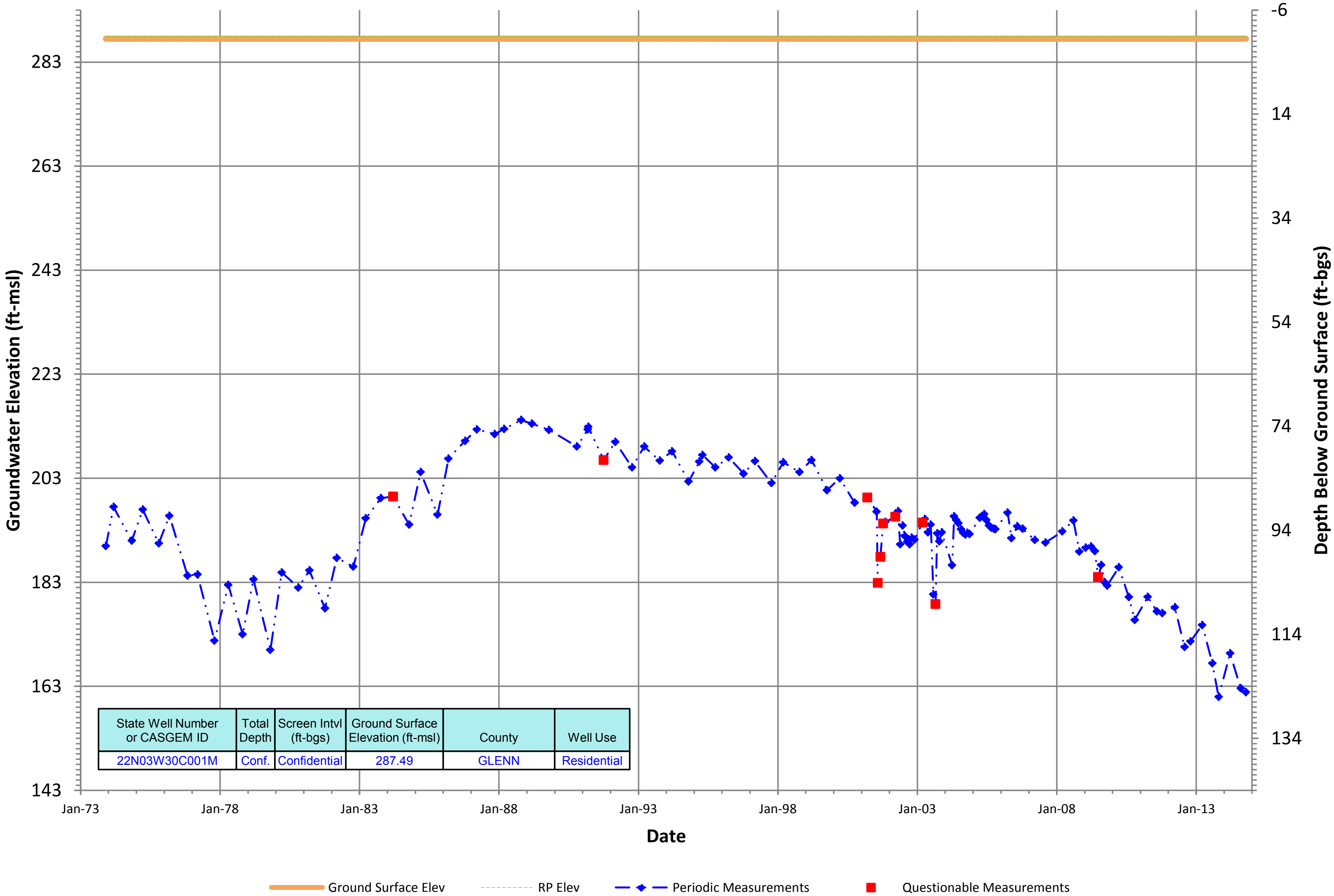
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W24E003M	Conf.	Confidential	230.51	GLENN	Observation



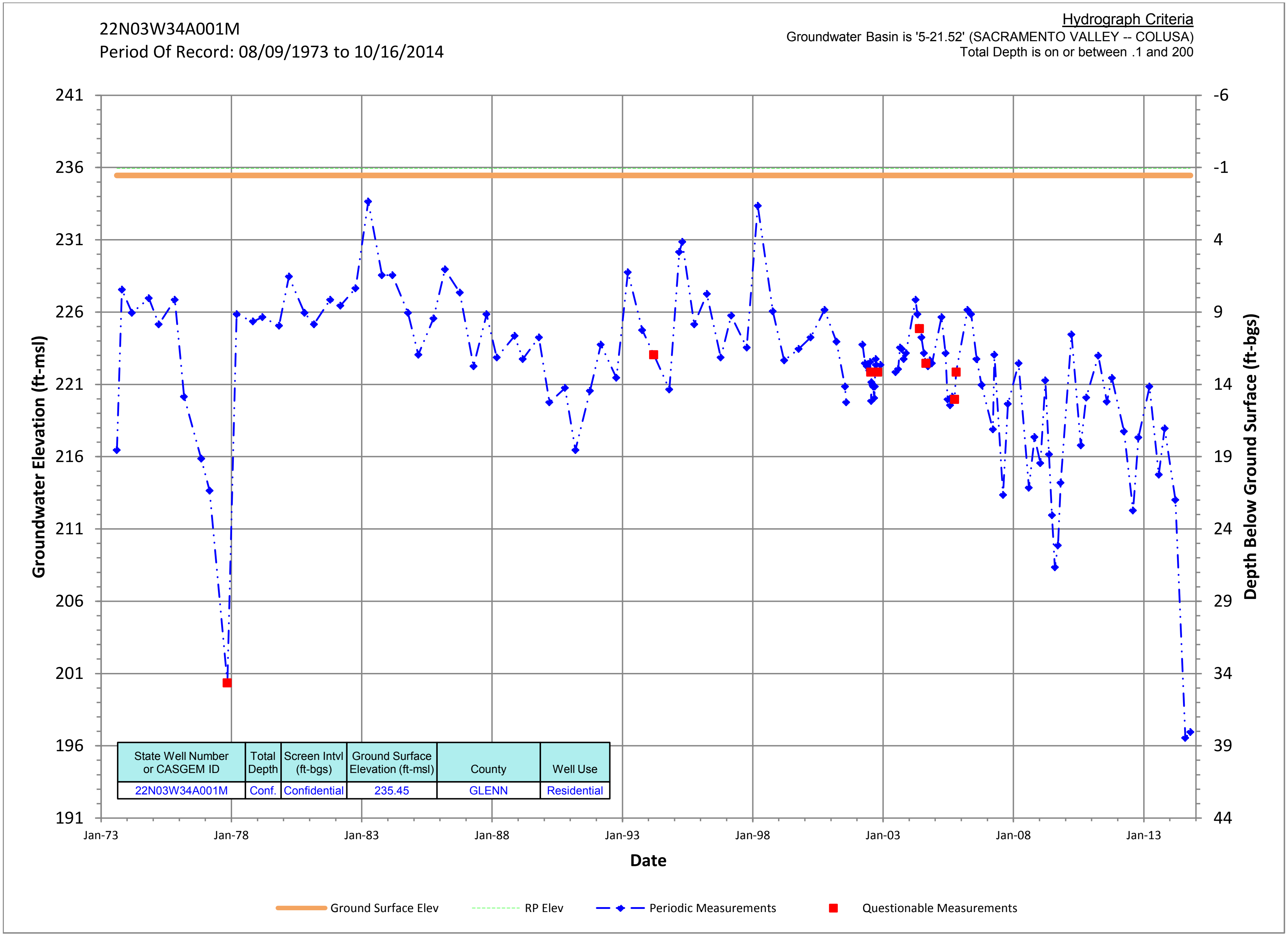
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W28P003M	Conf.	Confidential	258.22	GLENN	Observation

22N03W30C001M
Period Of Record: 11/27/1973 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W30C001M	Conf.	Confidential	287.49	GLENN	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W34A001M	Conf.	Confidential	235.45	GLENN	Residential

Intermediate Depth Groundwater Monitoring Well Hydrographs- Colusa Subbasin

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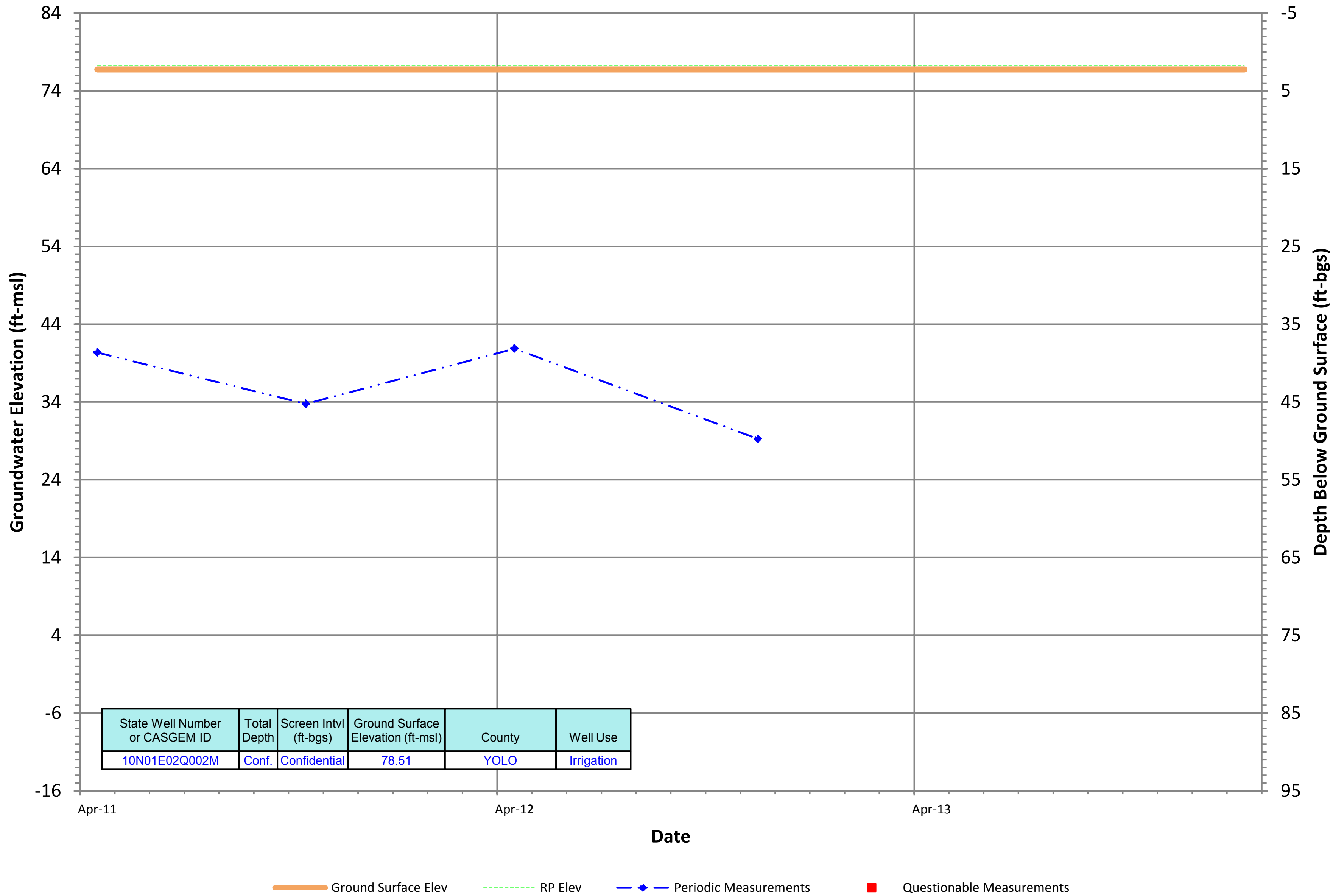
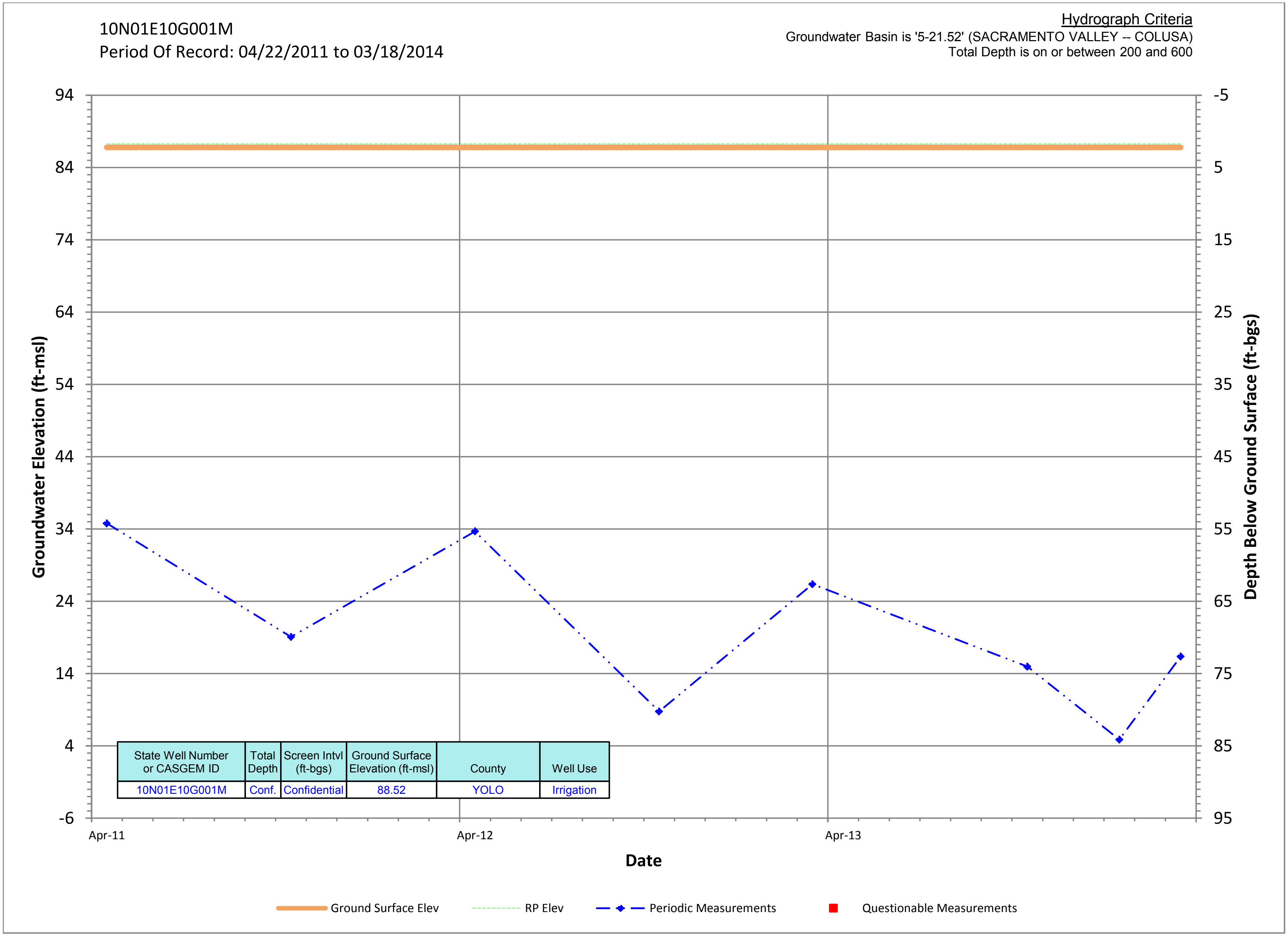
10N01E02Q002M
Period Of Record: 04/22/2011 to 01/31/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



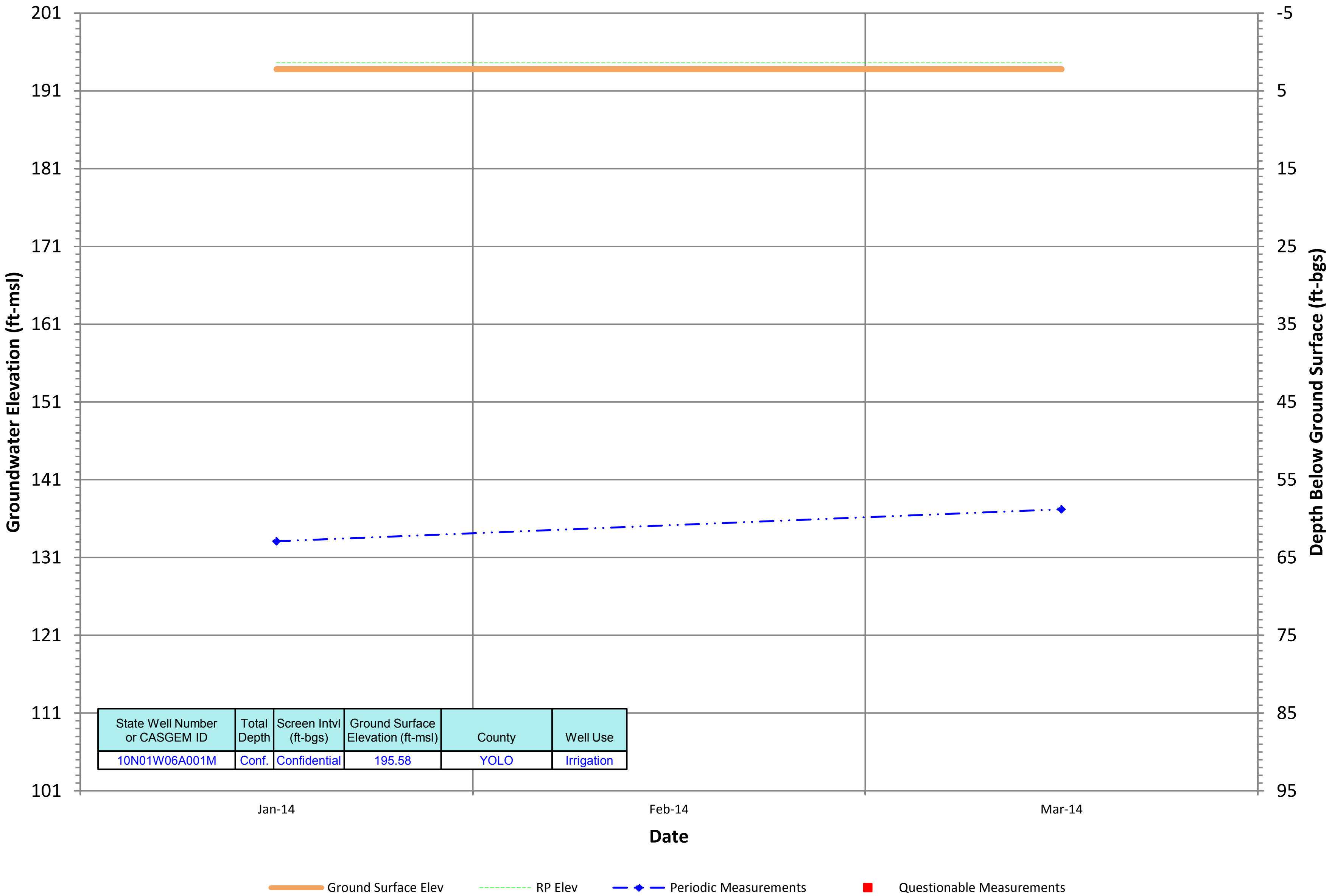
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E02Q002M	Conf.	Confidential	78.51	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E10G001M	Conf.	Confidential	88.52	YOLO	Irrigation

10N01W06A001M
Period Of Record: 01/28/2014 to 03/13/2014

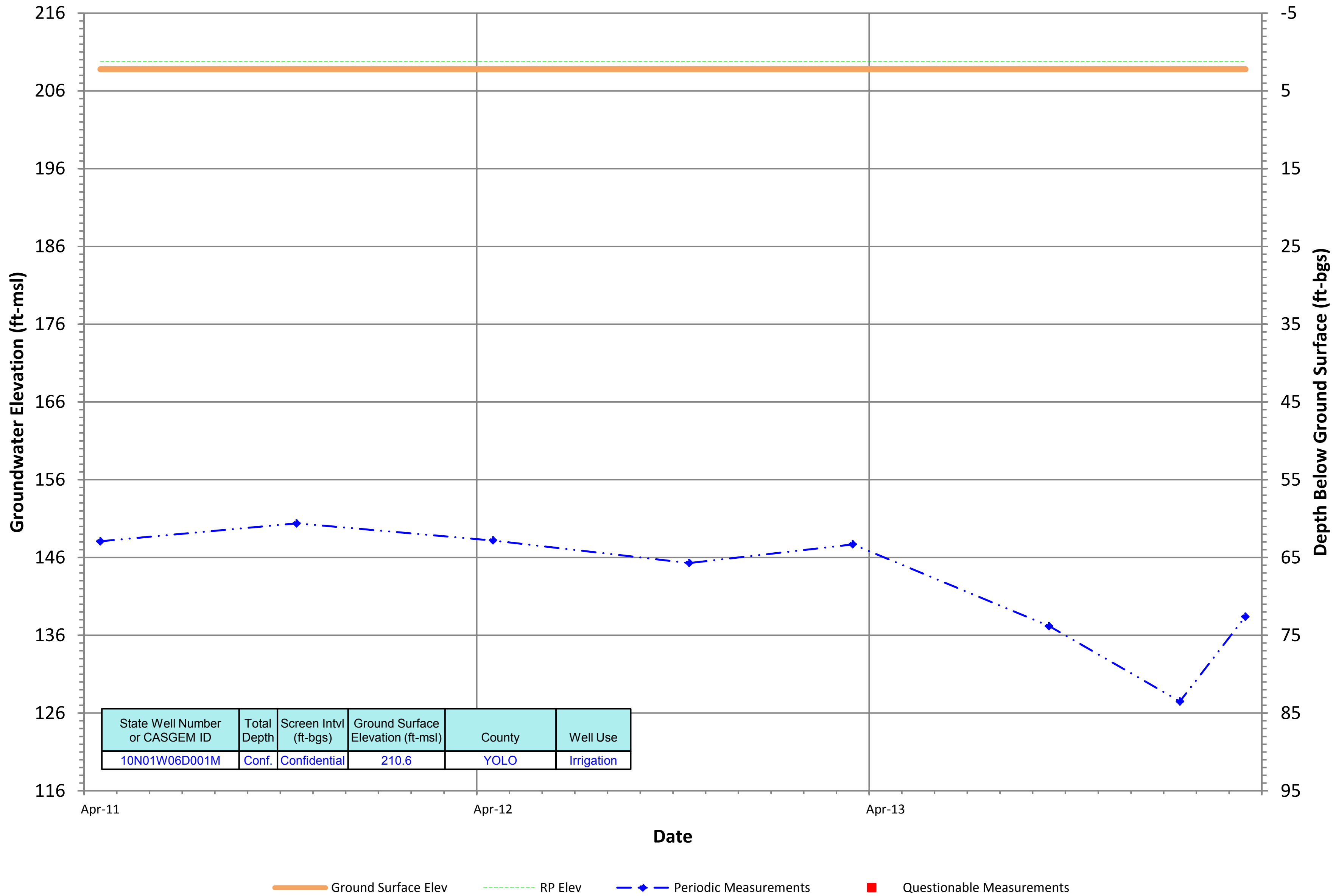
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W06A001M	Conf.	Confidential	195.58	YOLO	Irrigation

10N01W06D001M
Period Of Record: 04/20/2011 to 03/13/2014

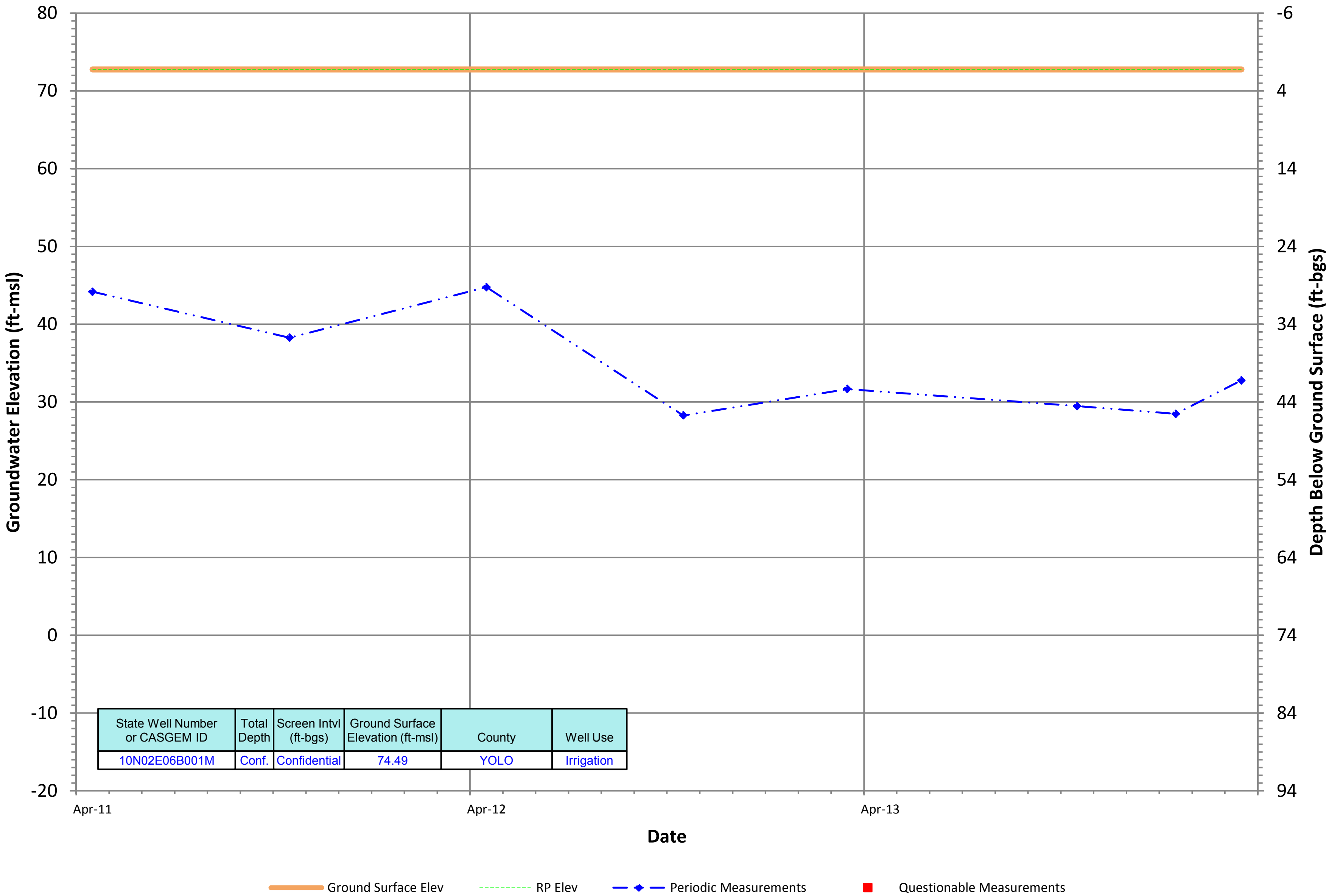
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W06D001M	Conf.	Confidential	210.6	YOLO	Irrigation

10N02E06B001M
Period Of Record: 04/22/2011 to 03/18/2014

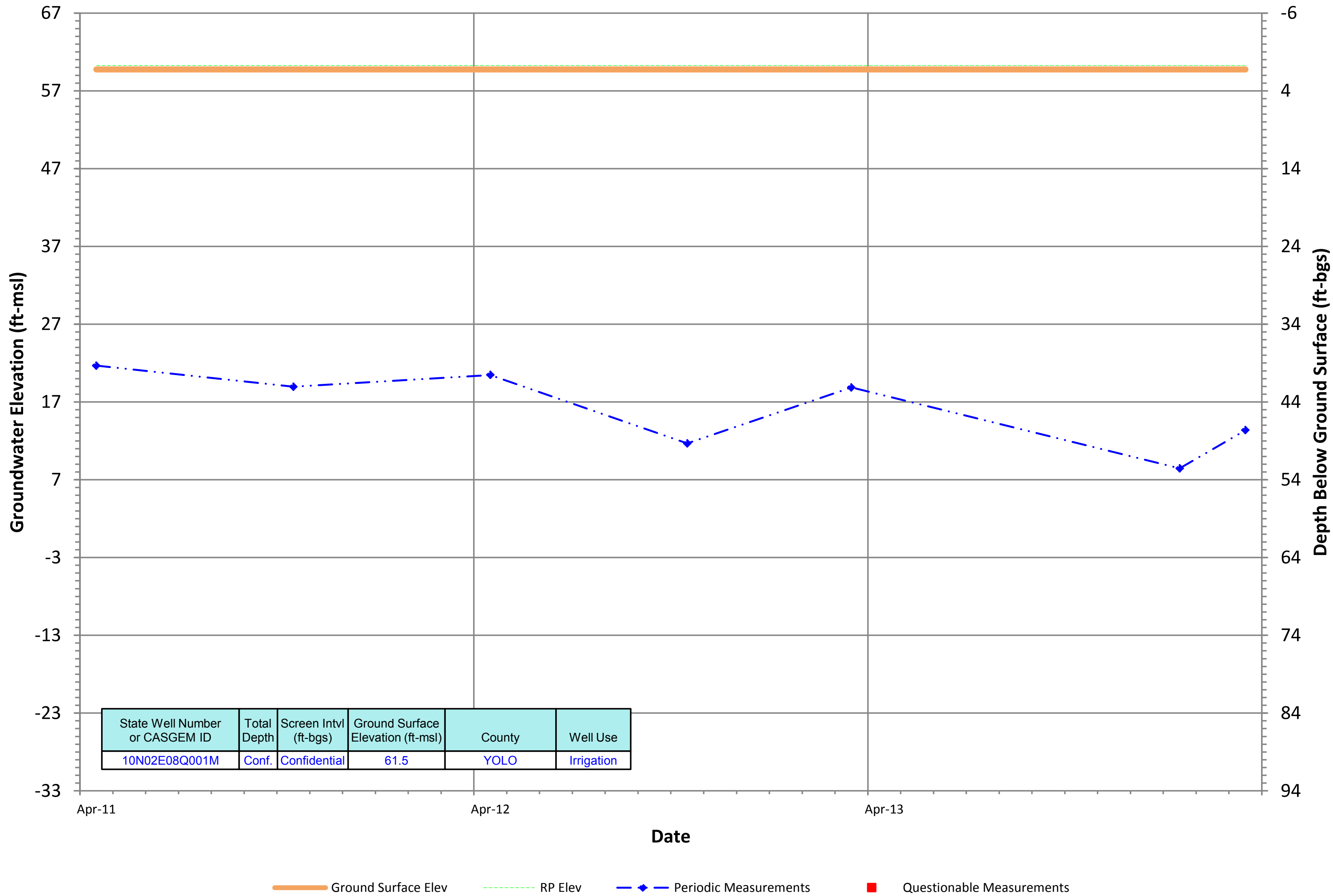
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E06B001M	Conf.	Confidential	74.49	YOLO	Irrigation

10N02E08Q001M
Period Of Record: 04/22/2011 to 03/19/2014

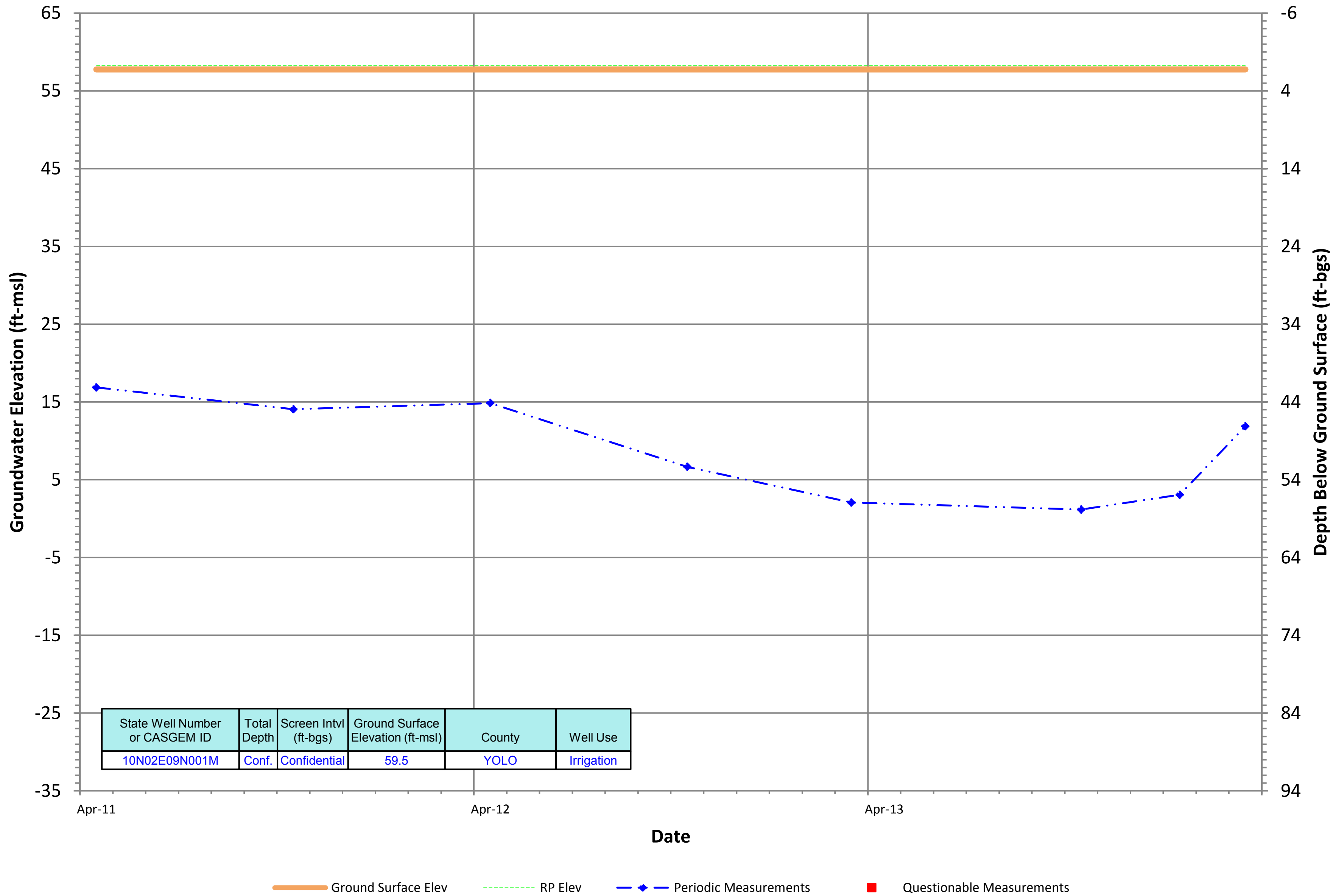
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E08Q001M	Conf.	Confidential	61.5	YOLO	Irrigation

10N02E09N001M
Period Of Record: 04/22/2011 to 03/19/2014

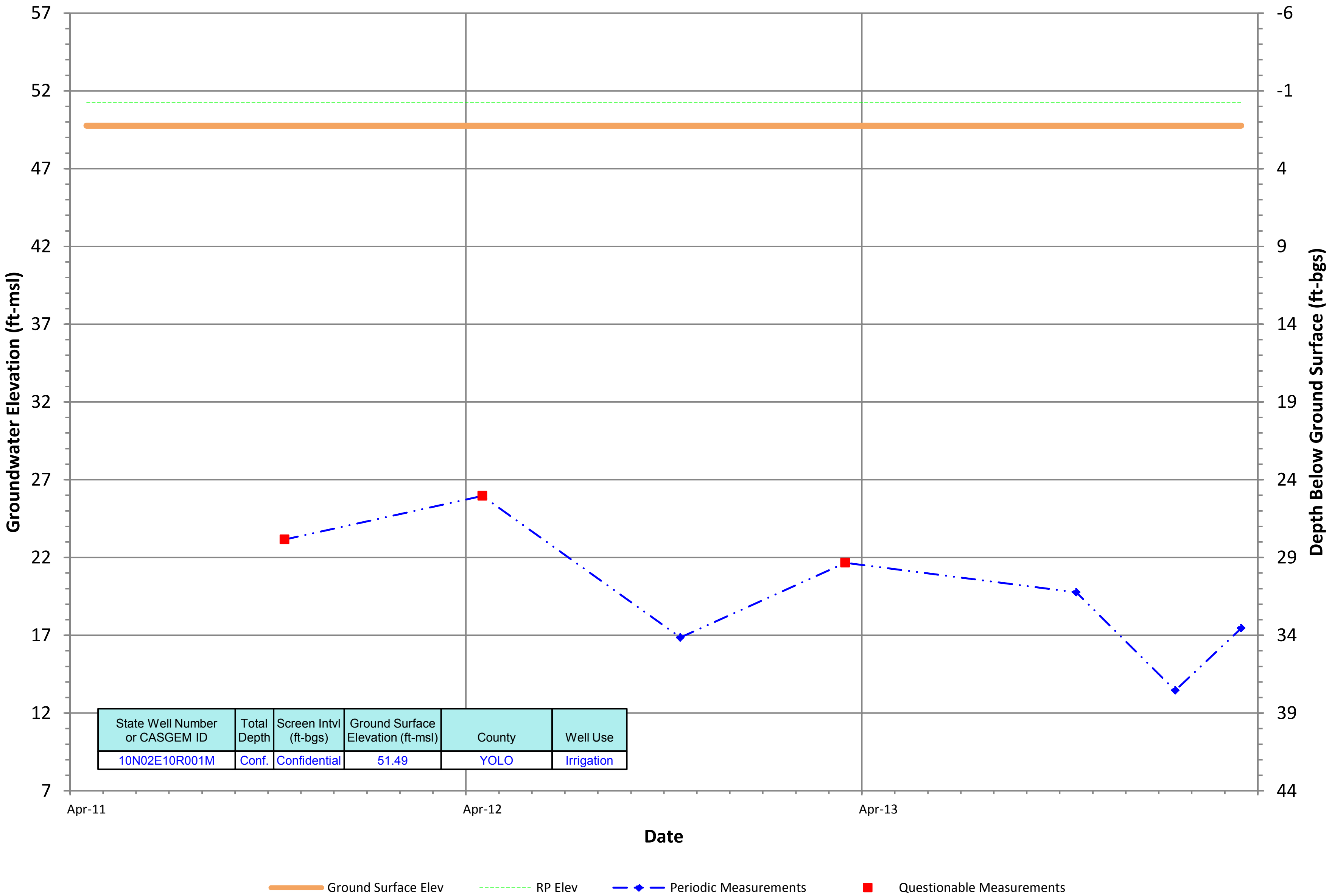
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E09N001M	Conf.	Confidential	59.5	YOLO	Irrigation

10N02E10R001M
Period Of Record: 04/22/2011 to 03/19/2014

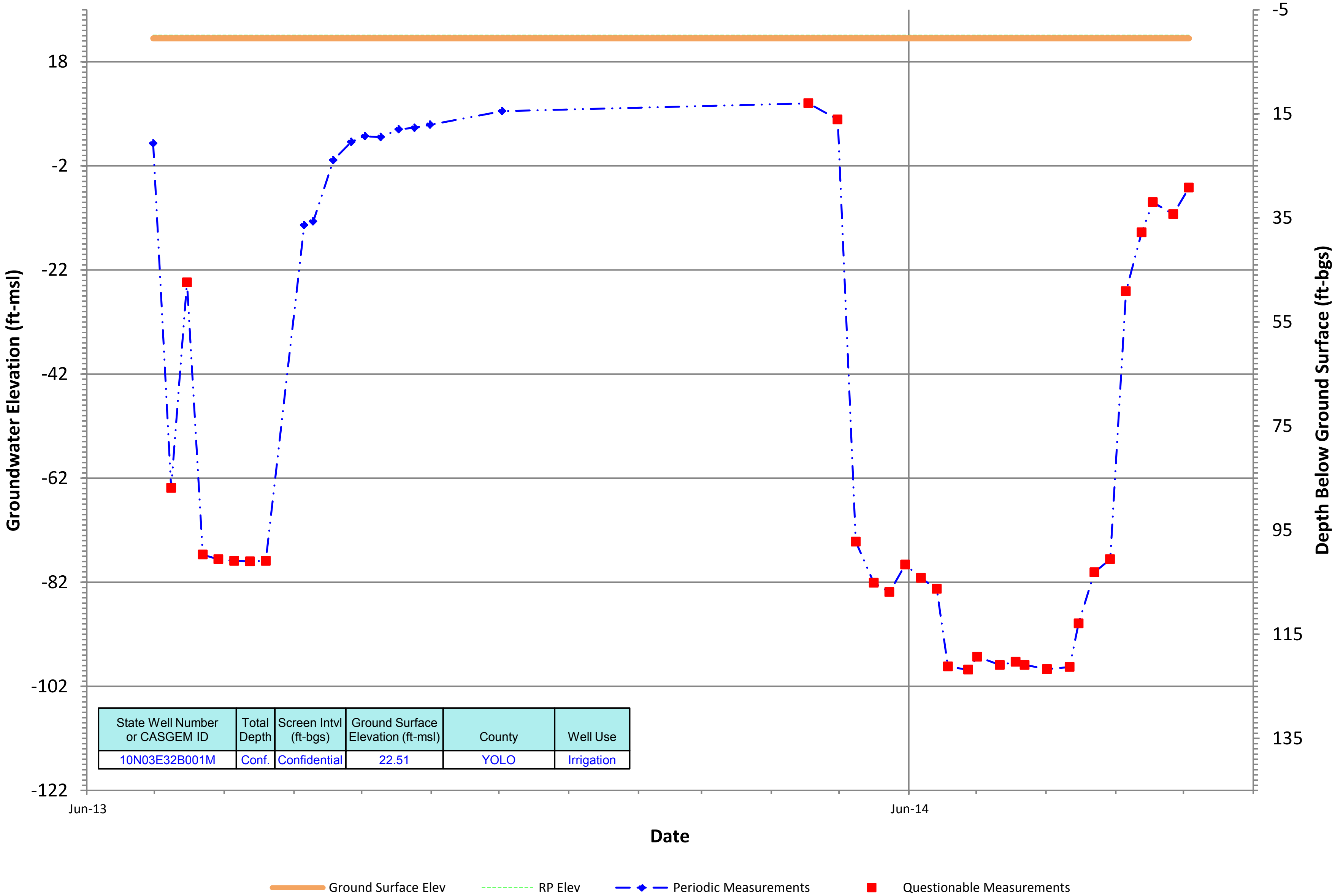
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E10R001M	Conf.	Confidential	51.49	YOLO	Irrigation

10N03E32B001M
Period Of Record: 06/30/2013 to 10/03/2014

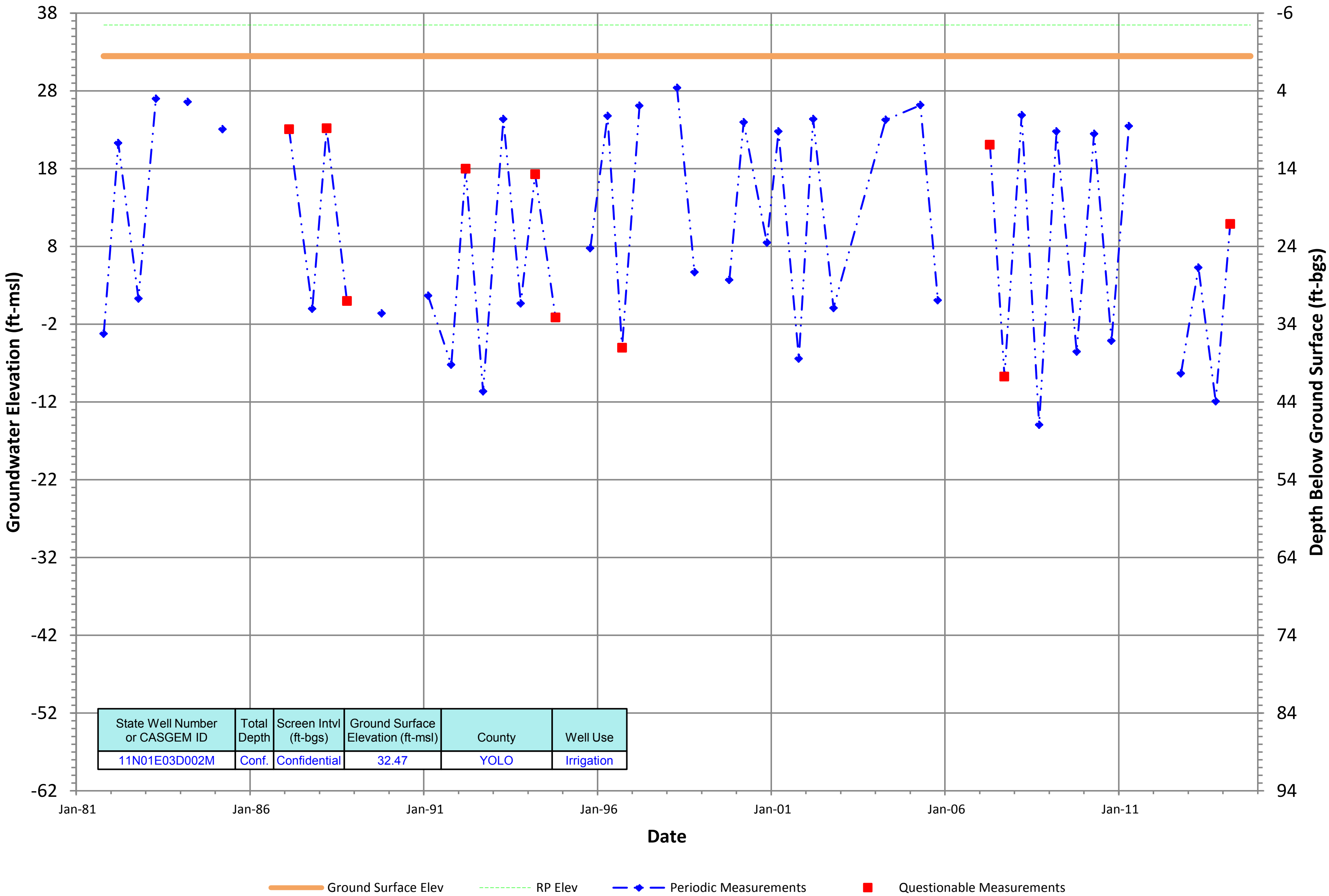
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



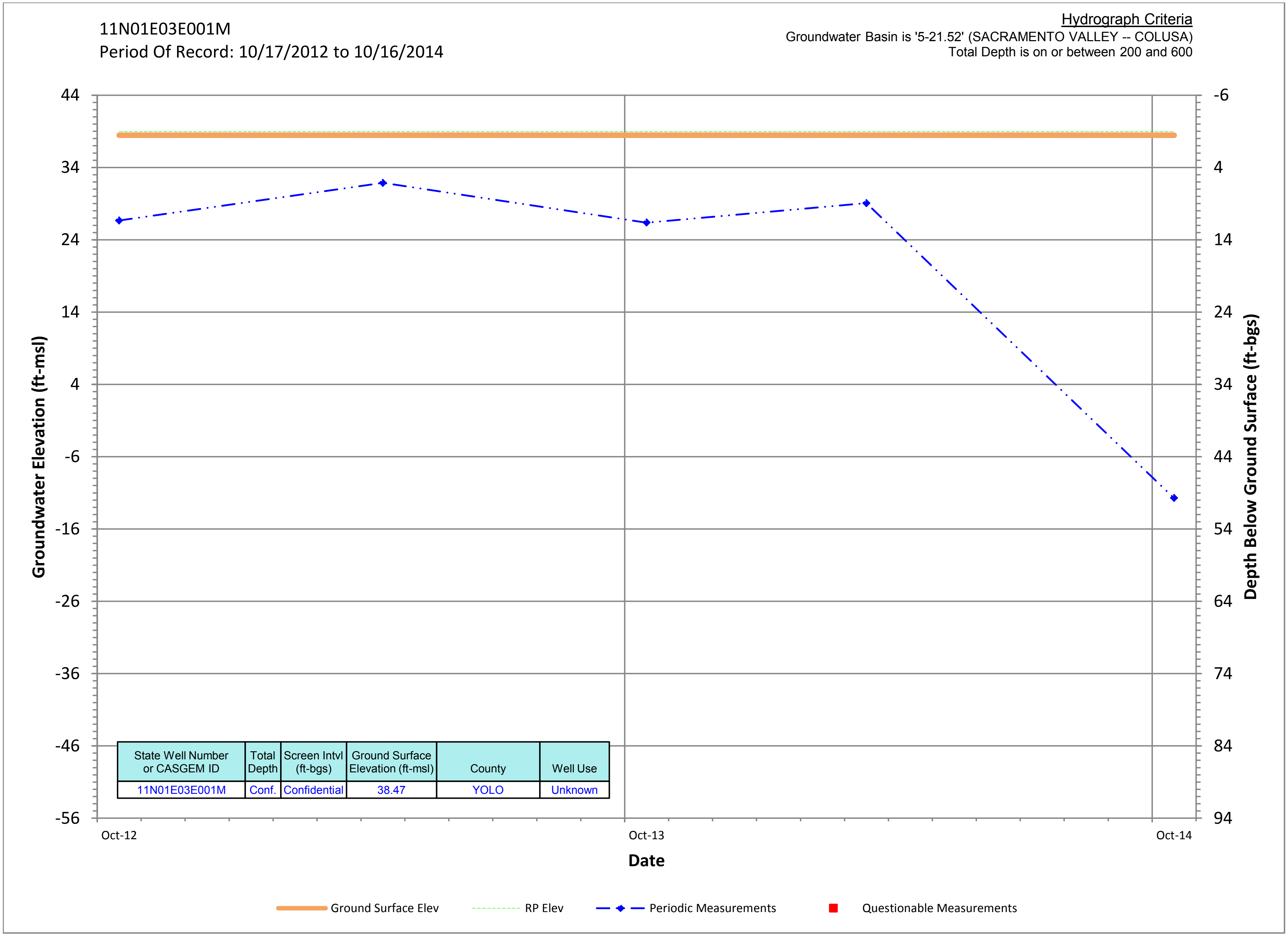
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N03E32B001M	Conf.	Confidential	22.51	YOLO	Irrigation

11N01E03D002M
Period Of Record: 10/14/1981 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



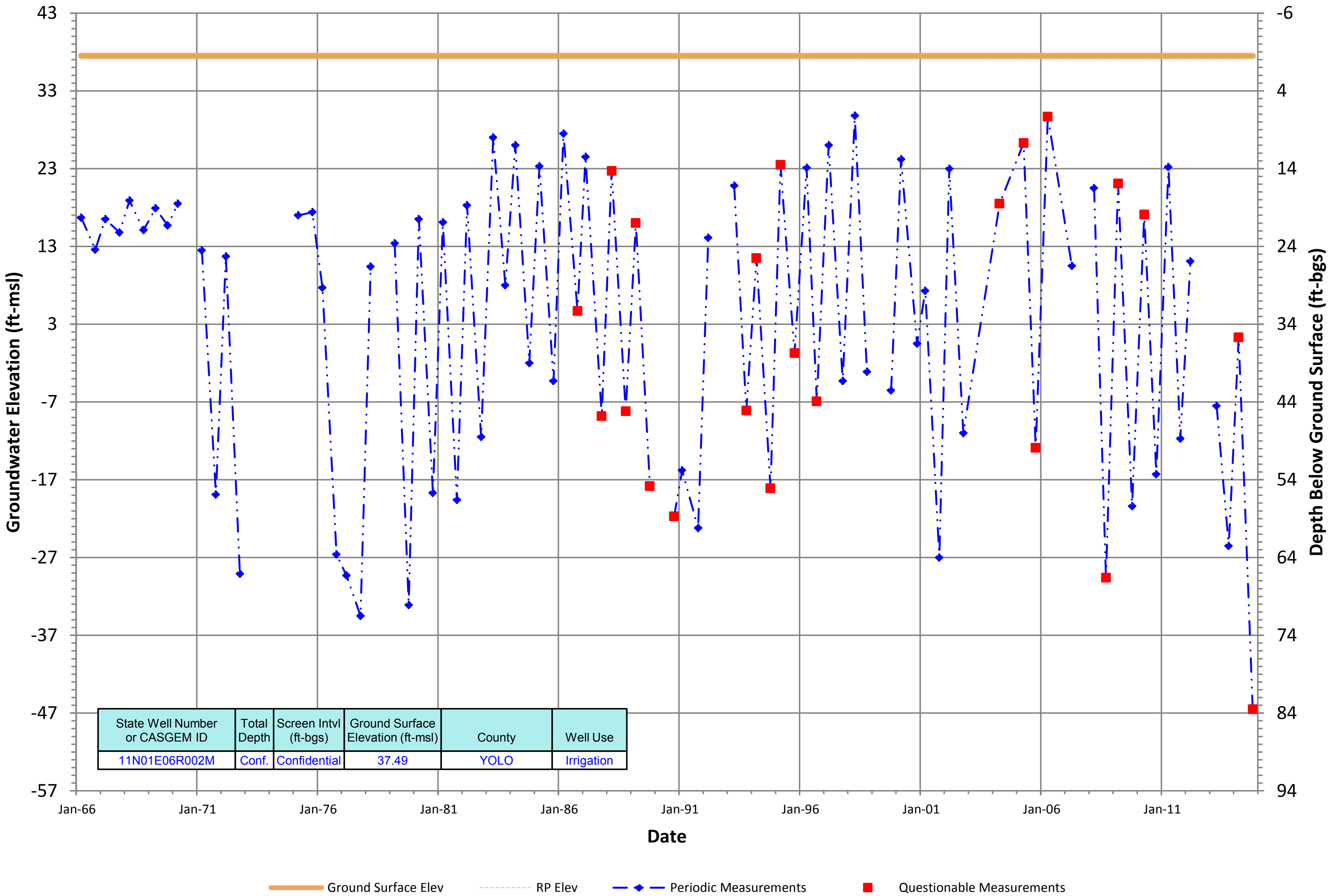
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E03D002M	Conf.	Confidential	32.47	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E03E001M	Conf.	Confidential	38.47	YOLO	Unknown

11N01E06R002M
Period Of Record: 03/16/1966 to 10/16/2014

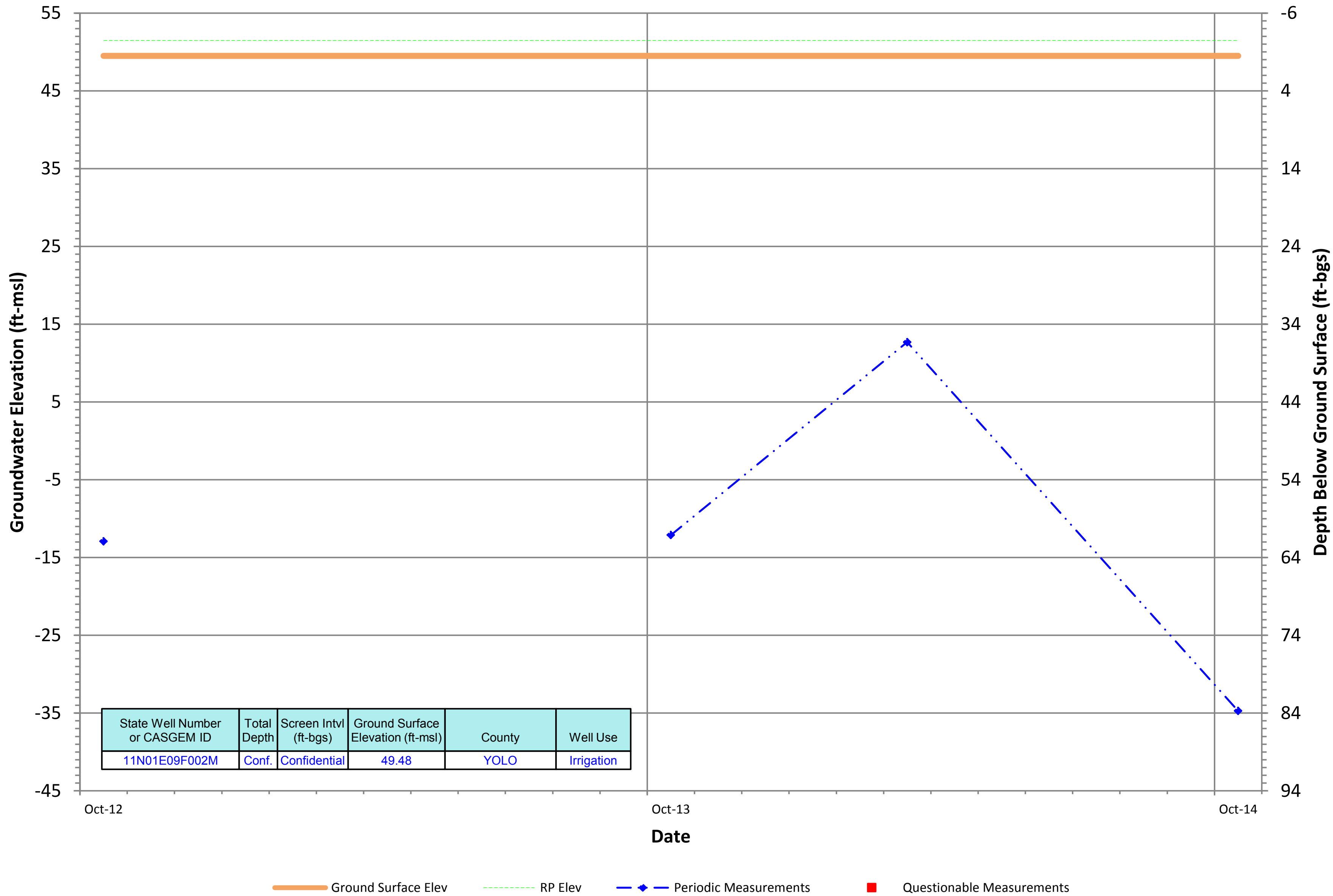
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E06R002M	Conf.	Confidential	37.49	YOLO	Irrigation

11N01E09F002M
Period Of Record: 10/17/2012 to 10/16/2014

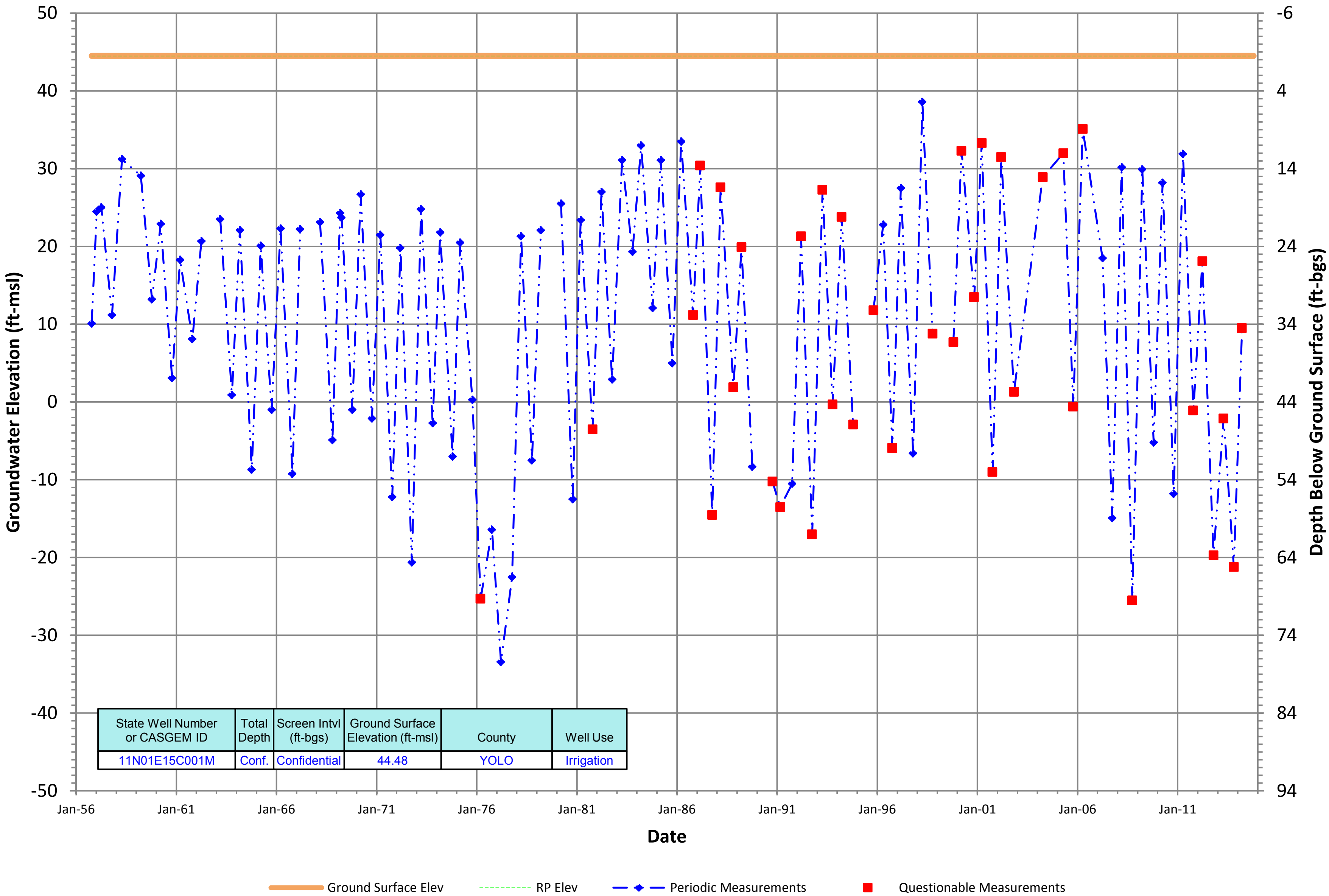
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



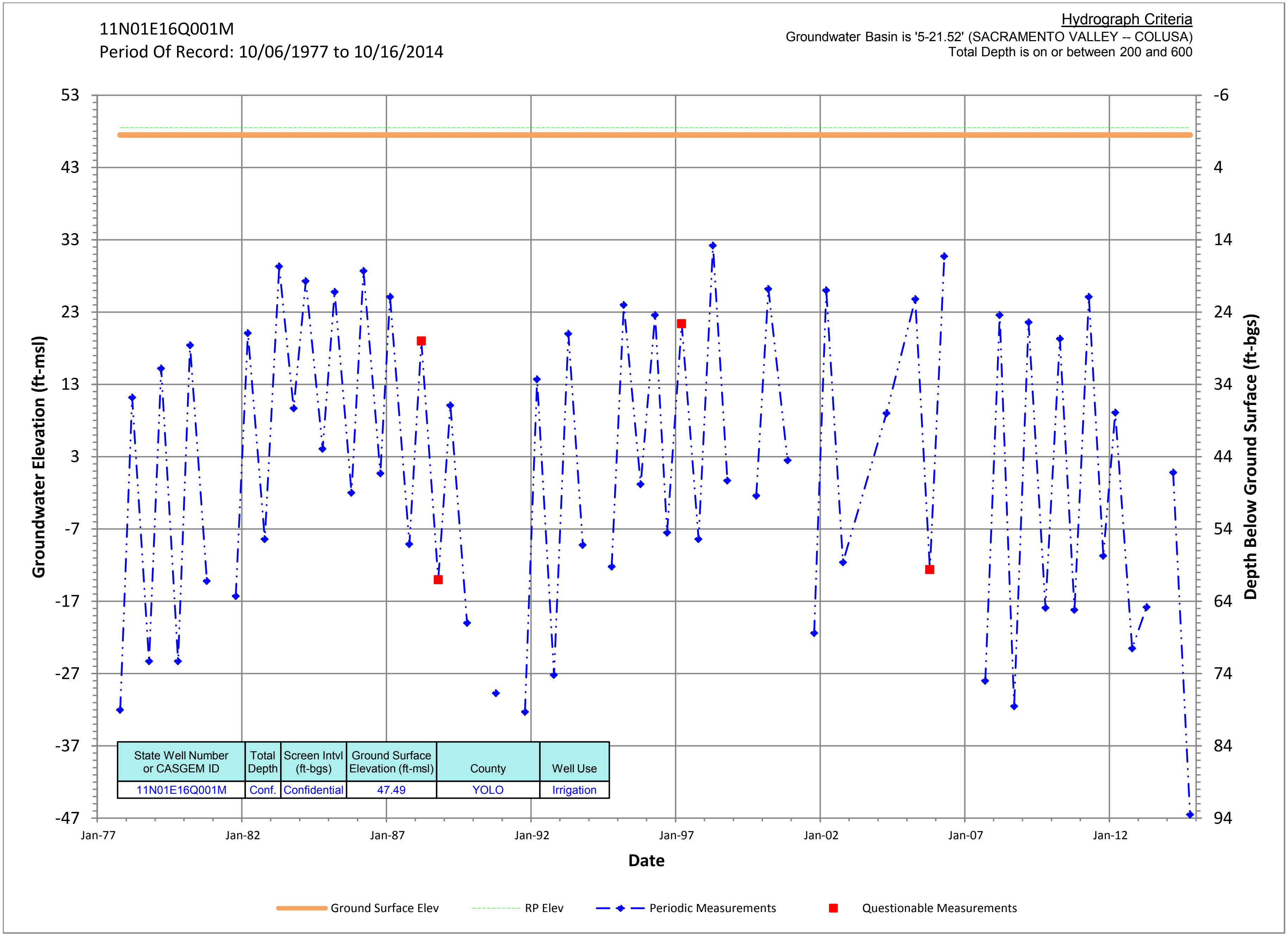
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E09F002M	Conf.	Confidential	49.48	YOLO	Irrigation

11N01E15C001M
Period Of Record: 10/10/1956 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



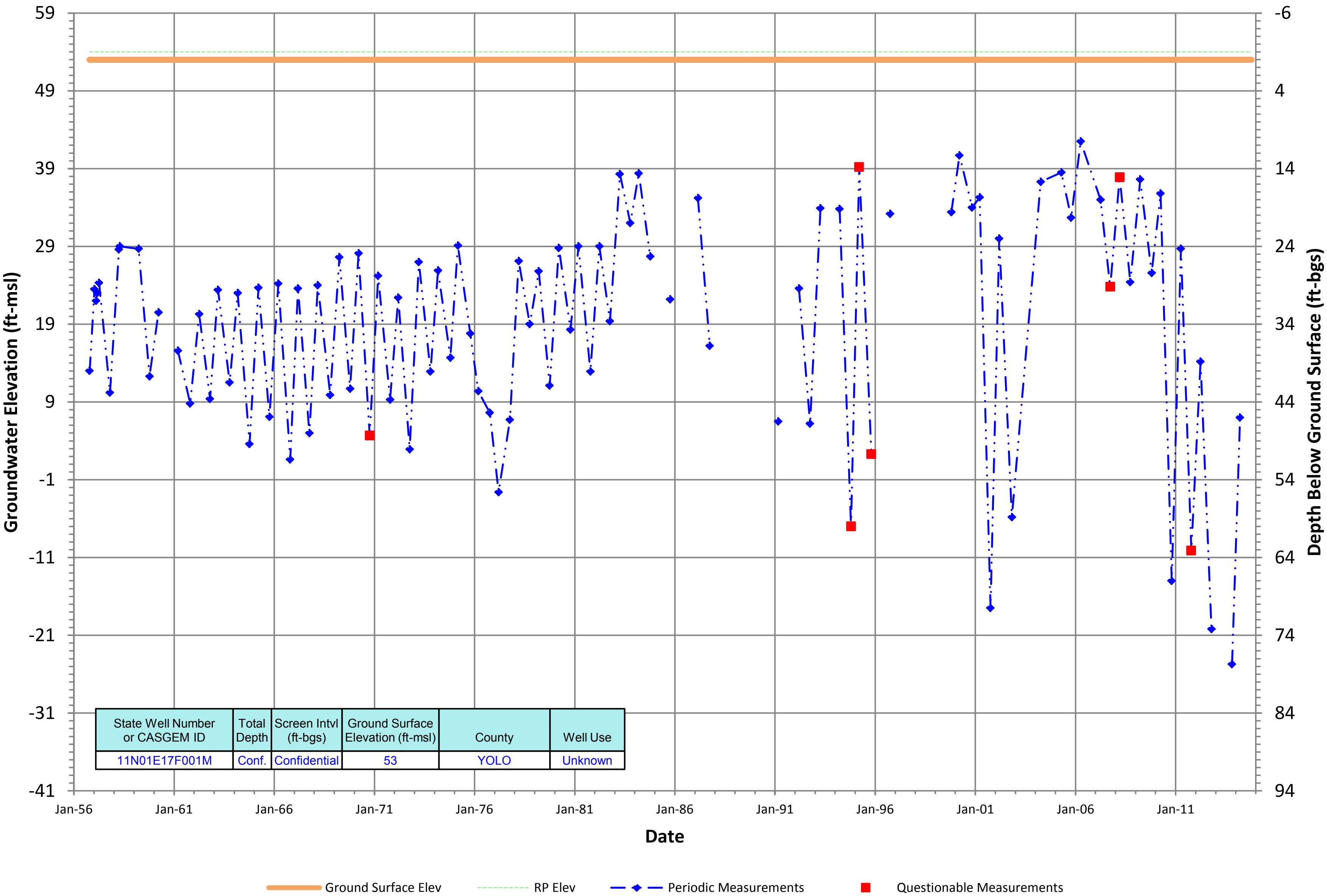
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E15C001M	Conf.	Confidential	44.48	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E16Q001M	Conf.	Confidential	47.49	YOLO	Irrigation

11N01E17F001M
Period Of Record: 10/12/1956 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E17F001M	Conf.	Confidential	53	YOLO	Unknown

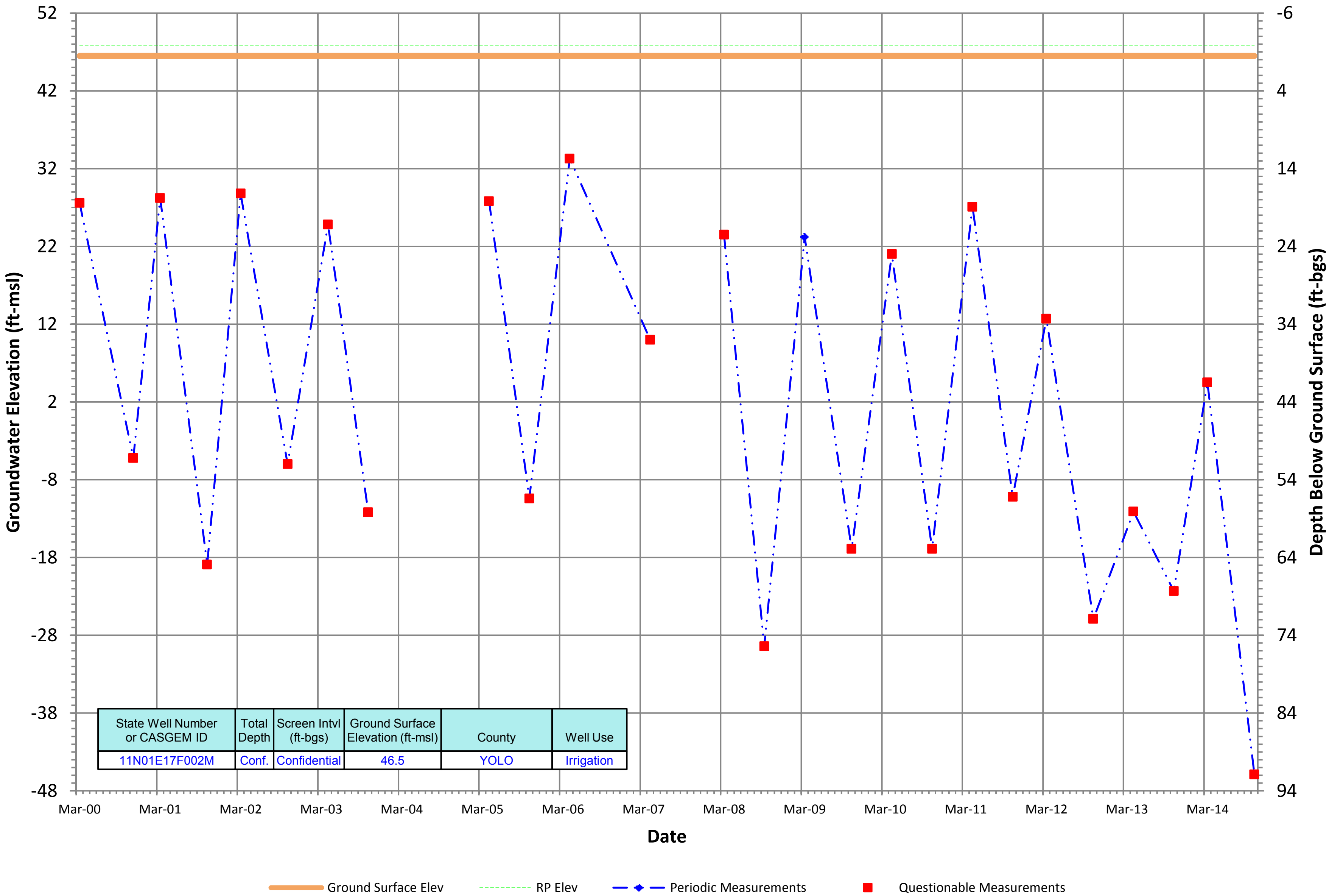
11N01E17F002M

Period Of Record: 03/17/2000 to 10/16/2014

Hydrograph Criteria

Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)

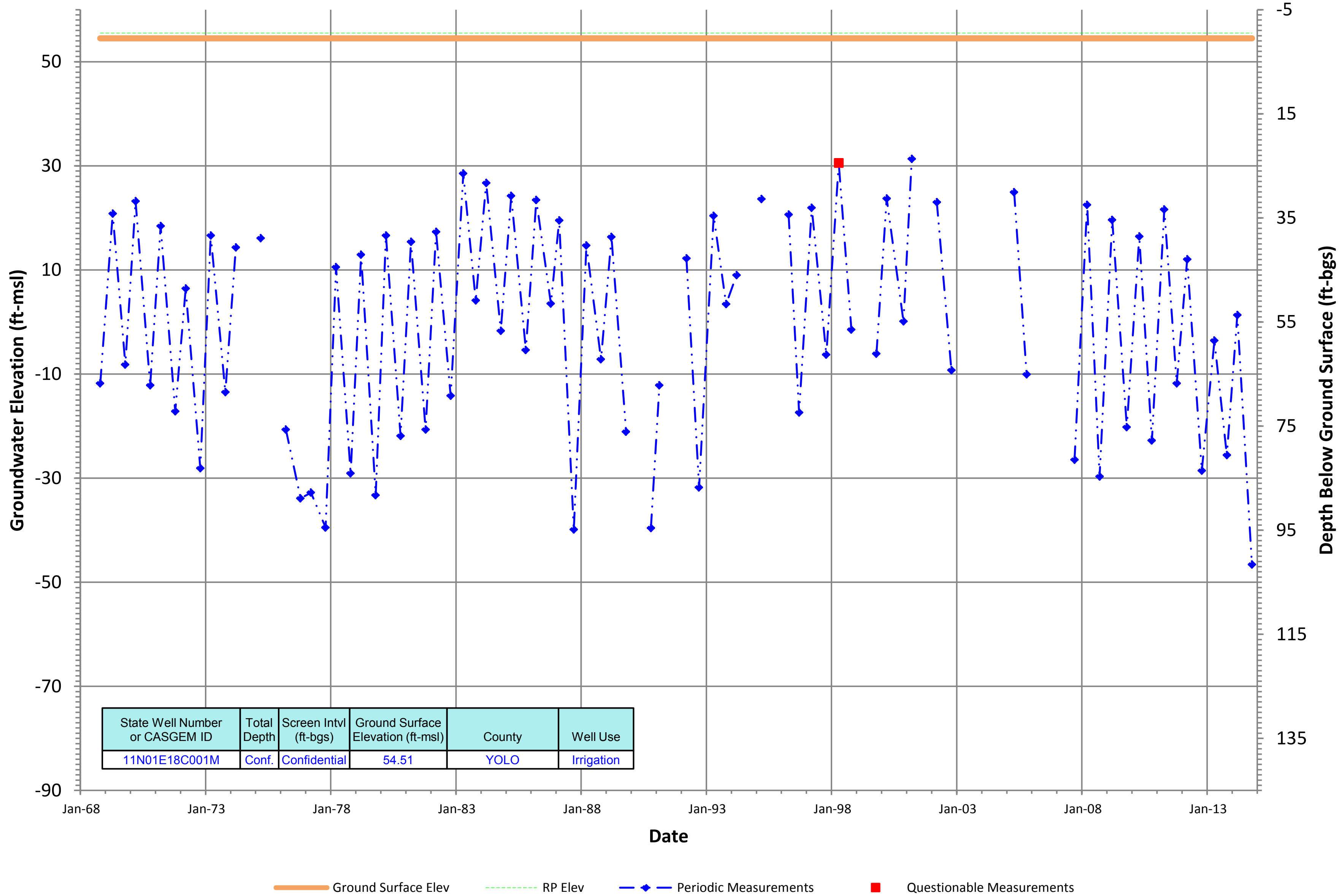
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E17F002M	Conf.	Confidential	46.5	YOLO	Irrigation

11N01E18C001M
Period Of Record: 10/16/1968 to 10/17/2014

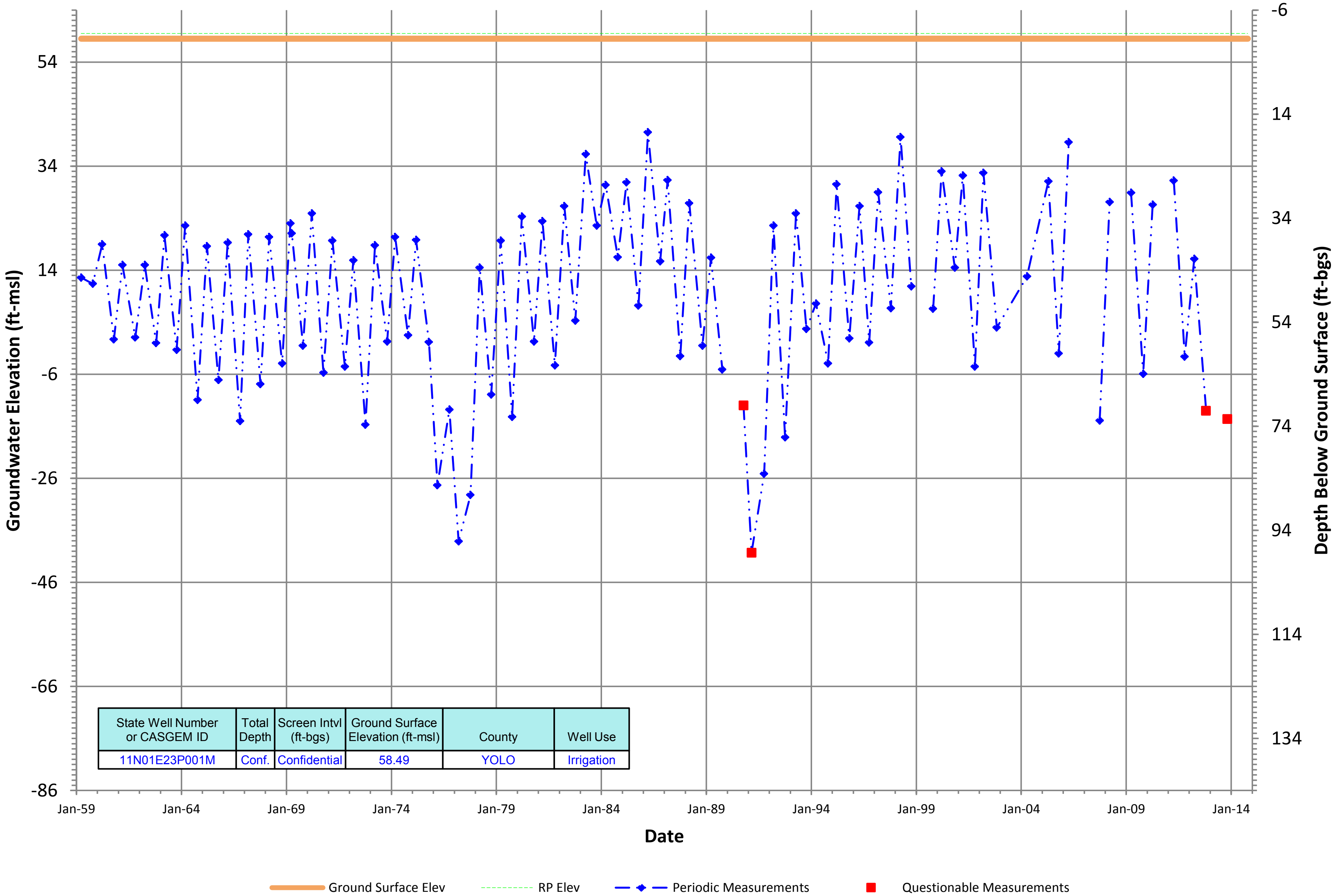
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E18C001M	Conf.	Confidential	54.51	YOLO	Irrigation

11N01E23P001M
Period Of Record: 03/23/1959 to 10/16/2014

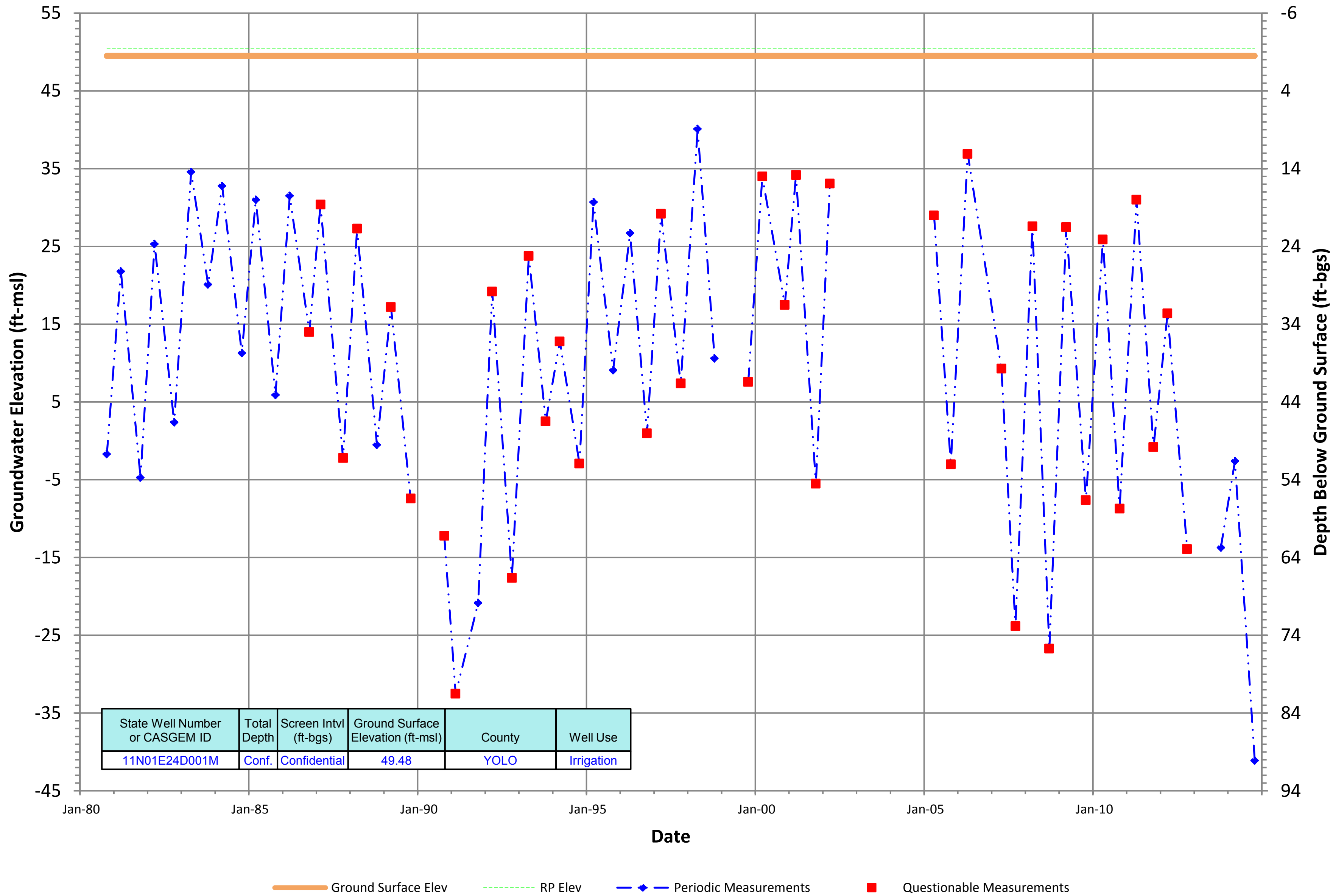
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E23P001M	Conf.	Confidential	58.49	YOLO	Irrigation

11N01E24D001M
Period Of Record: 10/16/1980 to 10/16/2014

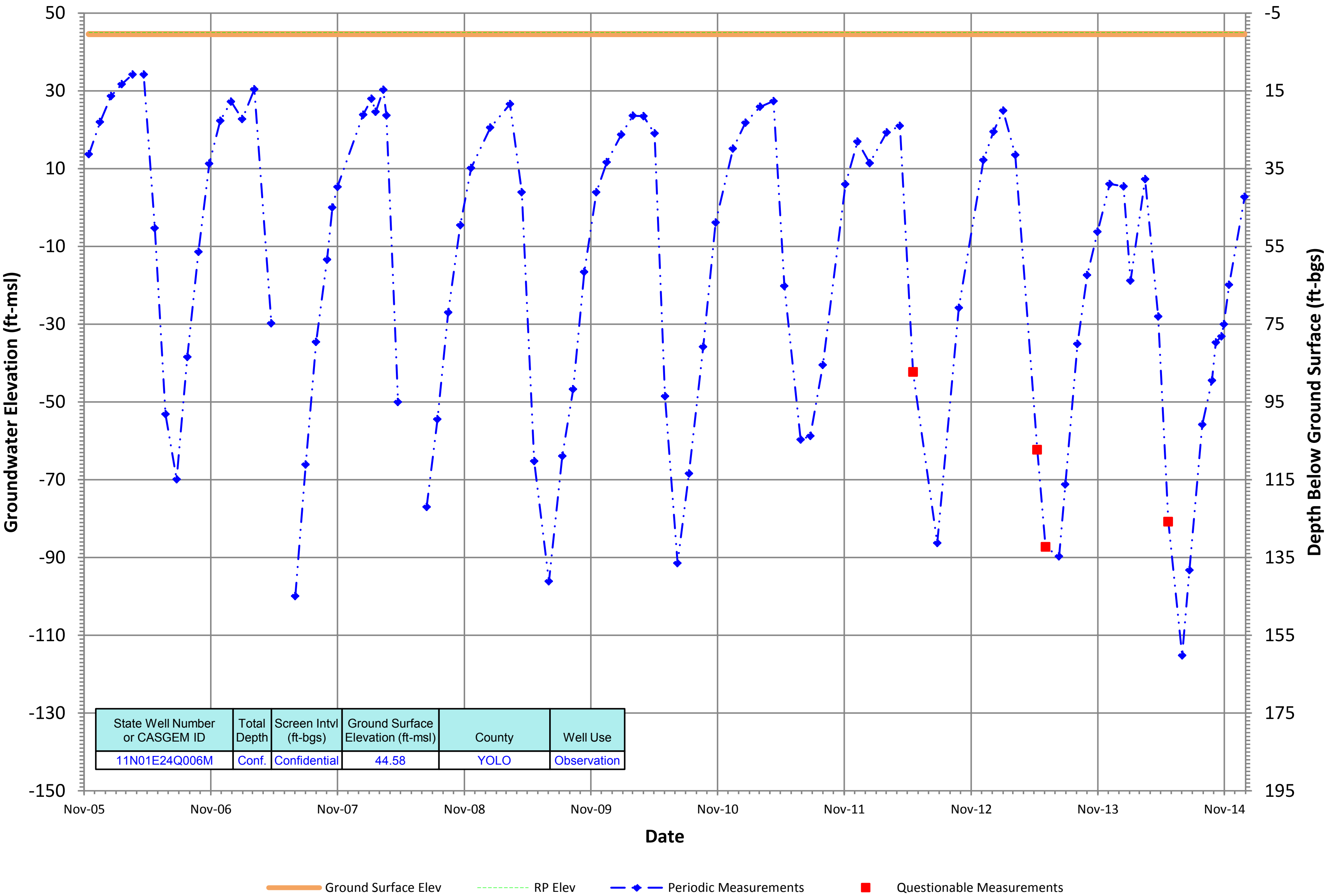
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E24D001M	Conf.	Confidential	49.48	YOLO	Irrigation

11N01E24Q006M
Period Of Record: 11/14/2005 to 12/29/2014

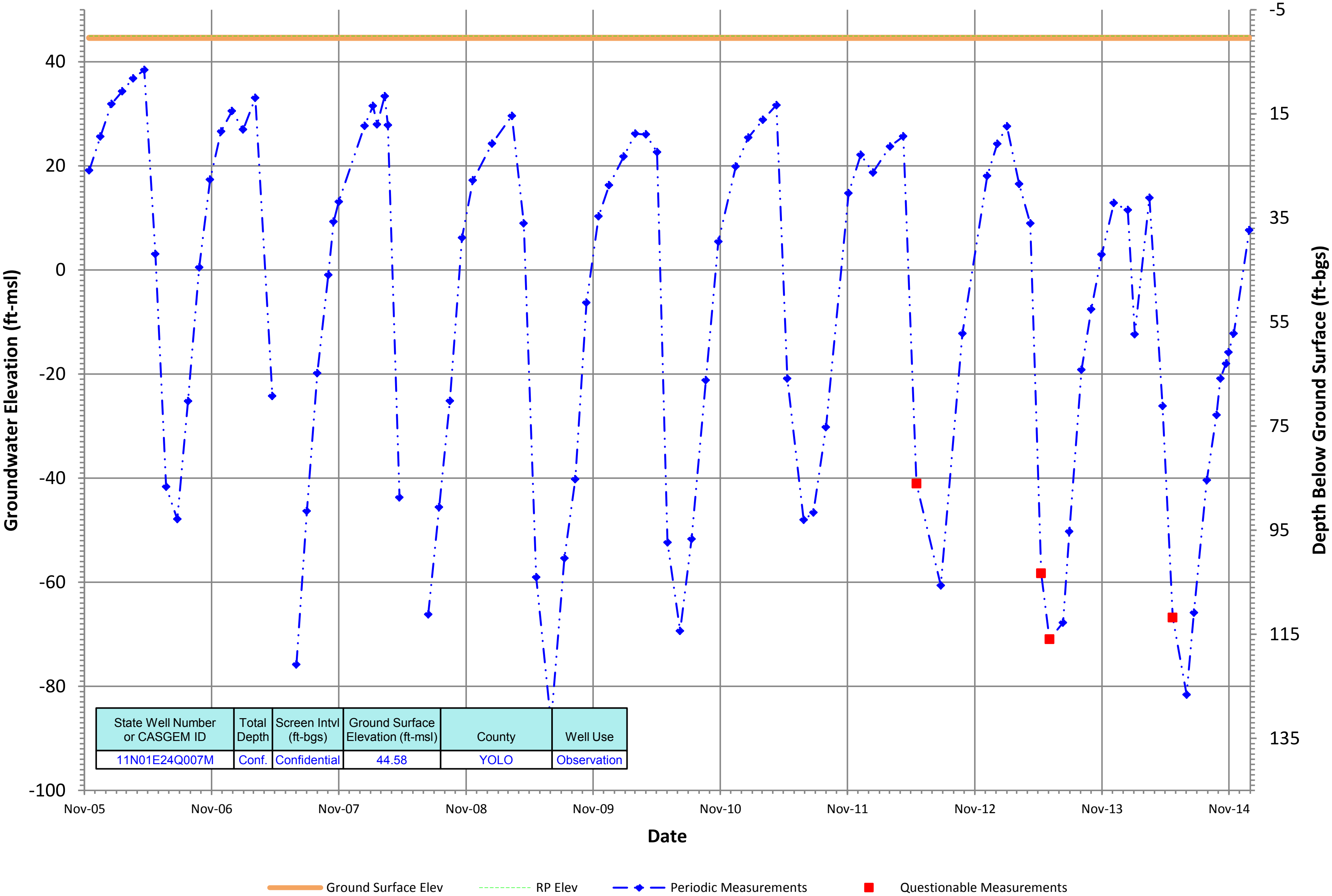
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E24Q006M	Conf.	Confidential	44.58	YOLO	Observation

11N01E24Q007M
Period Of Record: 11/14/2005 to 12/29/2014

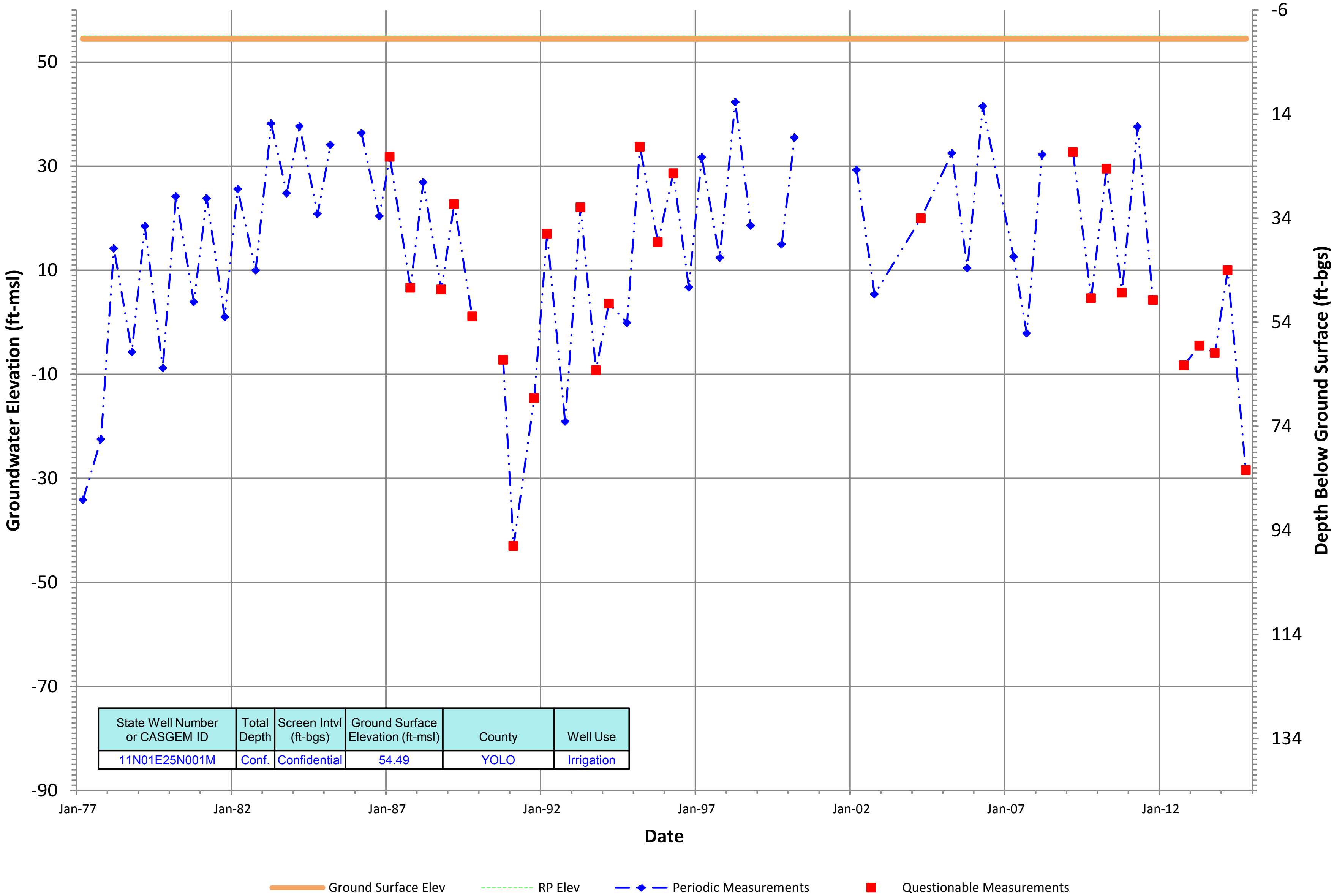
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



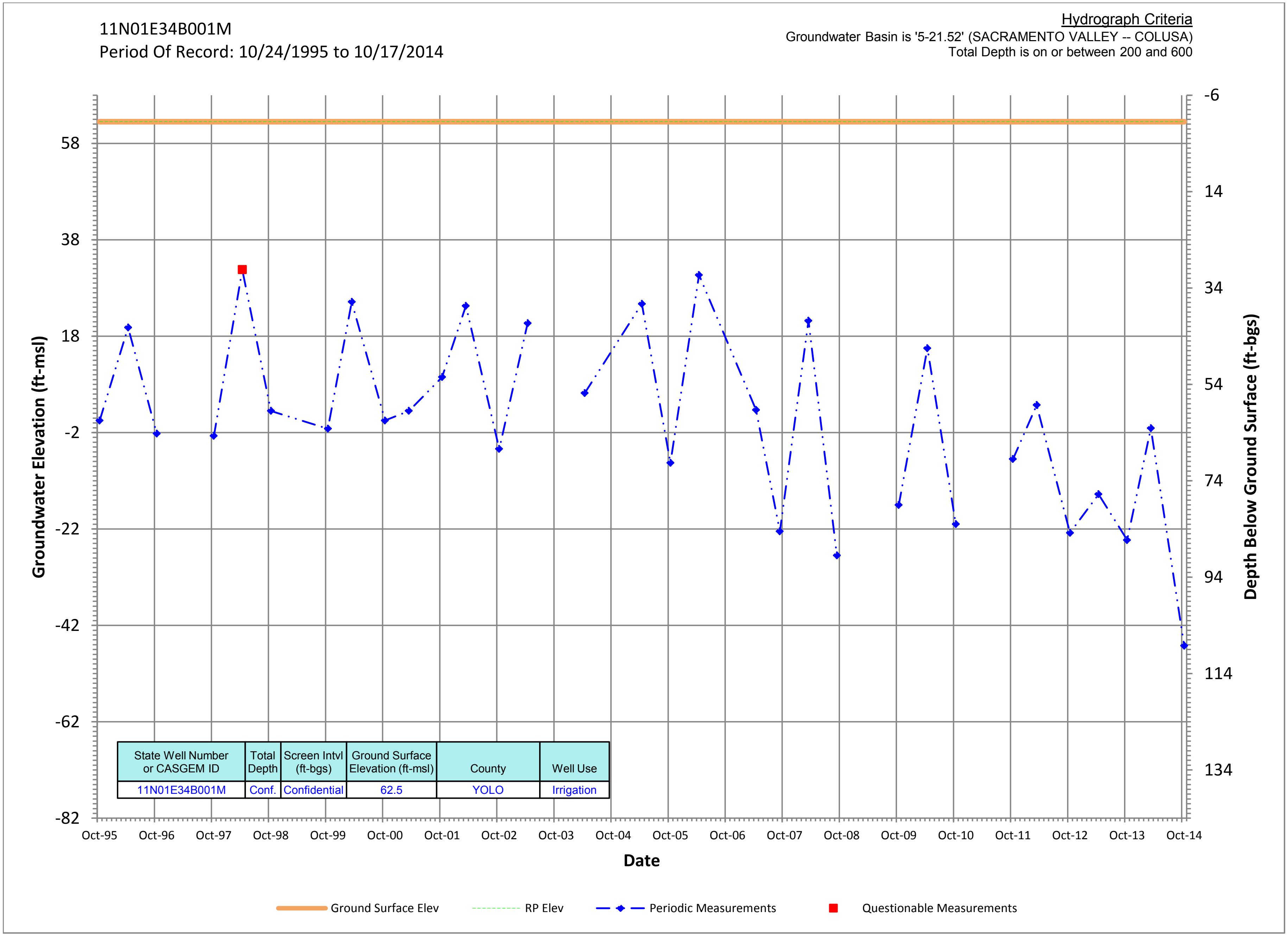
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E24Q007M	Conf.	Confidential	44.58	YOLO	Observation

11N01E25N001M
Period Of Record: 03/17/1977 to 10/16/2014

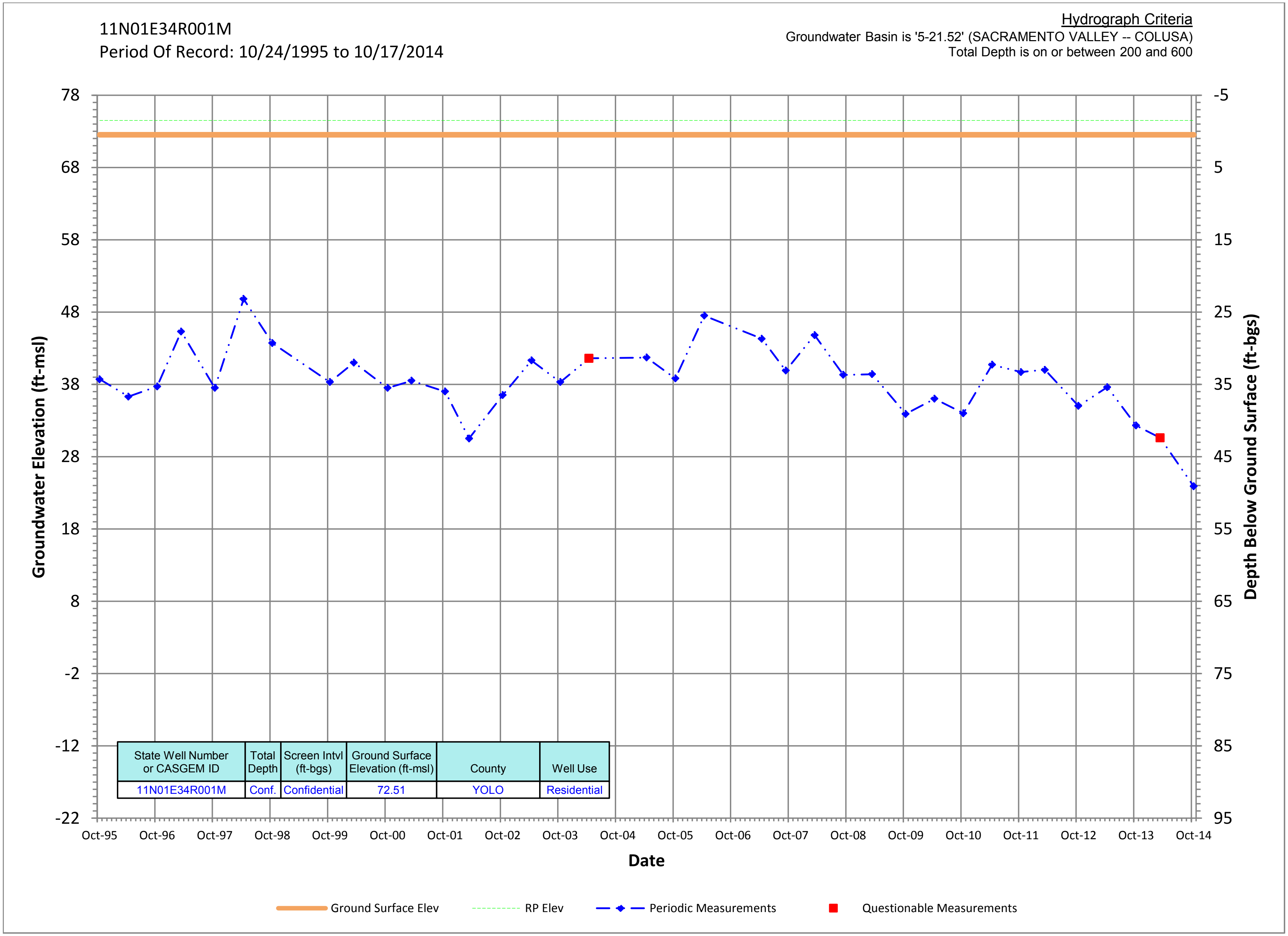
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



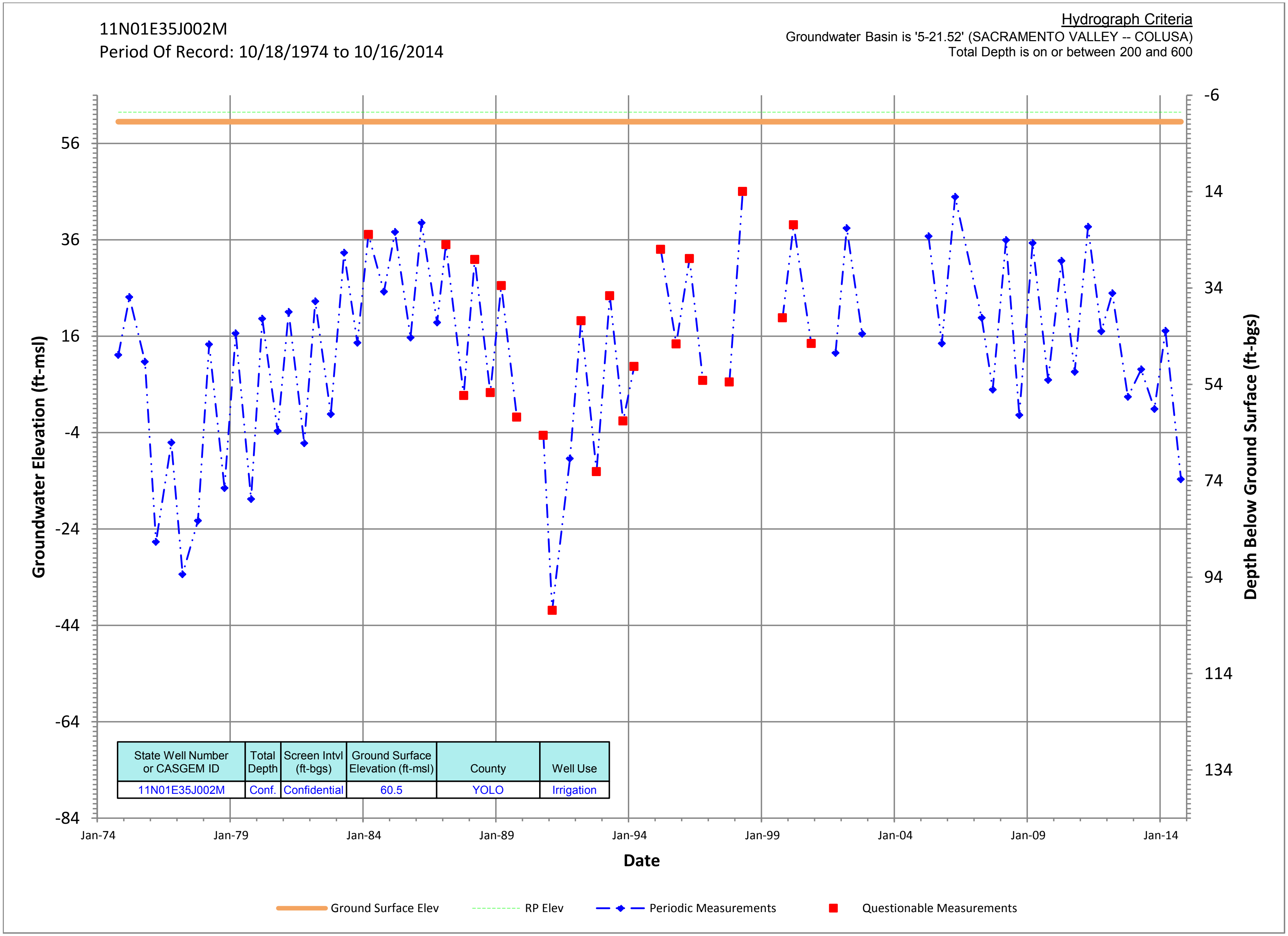
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E25N001M	Conf.	Confidential	54.49	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E34B001M	Conf.	Confidential	62.5	YOLO	Irrigation



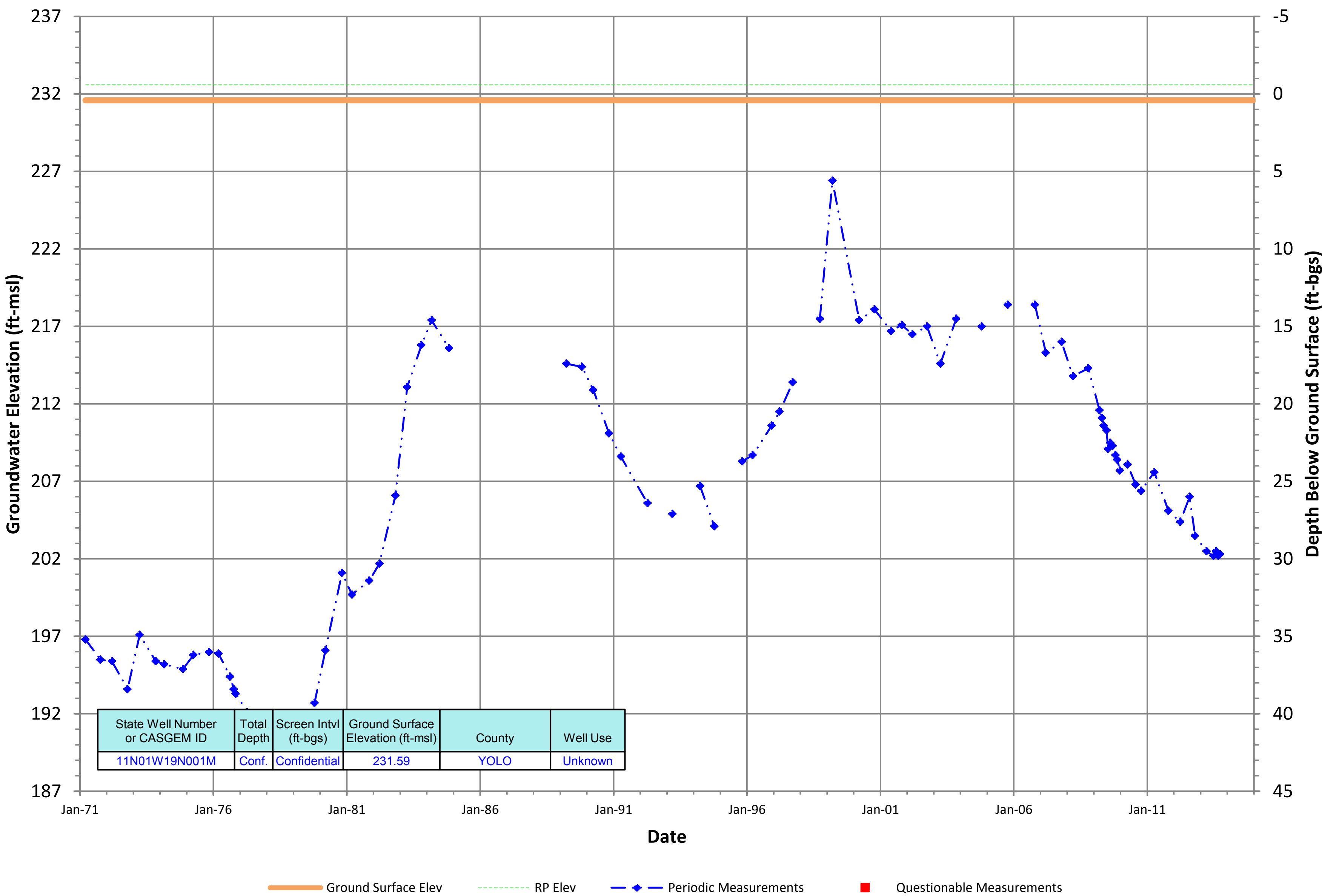
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E34R001M	Conf.	Confidential	72.51	YOLO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E35J002M	Conf.	Confidential	60.5	YOLO	Irrigation

11N01W19N001M
Period Of Record: 03/17/1971 to 12/22/2014

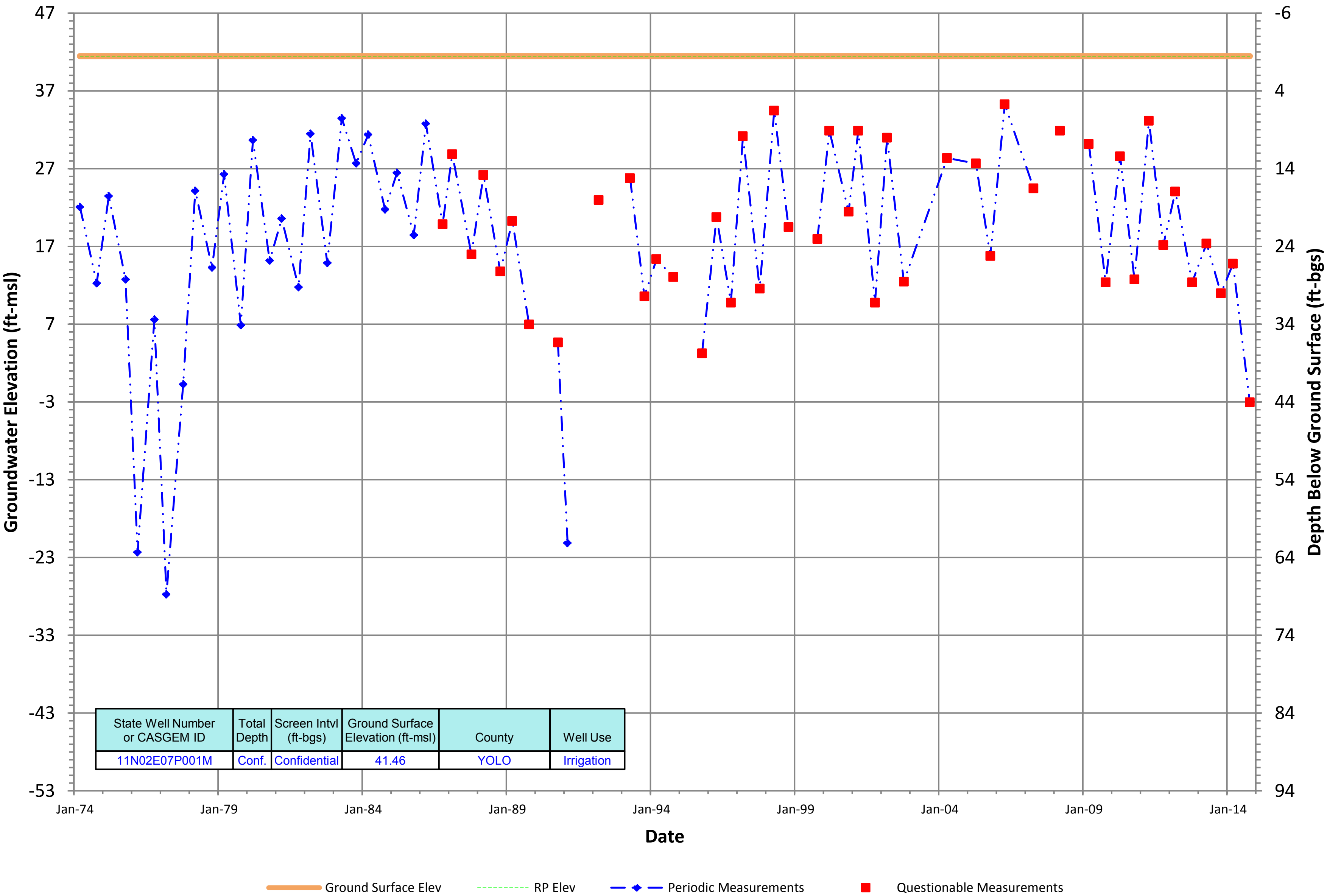
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01W19N001M	Conf.	Confidential	231.59	YOLO	Unknown

11N02E07P001M
Period Of Record: 03/06/1974 to 10/16/2014

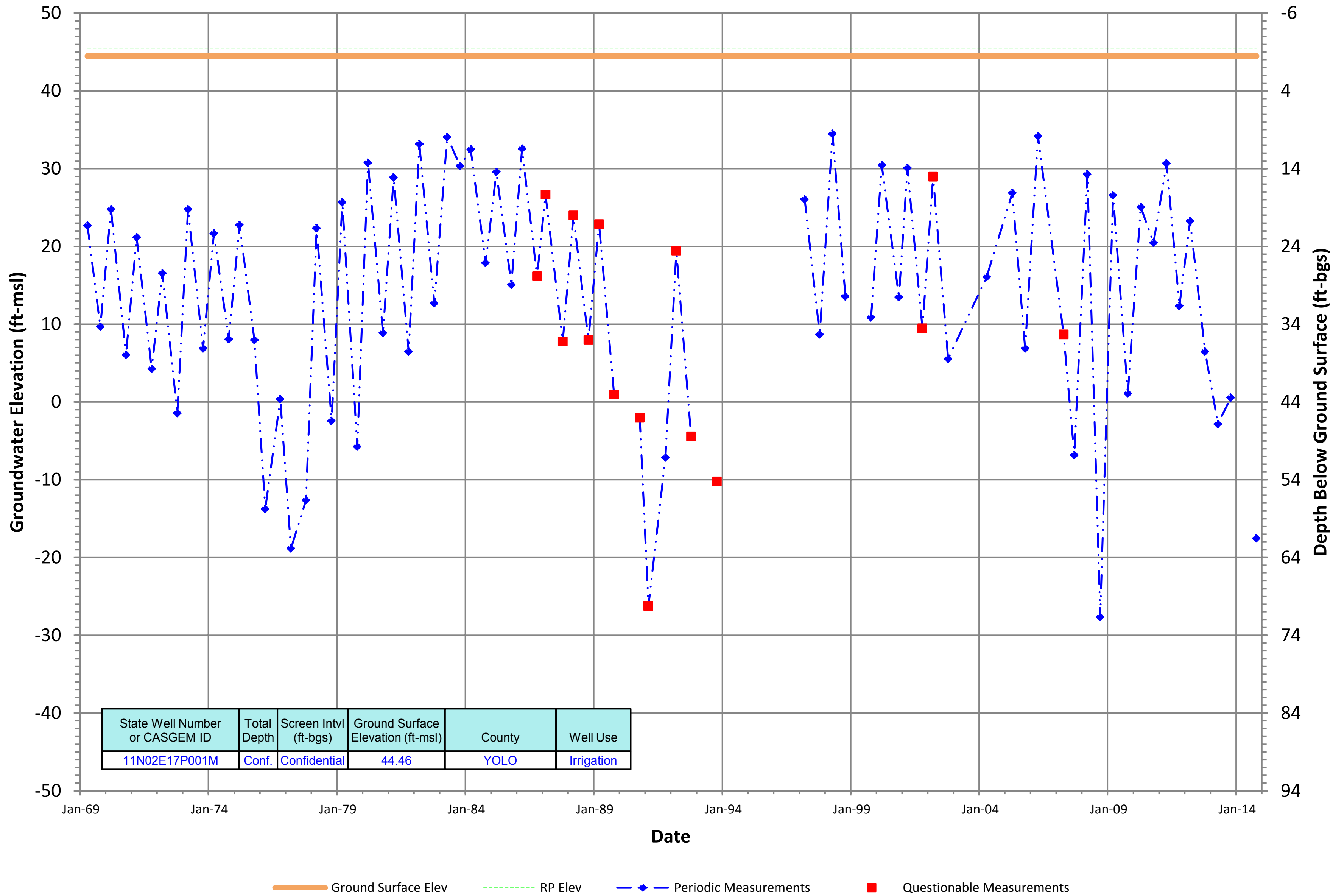
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02E07P001M	Conf.	Confidential	41.46	YOLO	Irrigation

11N02E17P001M
Period Of Record: 04/02/1969 to 10/16/2014

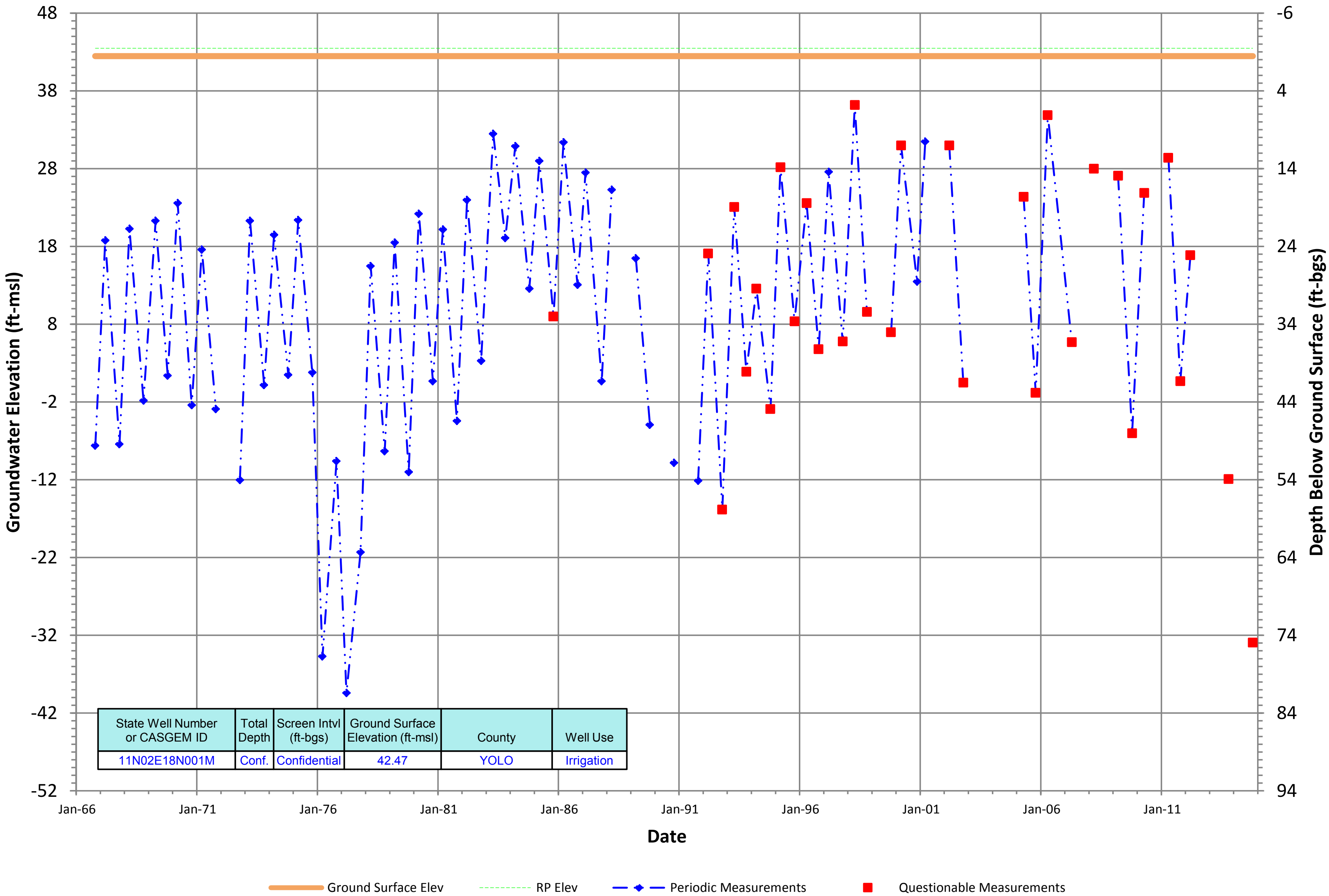
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



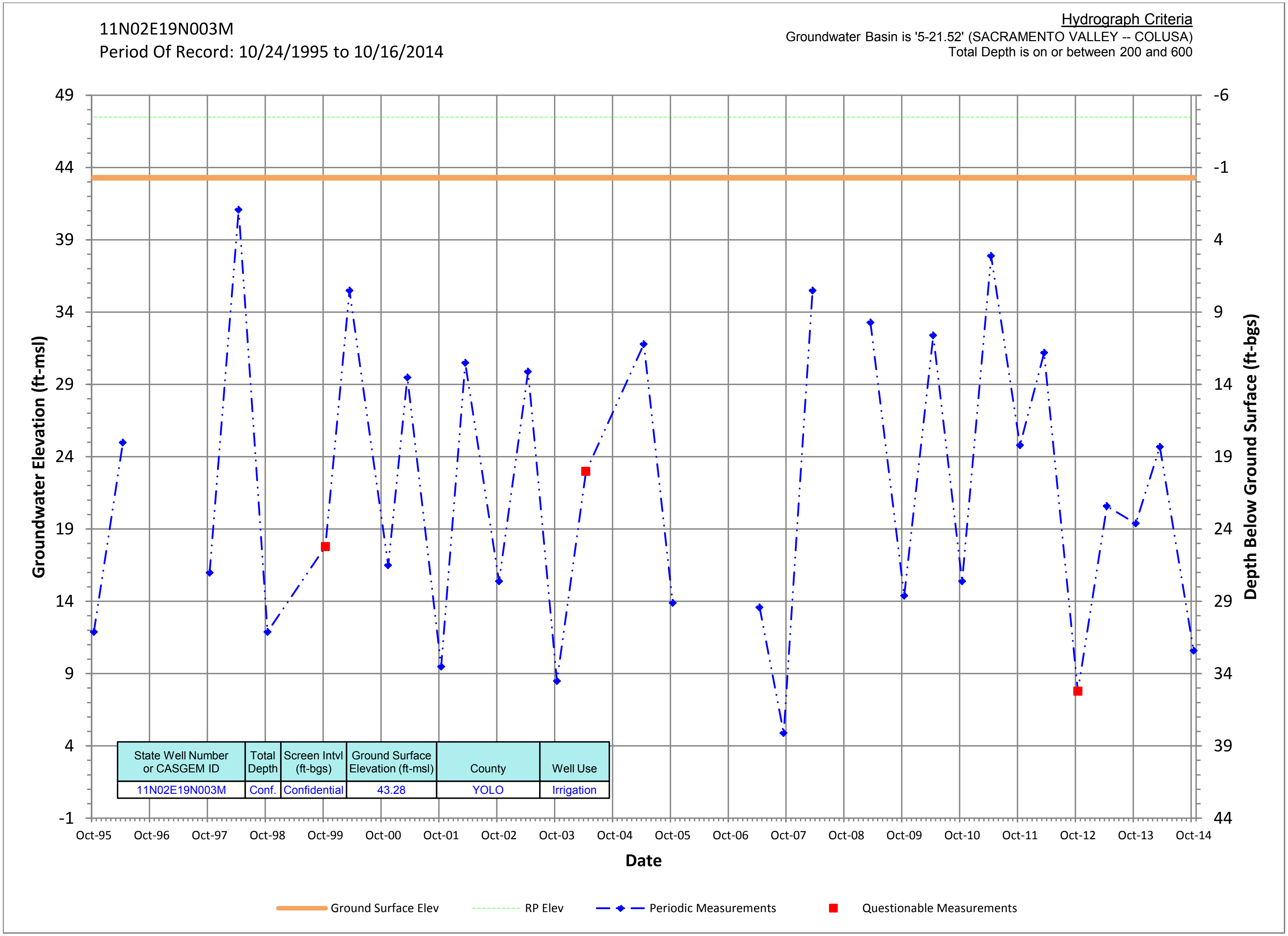
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02E17P001M	Conf.	Confidential	44.46	YOLO	Irrigation

11N02E18N001M
Period Of Record: 10/18/1966 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600

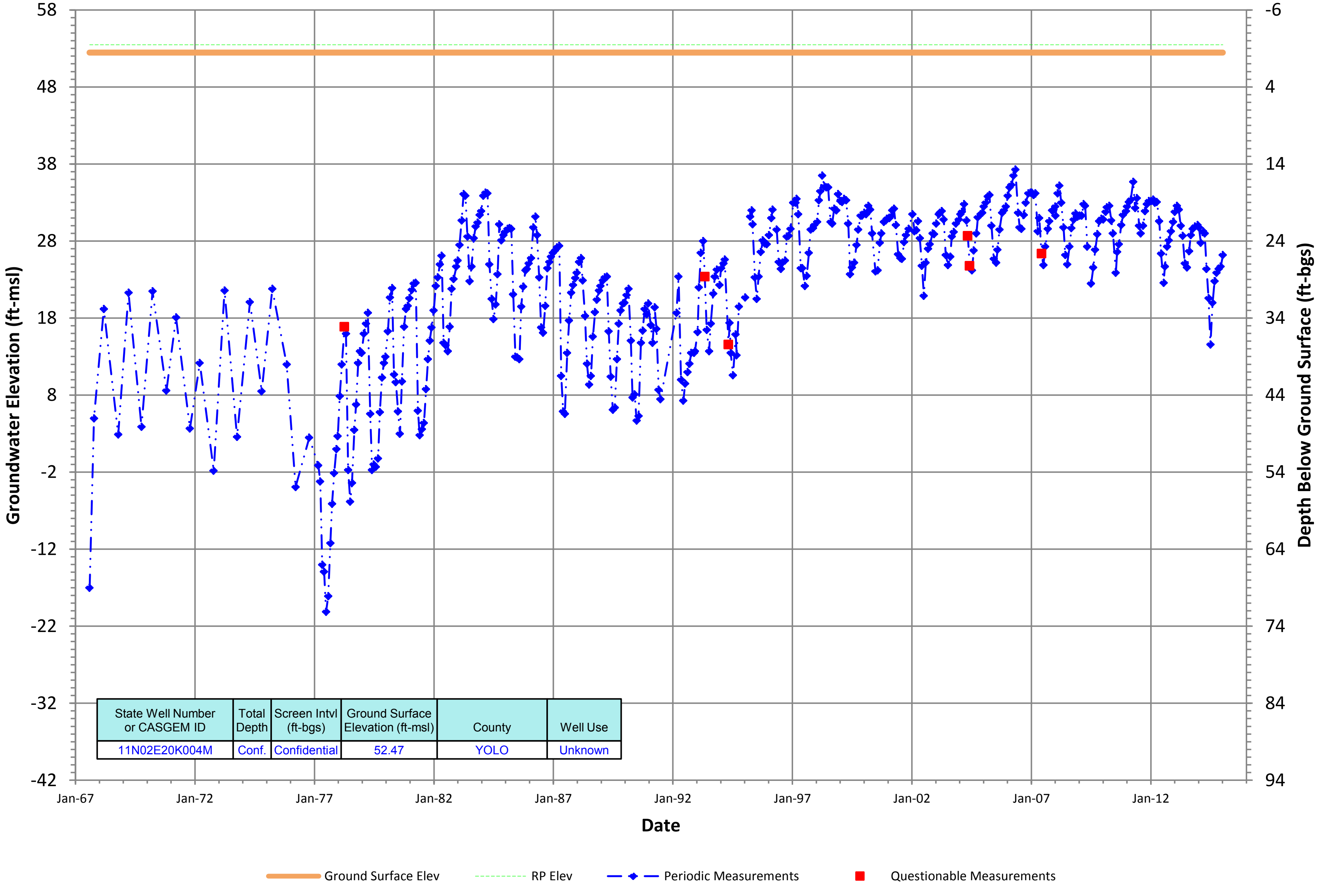


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02E18N001M	Conf.	Confidential	42.47	YOLO	Irrigation

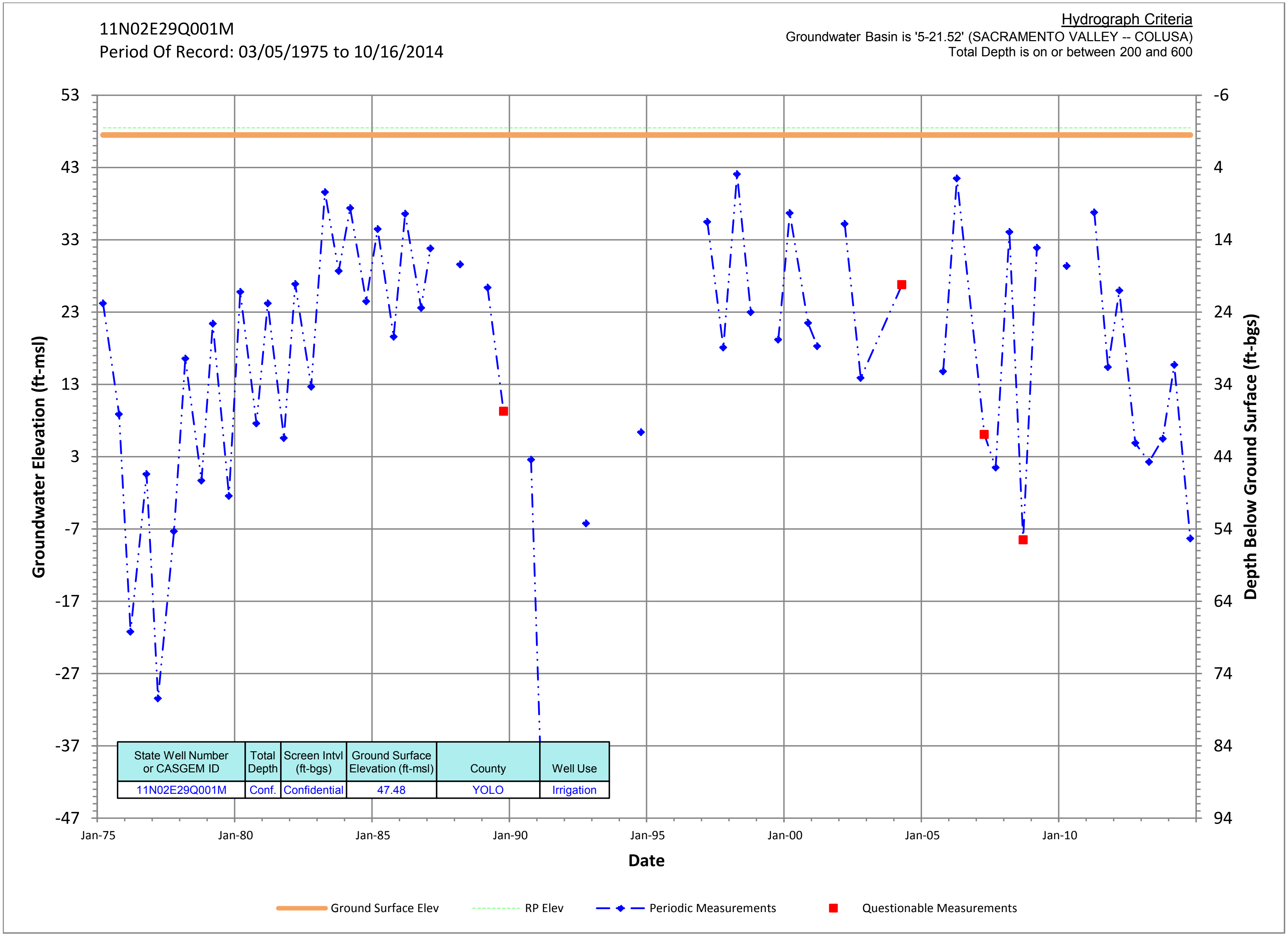

11N02E19N003M
Period Of Record: 10/24/1995 to 10/16/2014
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
49
44
39
34
29
24
19
14
9
4
-1
-6
-1
4
9
14
19
24
29
34
39
44
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
11N02E19N003M
Conf.
Confidential
43.28
YOLO
Irrigation
Oct-95
Oct-96
Oct-97
Oct-98
Oct-99
Oct-00
Oct-01
Oct-02
Oct-03
Oct-04
Oct-05
Oct-06
Oct-07
Oct-08
Oct-09
Oct-10
Oct-11
Oct-12
Oct-13
Oct-14
Date
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

11N02E20K004M
Period Of Record: 08/04/1967 to 01/06/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



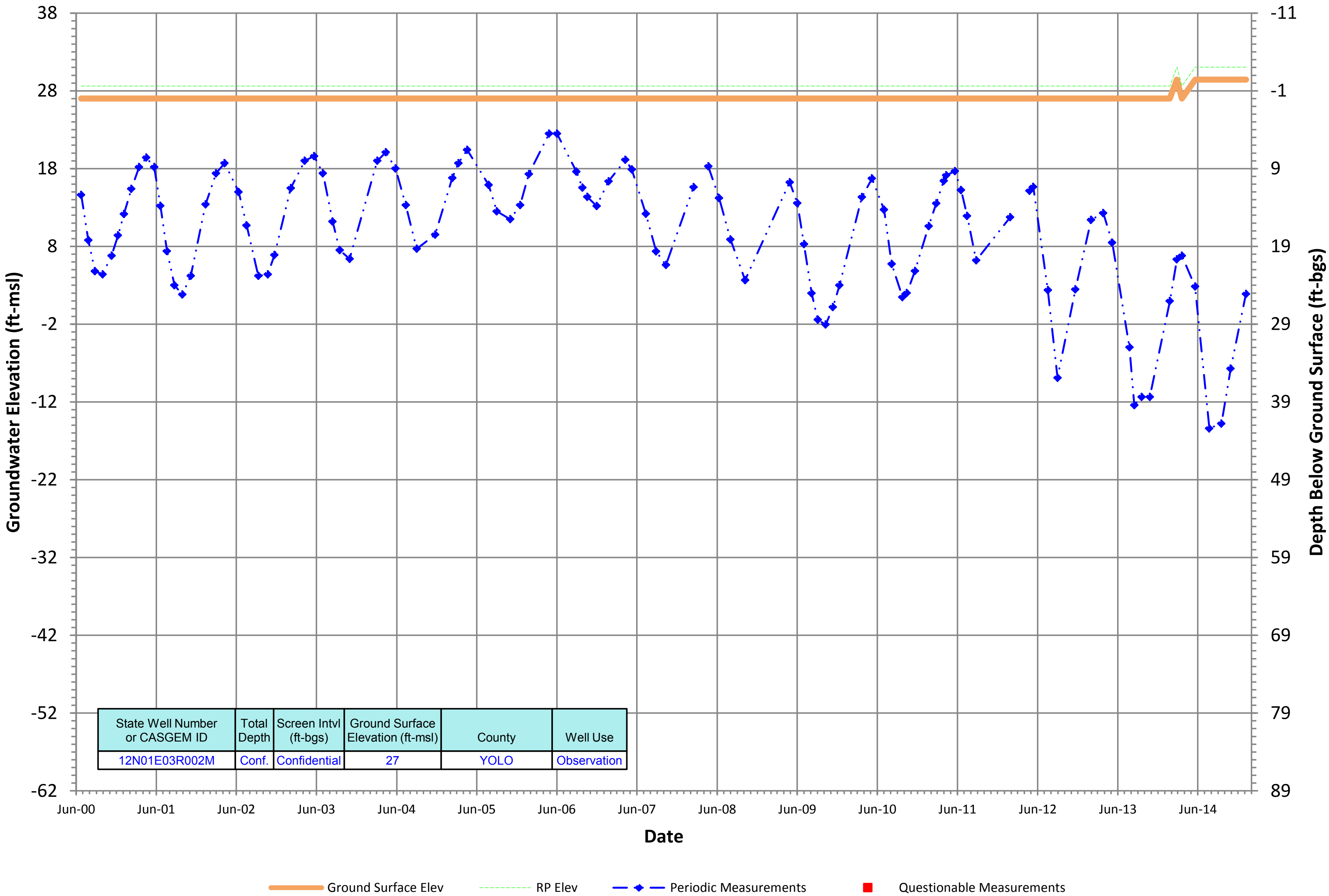
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02E20K004M	Conf.	Confidential	52.47	YOLO	Unknown



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02E29Q001M	Conf.	Confidential	47.48	YOLO	Irrigation

12N01E03R002M
Period Of Record: 06/23/2000 to 01/06/2015

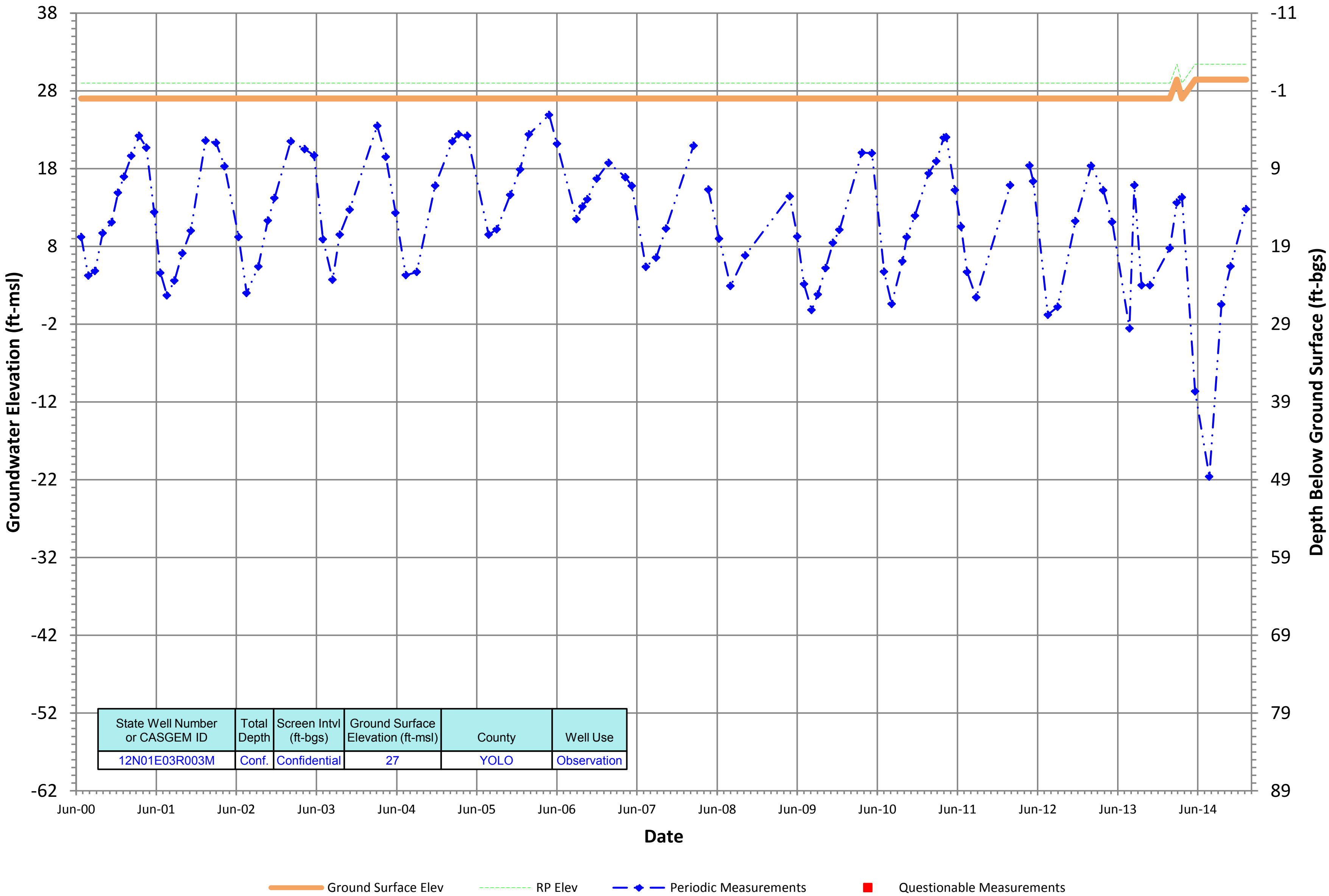
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E03R002M	Conf.	Confidential	27	YOLO	Observation

12N01E03R003M
Period Of Record: 06/23/2000 to 01/06/2015

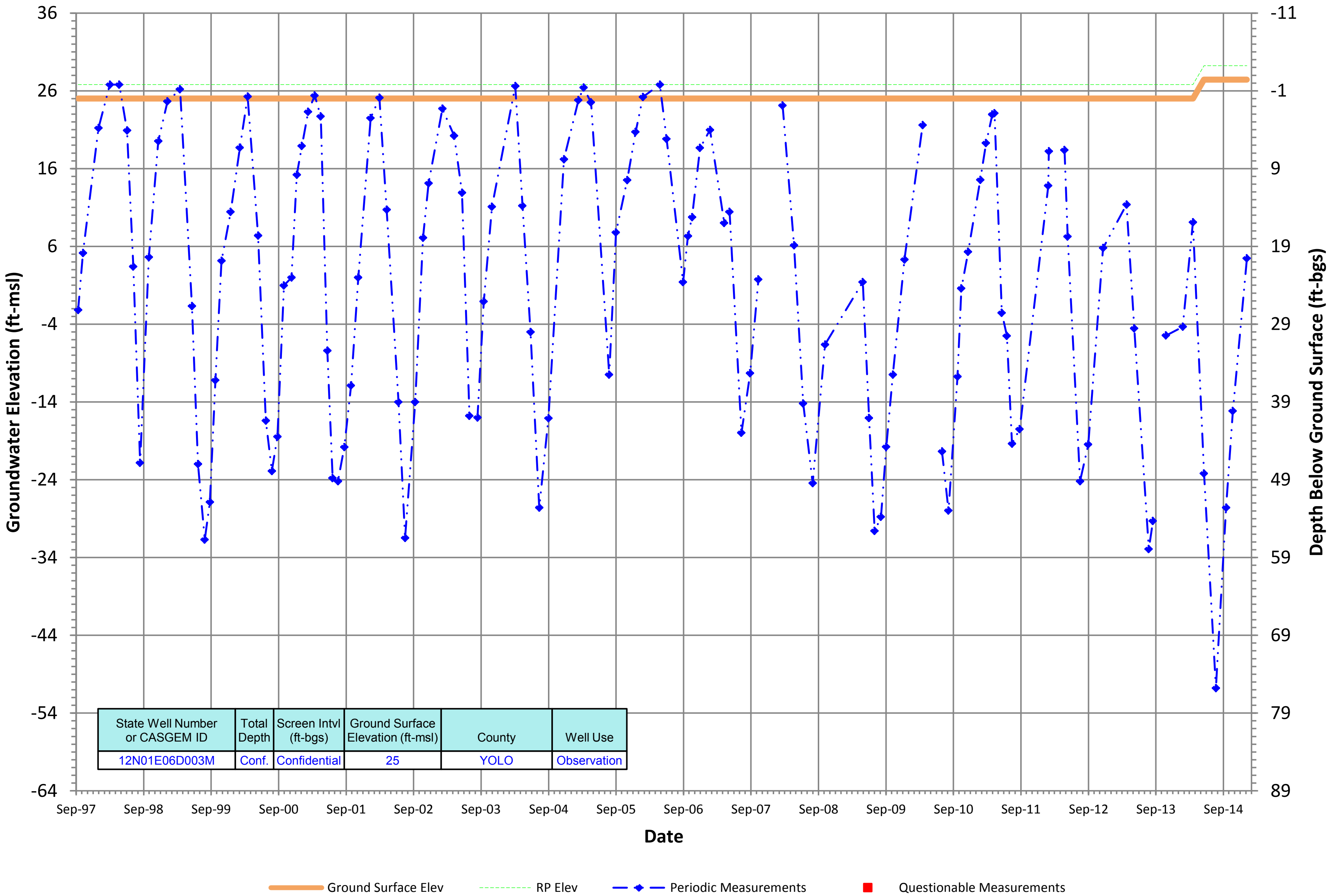
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E03R003M	Conf.	Confidential	27	YOLO	Observation

12N01E06D003M
Period Of Record: 09/11/1997 to 01/06/2015

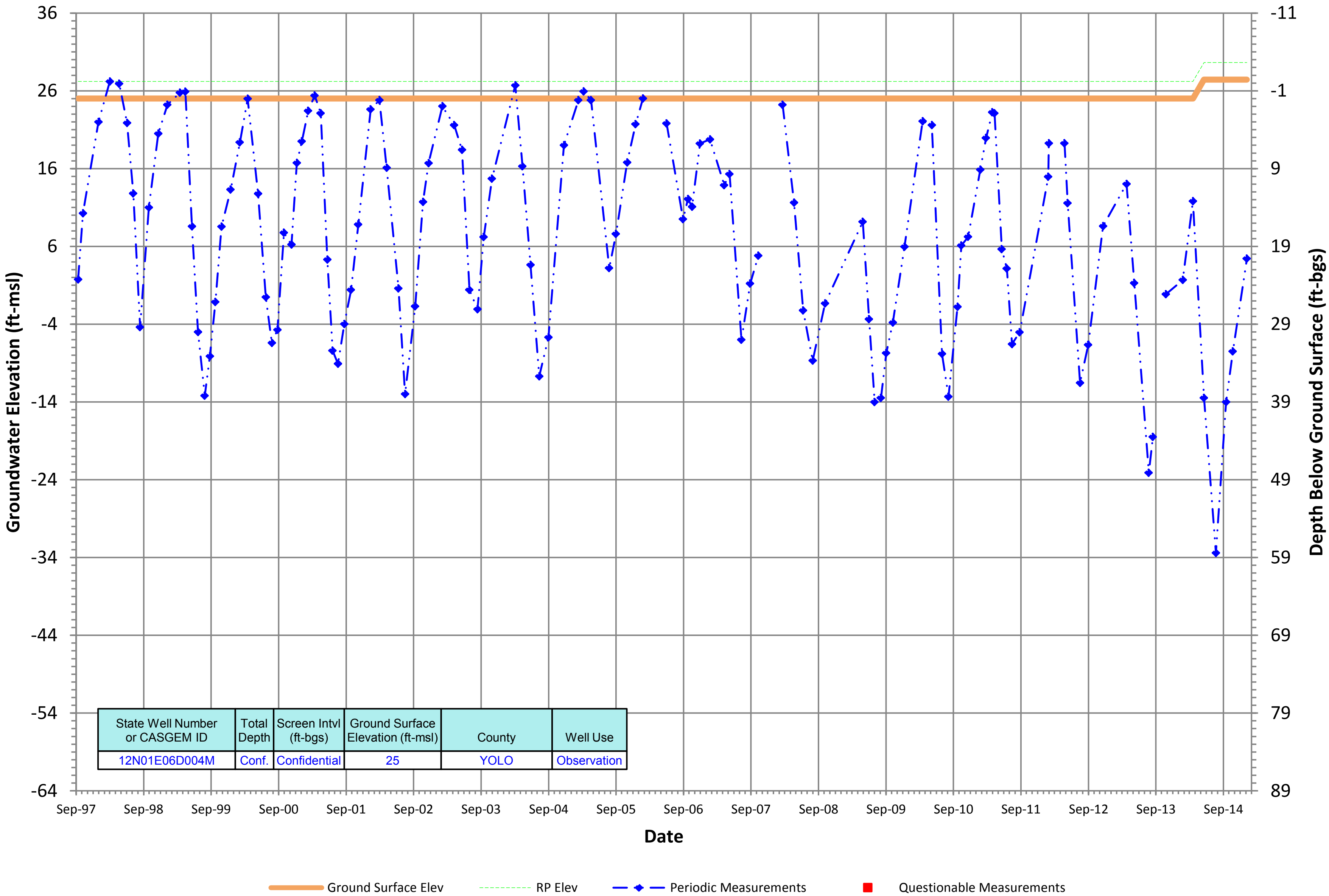
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E06D003M	Conf.	Confidential	25	YOLO	Observation

12N01E06D004M
Period Of Record: 09/11/1997 to 01/06/2015

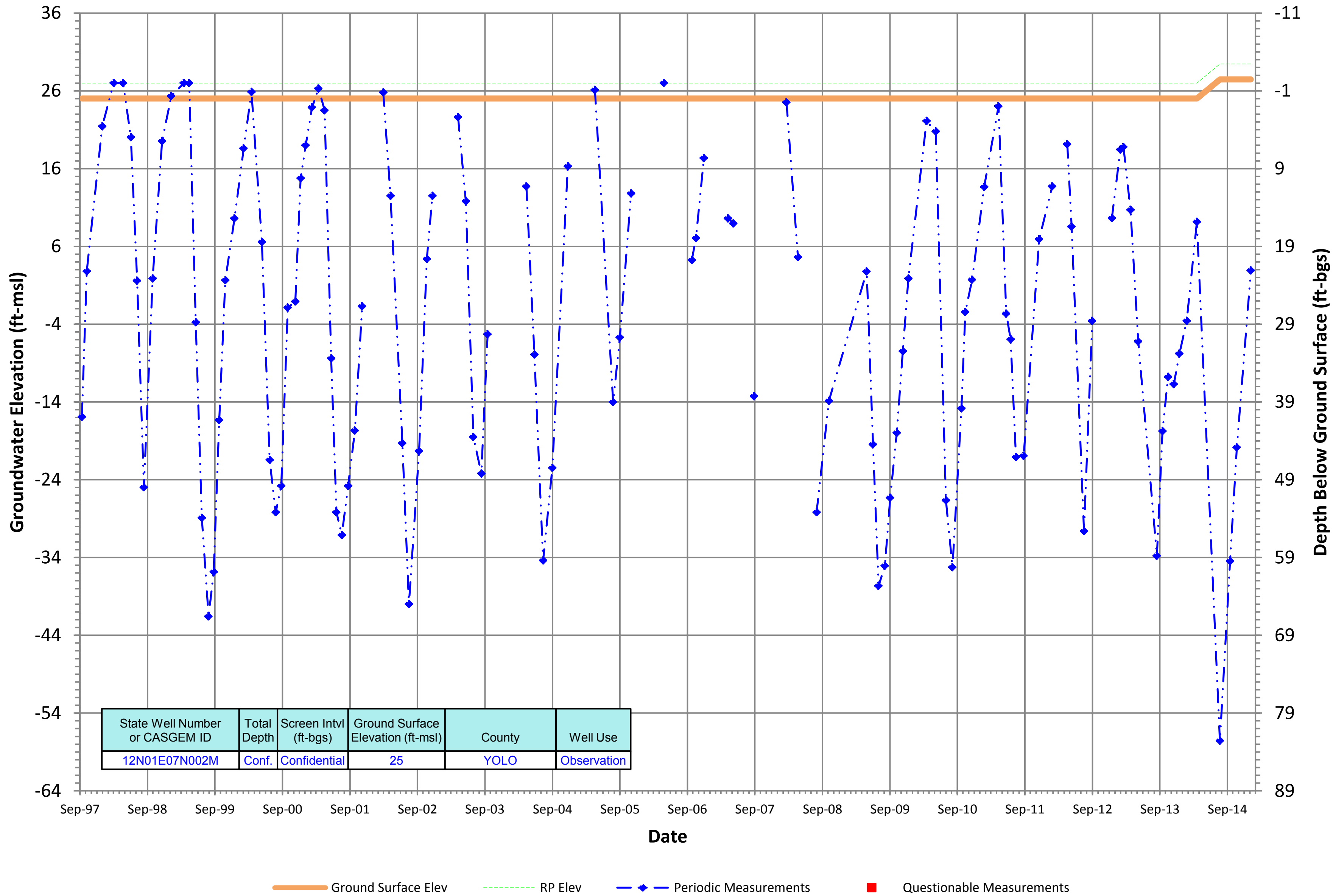
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



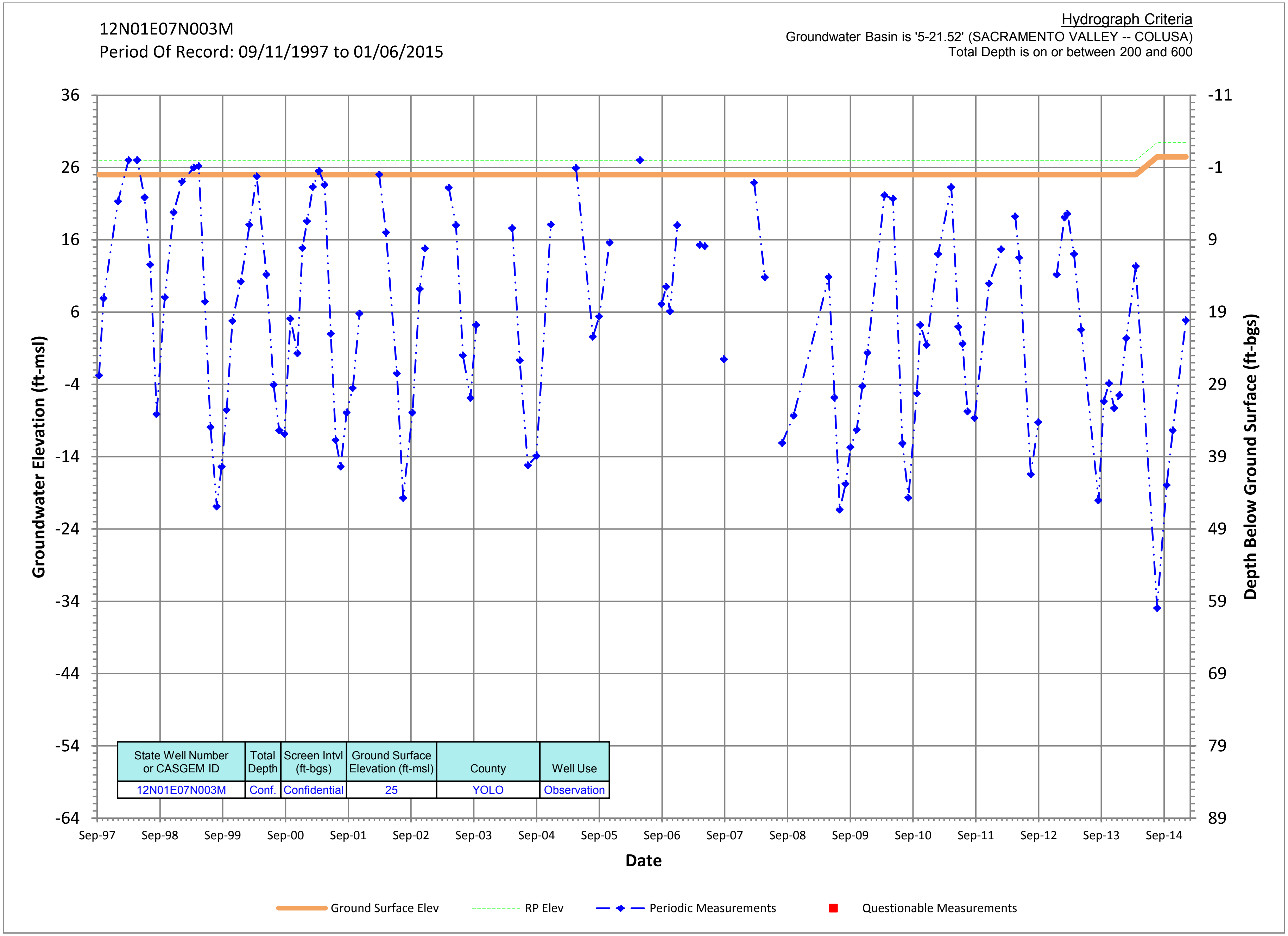
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E06D004M	Conf.	Confidential	25	YOLO	Observation

12N01E07N002M
Period Of Record: 09/11/1997 to 01/06/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



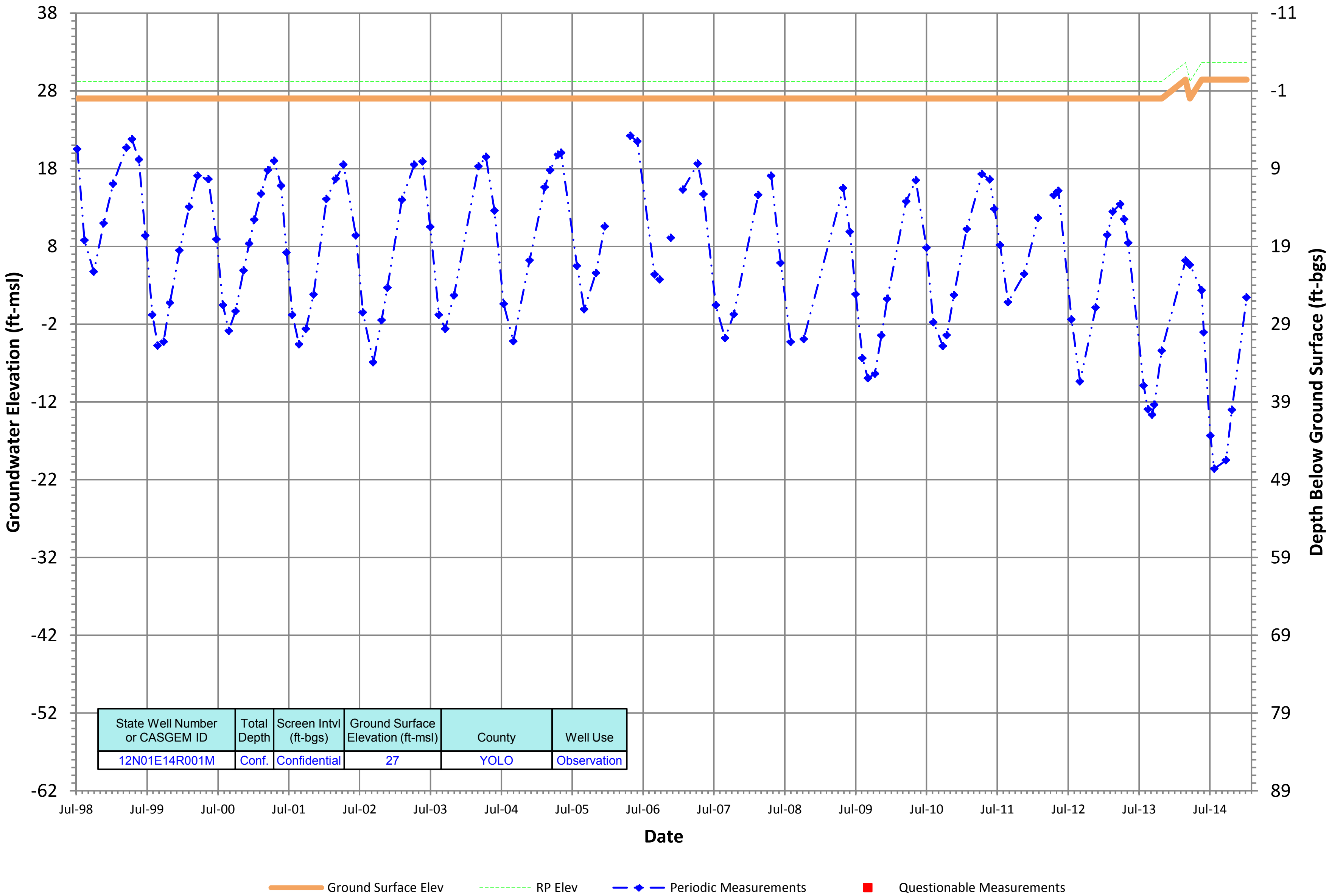
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E07N002M	Conf.	Confidential	25	YOLO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E07N003M	Conf.	Confidential	25	YOLO	Observation

12N01E14R001M
Period Of Record: 07/06/1998 to 01/06/2015

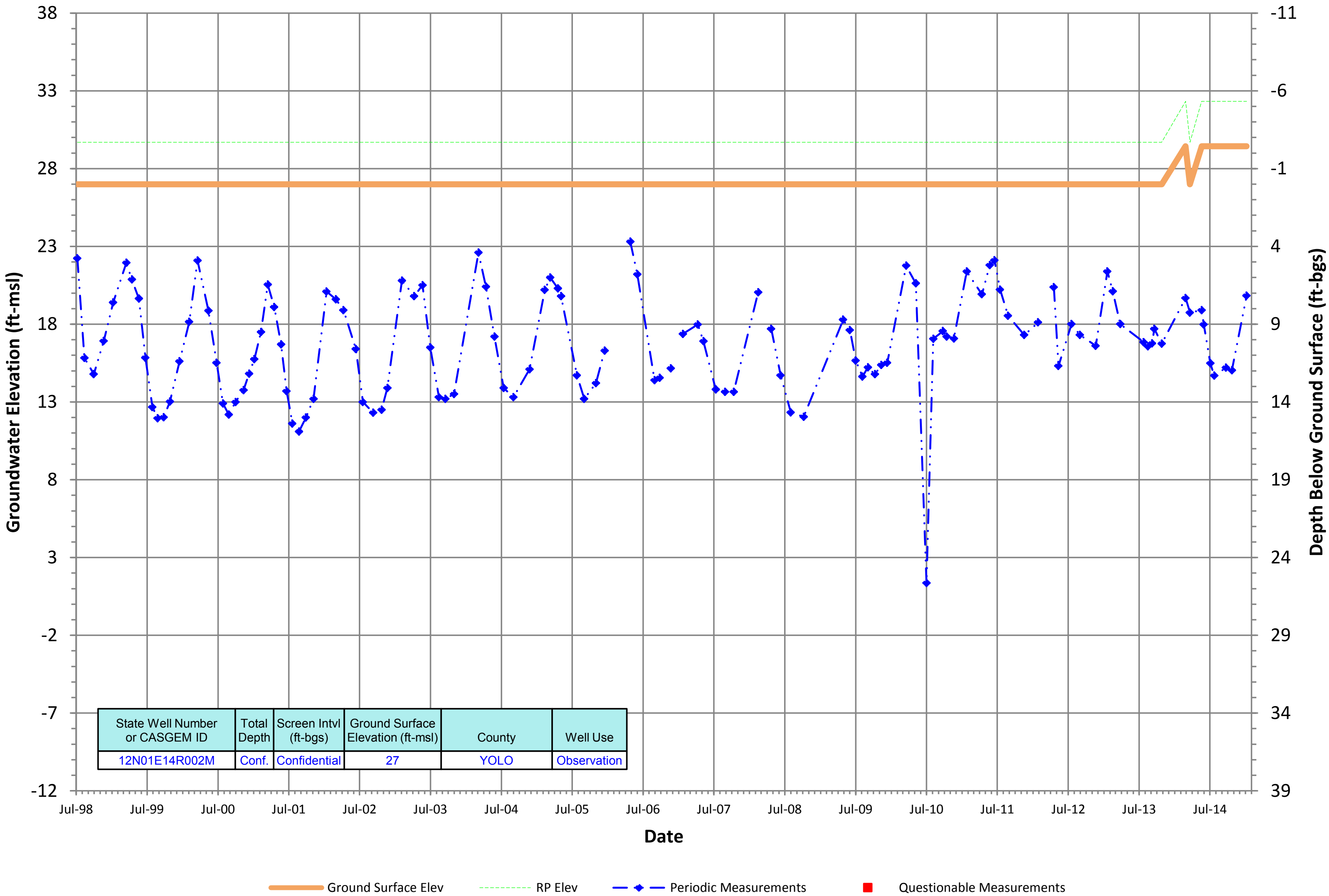
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E14R001M	Conf.	Confidential	27	YOLO	Observation

12N01E14R002M
Period Of Record: 07/06/1998 to 01/06/2015

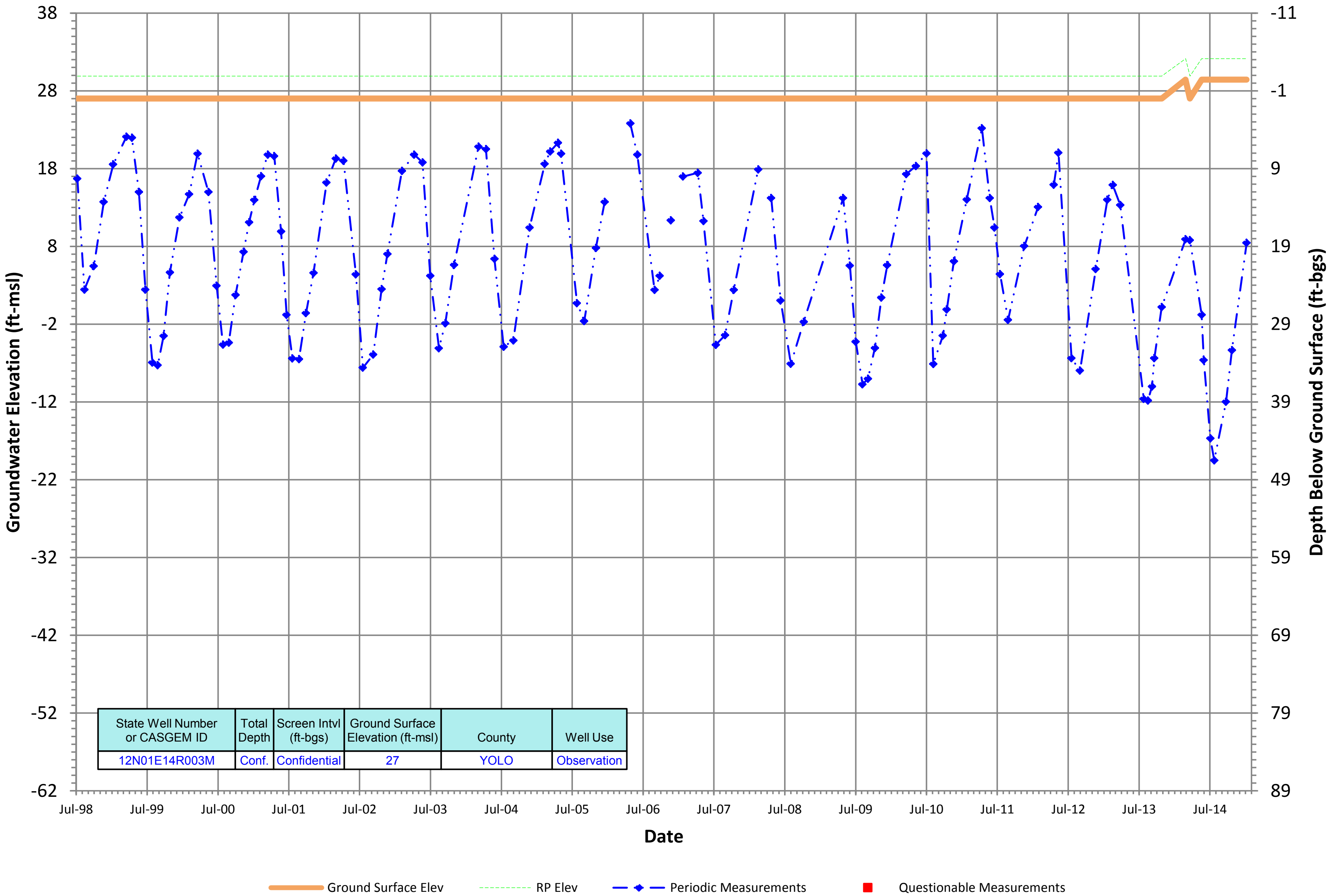
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E14R002M	Conf.	Confidential	27	YOLO	Observation

12N01E14R003M
Period Of Record: 07/06/1998 to 01/06/2015

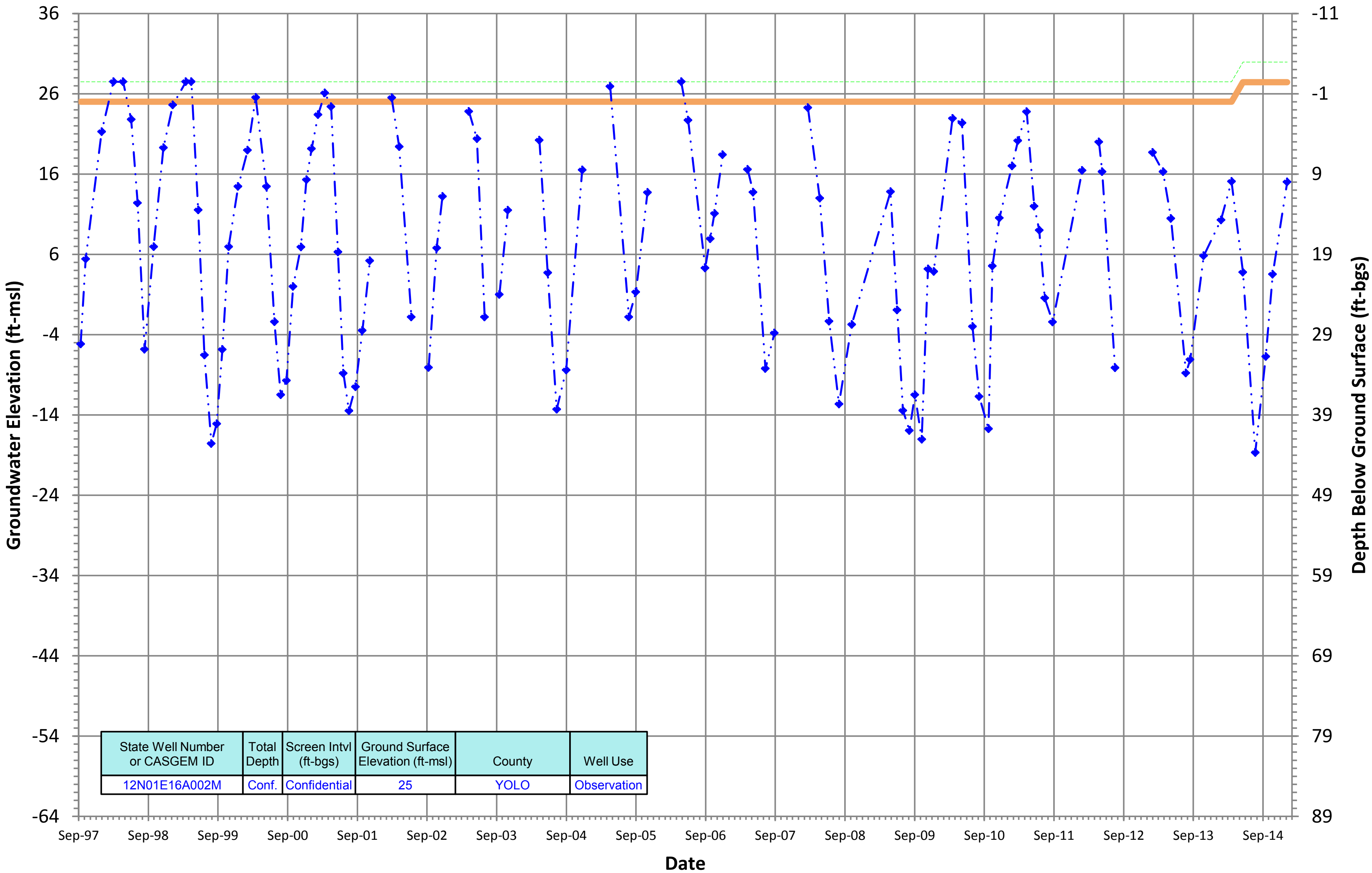
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E14R003M	Conf.	Confidential	27	YOLO	Observation

12N01E16A002M
Period Of Record: 09/11/1997 to 01/06/2015

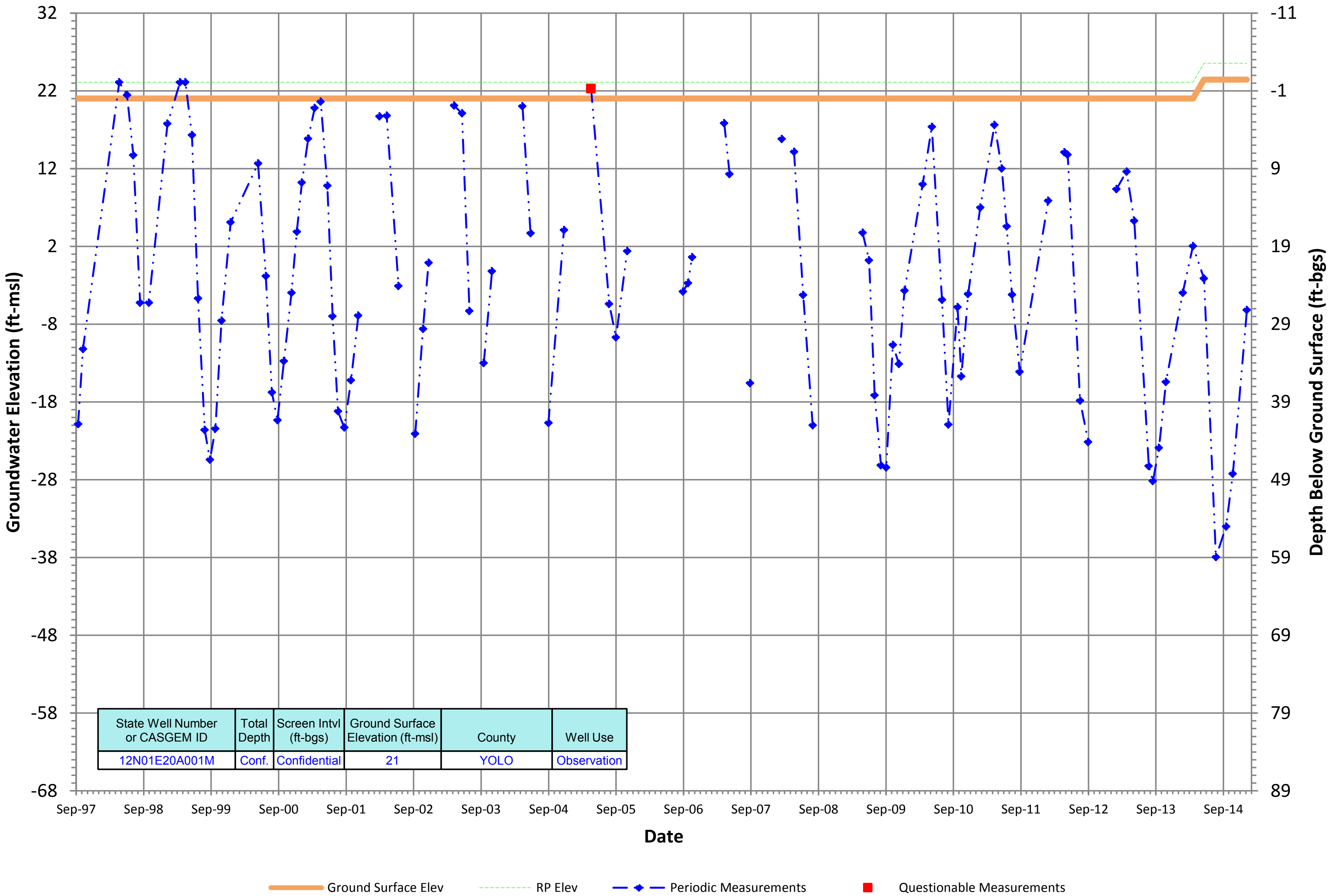
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



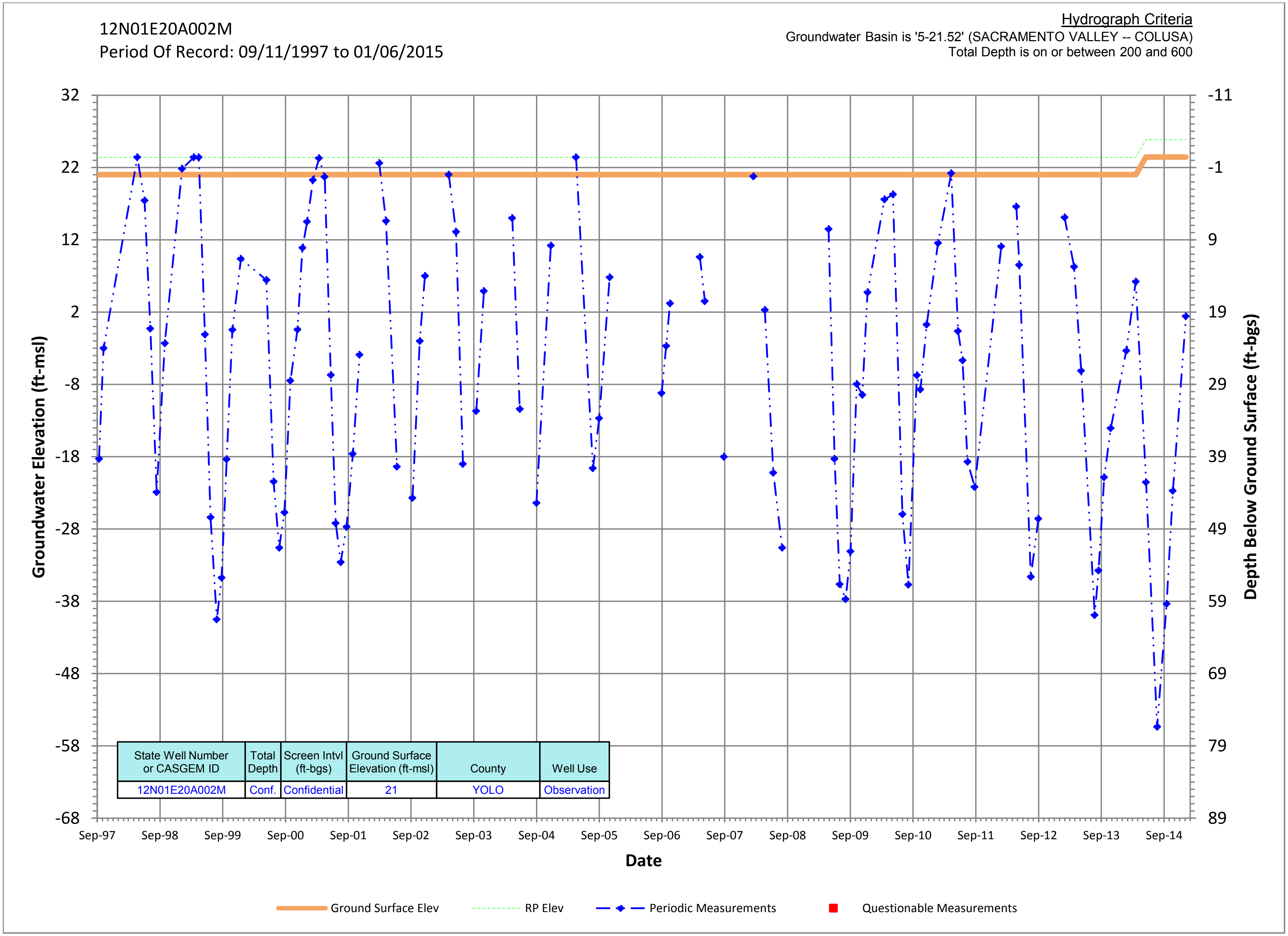
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E16A002M	Conf.	Confidential	25	YOLO	Observation

12N01E20A001M
Period Of Record: 09/11/1997 to 01/06/2015

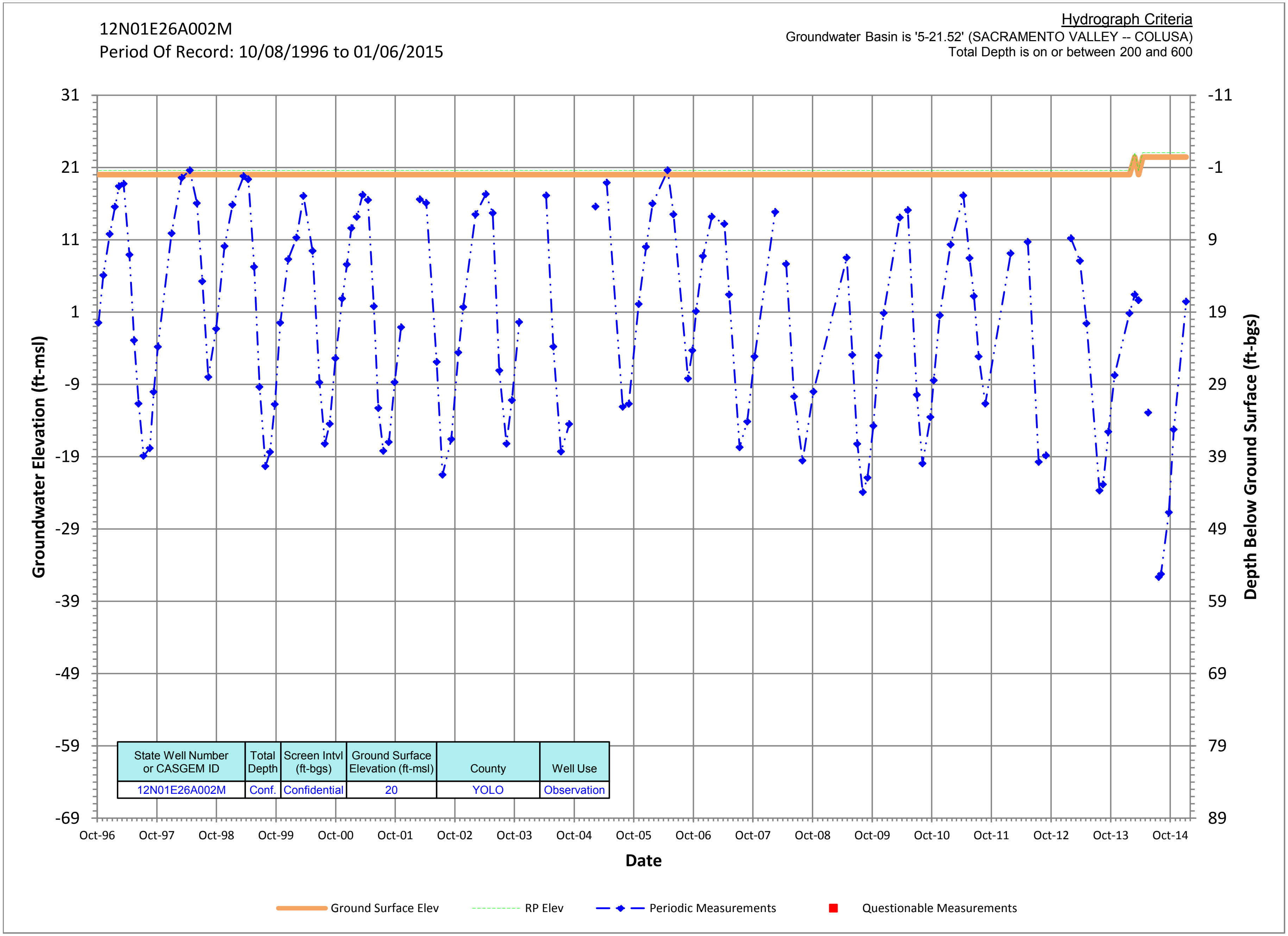
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



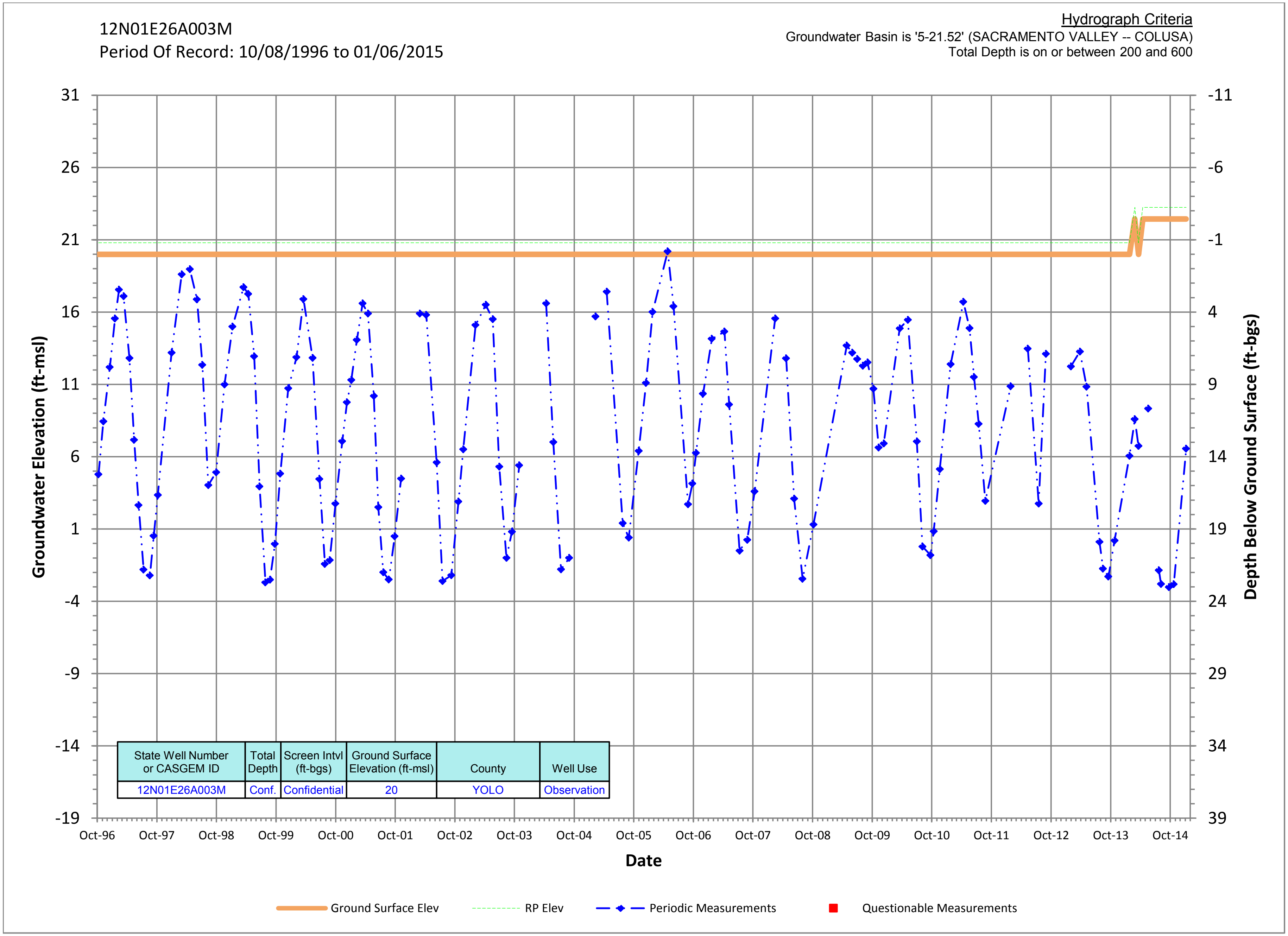
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E20A001M	Conf.	Confidential	21	YOLO	Observation



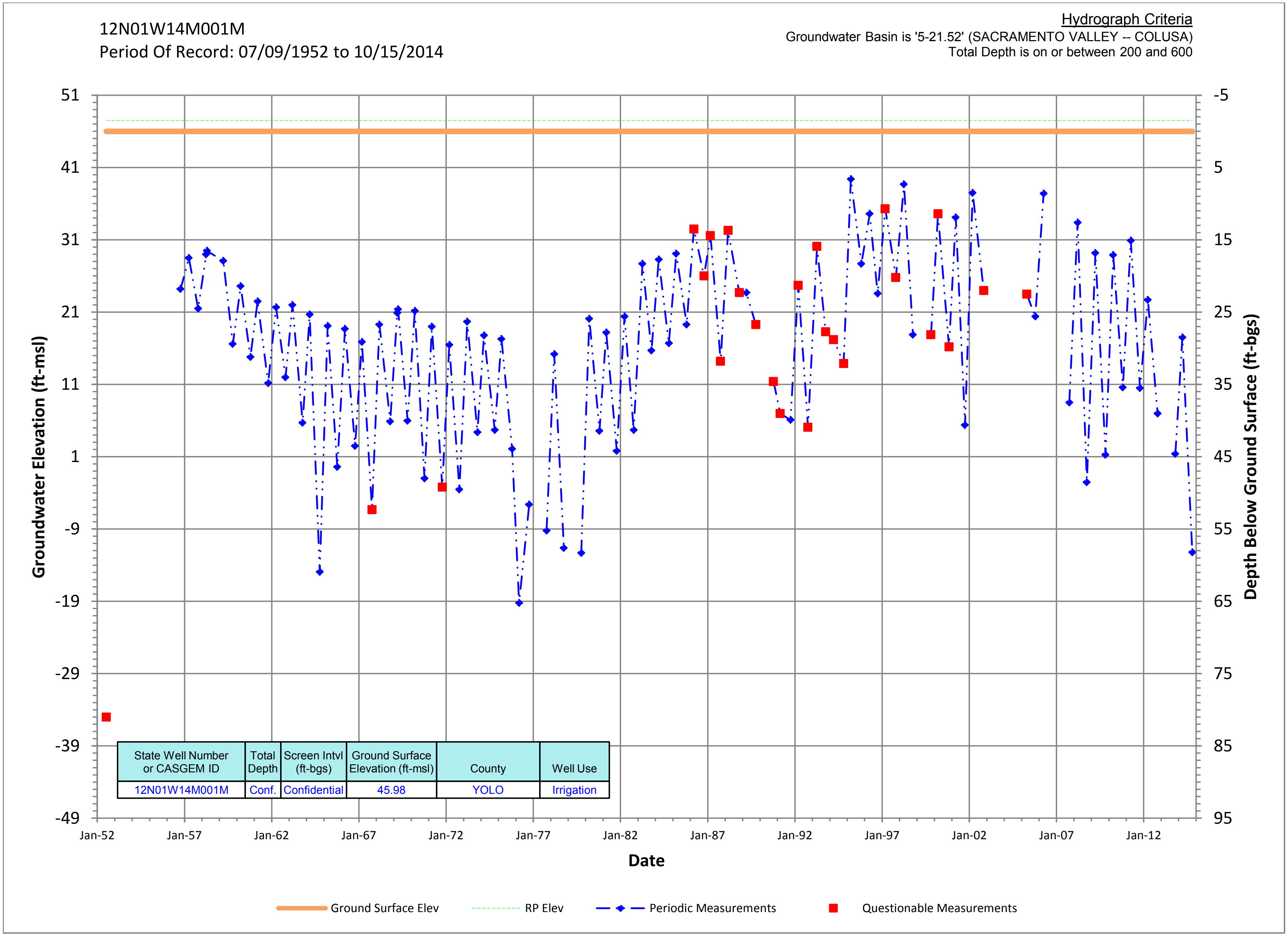
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E20A002M	Conf.	Confidential	21	YOLO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E26A002M	Conf.	Confidential	20	YOLO	Observation



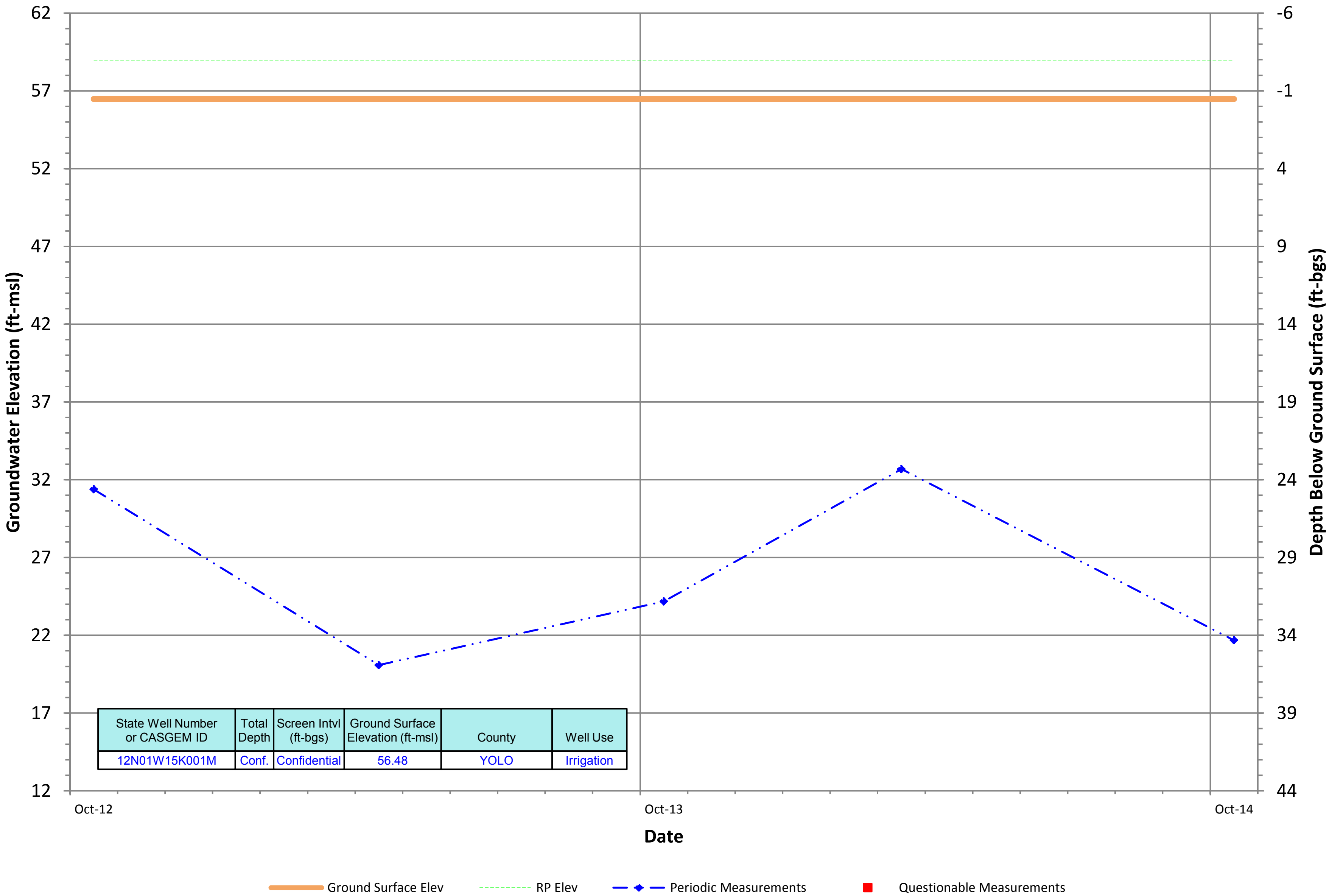
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E26A003M	Conf.	Confidential	20	YOLO	Observation



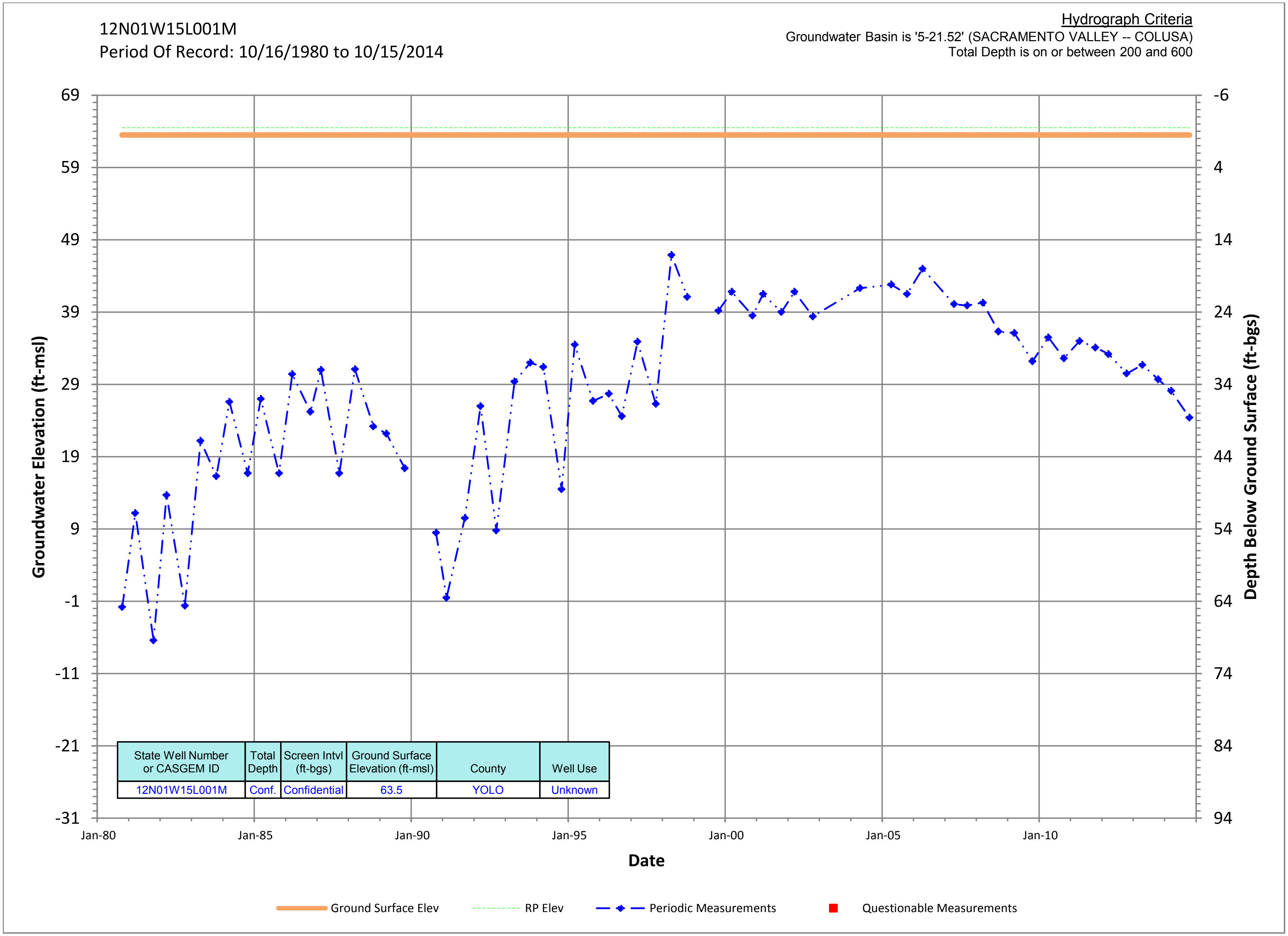
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01W14M001M	Conf.	Confidential	45.98	YOLO	Irrigation

12N01W15K001M
Period Of Record: 10/17/2012 to 10/15/2014

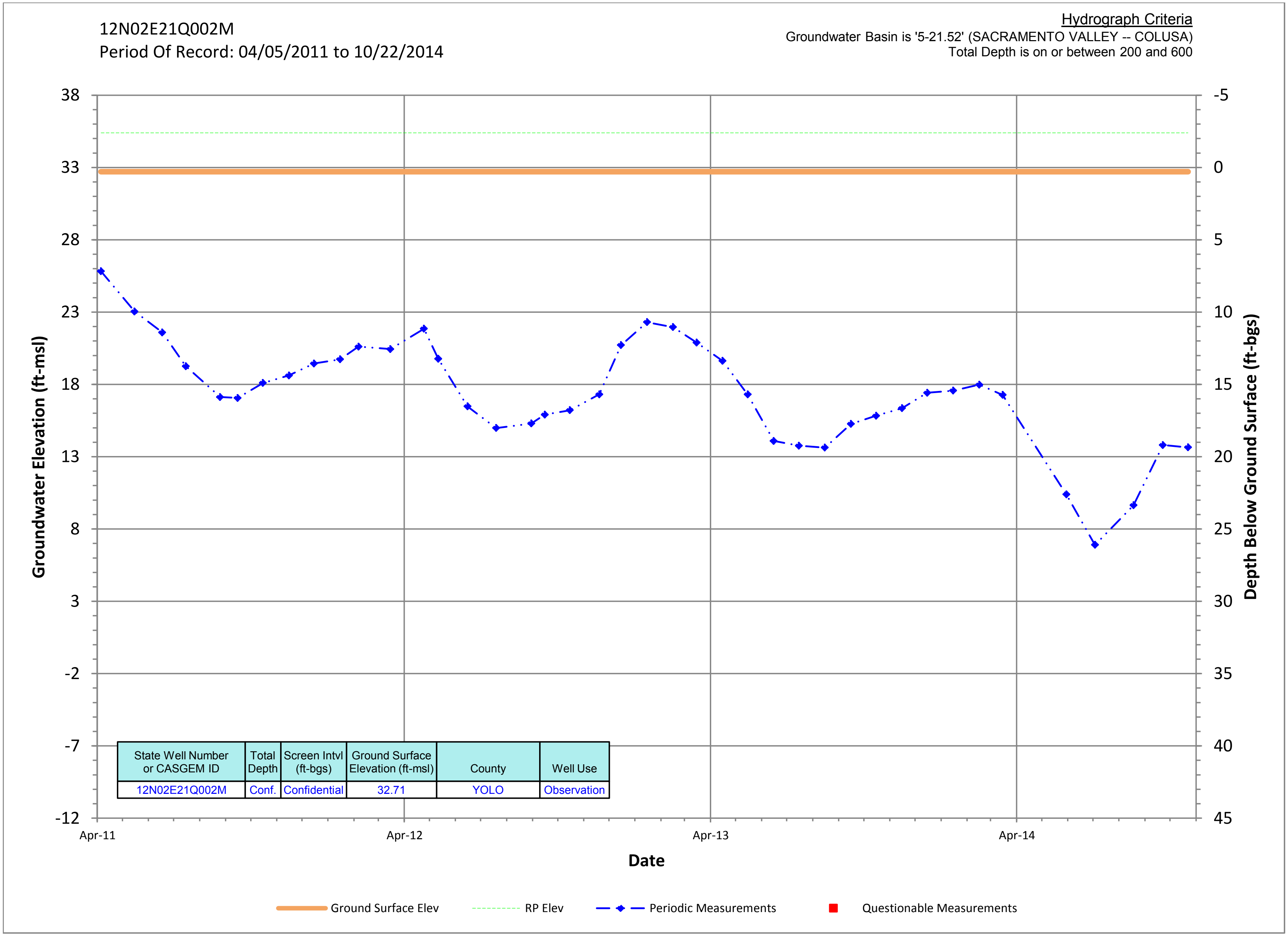
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01W15K001M	Conf.	Confidential	56.48	YOLO	Irrigation



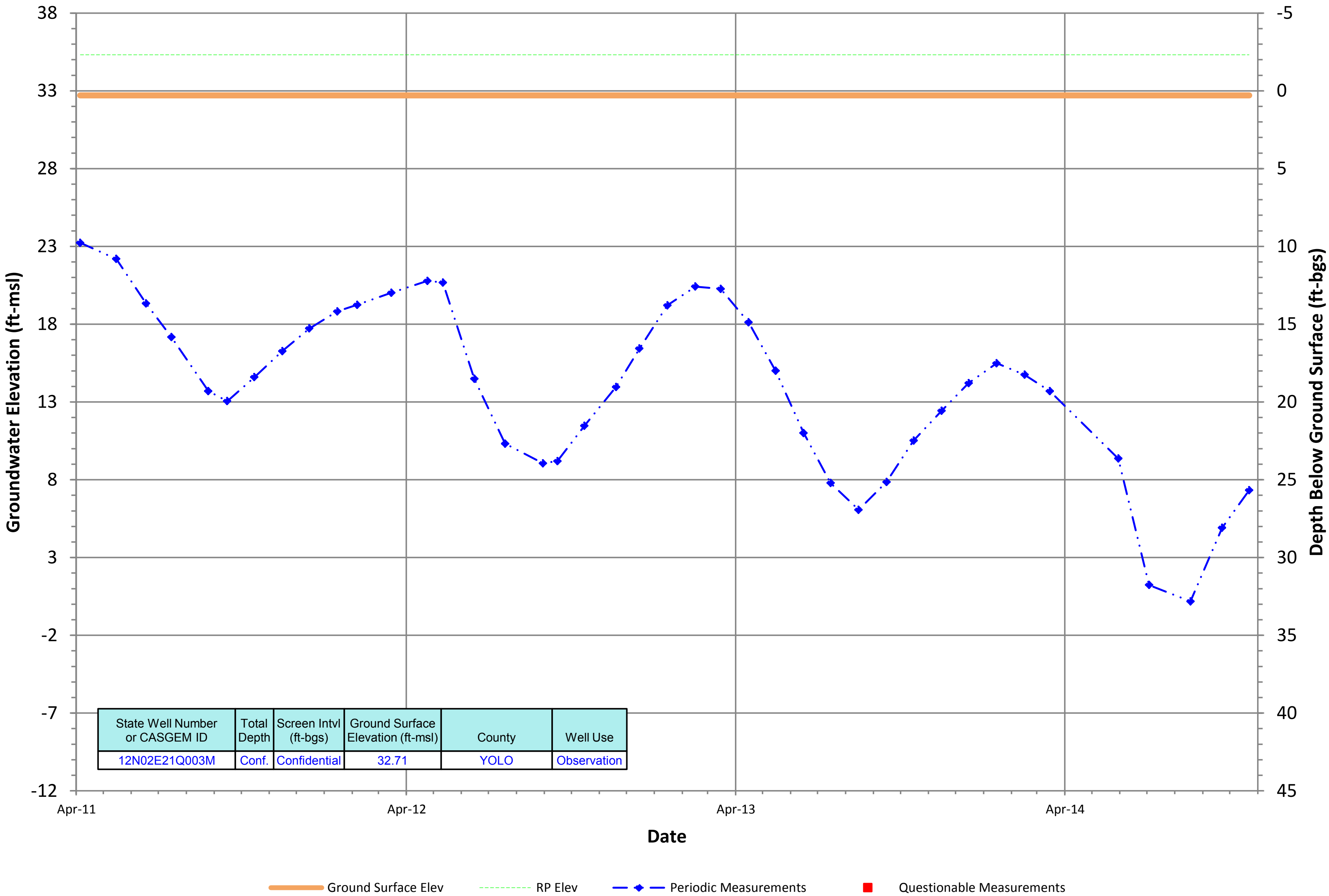
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01W15L001M	Conf.	Confidential	63.5	YOLO	Unknown



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E21Q002M	Conf.	Confidential	32.71	YOLO	Observation

12N02E21Q003M
Period Of Record: 04/05/2011 to 10/22/2014

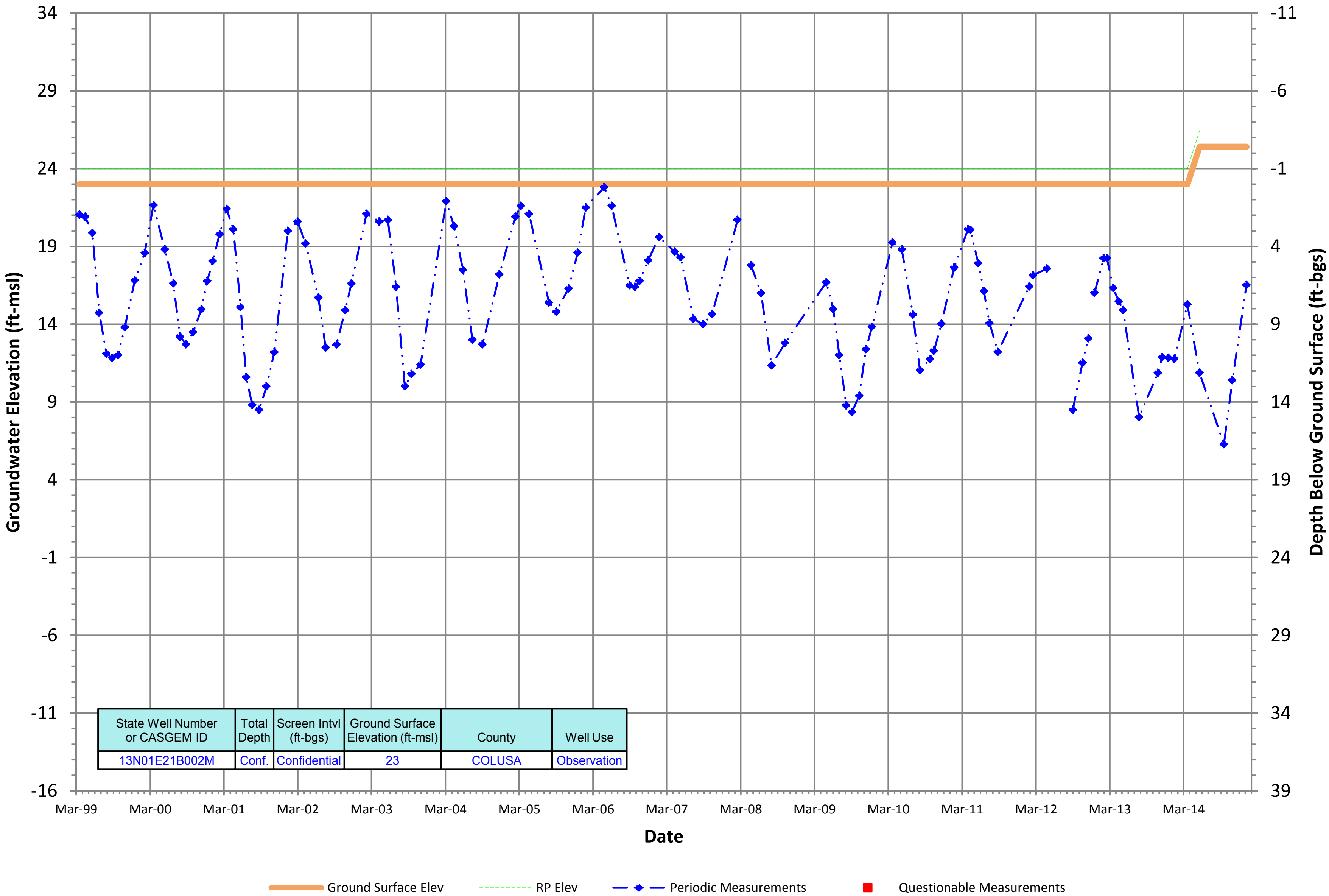
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E21Q003M	Conf.	Confidential	32.71	YOLO	Observation

13N01E21B002M
Period Of Record: 03/16/1999 to 01/06/2015

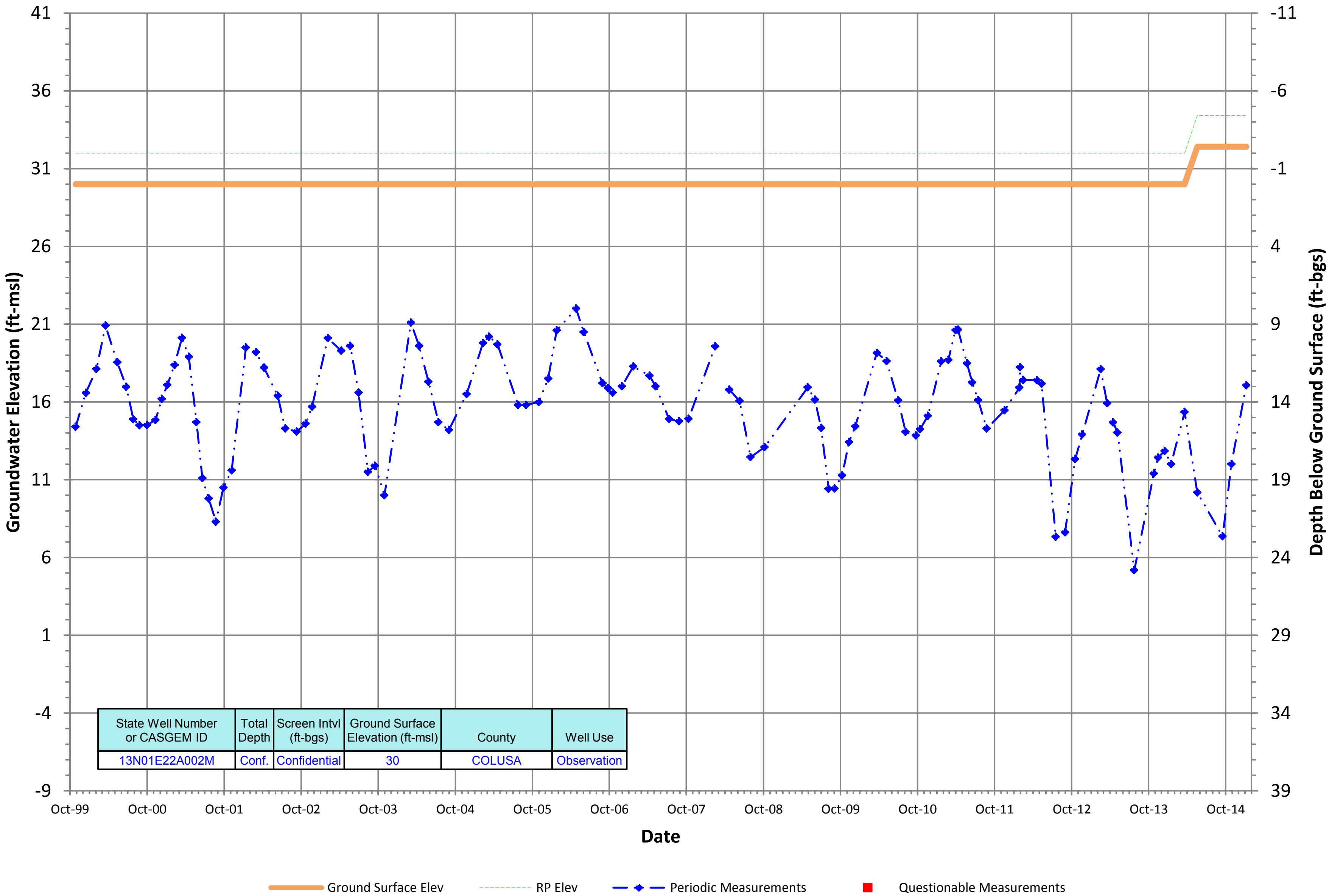
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E21B002M	Conf.	Confidential	23	COLUSA	Observation

13N01E22A002M
Period Of Record: 10/27/1999 to 01/06/2015

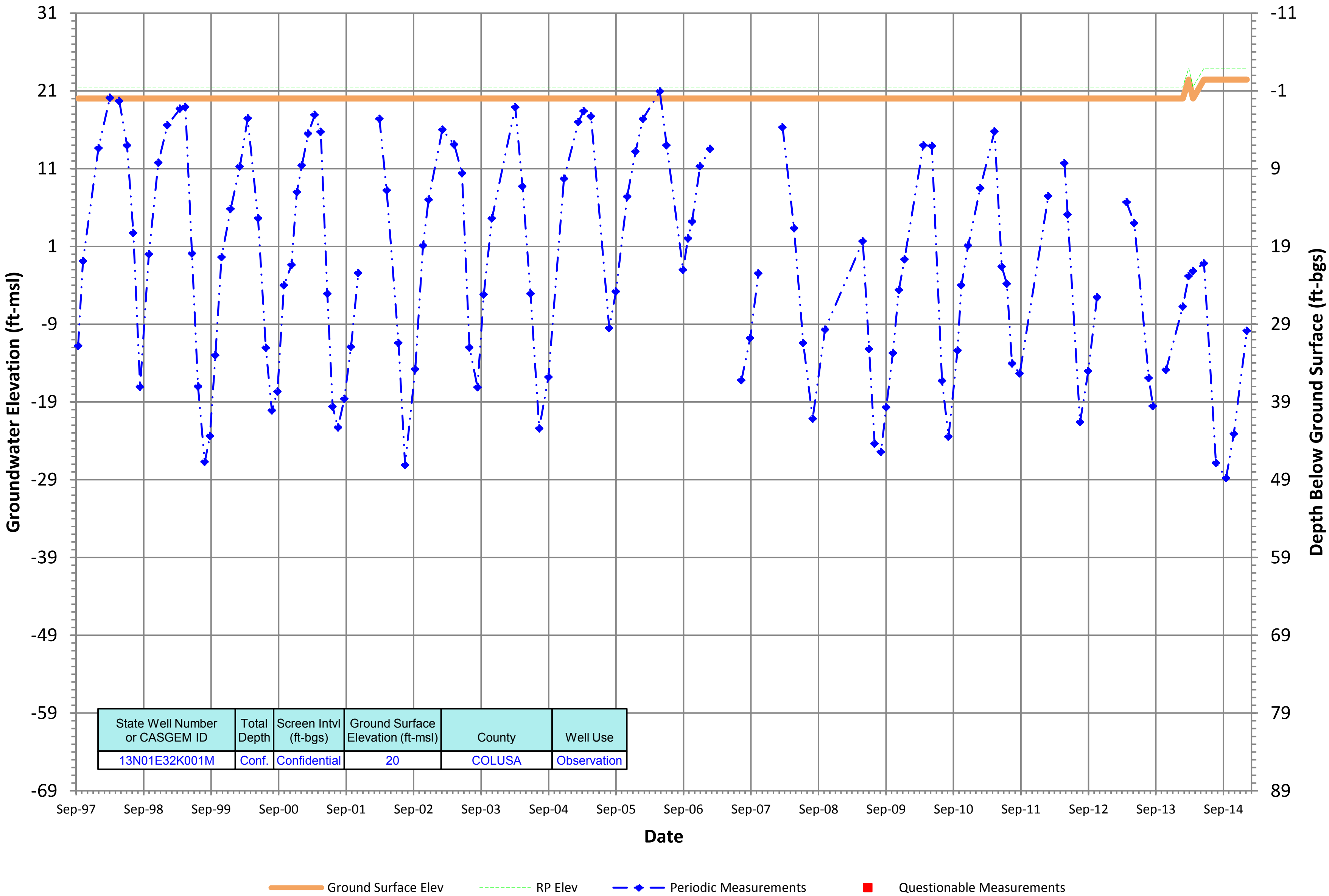
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E22A002M	Conf.	Confidential	30	COLUSA	Observation

13N01E32K001M
Period Of Record: 09/11/1997 to 01/06/2015

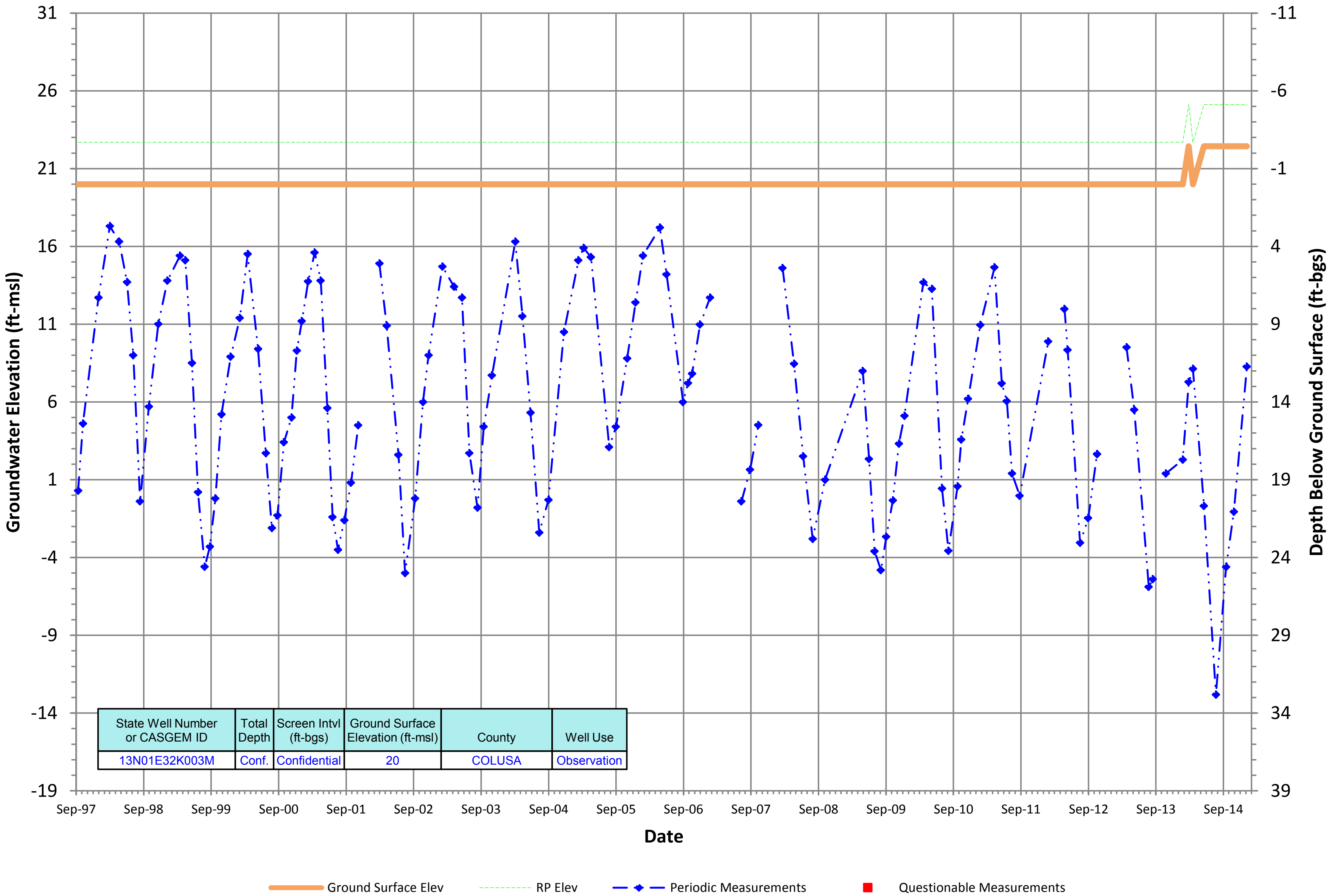
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



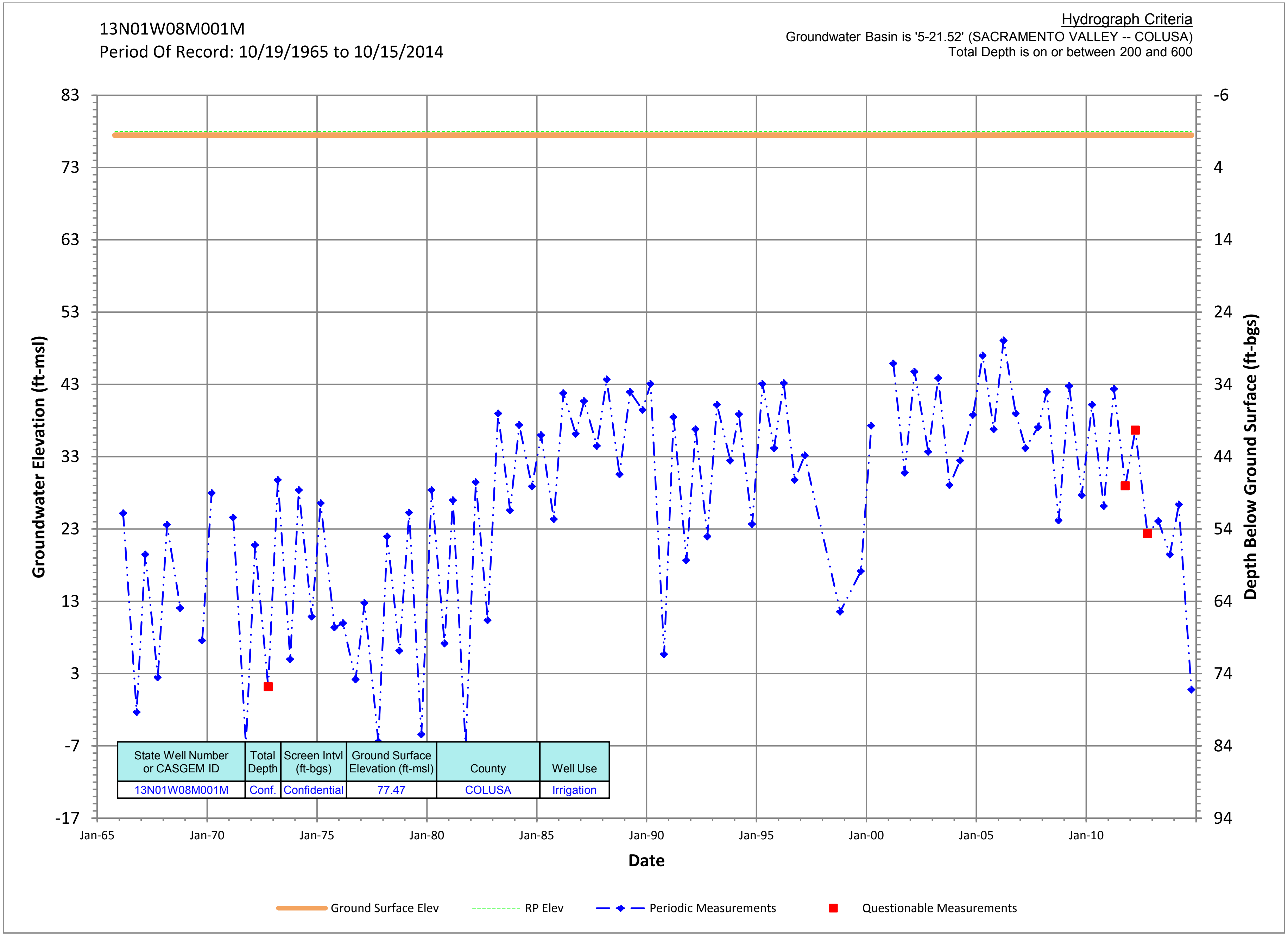
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E32K001M	Conf.	Confidential	20	COLUSA	Observation

13N01E32K003M
Period Of Record: 09/11/1997 to 01/06/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



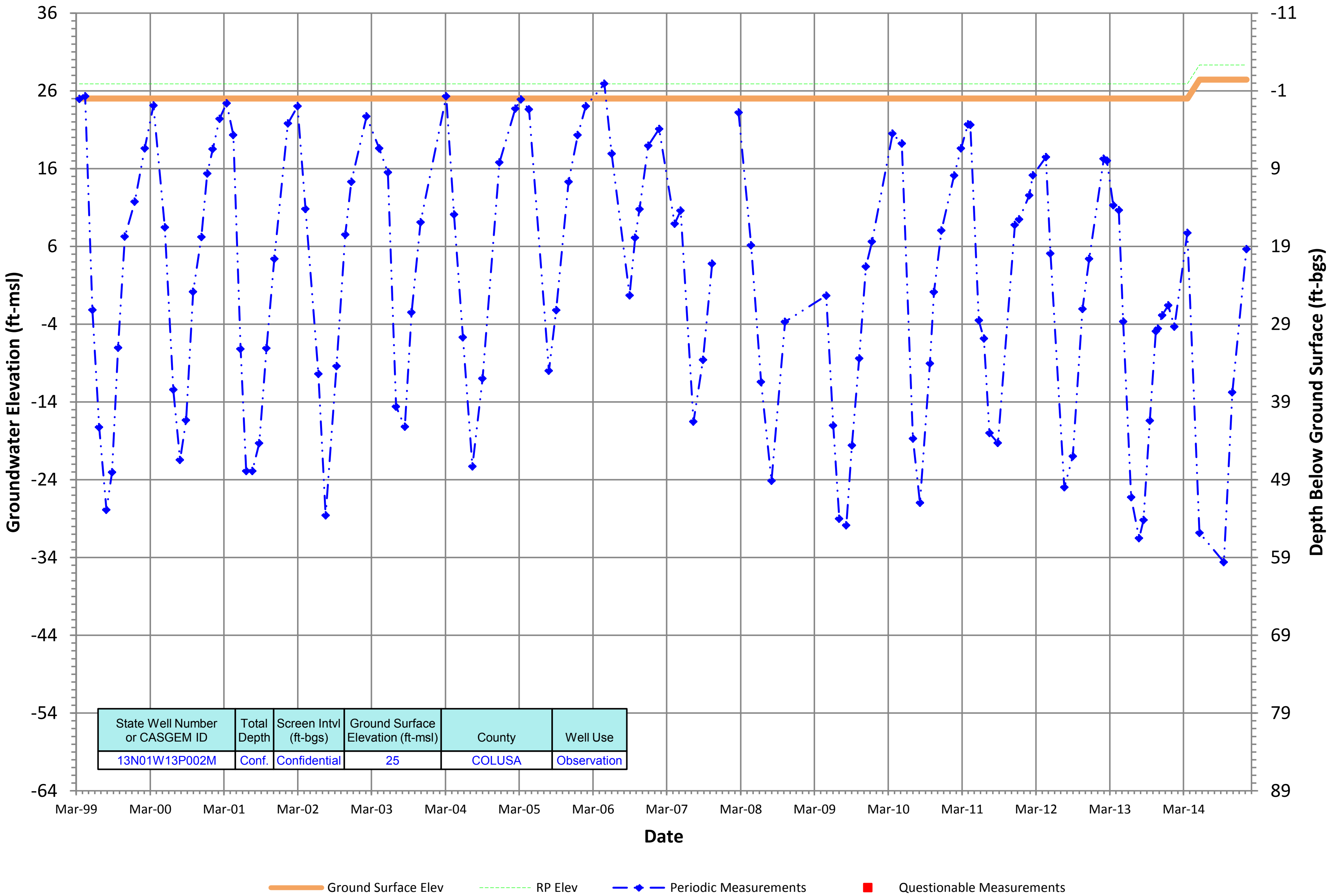
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E32K003M	Conf.	Confidential	20	COLUSA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W08M001M	Conf.	Confidential	77.47	COLUSA	Irrigation

13N01W13P002M
Period Of Record: 03/16/1999 to 01/06/2015

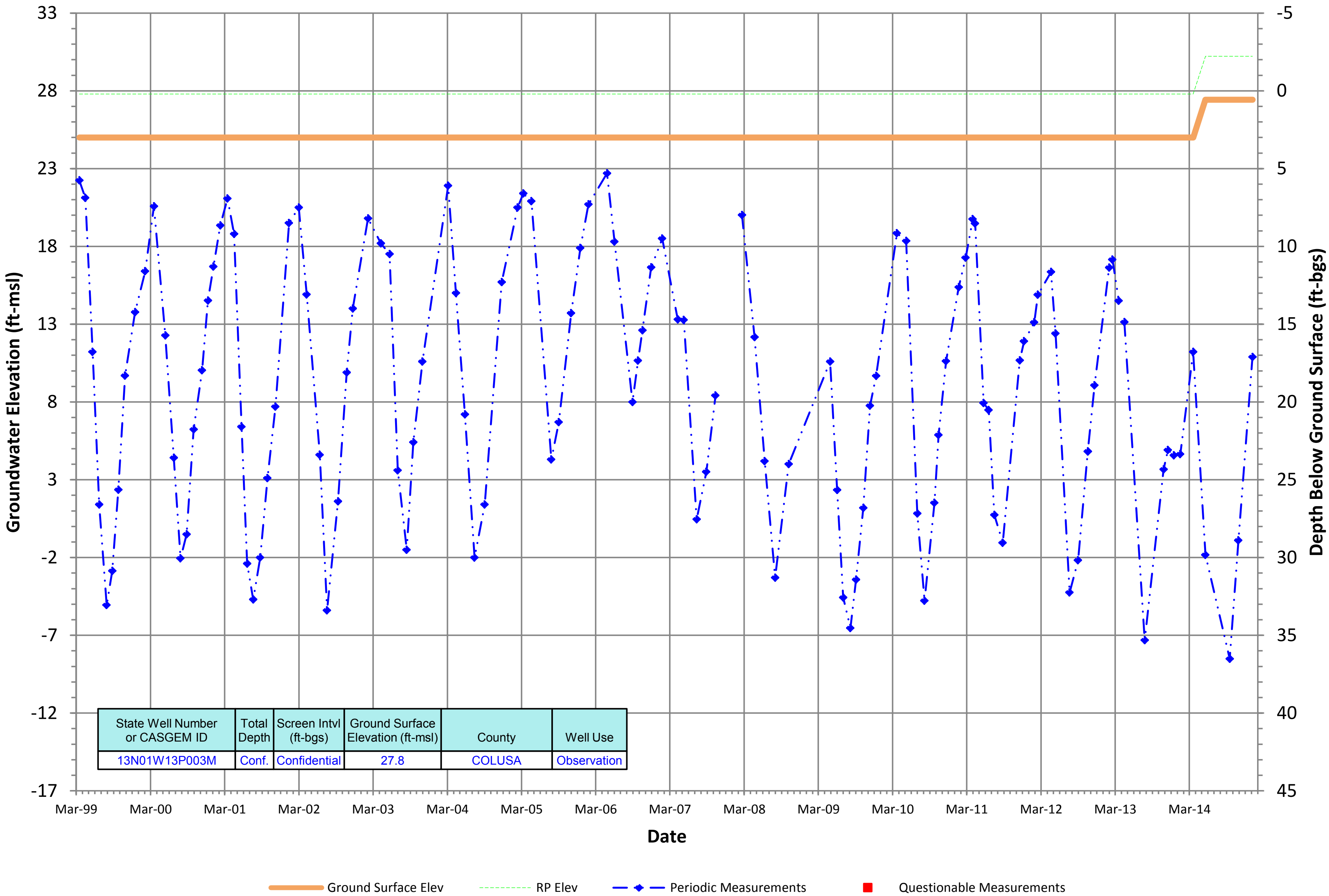
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W13P002M	Conf.	Confidential	25	COLUSA	Observation

13N01W13P003M
Period Of Record: 03/16/1999 to 01/06/2015

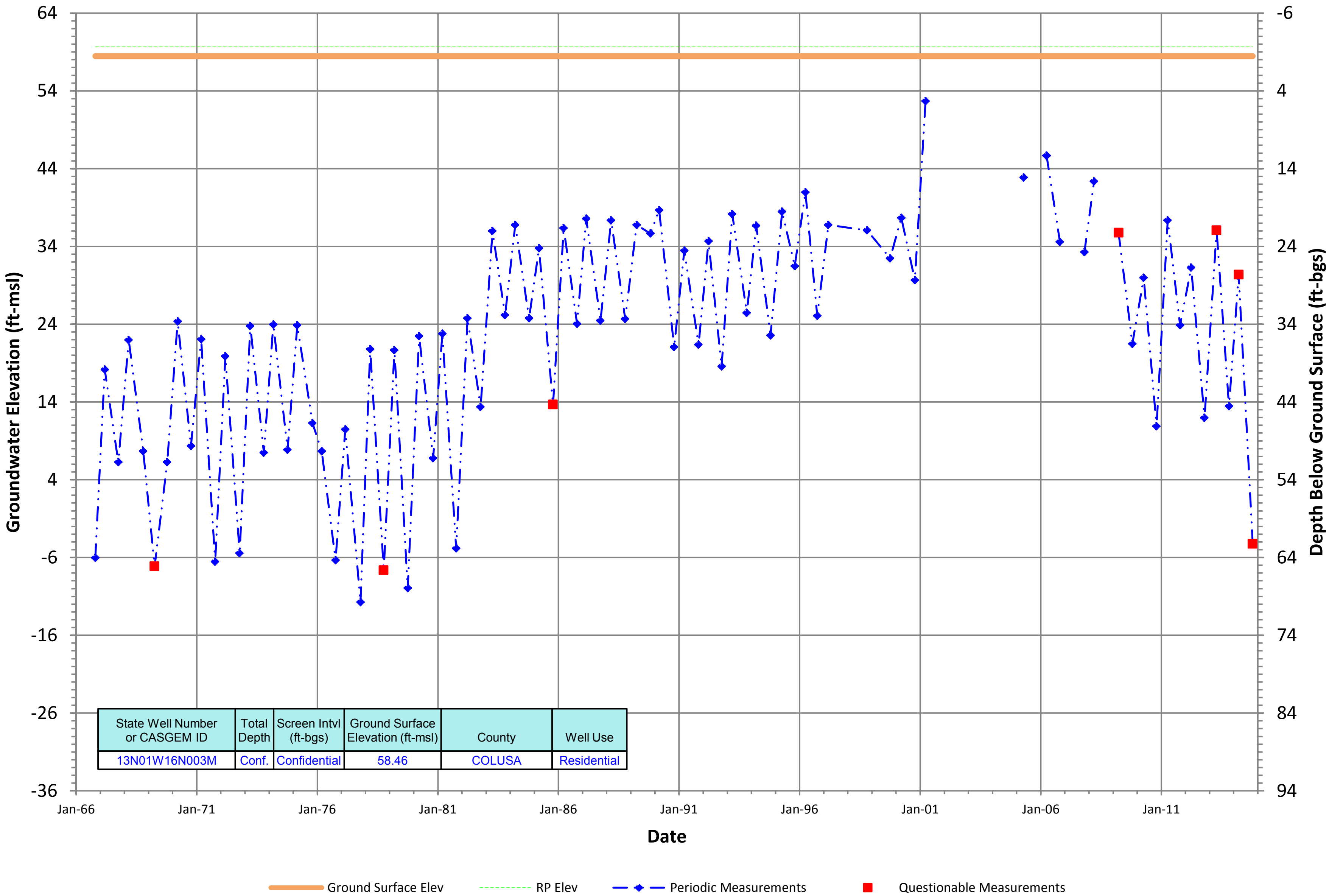
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W13P003M	Conf.	Confidential	27.8	COLUSA	Observation

13N01W16N003M
Period Of Record: 10/18/1966 to 10/15/2014

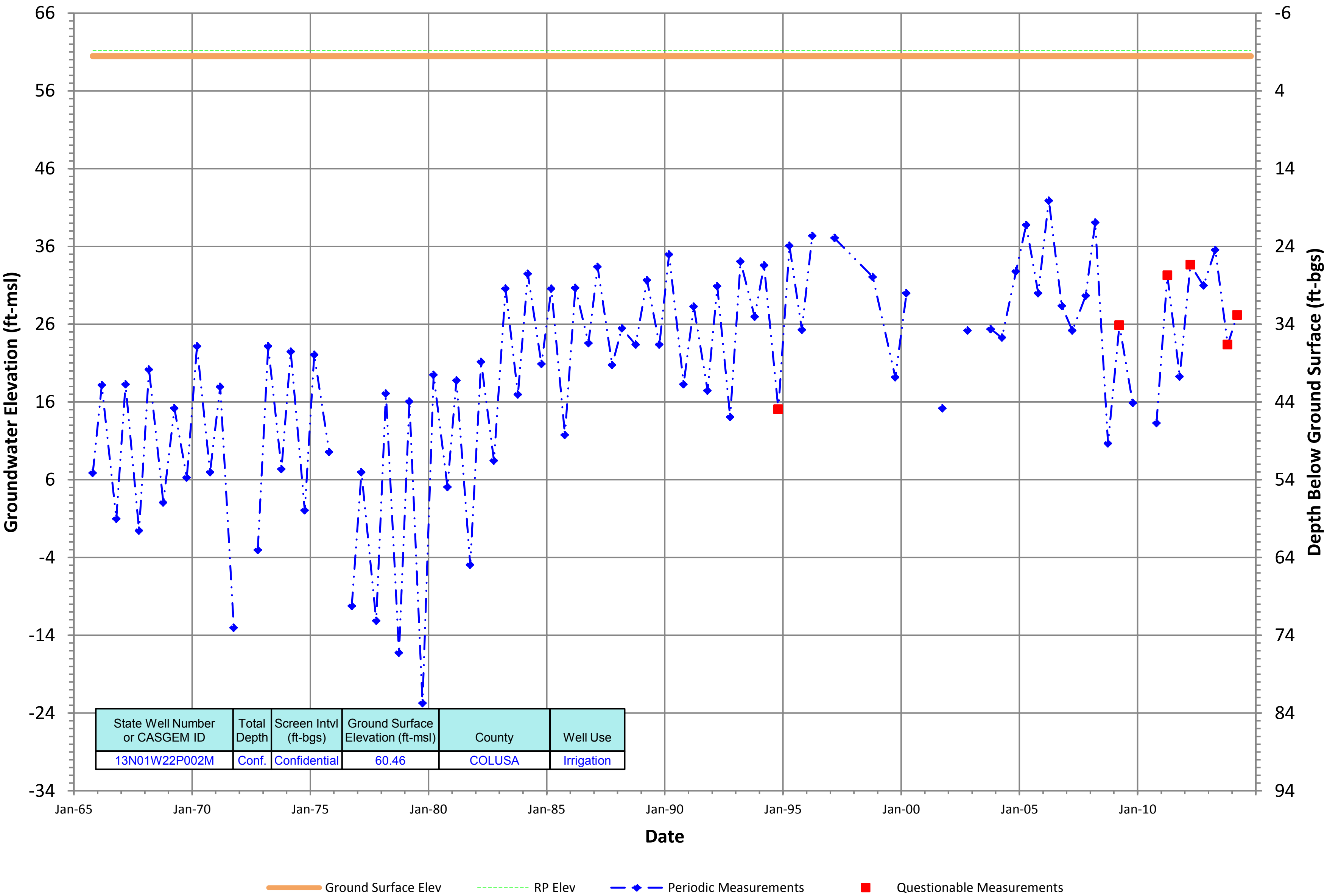
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W16N003M	Conf.	Confidential	58.46	COLUSA	Residential

13N01W22P002M
Period Of Record: 10/18/1965 to 10/15/2014

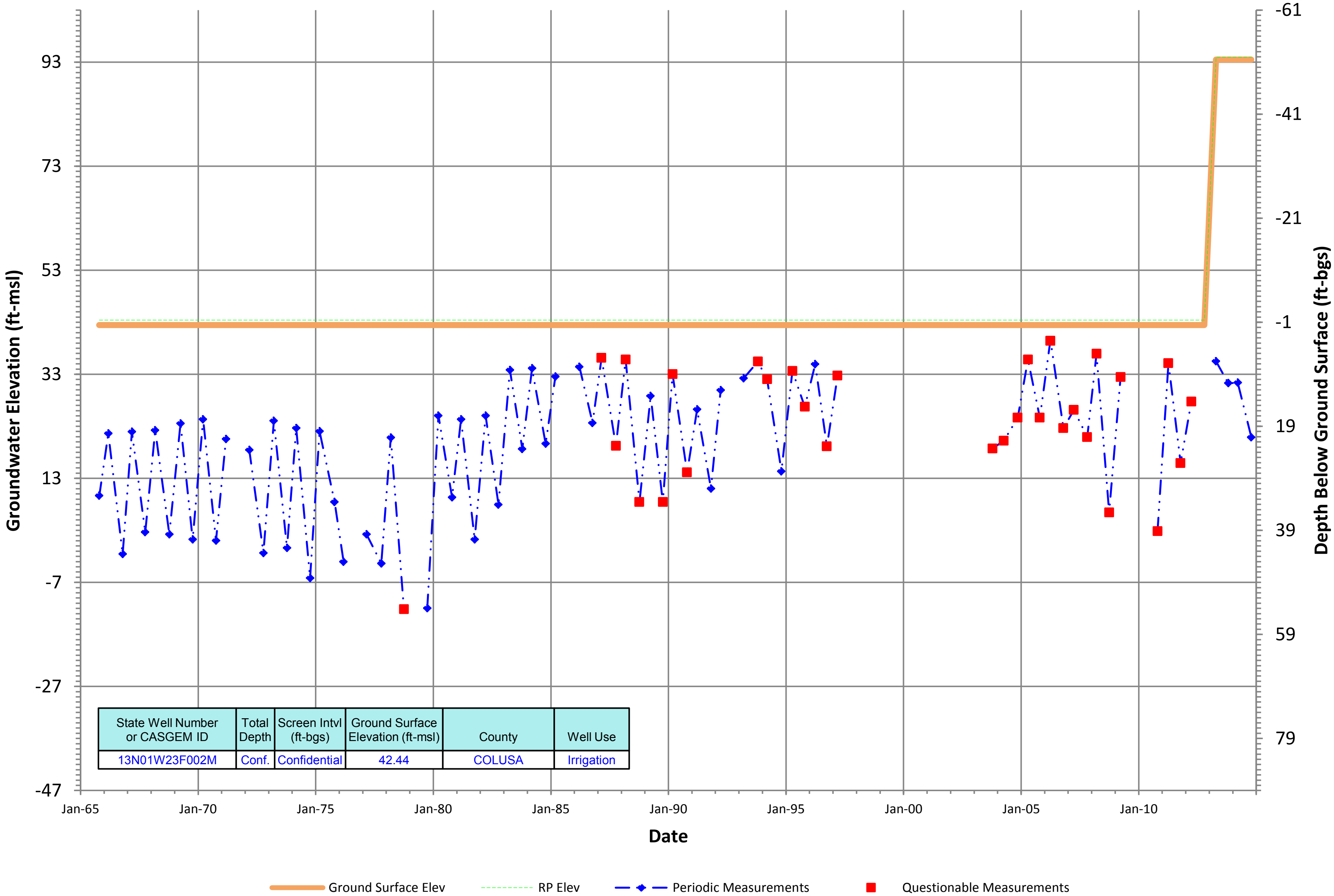
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



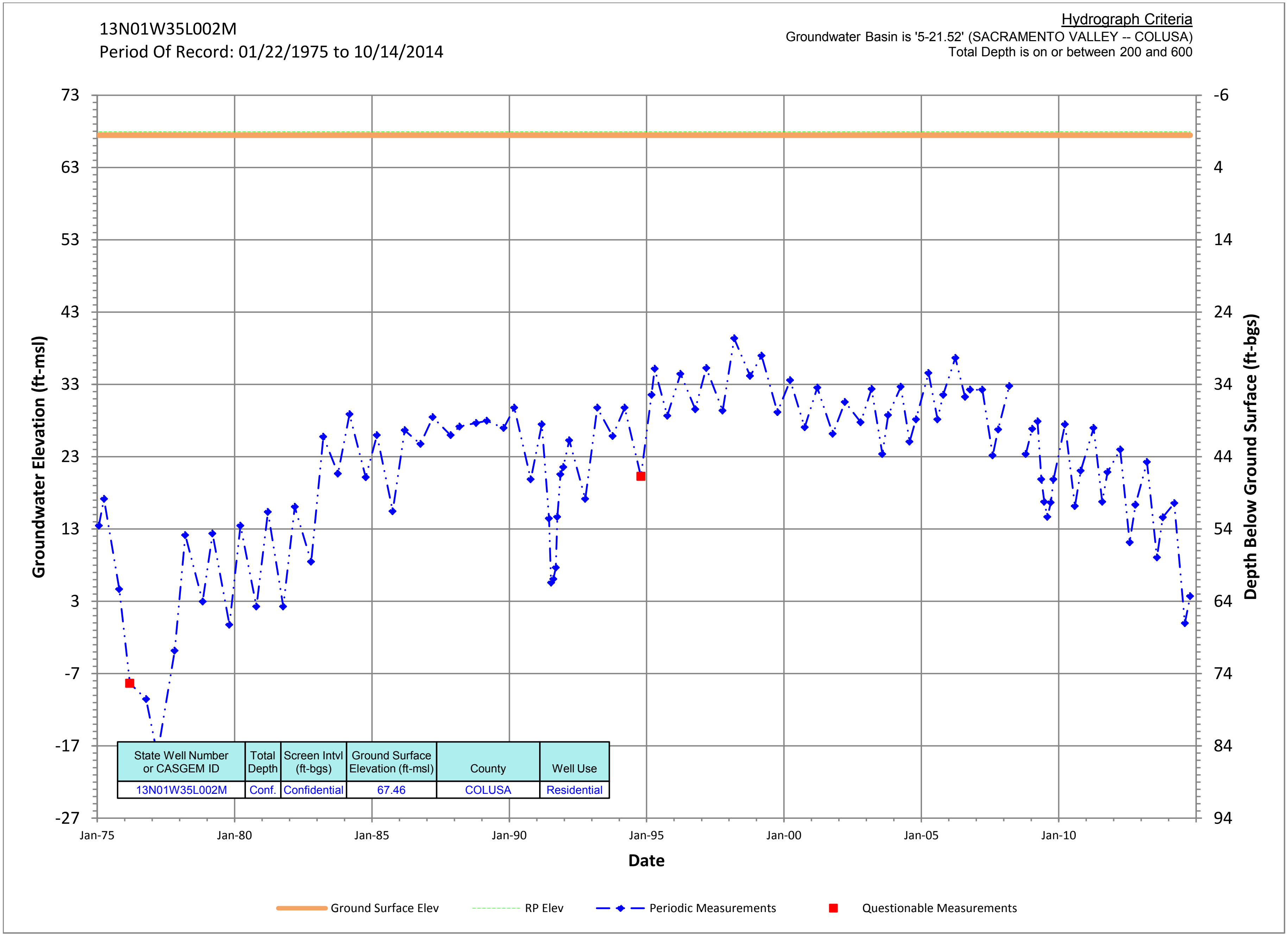
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W22P002M	Conf.	Confidential	60.46	COLUSA	Irrigation

13N01W23F002M
Period Of Record: 10/18/1965 to 10/15/2014

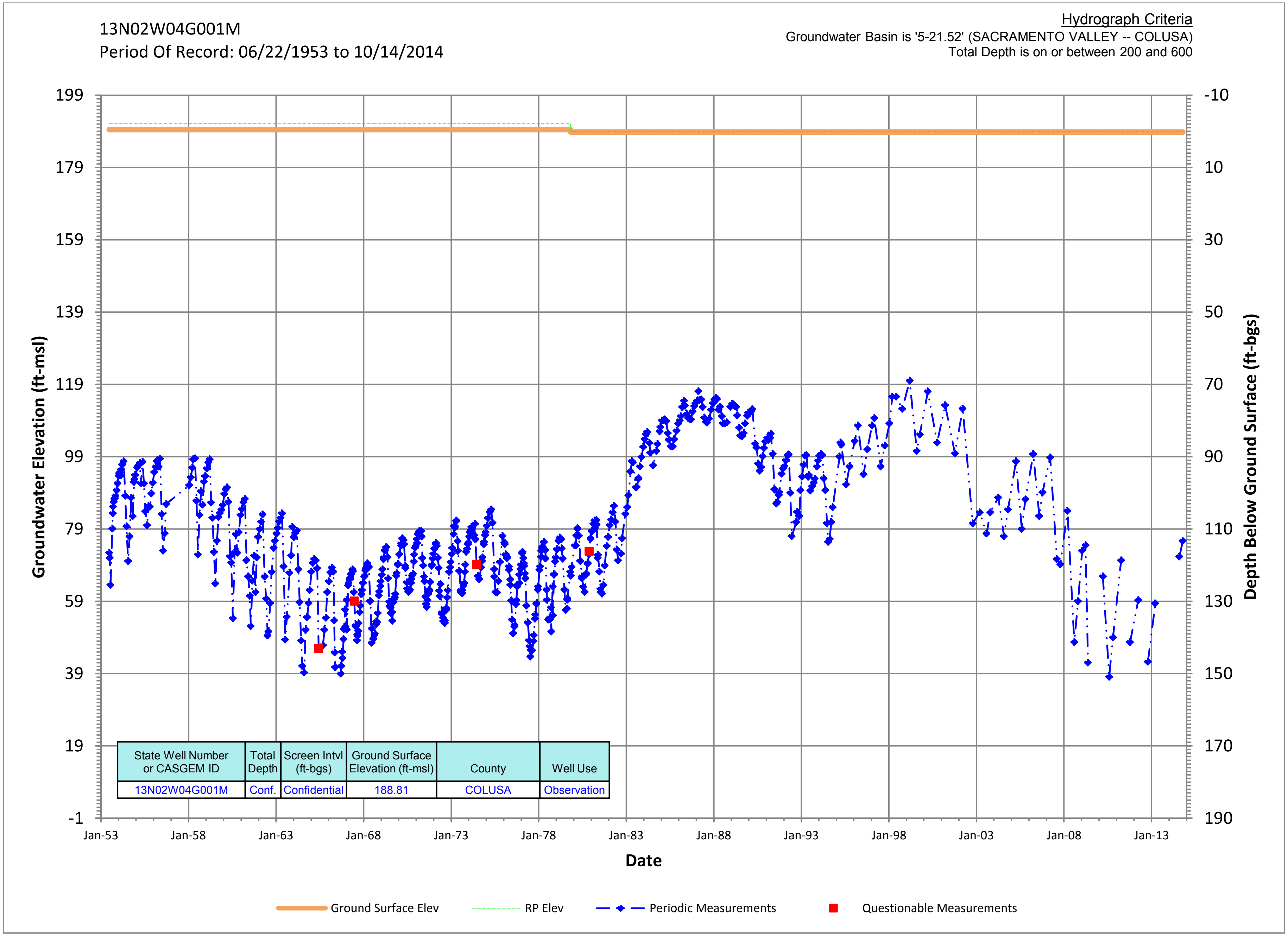
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W23F002M	Conf.	Confidential	42.44	COLUSA	Irrigation

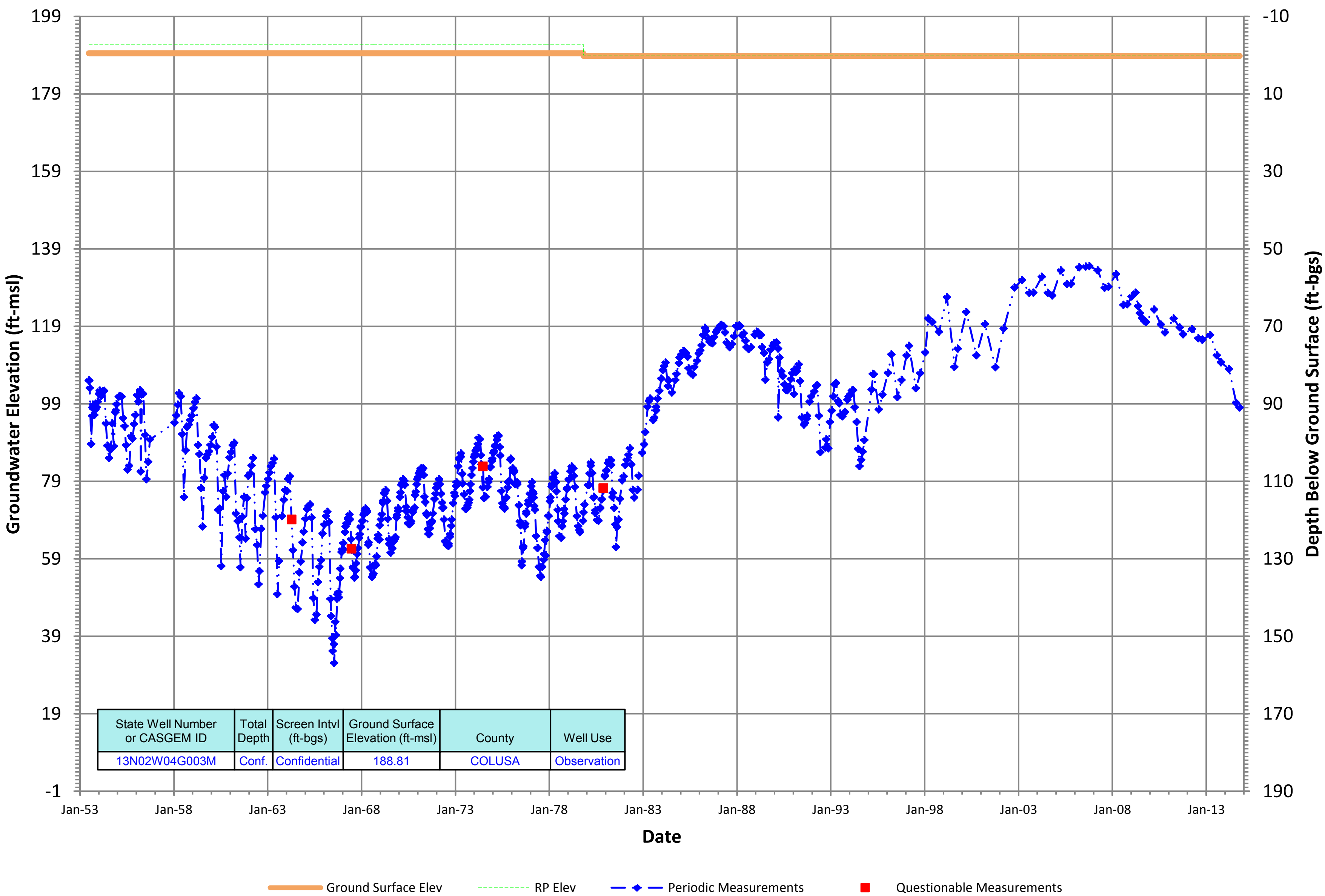


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W35L002M	Conf.	Confidential	67.46	COLUSA	Residential

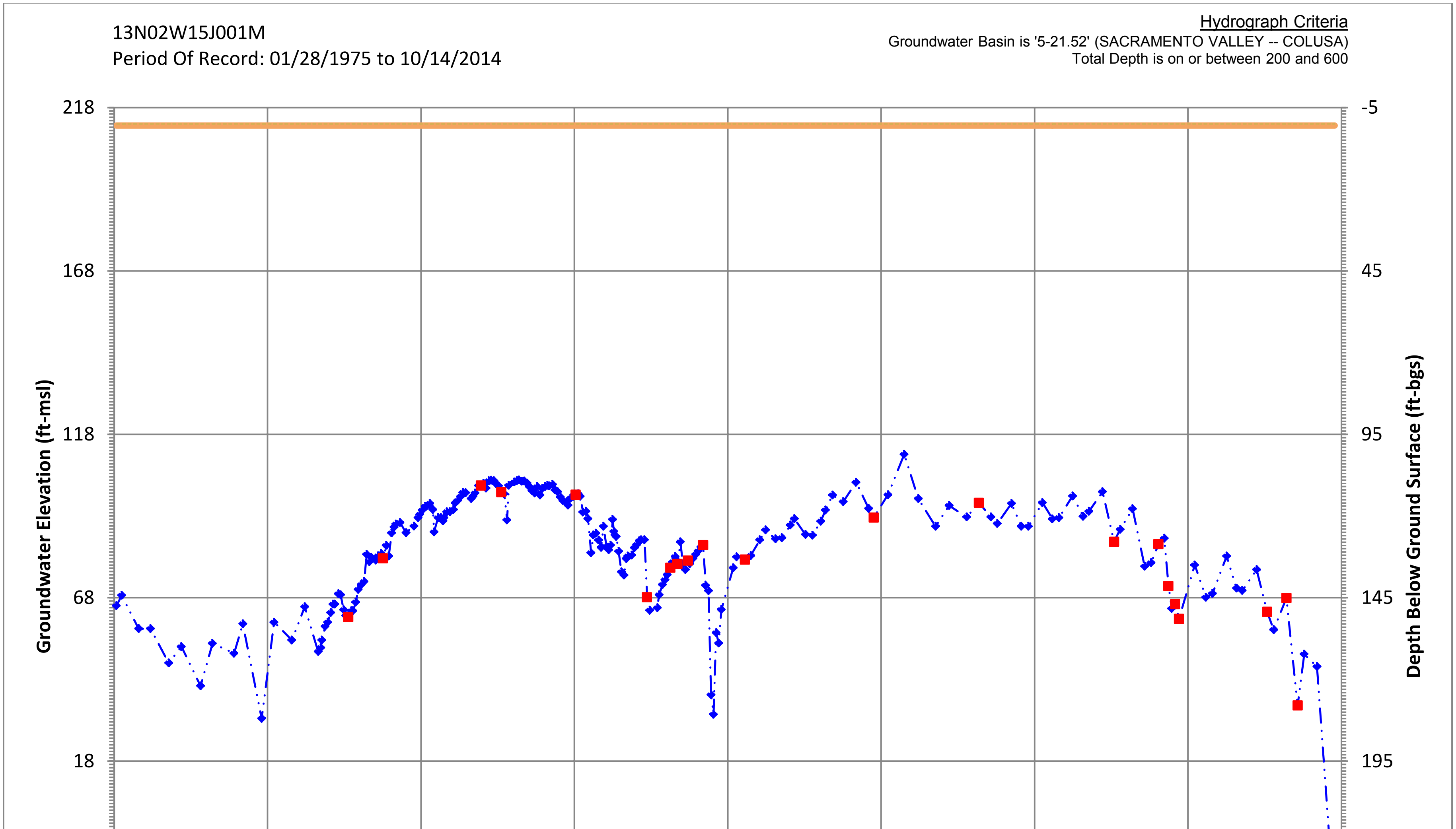

13N02W04G001M
Period Of Record: 06/22/1953 to 10/14/2014
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
199
179
159
139
119
99
79
59
39
19
-1
-10
10
30
50
70
90
110
130
150
170
190
Jan-53
Jan-58
Jan-63
Jan-68
Jan-73
Jan-78
Jan-83
Jan-88
Jan-93
Jan-98
Jan-03
Jan-08
Jan-13
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
13N02W04G001M
Conf.
Confidential
188.81
COLUSA
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

13N02W04G003M
Period Of Record: 06/22/1953 to 10/14/2014

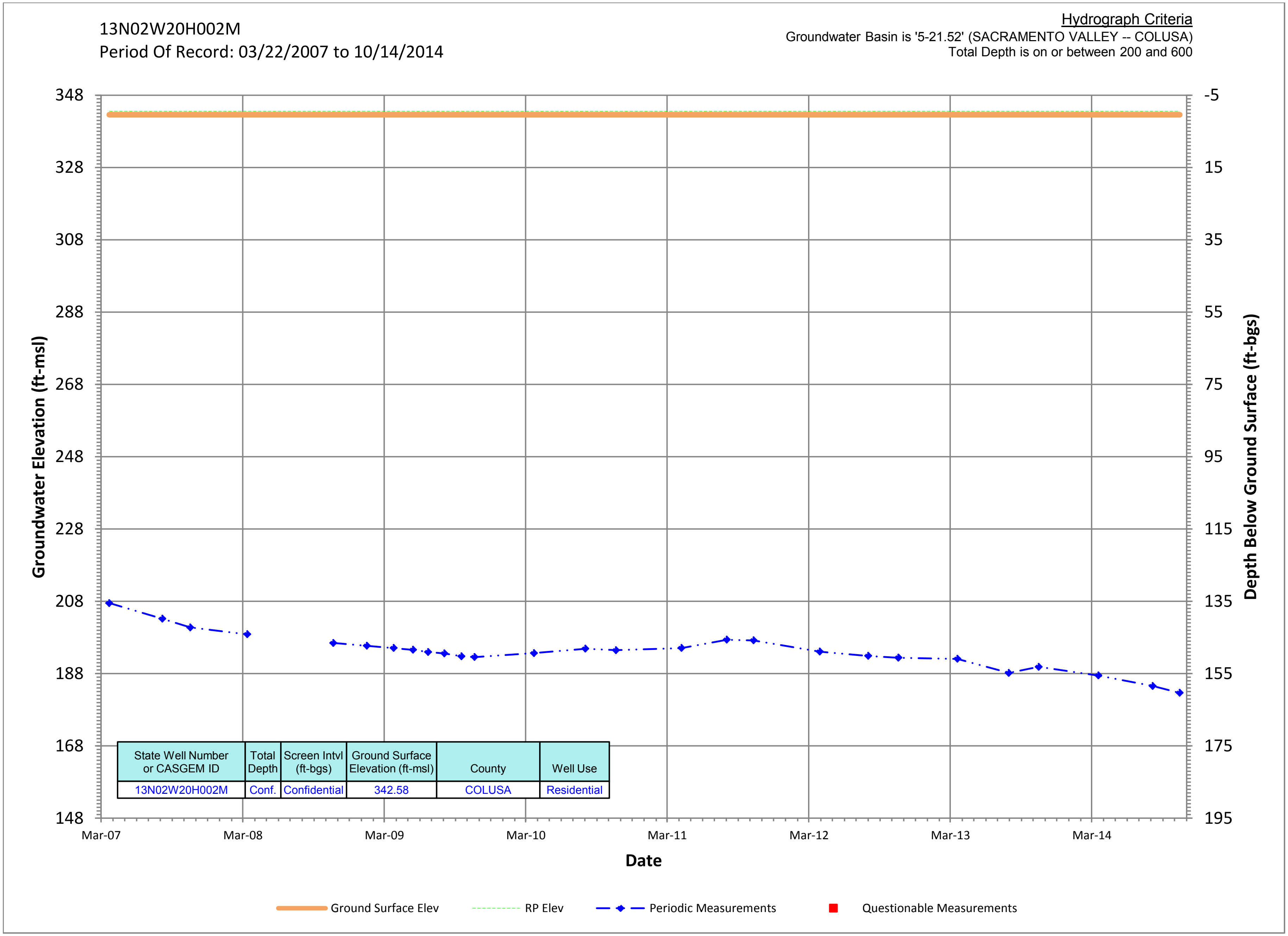
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W04G003M	Conf.	Confidential	188.81	COLUSA	Observation



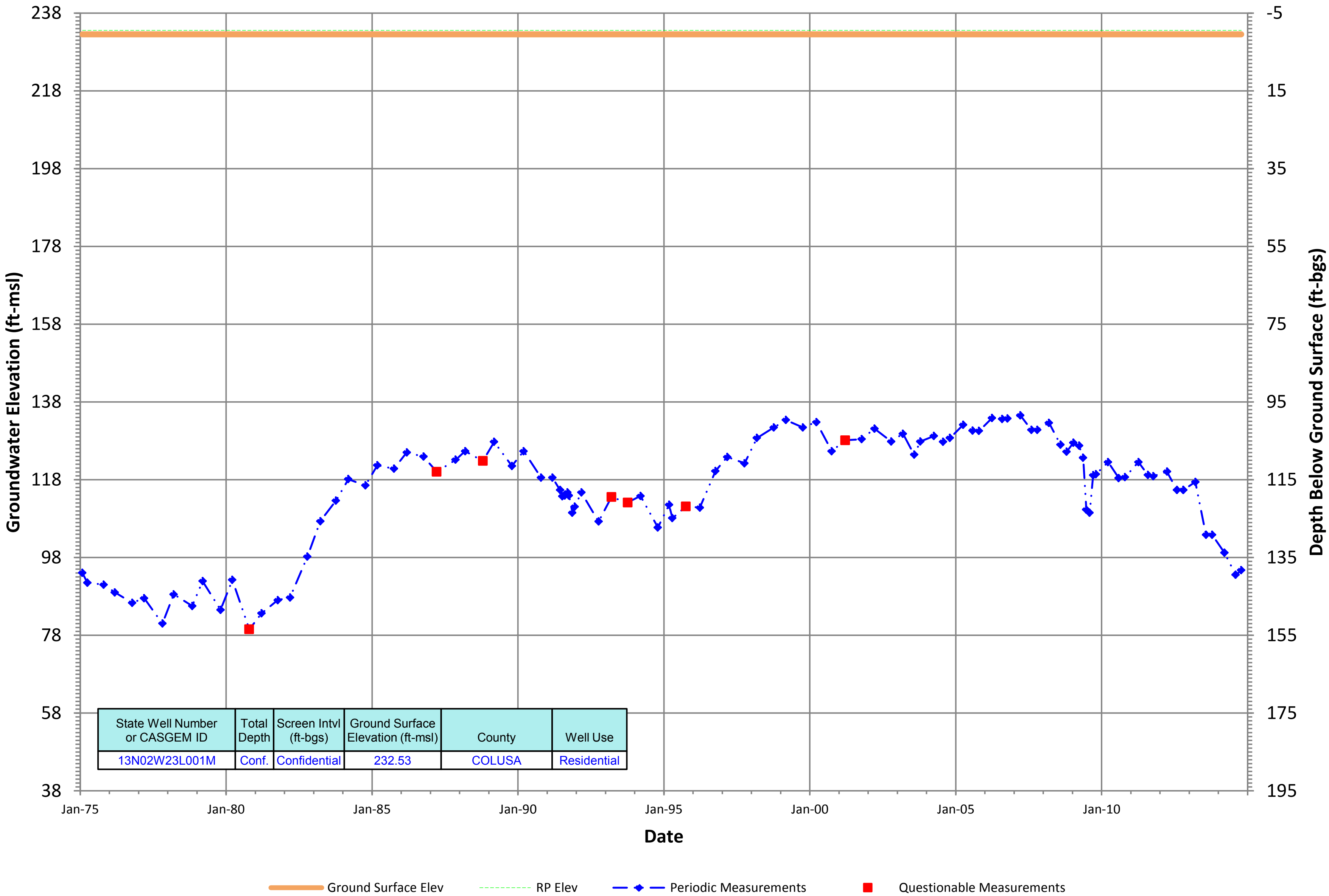
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W15J001M	Conf.	Confidential	212.52	COLUSA	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W20H002M	Conf.	Confidential	342.58	COLUSA	Residential

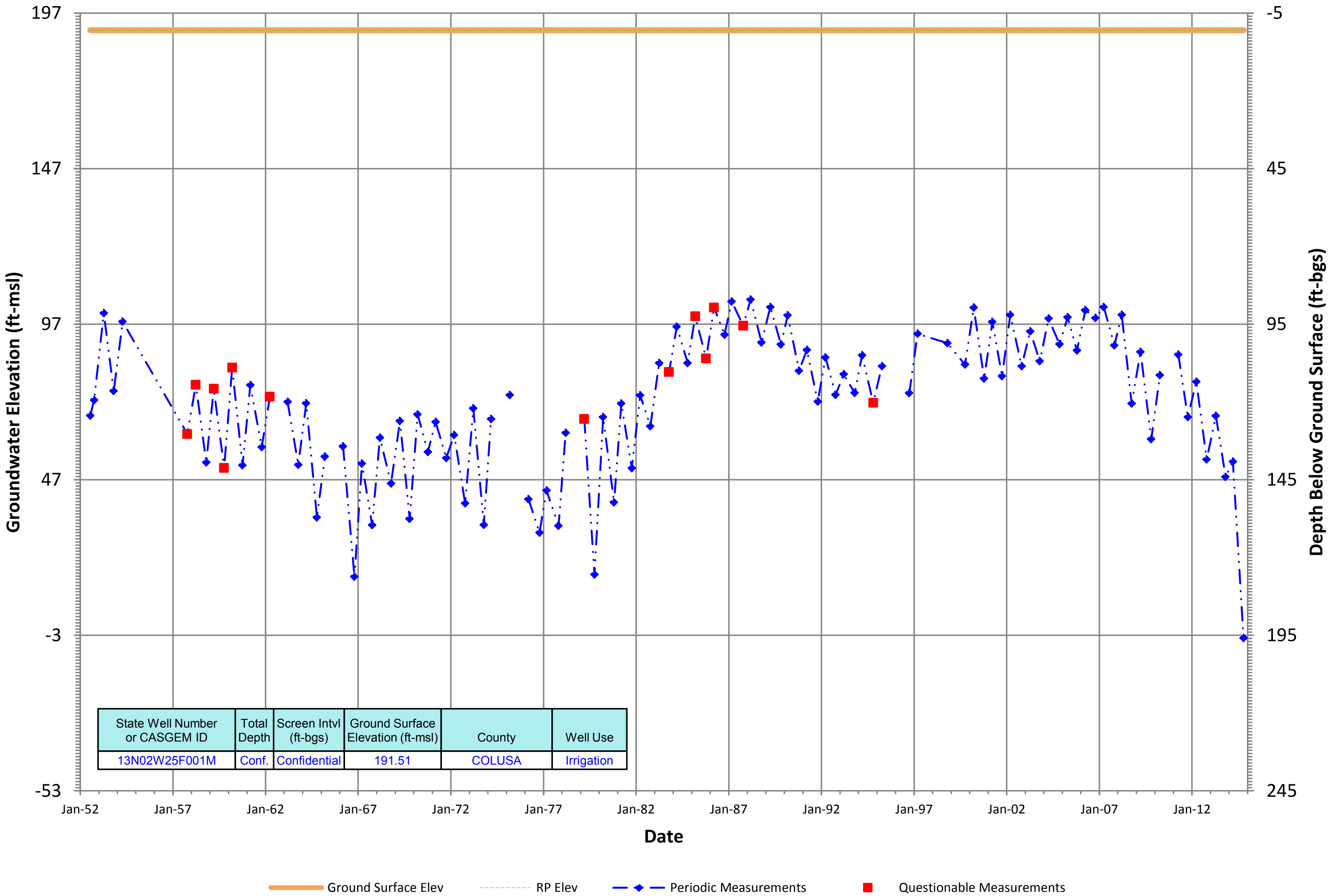
13N02W23L001M
Period Of Record: 01/28/1975 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



13N02W25F001M
Period Of Record: 07/17/1952 to 10/15/2014

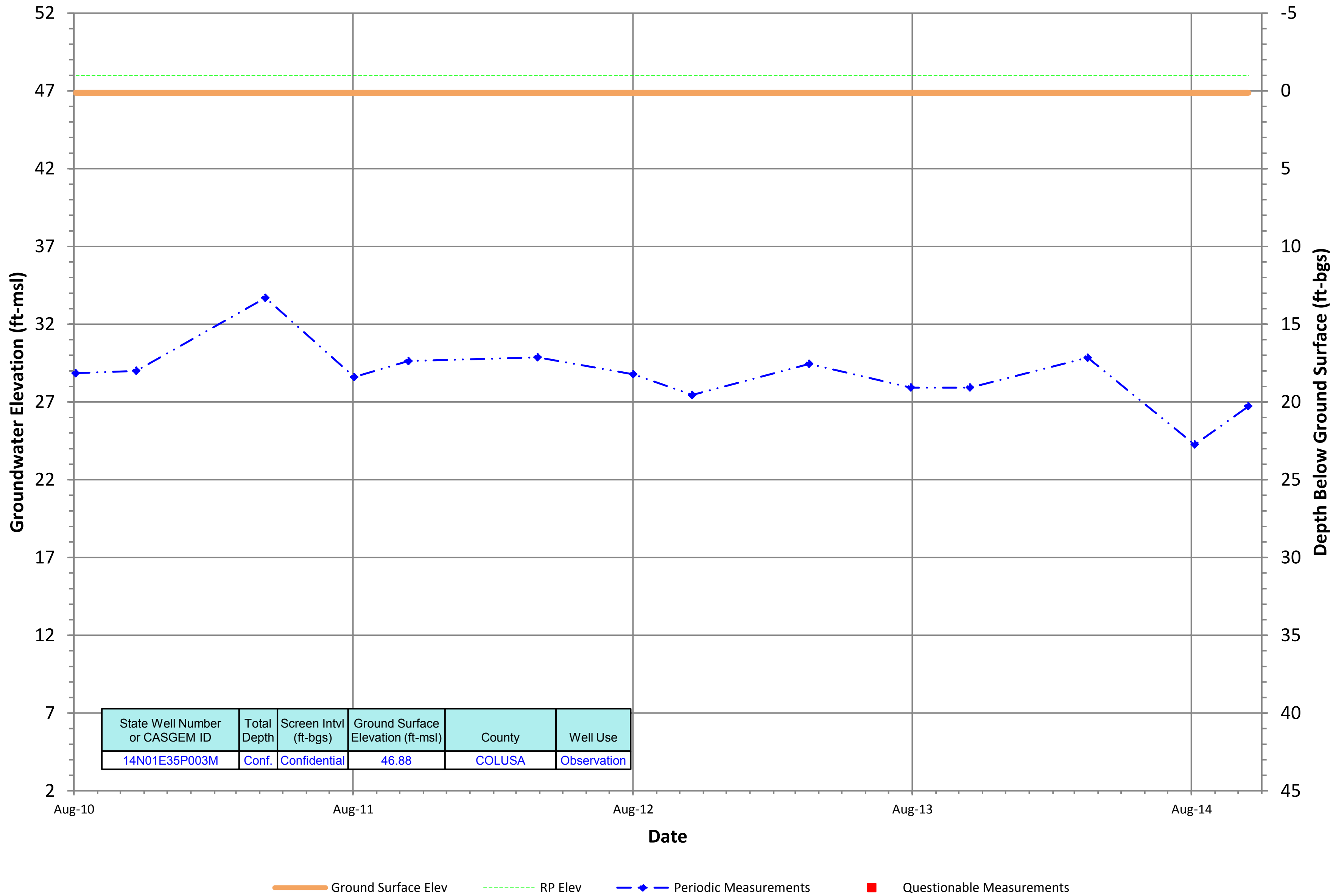
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



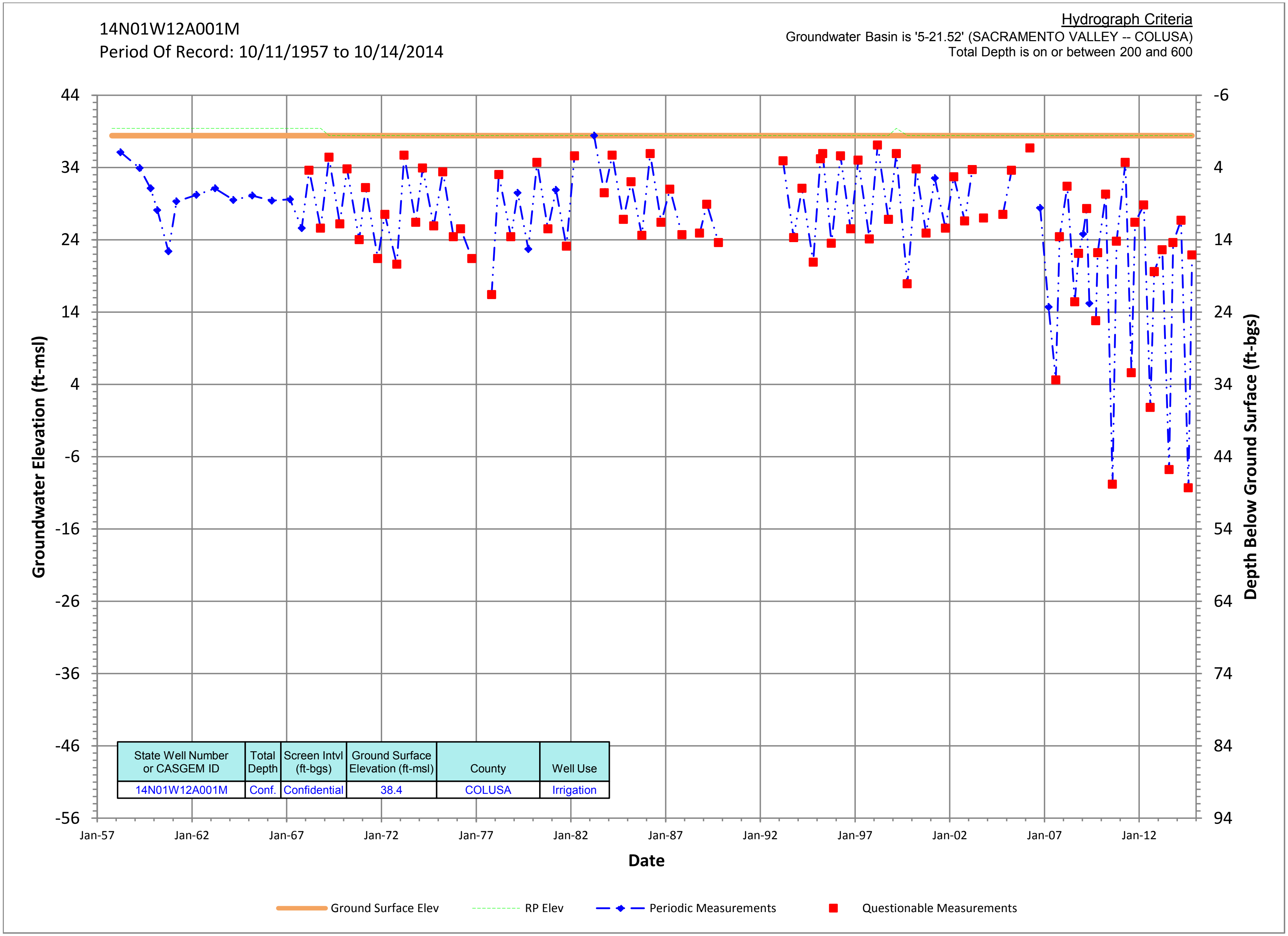
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W25F001M	Conf.	Confidential	191.51	COLUSA	Irrigation

14N01E35P003M
Period Of Record: 08/03/2010 to 10/14/2014

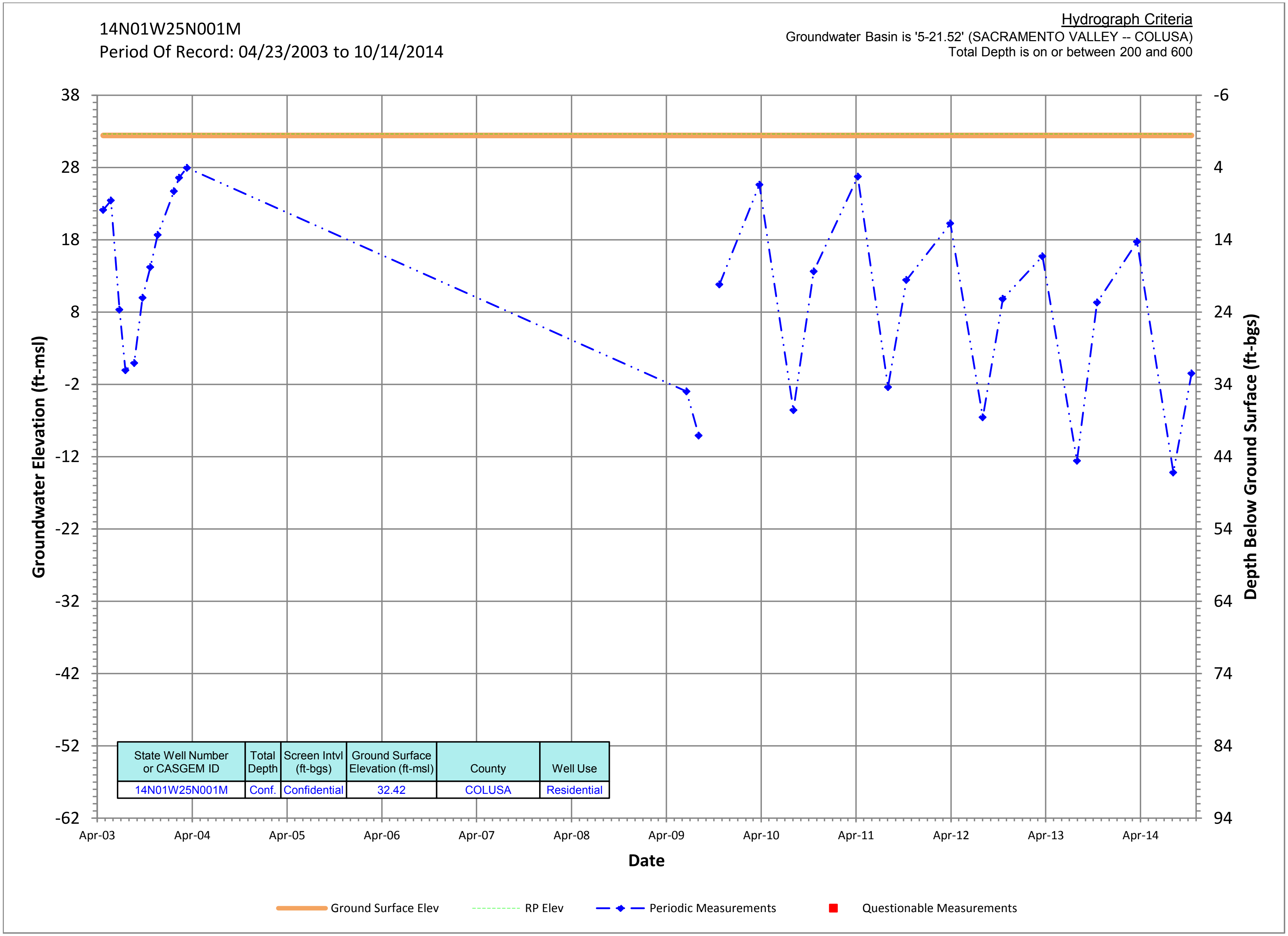
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01E35P003M	Conf.	Confidential	46.88	COLUSA	Observation



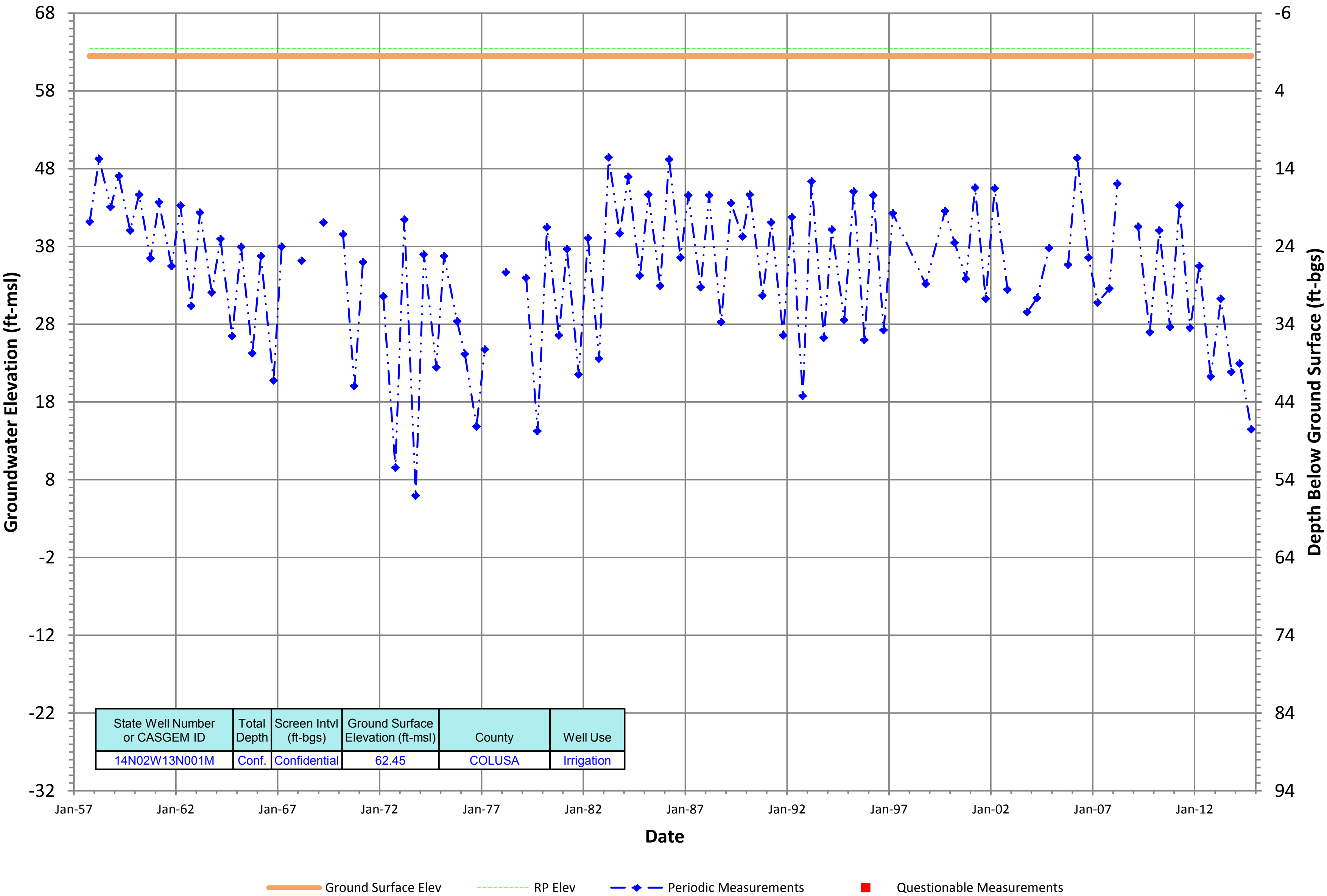
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01W12A001M	Conf.	Confidential	38.4	COLUSA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01W25N001M	Conf.	Confidential	32.42	COLUSA	Residential

14N02W13N001M
Period Of Record: 10/10/1957 to 10/15/2014

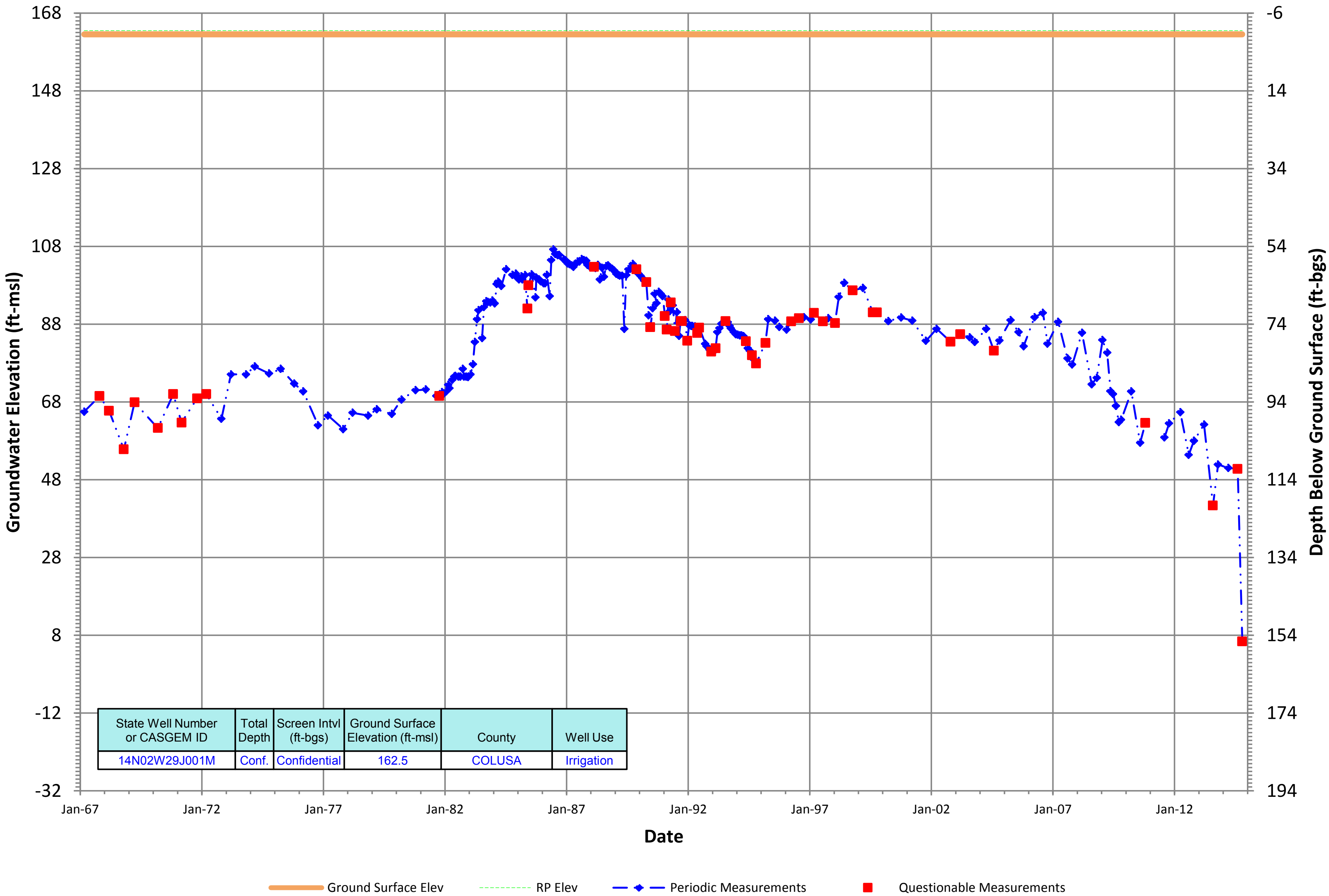
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



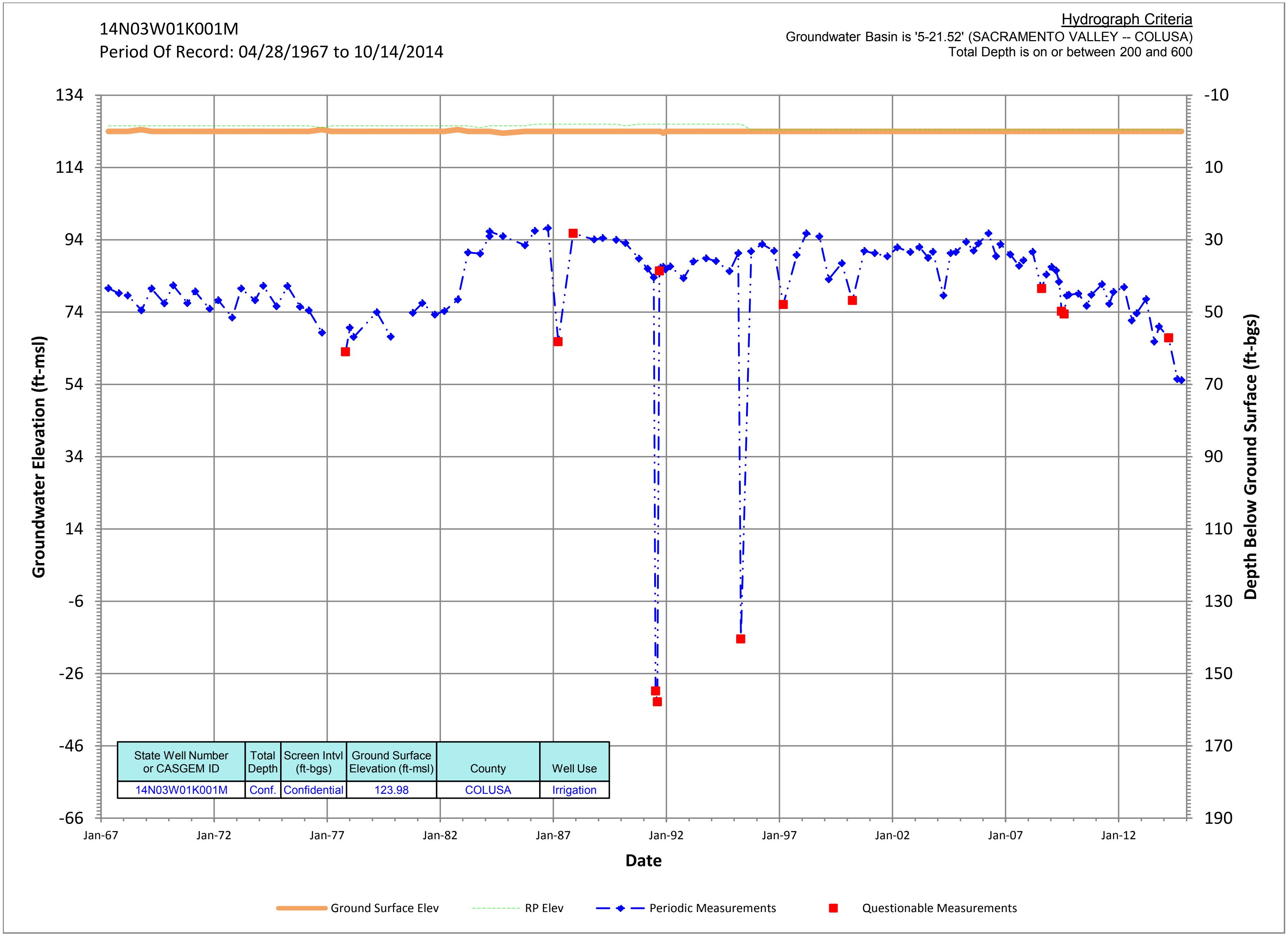
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02W13N001M	Conf.	Confidential	62.45	COLUSA	Irrigation

14N02W29J001M
Period Of Record: 02/28/1967 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



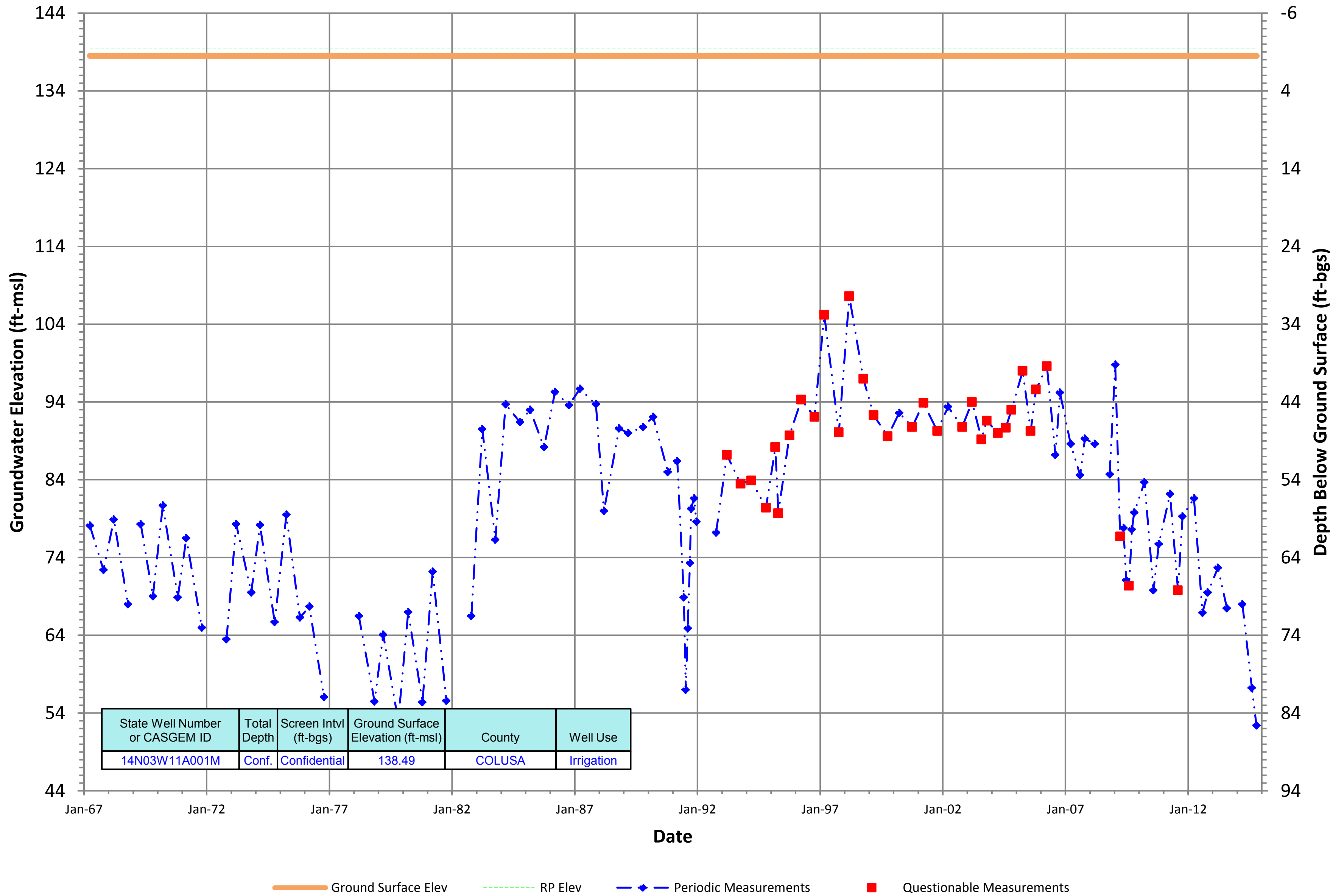
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02W29J001M	Conf.	Confidential	162.5	COLUSA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03W01K001M	Conf.	Confidential	123.98	COLUSA	Irrigation

14N03W11A001M
Period Of Record: 03/29/1967 to 10/14/2014

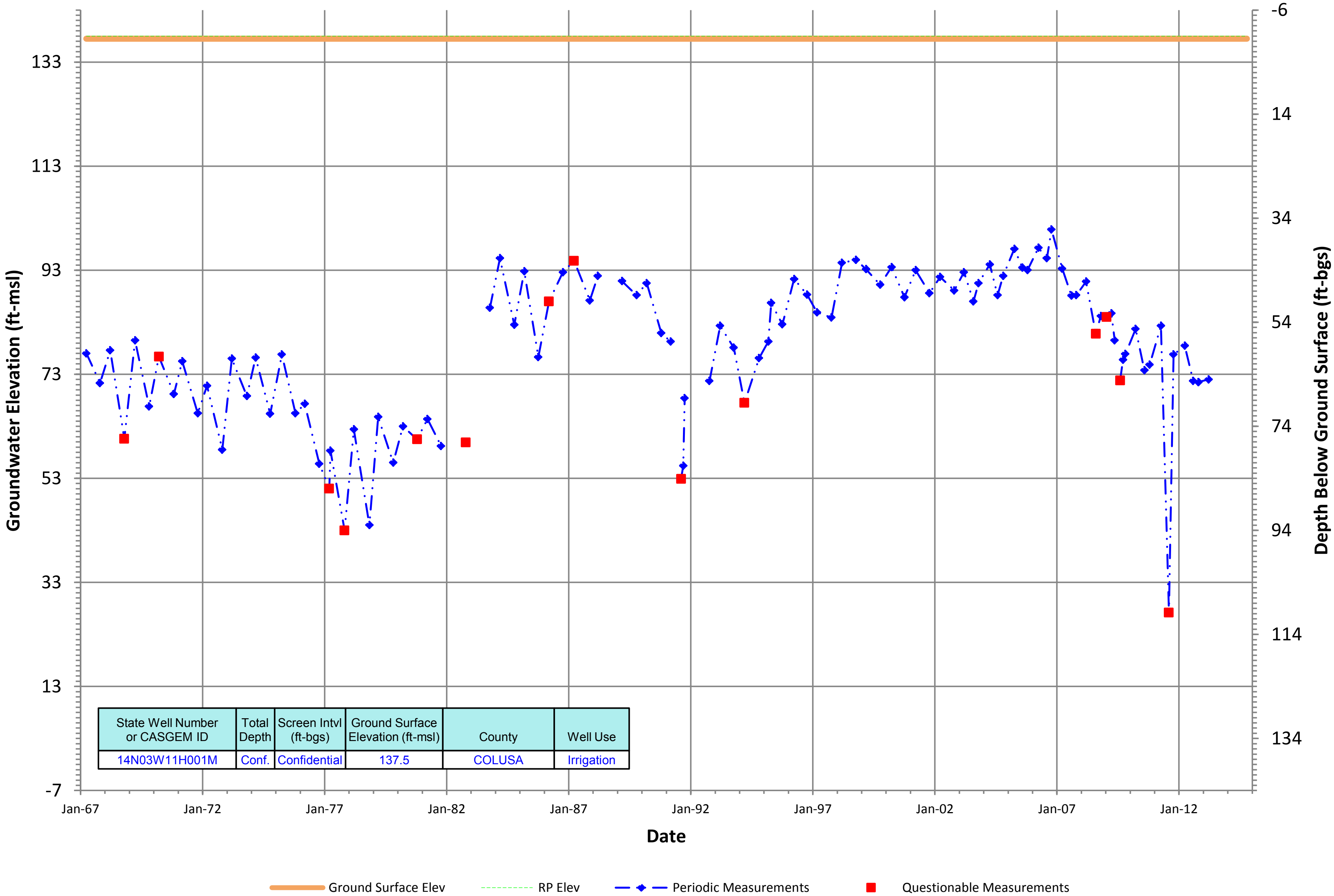
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



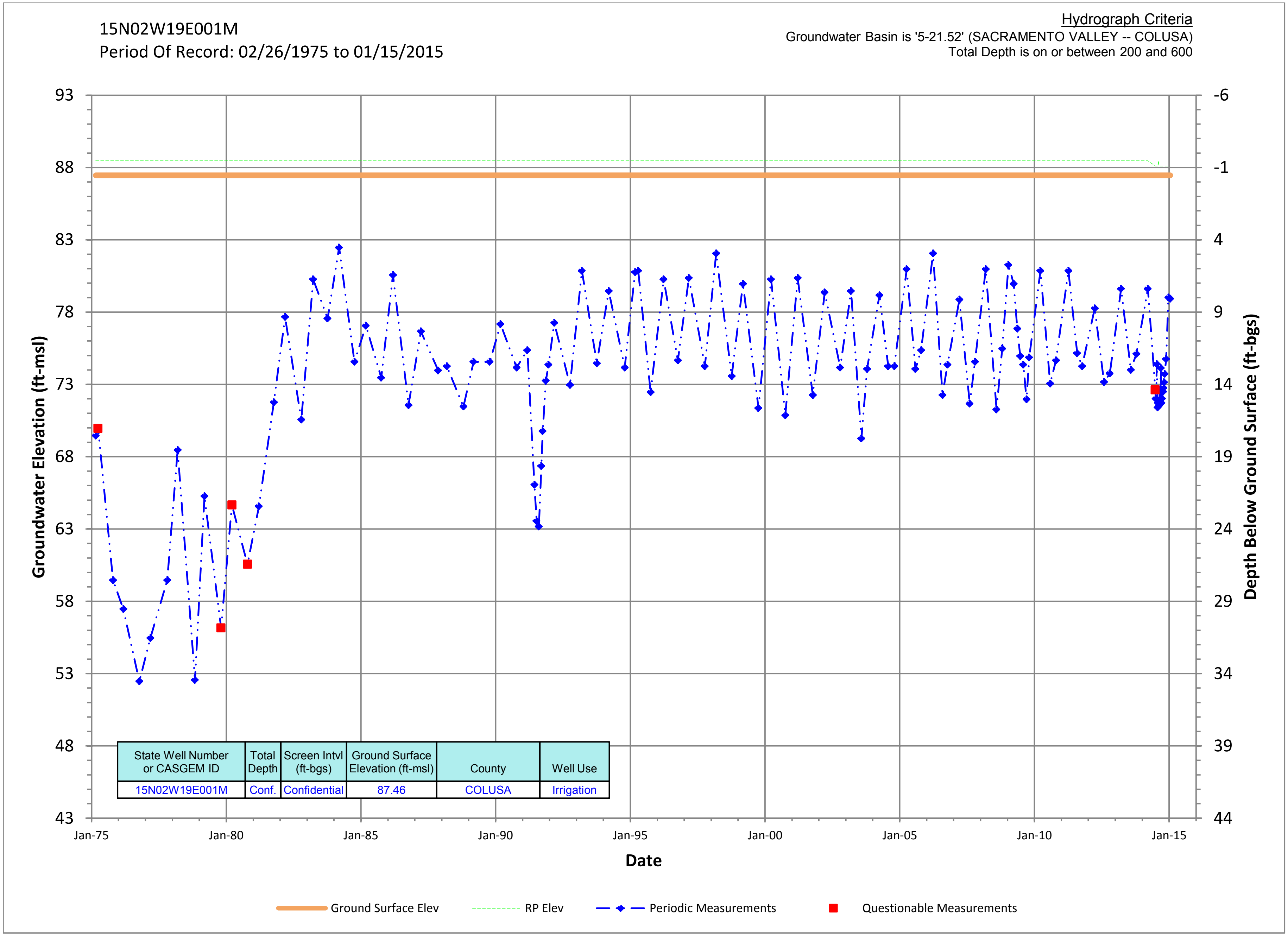
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03W11A001M	Conf.	Confidential	138.49	COLUSA	Irrigation

14N03W11H001M
Period Of Record: 03/29/1967 to 10/14/2014

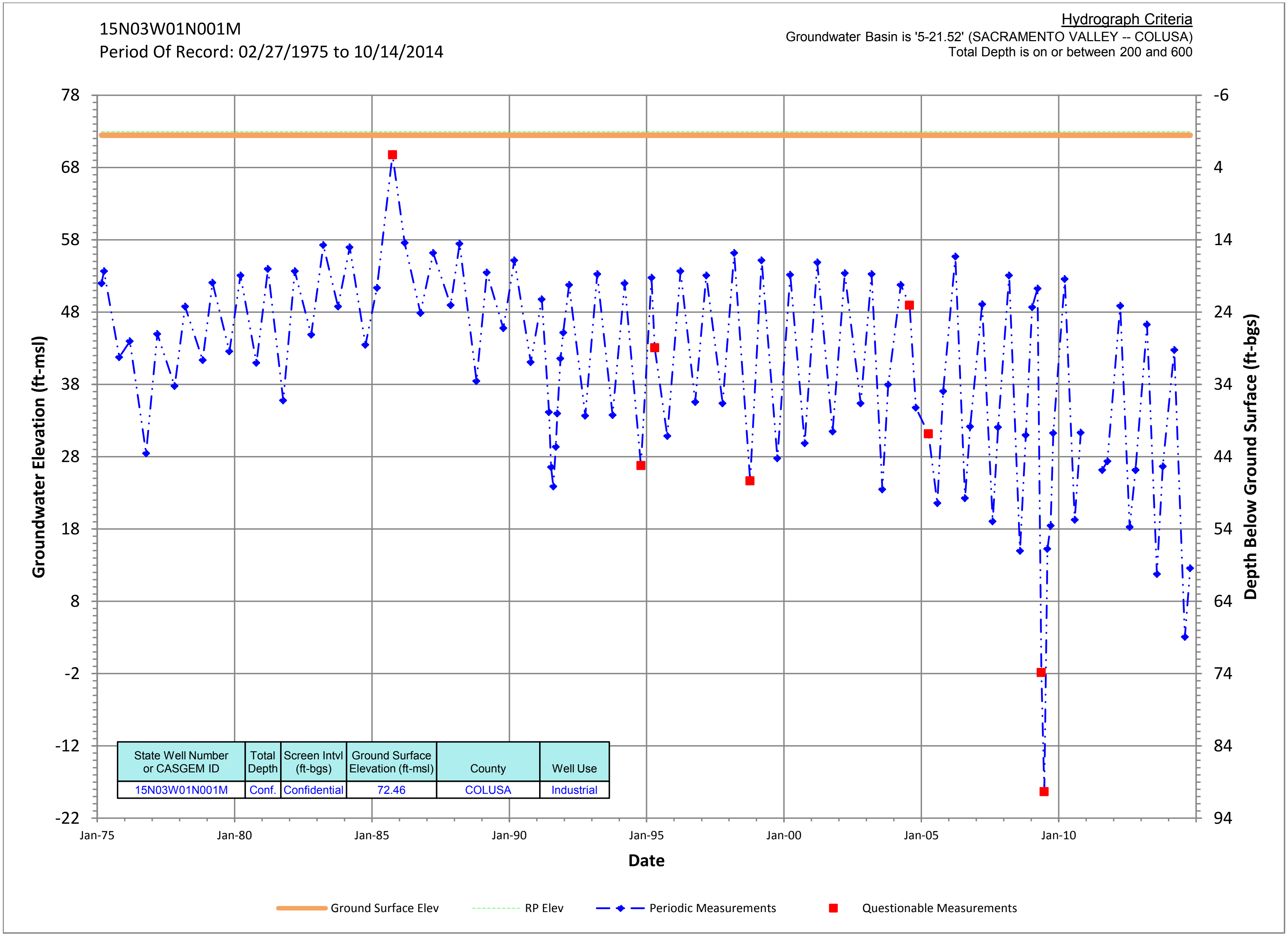
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



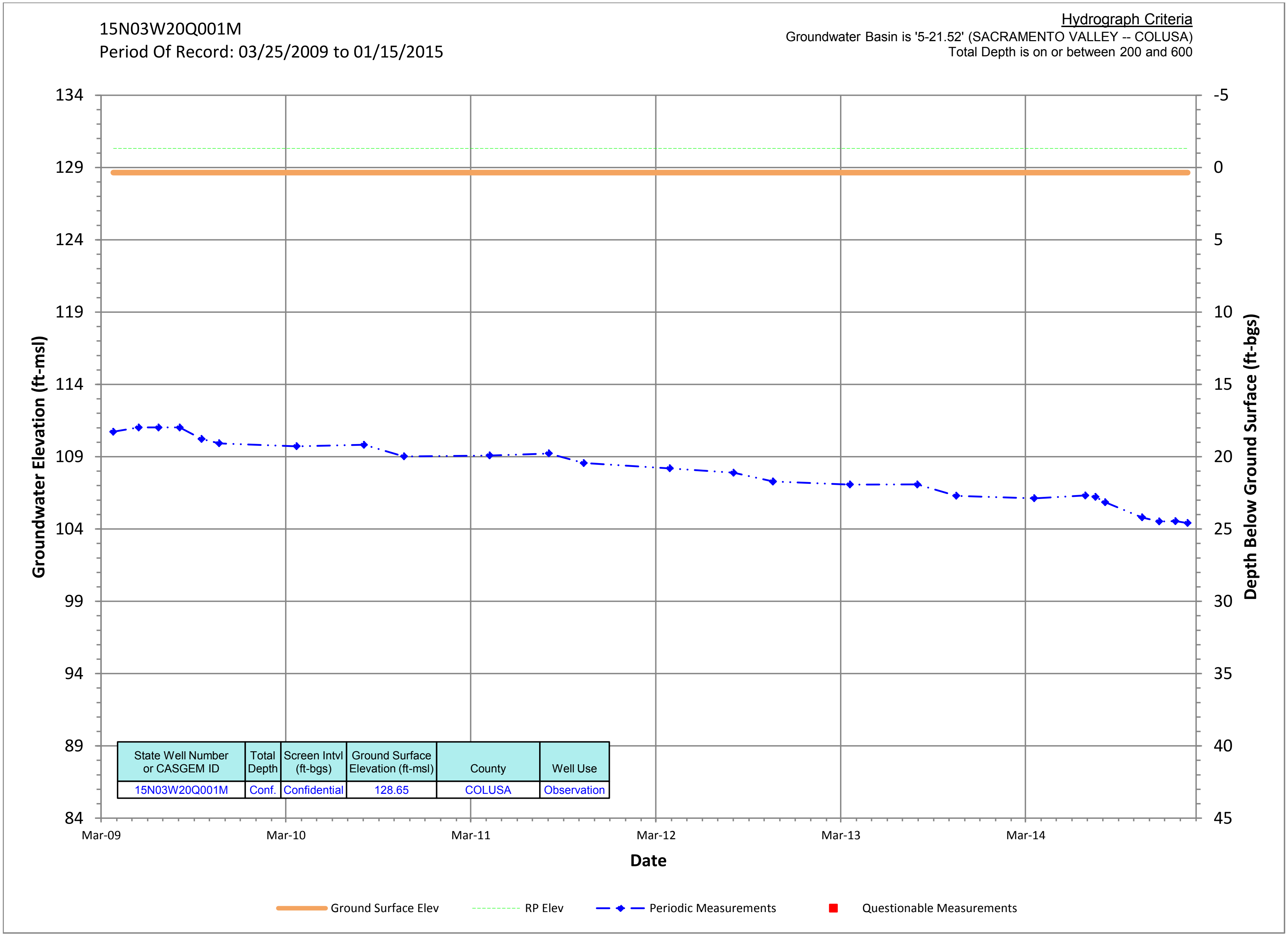
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03W11H001M	Conf.	Confidential	137.5	COLUSA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N02W19E001M	Conf.	Confidential	87.46	COLUSA	Irrigation



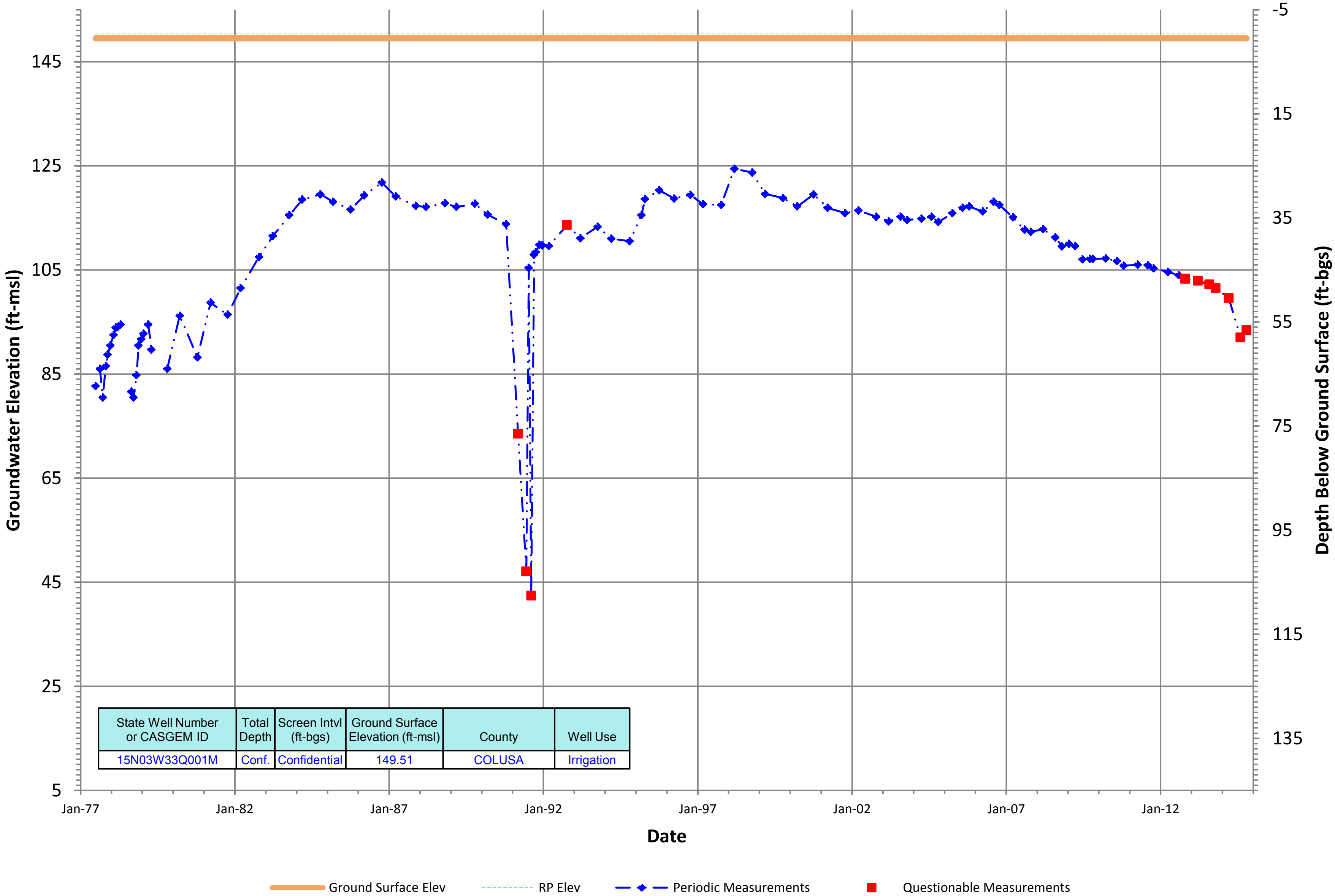
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03W01N001M	Conf.	Confidential	72.46	COLUSA	Industrial



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03W20Q001M	Conf.	Confidential	128.65	COLUSA	Observation

15N03W33Q001M
Period Of Record: 06/28/1977 to 10/14/2014

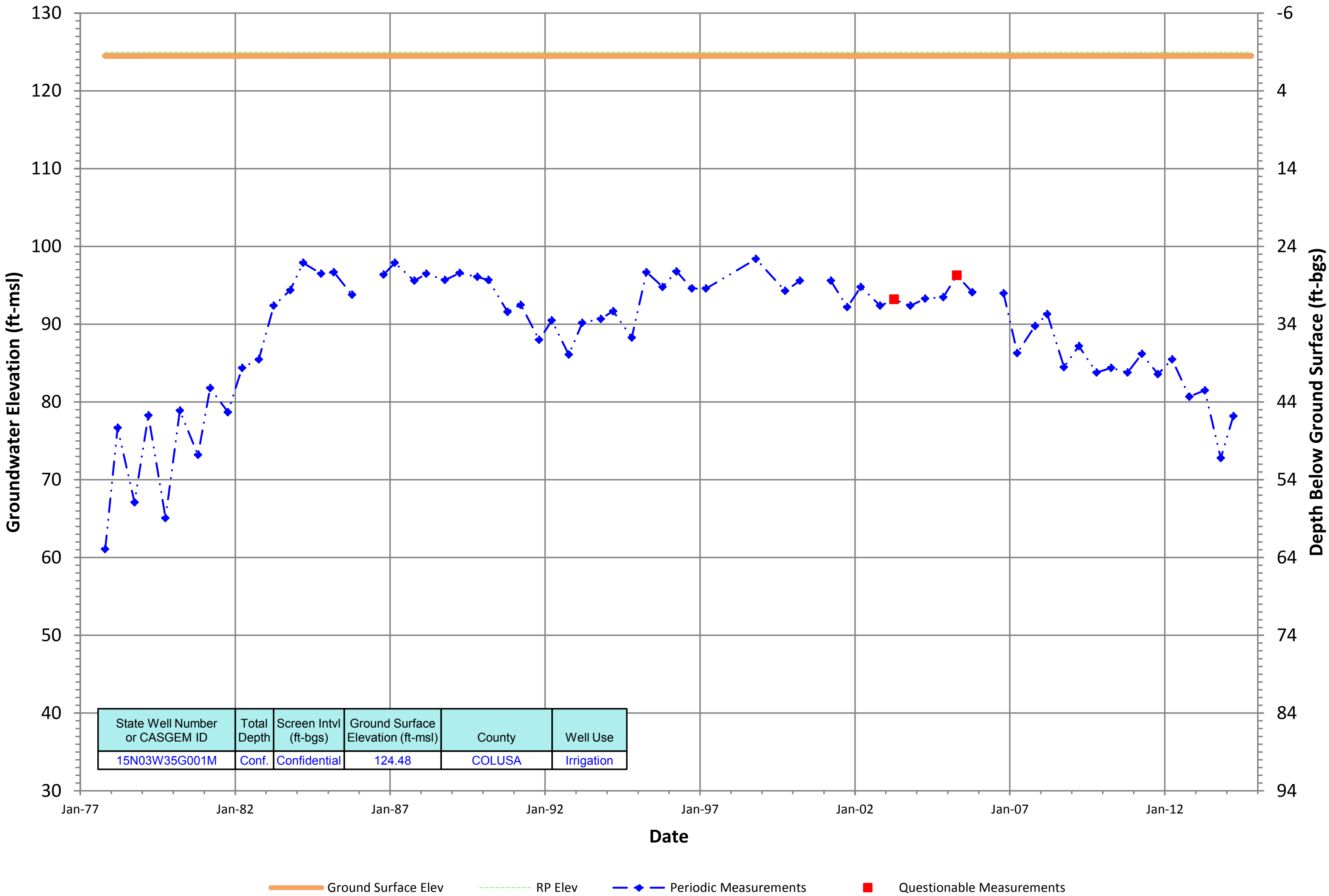
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



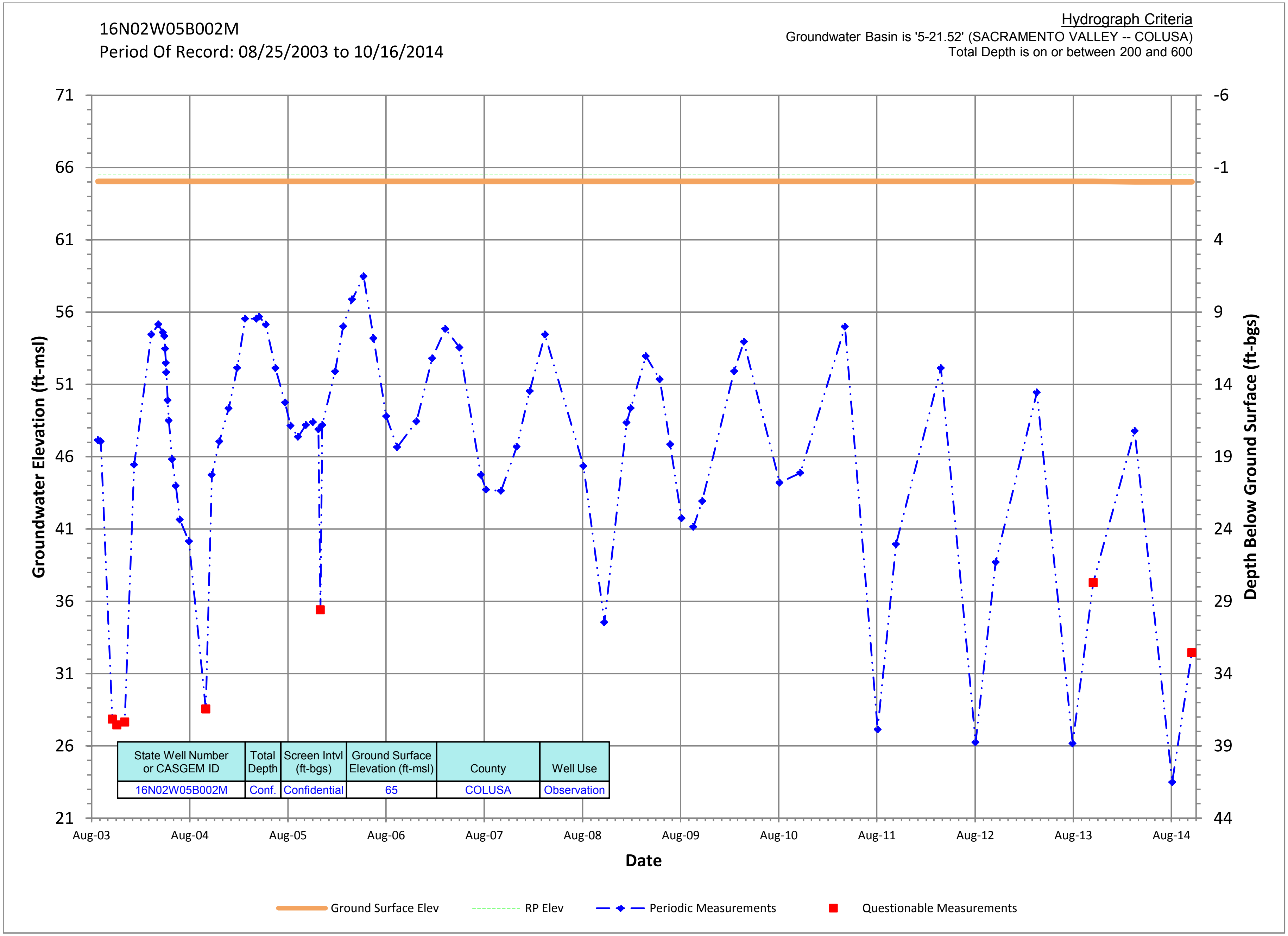
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03W33Q001M	Conf.	Confidential	149.51	COLUSA	Irrigation

15N03W35G001M
Period Of Record: 10/21/1977 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600

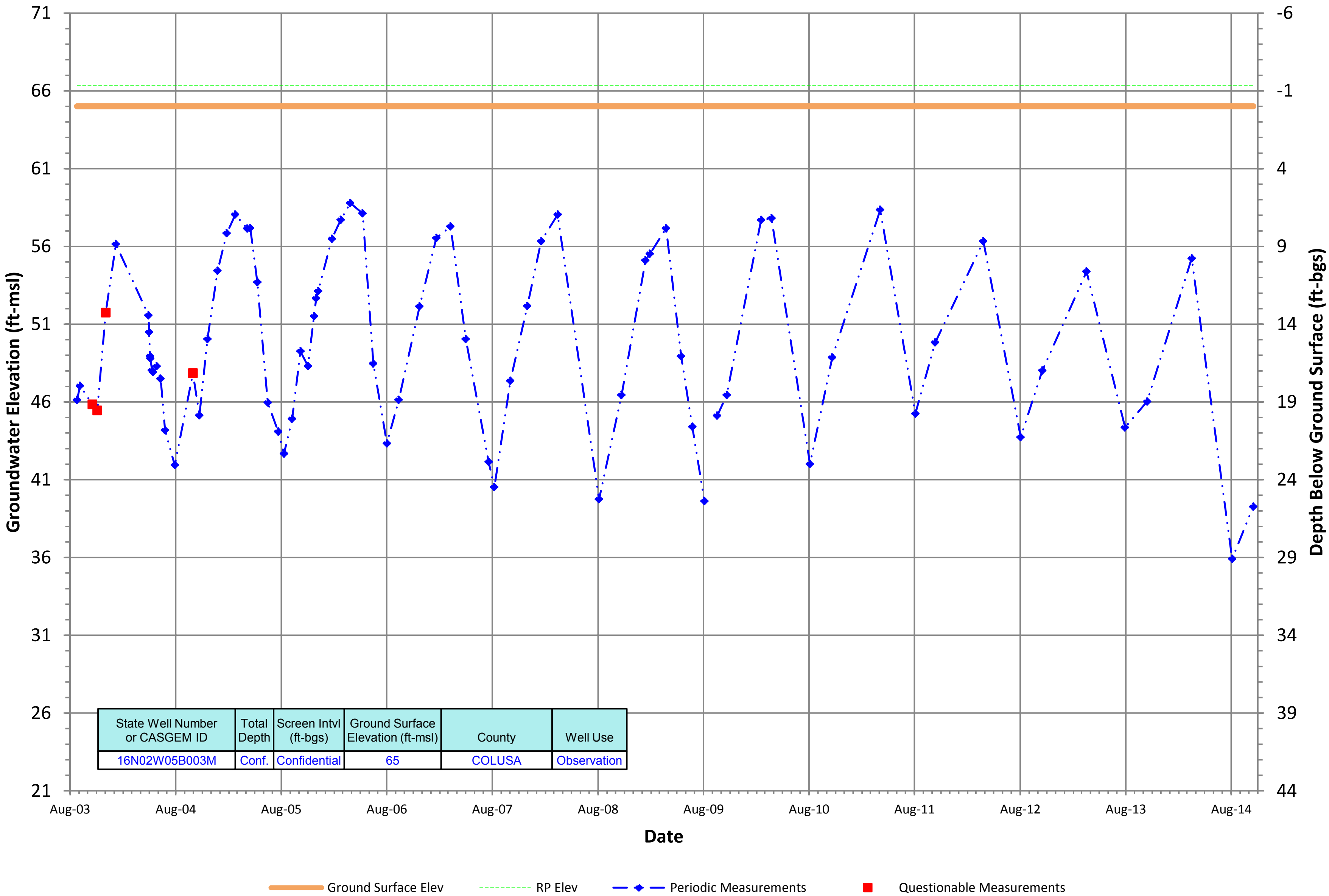


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03W35G001M	Conf.	Confidential	124.48	COLUSA	Irrigation


16N02W05B002M
Period Of Record: 08/25/2003 to 10/16/2014
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
71
66
61
56
51
46
41
36
31
26
21
-6
-1
4
9
14
19
24
29
34
39
44
Aug-03
Aug-04
Aug-05
Aug-06
Aug-07
Aug-08
Aug-09
Aug-10
Aug-11
Aug-12
Aug-13
Aug-14
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
16N02W05B002M
Conf.
Confidential
65
COLUSA
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

16N02W05B003M
Period Of Record: 08/25/2003 to 10/16/2014

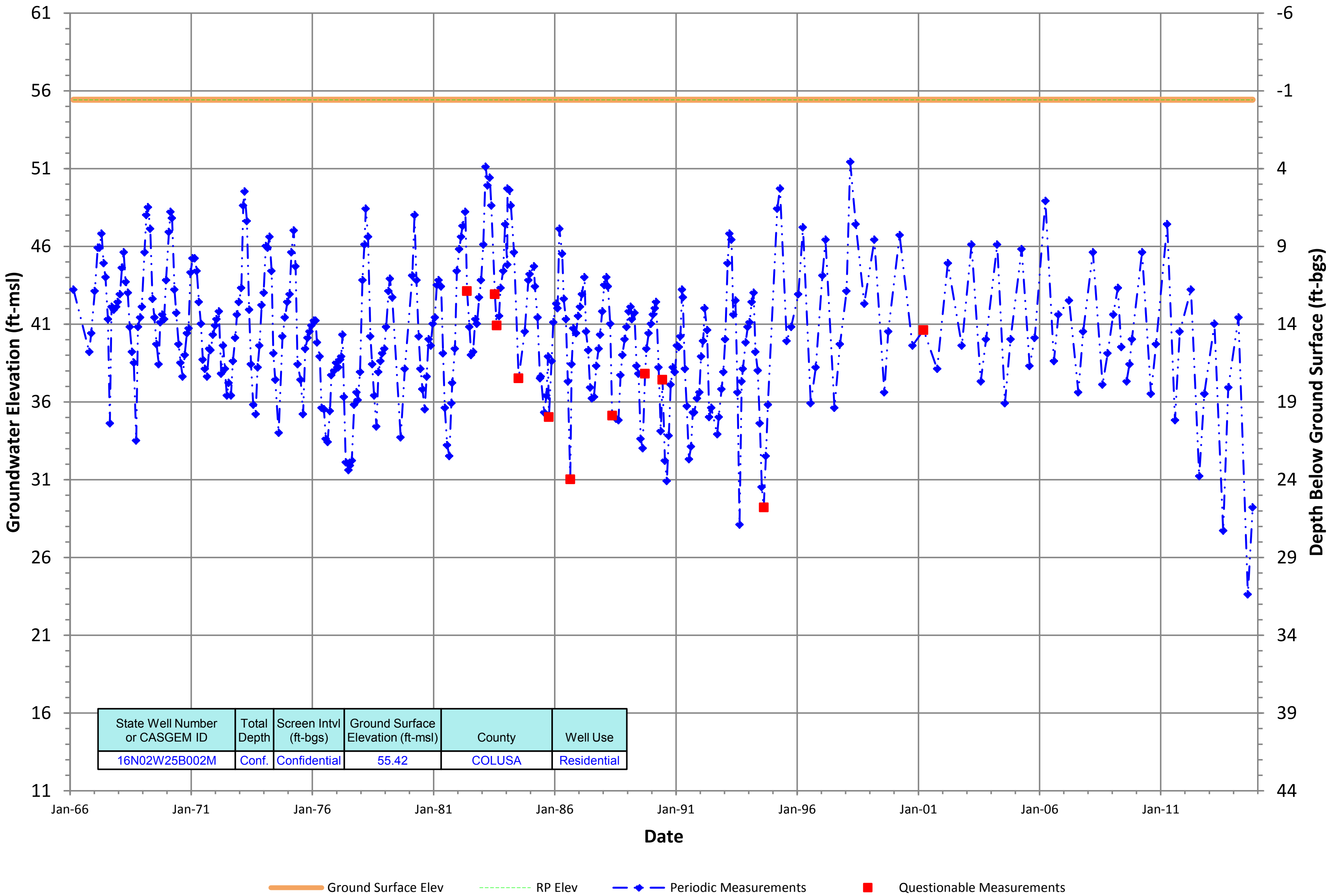
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N02W05B003M	Conf.	Confidential	65	COLUSA	Observation

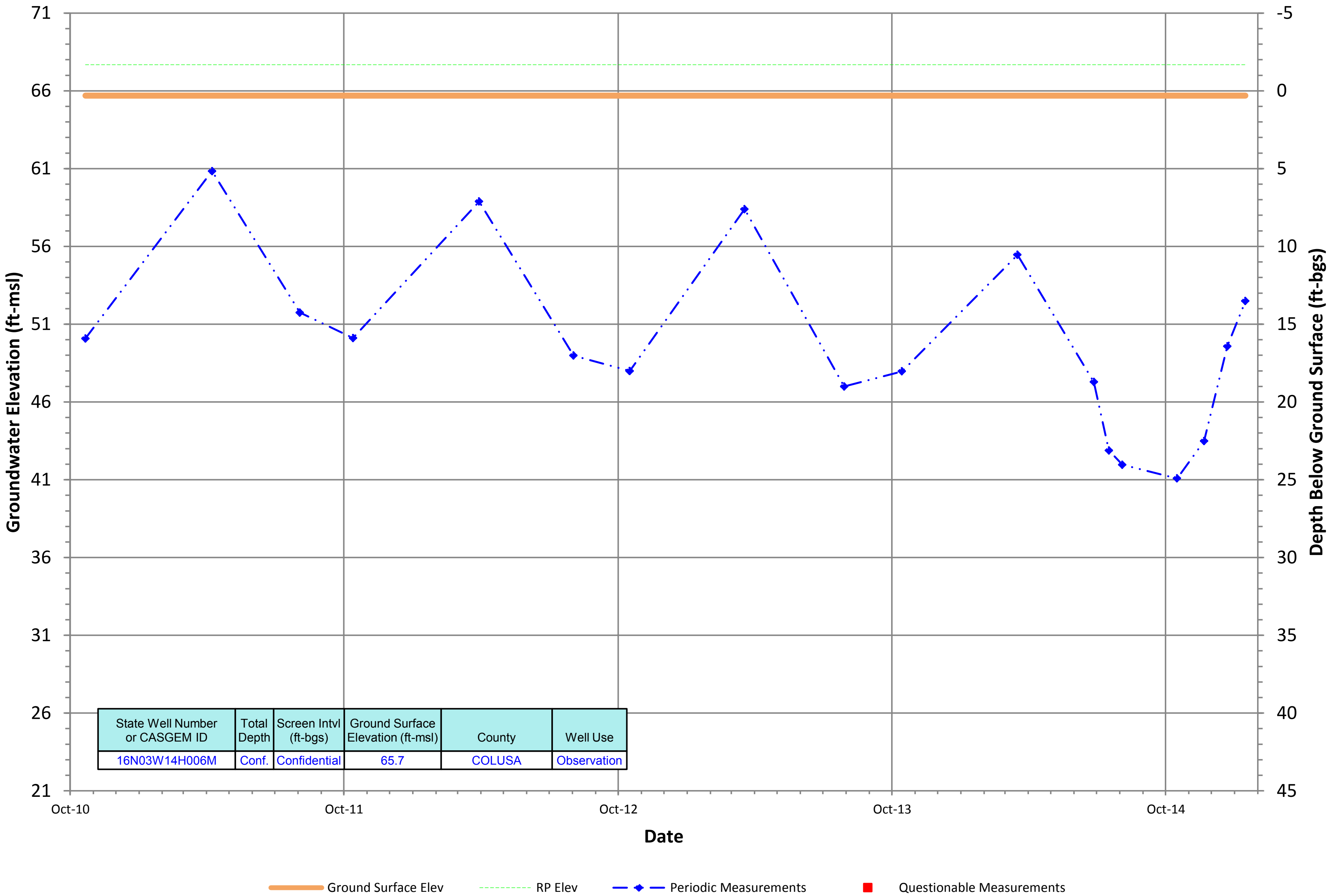
16N02W25B002M
Period Of Record: 02/21/1966 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



16N03W14H006M
Period Of Record: 10/21/2010 to 01/15/2015

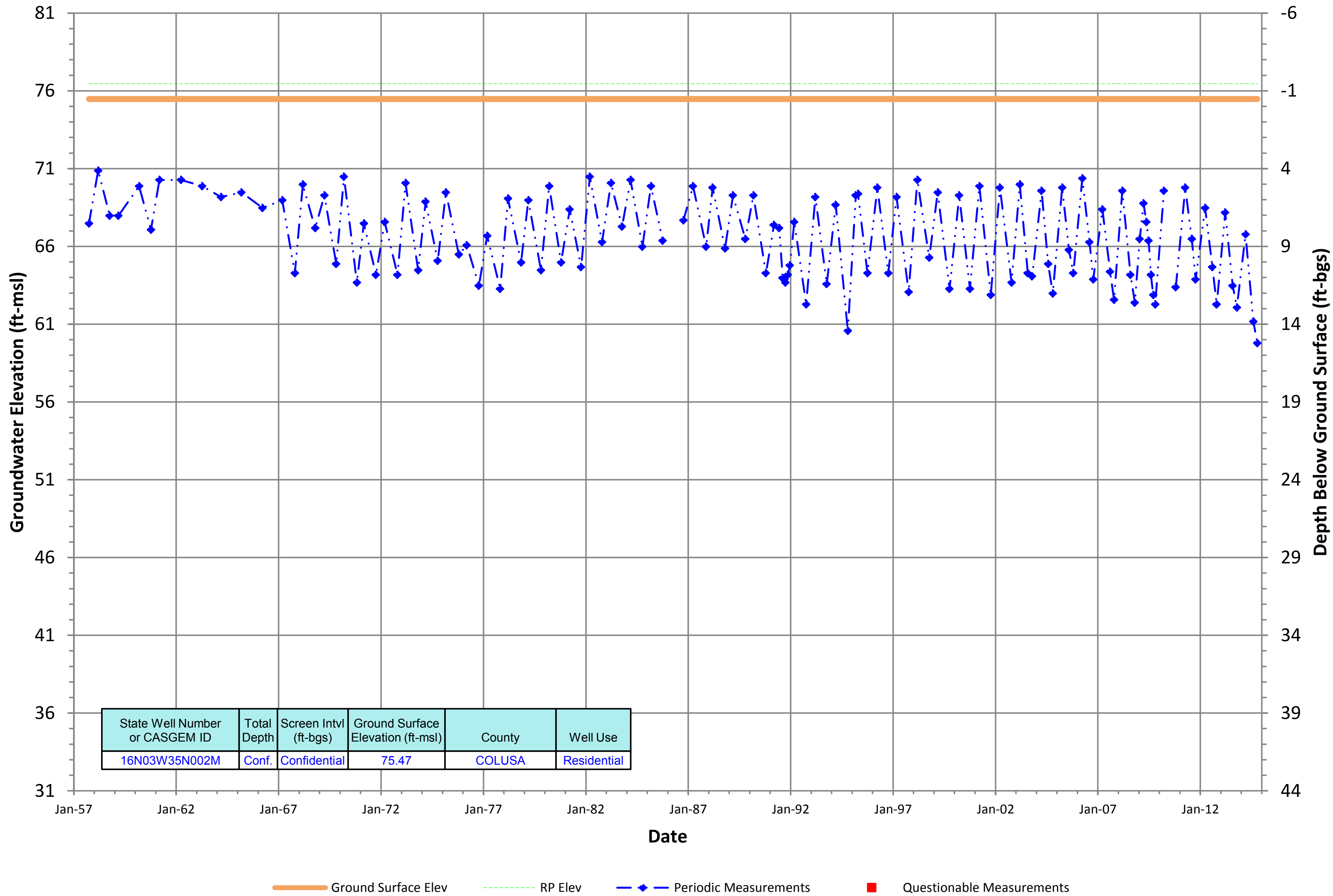
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03W14H006M	Conf.	Confidential	65.7	COLUSA	Observation

16N03W35N002M
Period Of Record: 09/27/1957 to 10/14/2014

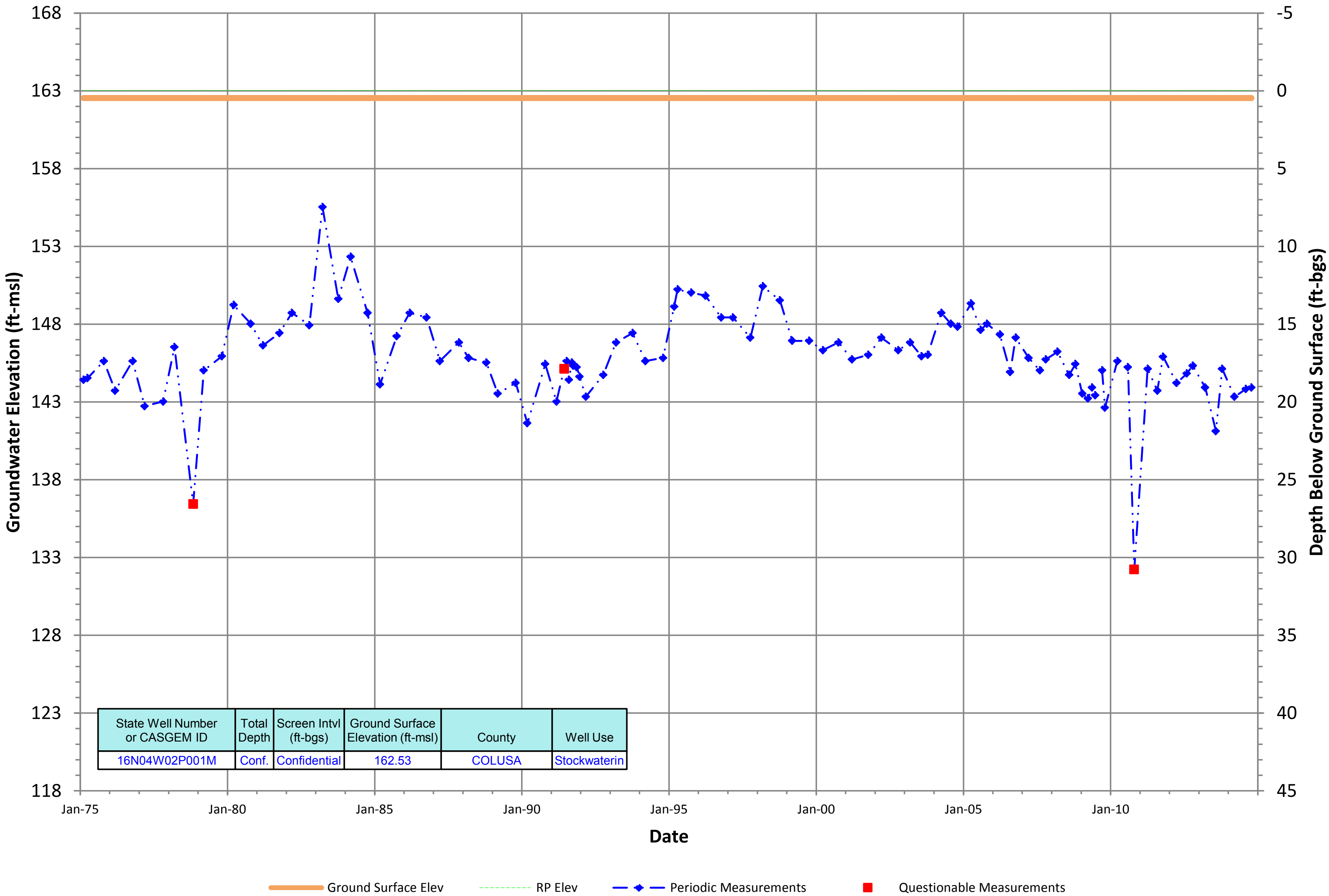
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03W35N002M	Conf.	Confidential	75.47	COLUSA	Residential

16N04W02P001M
Period Of Record: 02/11/1975 to 10/14/2014

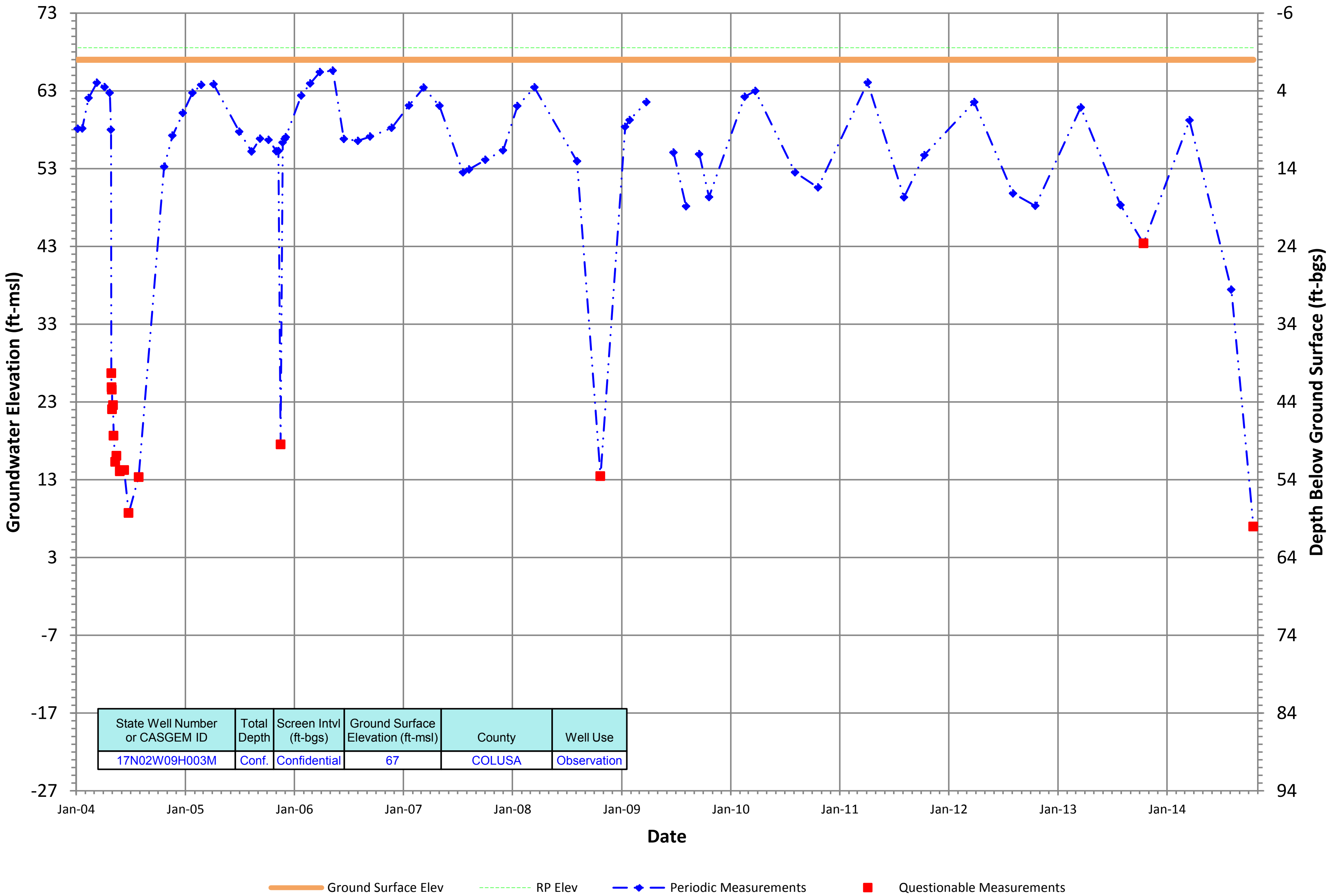
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N04W02P001M	Conf.	Confidential	162.53	COLUSA	Stockwaterin

17N02W09H003M
Period Of Record: 01/06/2004 to 10/17/2014

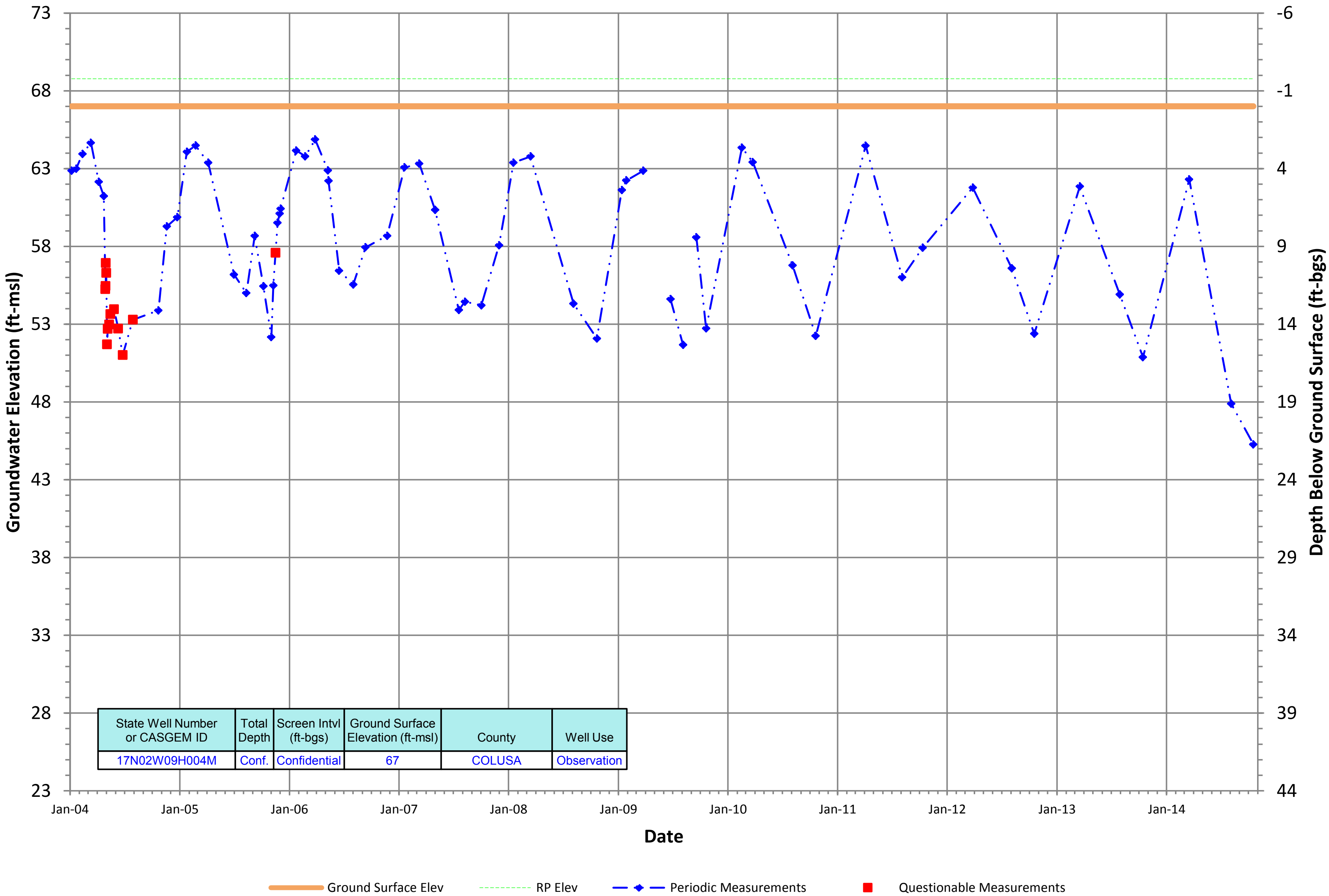
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



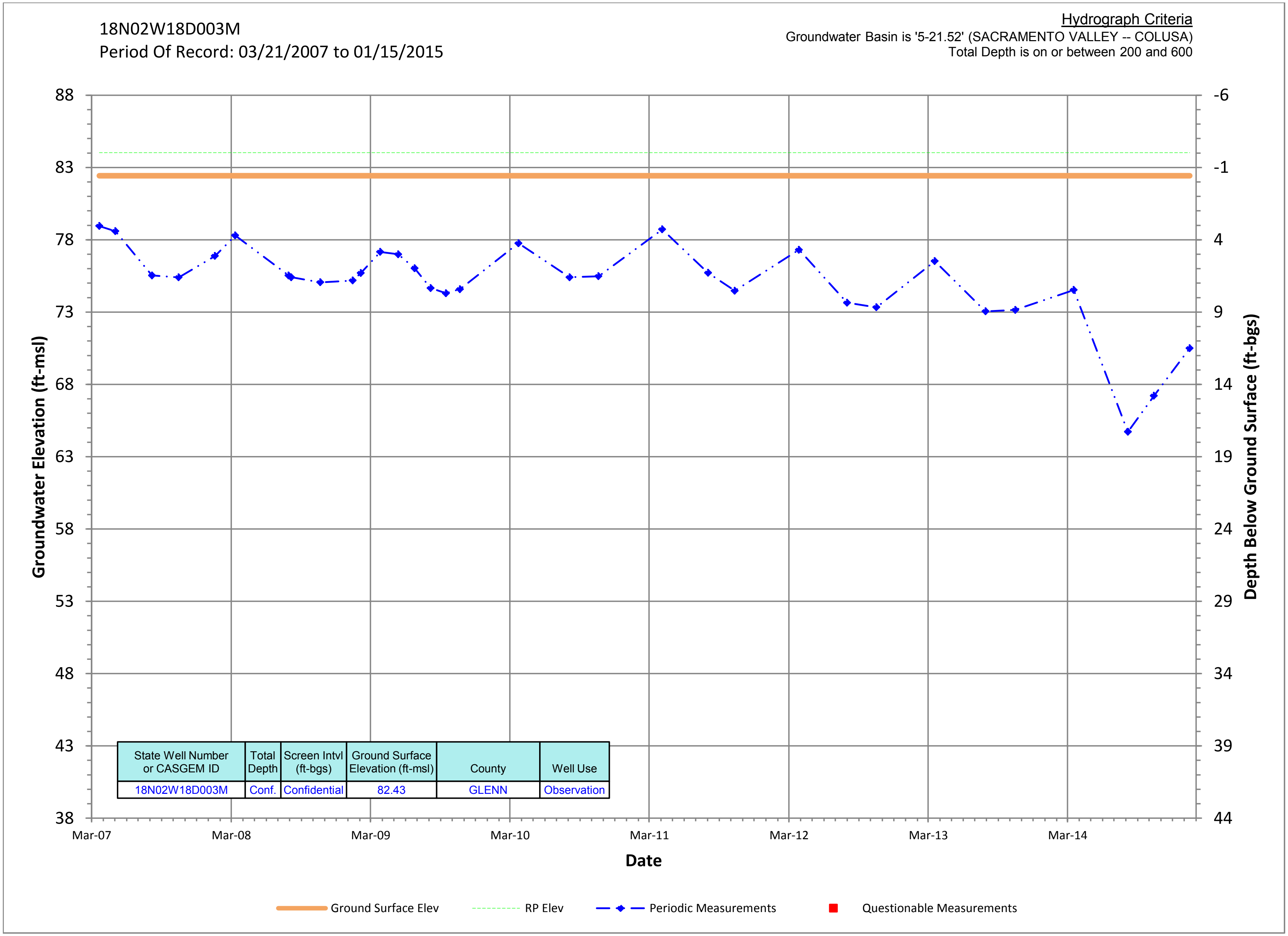
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02W09H003M	Conf.	Confidential	67	COLUSA	Observation

17N02W09H004M
Period Of Record: 01/06/2004 to 10/17/2014

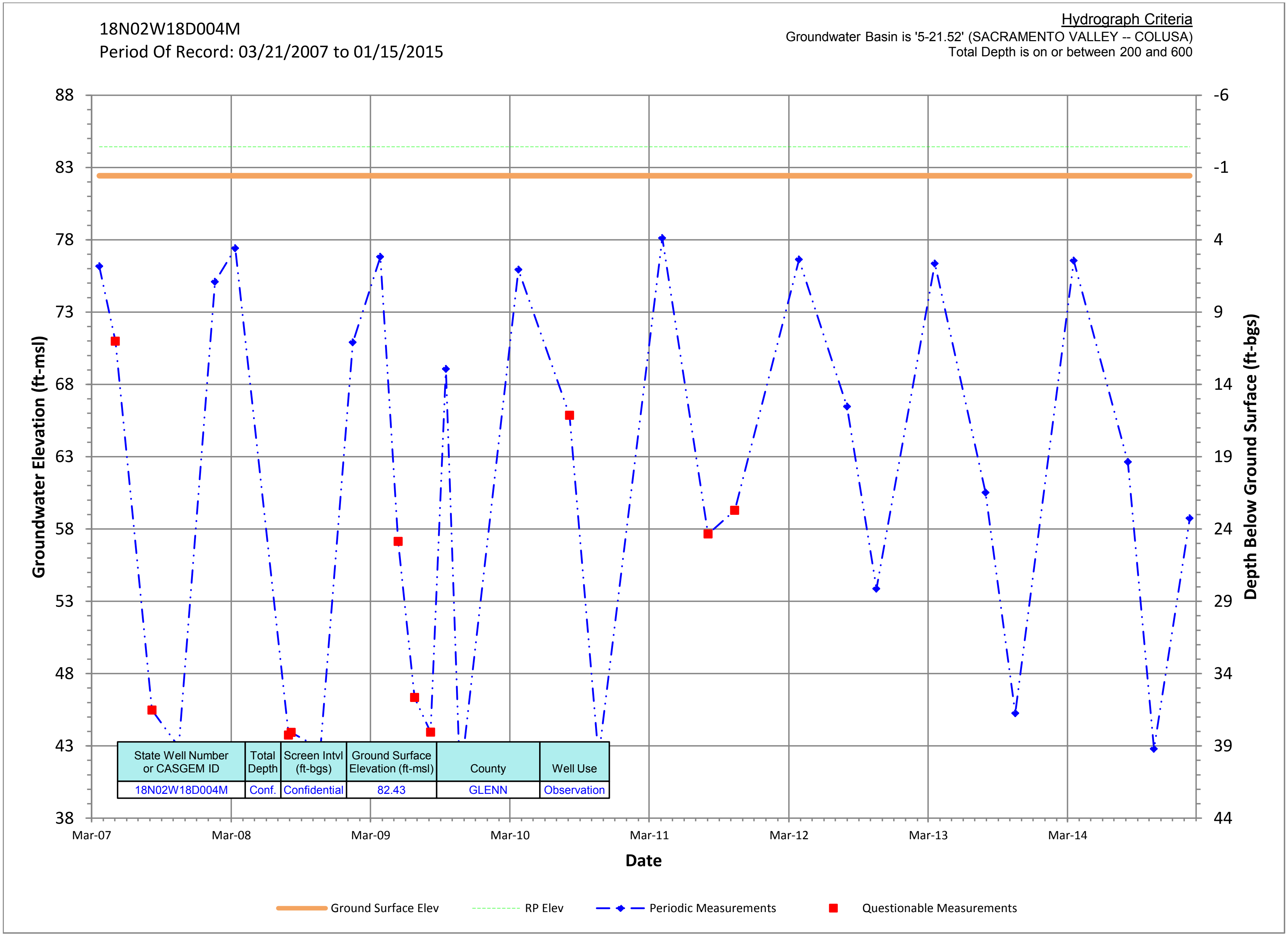
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02W09H004M	Conf.	Confidential	67	COLUSA	Observation



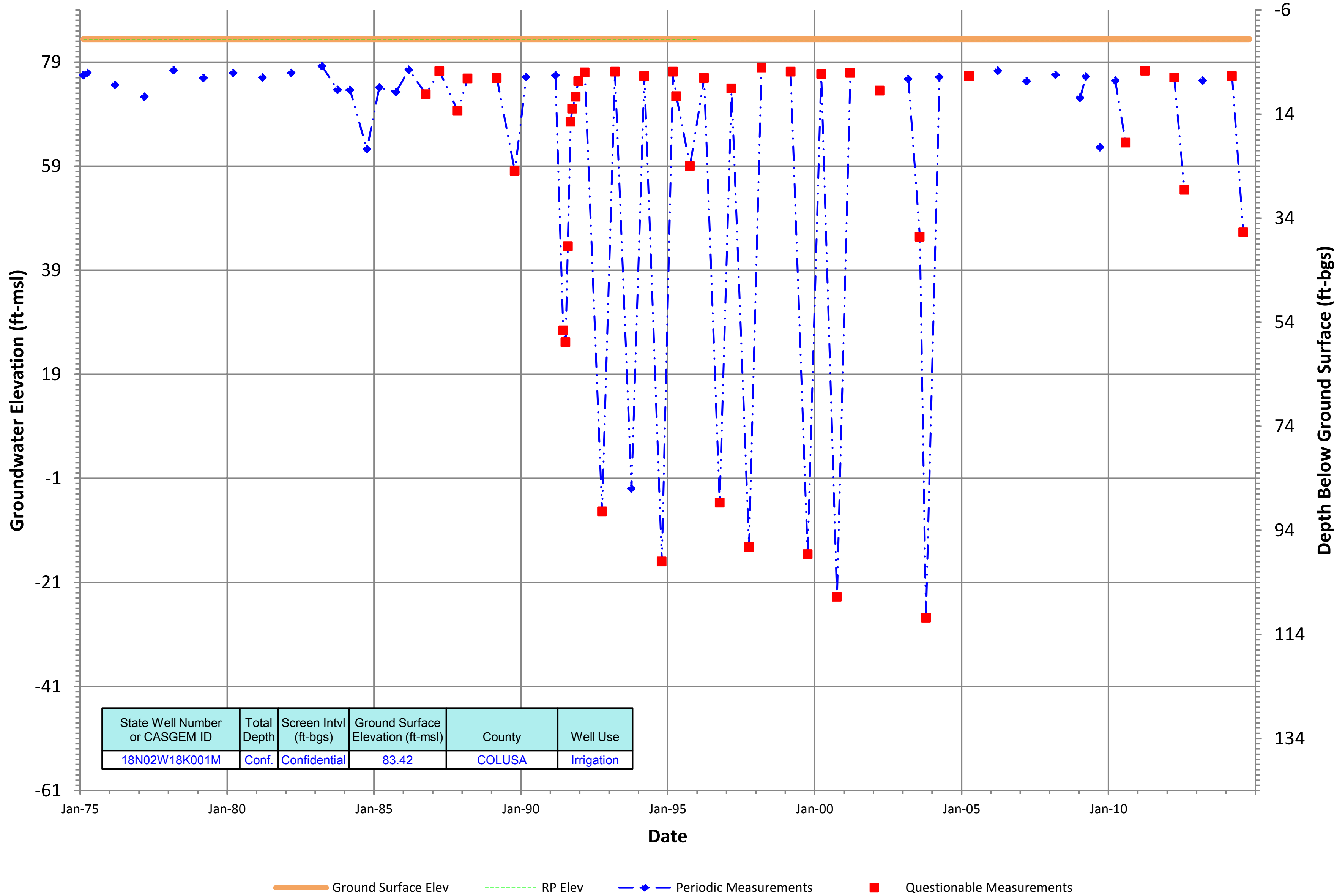
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02W18D003M	Conf.	Confidential	82.43	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02W18D004M	Conf.	Confidential	82.43	GLENN	Observation

18N02W18K001M
Period Of Record: 02/10/1975 to 10/16/2014

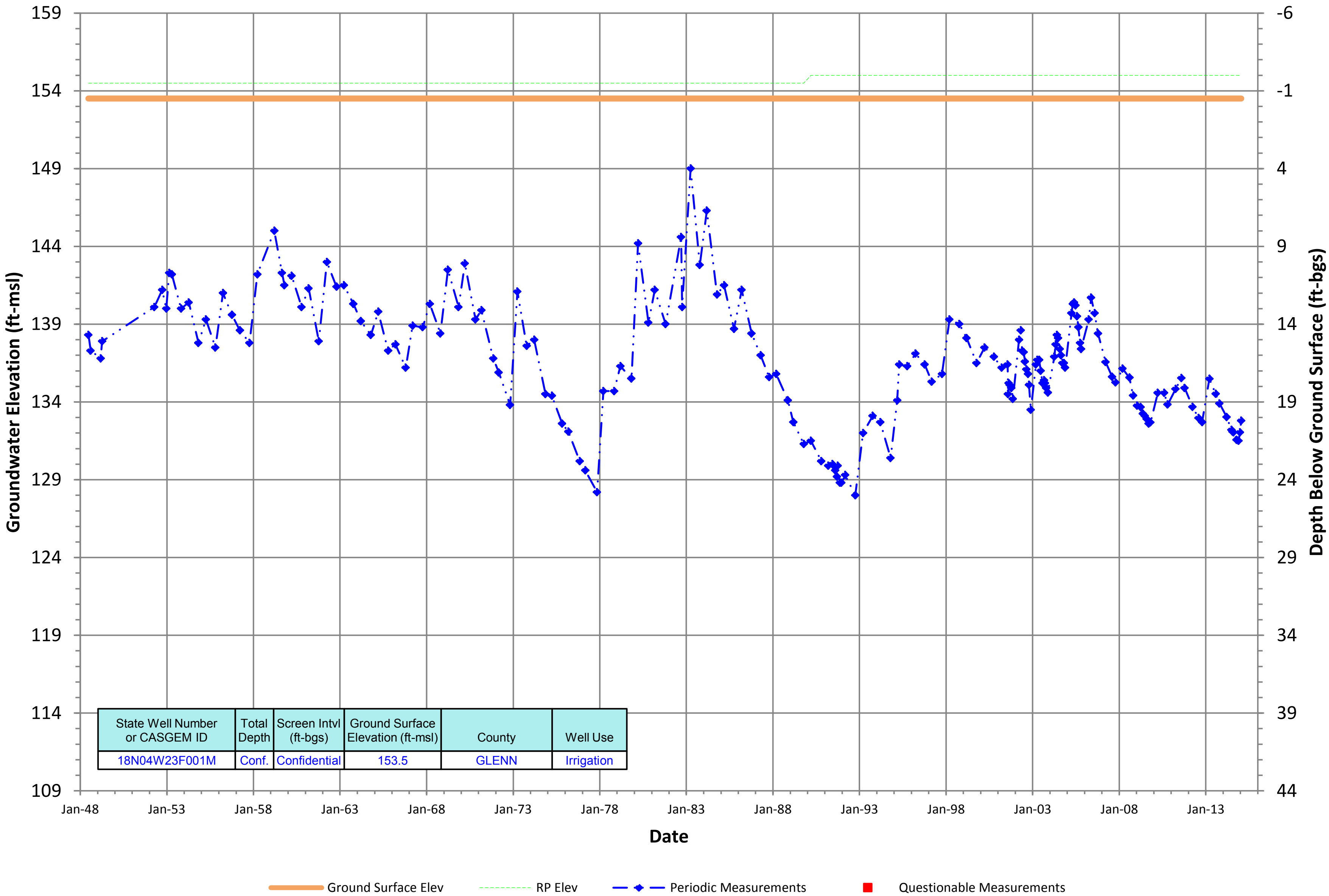
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02W18K001M	Conf.	Confidential	83.42	COLUSA	Irrigation

18N04W23F001M
Period Of Record: 06/21/1948 to 01/15/2015

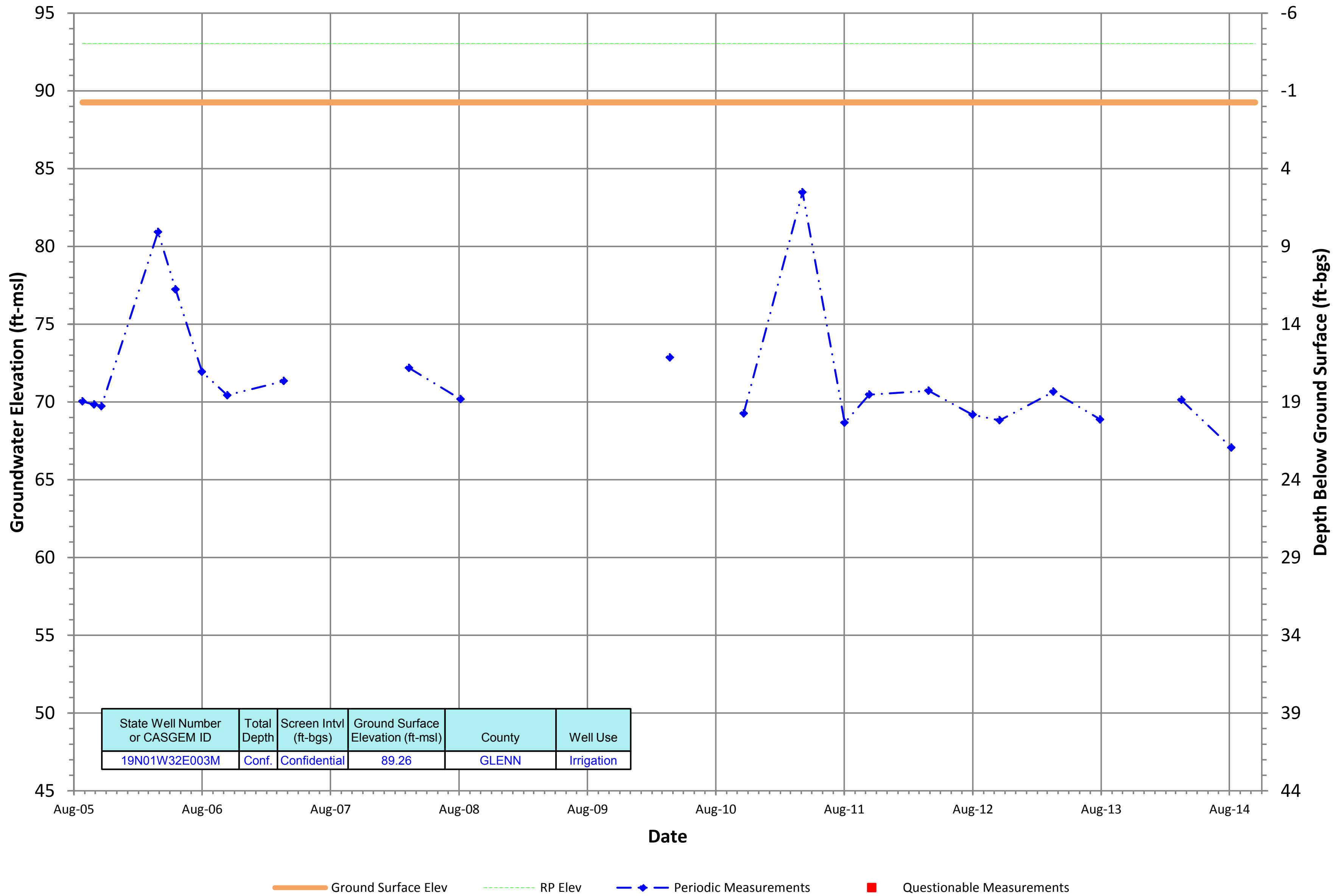
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N04W23F001M	Conf.	Confidential	153.5	GLENN	Irrigation

19N01W32E003M
Period Of Record: 08/25/2005 to 10/13/2014

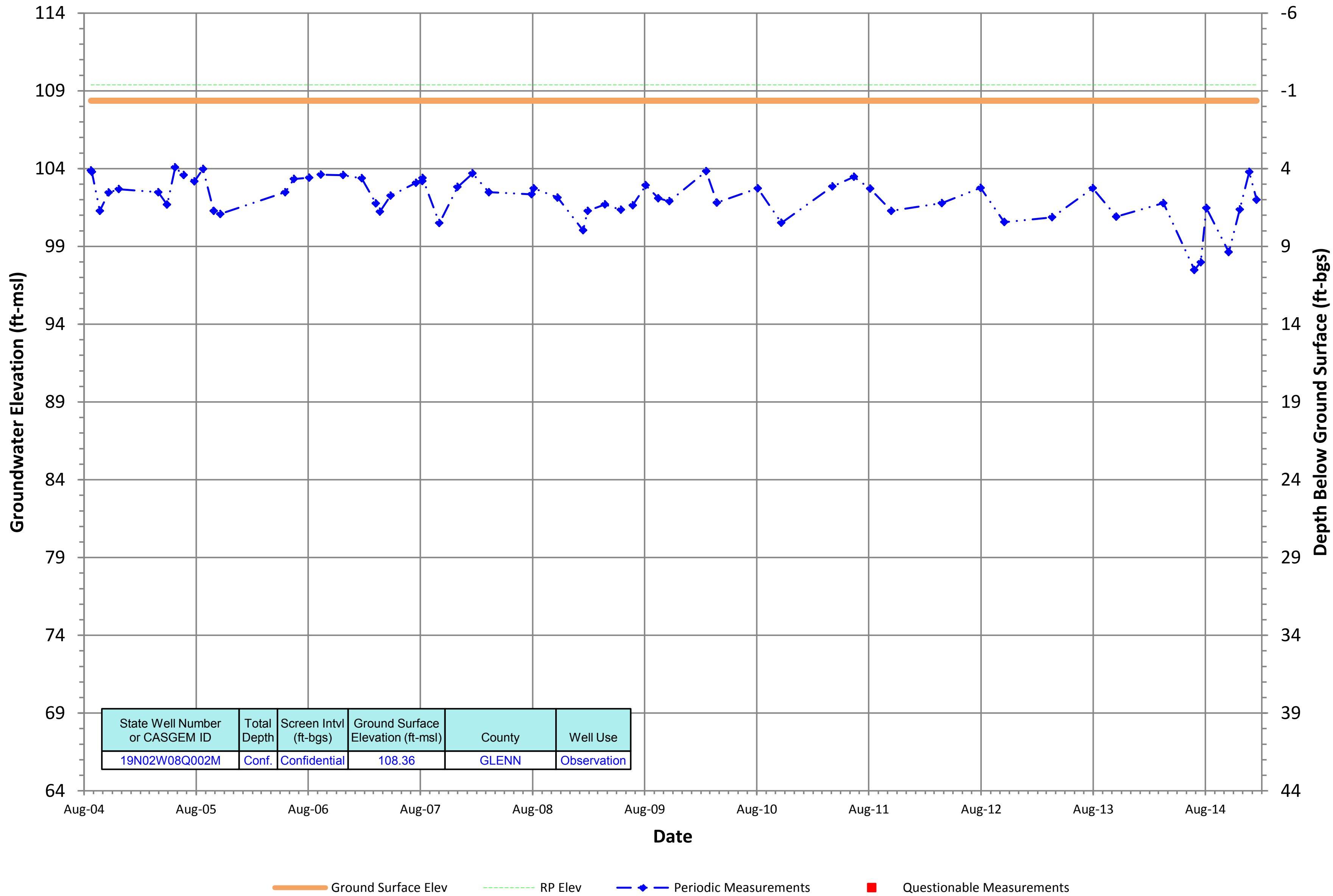
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



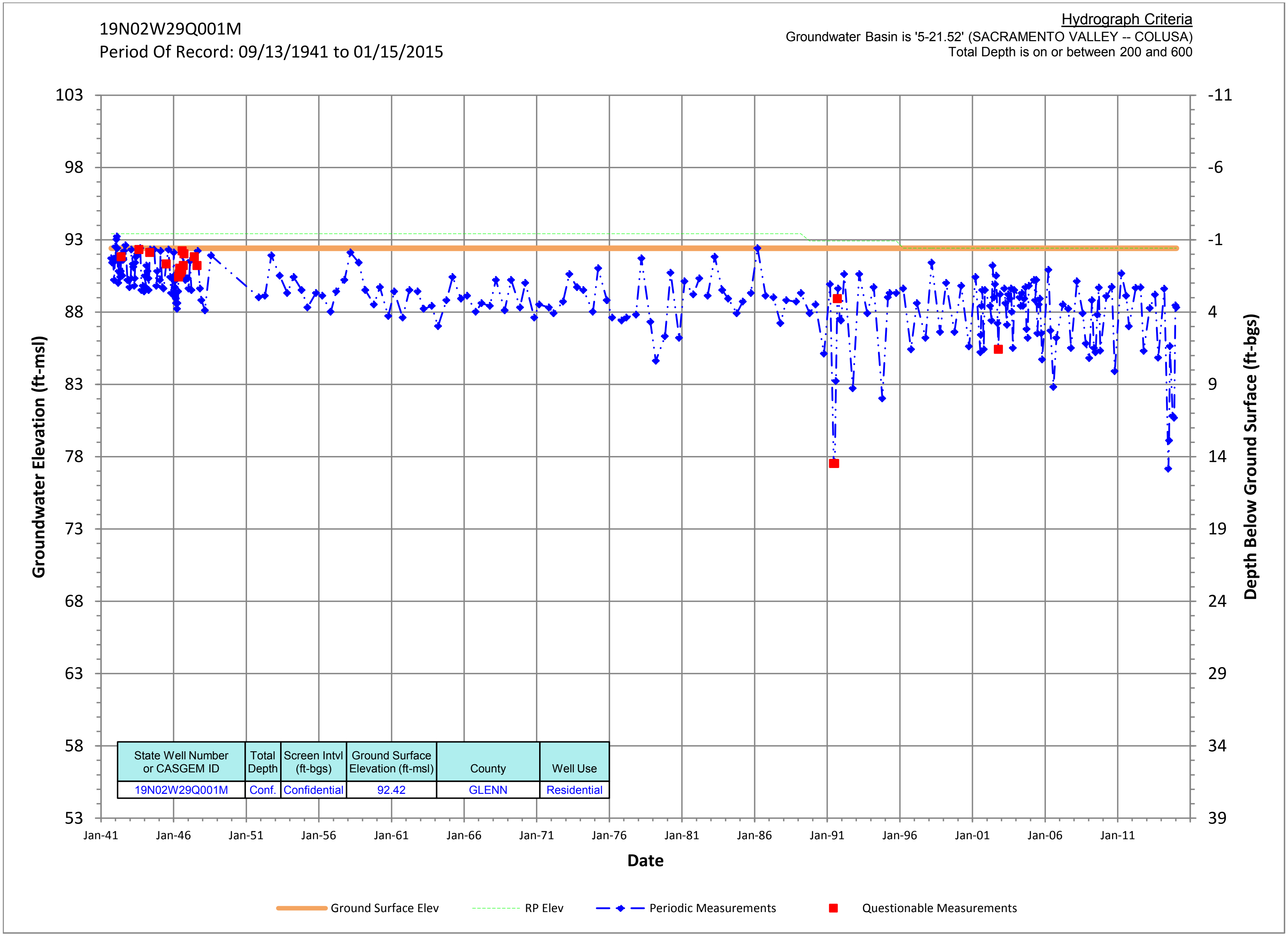
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W32E003M	Conf.	Confidential	89.26	GLENN	Irrigation

19N02W08Q002M
Period Of Record: 08/23/2004 to 01/15/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



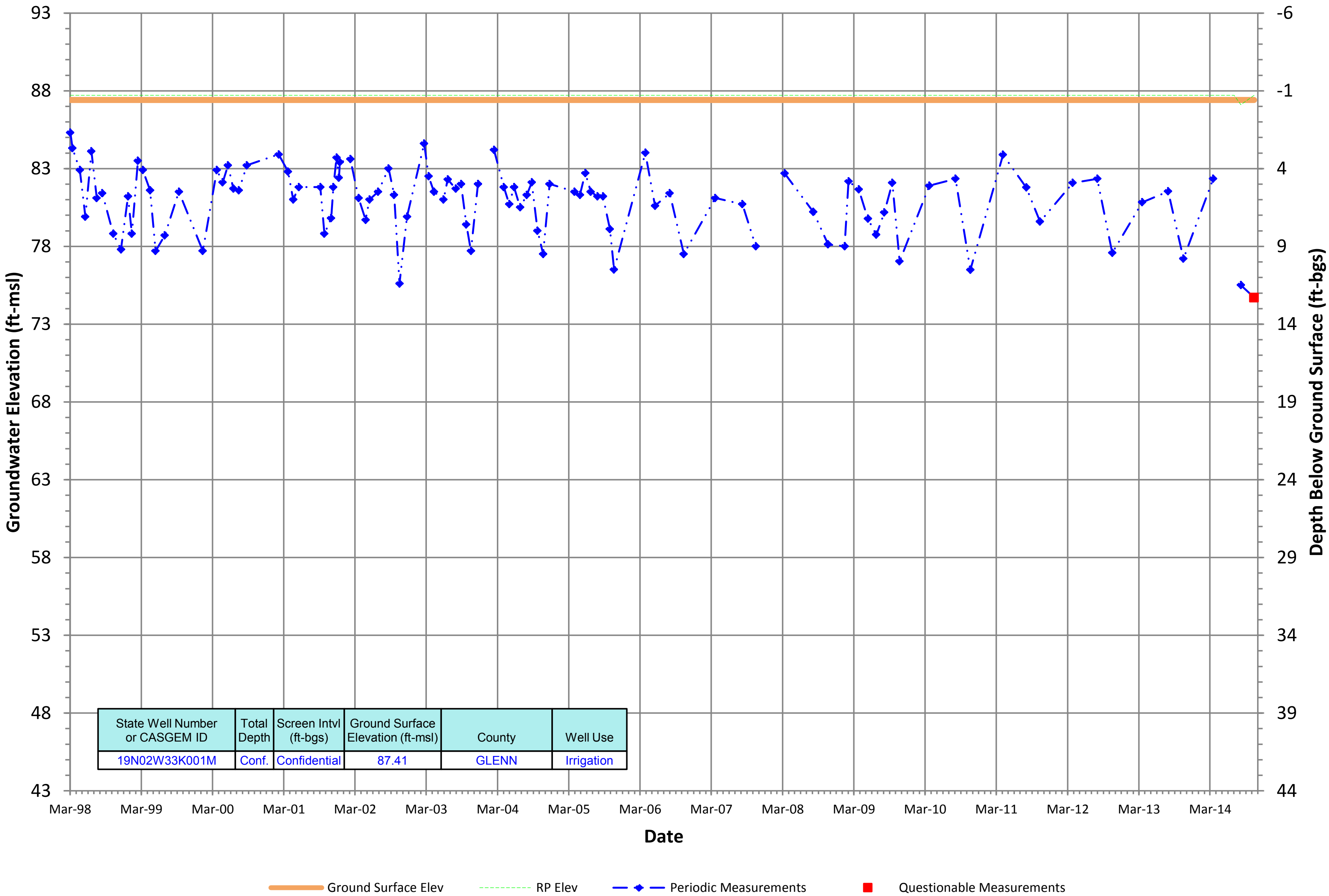
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W08Q002M	Conf.	Confidential	108.36	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W29Q001M	Conf.	Confidential	92.42	GLENN	Residential

19N02W33K001M
Period Of Record: 03/02/1998 to 10/13/2014

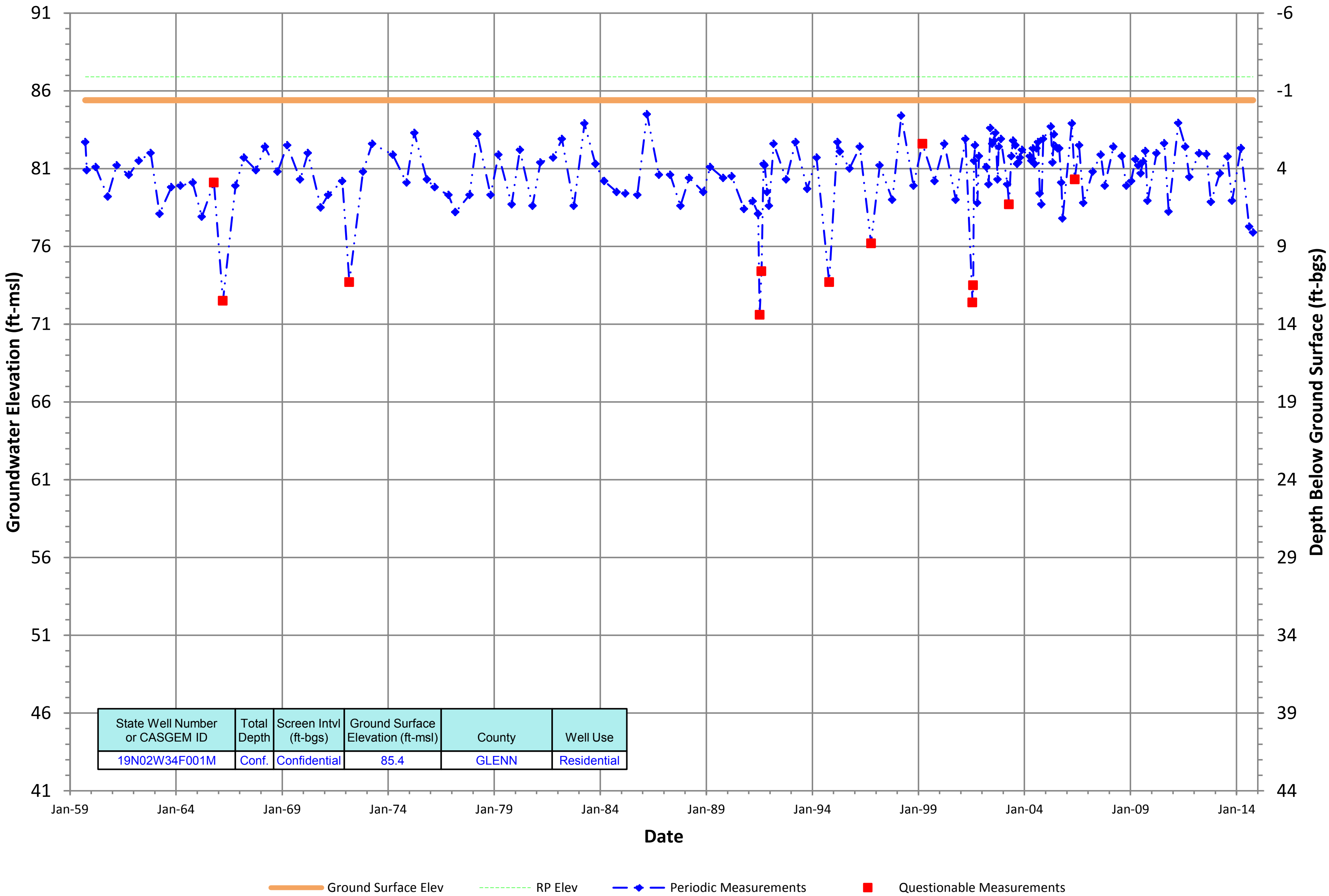
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W33K001M	Conf.	Confidential	87.41	GLENN	Irrigation

19N02W34F001M
Period Of Record: 09/21/1959 to 10/13/2014

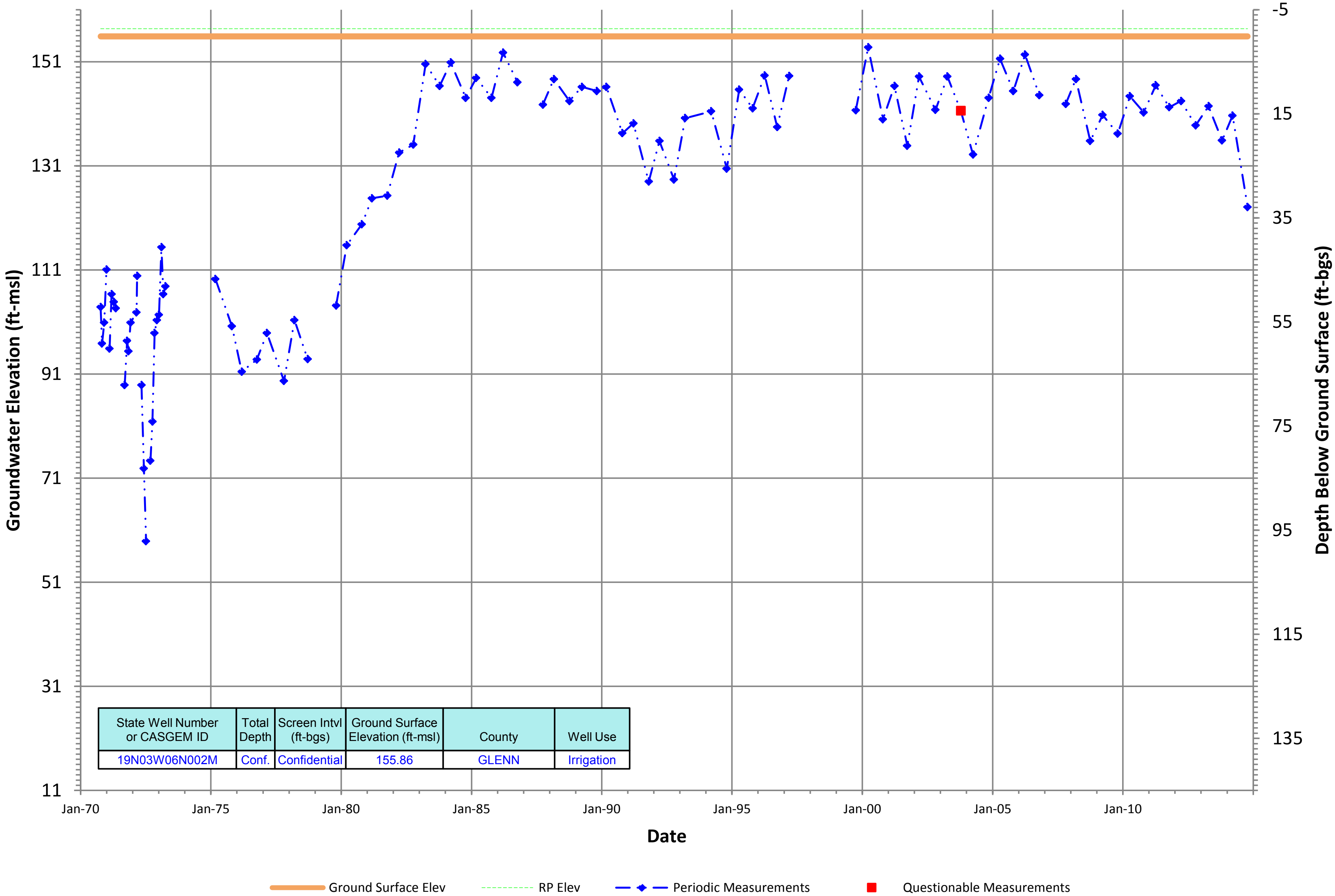
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W34F001M	Conf.	Confidential	85.4	GLENN	Residential

19N03W06N002M
Period Of Record: 10/08/1970 to 10/14/2014

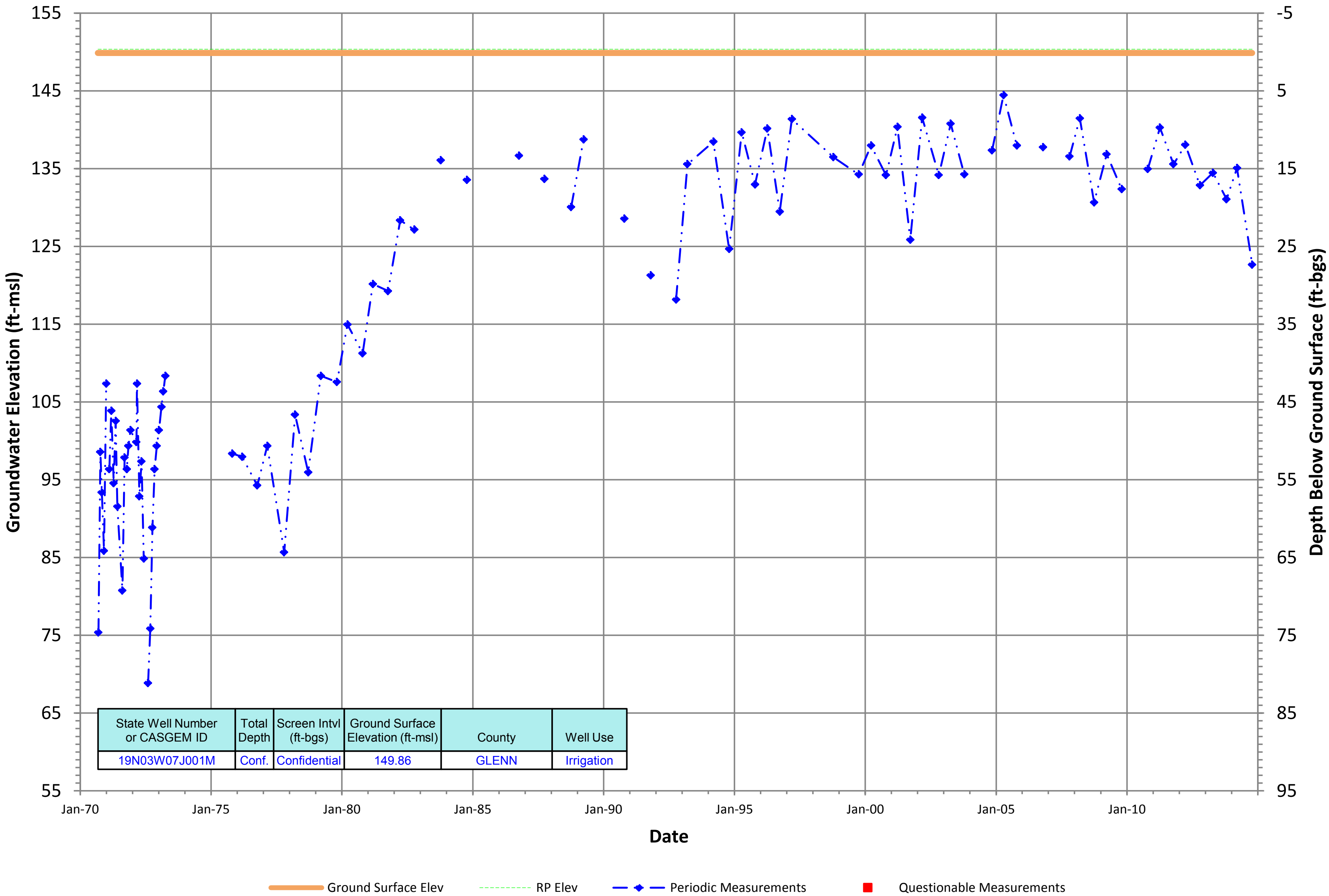
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N03W06N002M	Conf.	Confidential	155.86	GLENN	Irrigation

19N03W07J001M
Period Of Record: 09/03/1970 to 10/15/2014

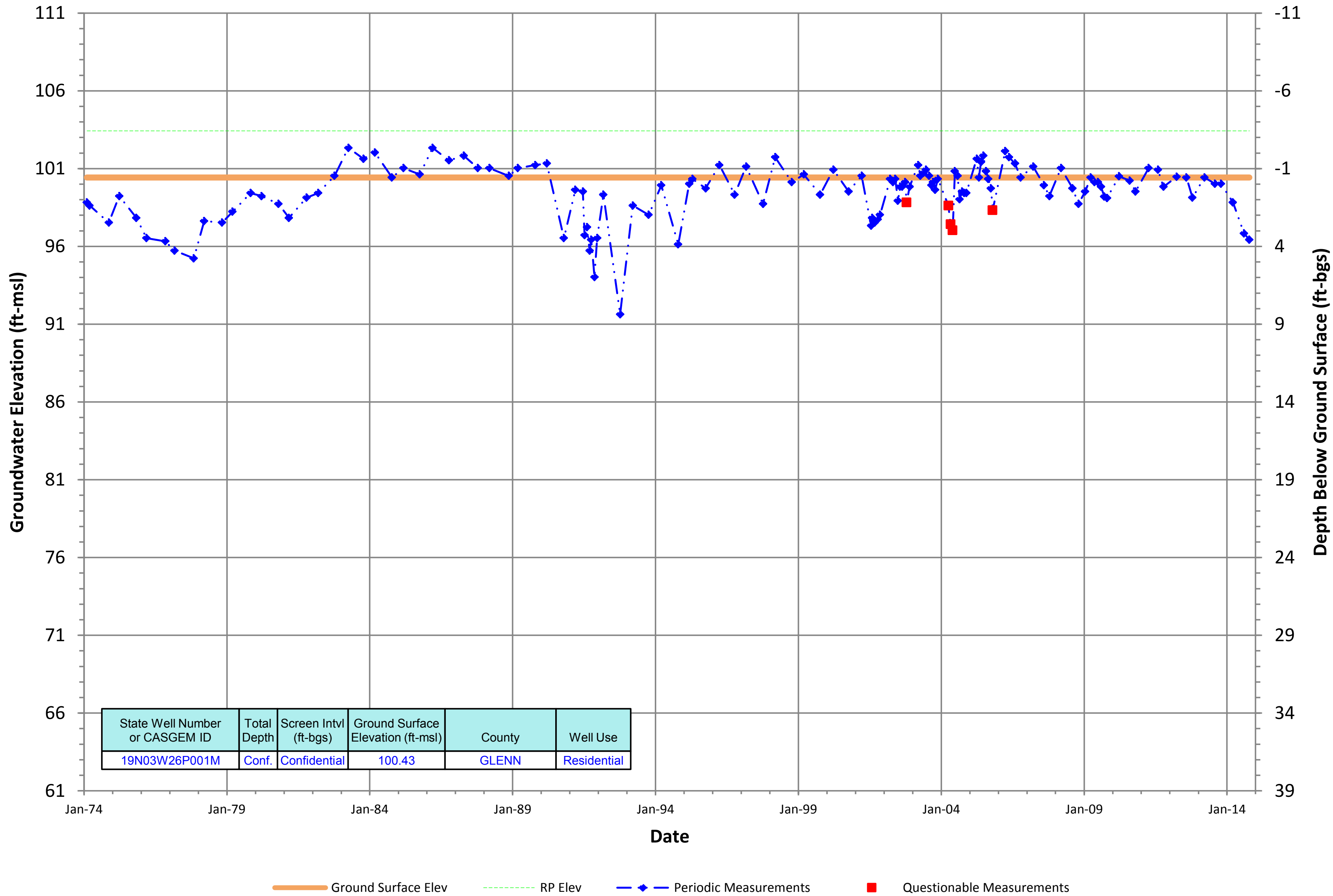
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



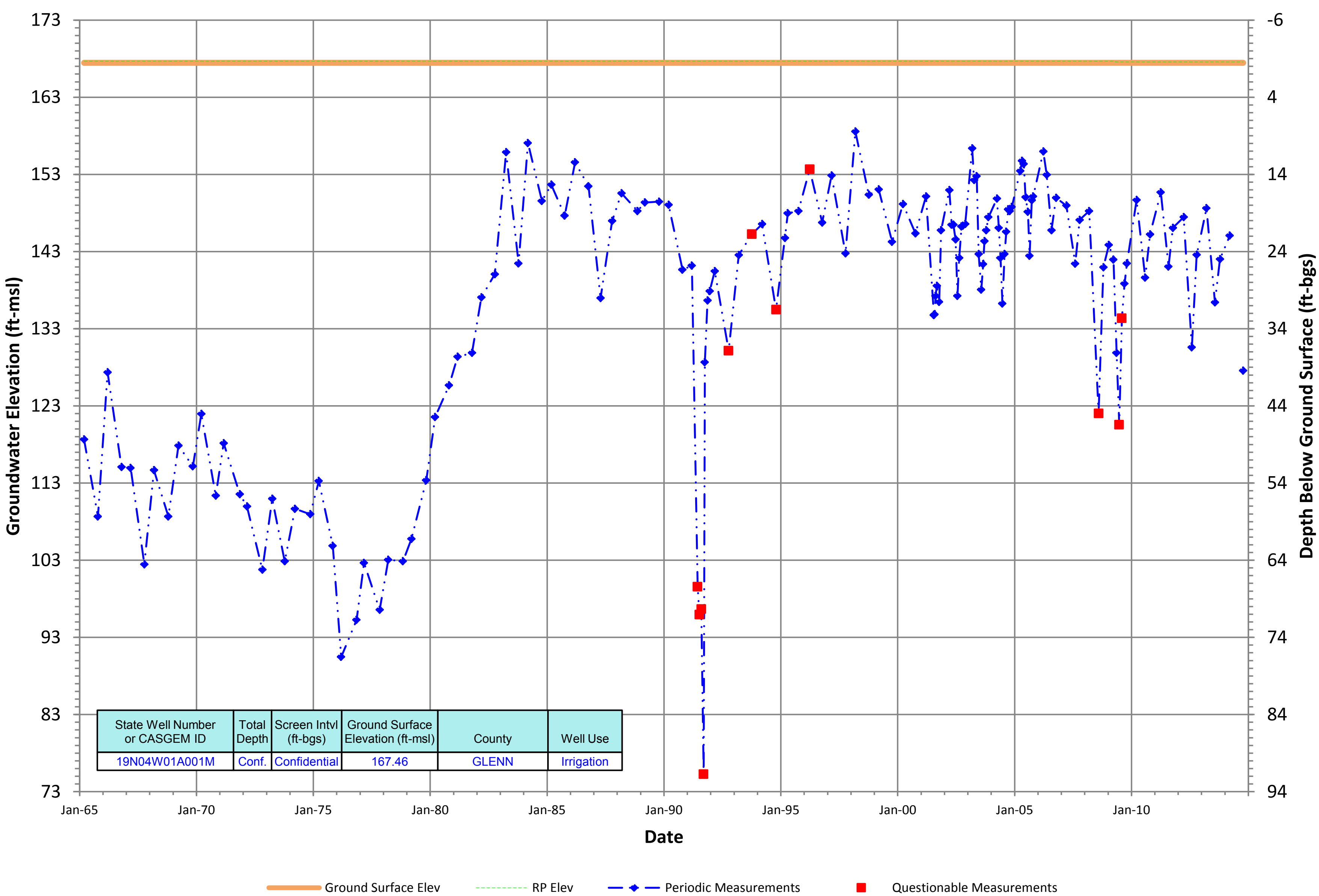
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N03W07J001M	Conf.	Confidential	149.86	GLENN	Irrigation

19N03W26P001M
Period Of Record: 02/06/1974 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



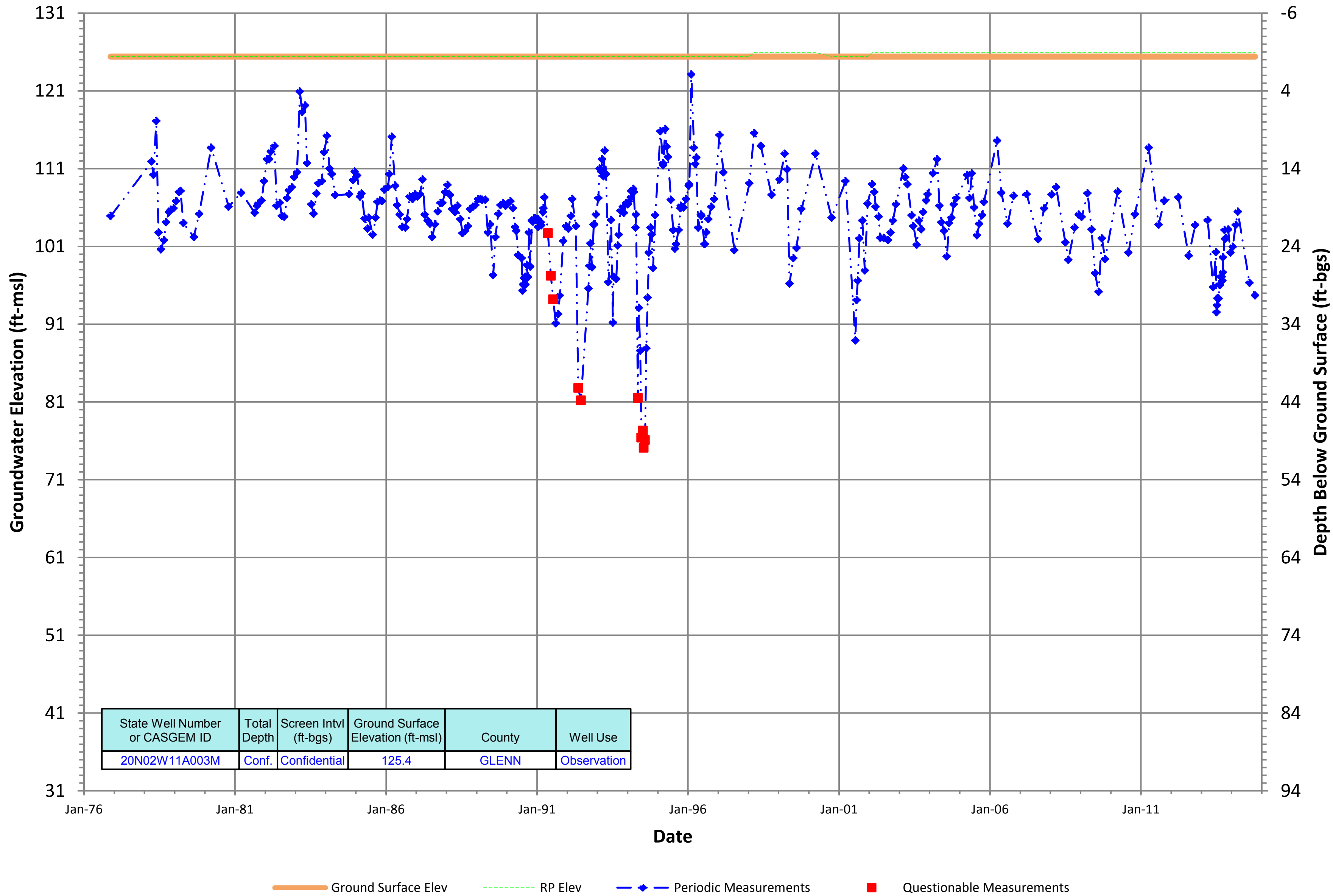
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N03W26P001M	Conf.	Confidential	100.43	GLENN	Residential



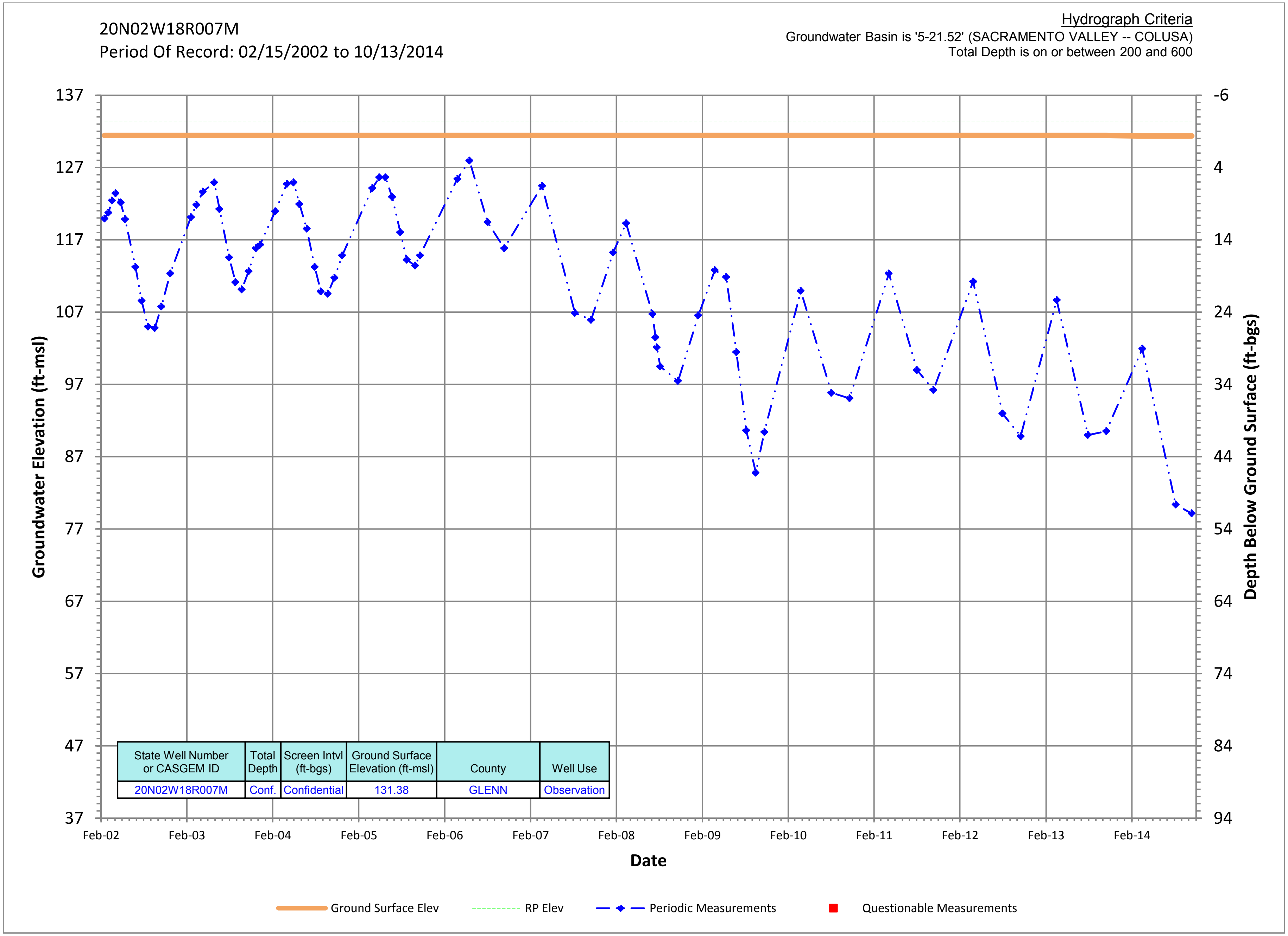
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N04W01A001M	Conf.	Confidential	167.46	GLENN	Irrigation

20N02W11A003M
Period Of Record: 11/17/1976 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



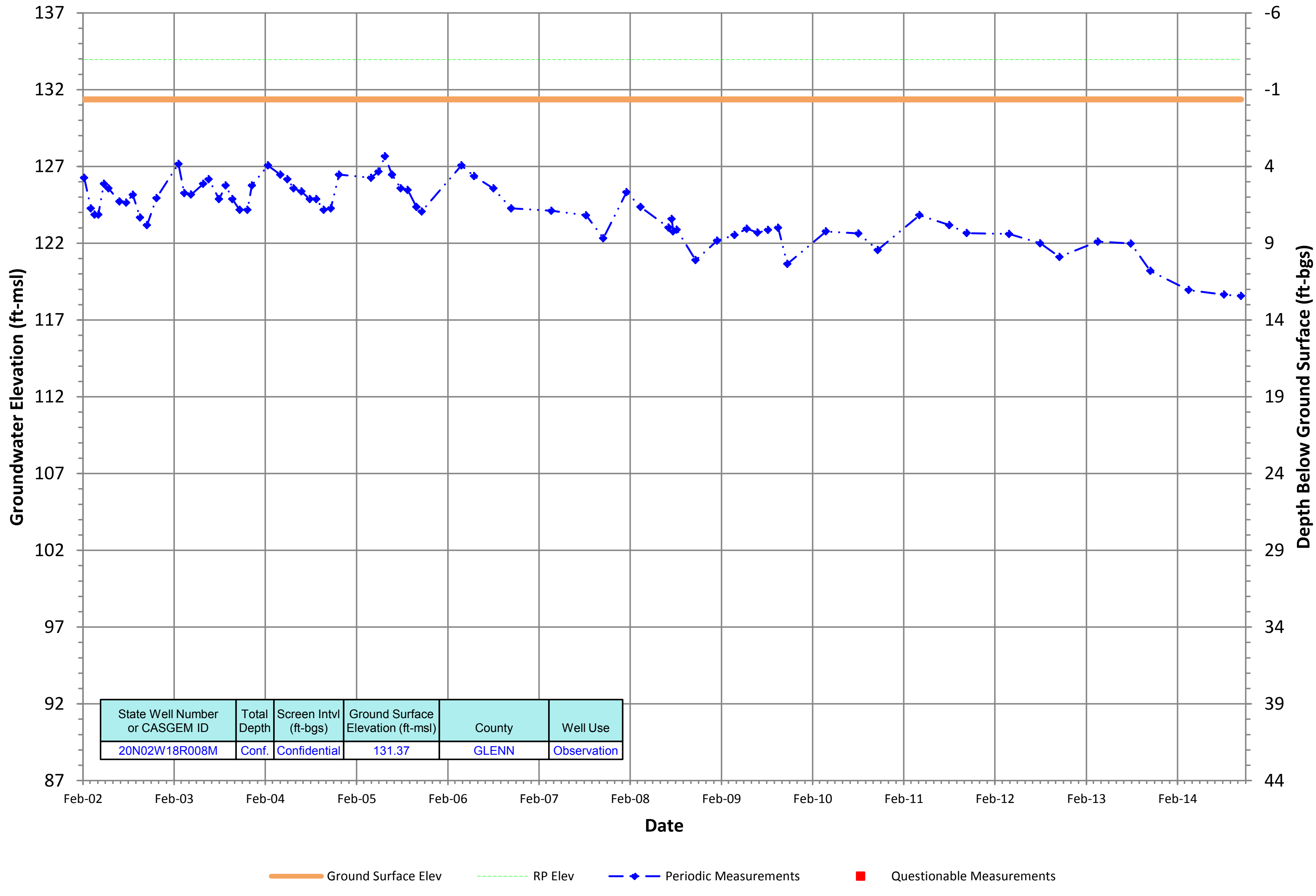
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W11A003M	Conf.	Confidential	125.4	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W18R007M	Conf.	Confidential	131.38	GLENN	Observation

20N02W18R008M
Period Of Record: 02/05/2002 to 10/13/2014

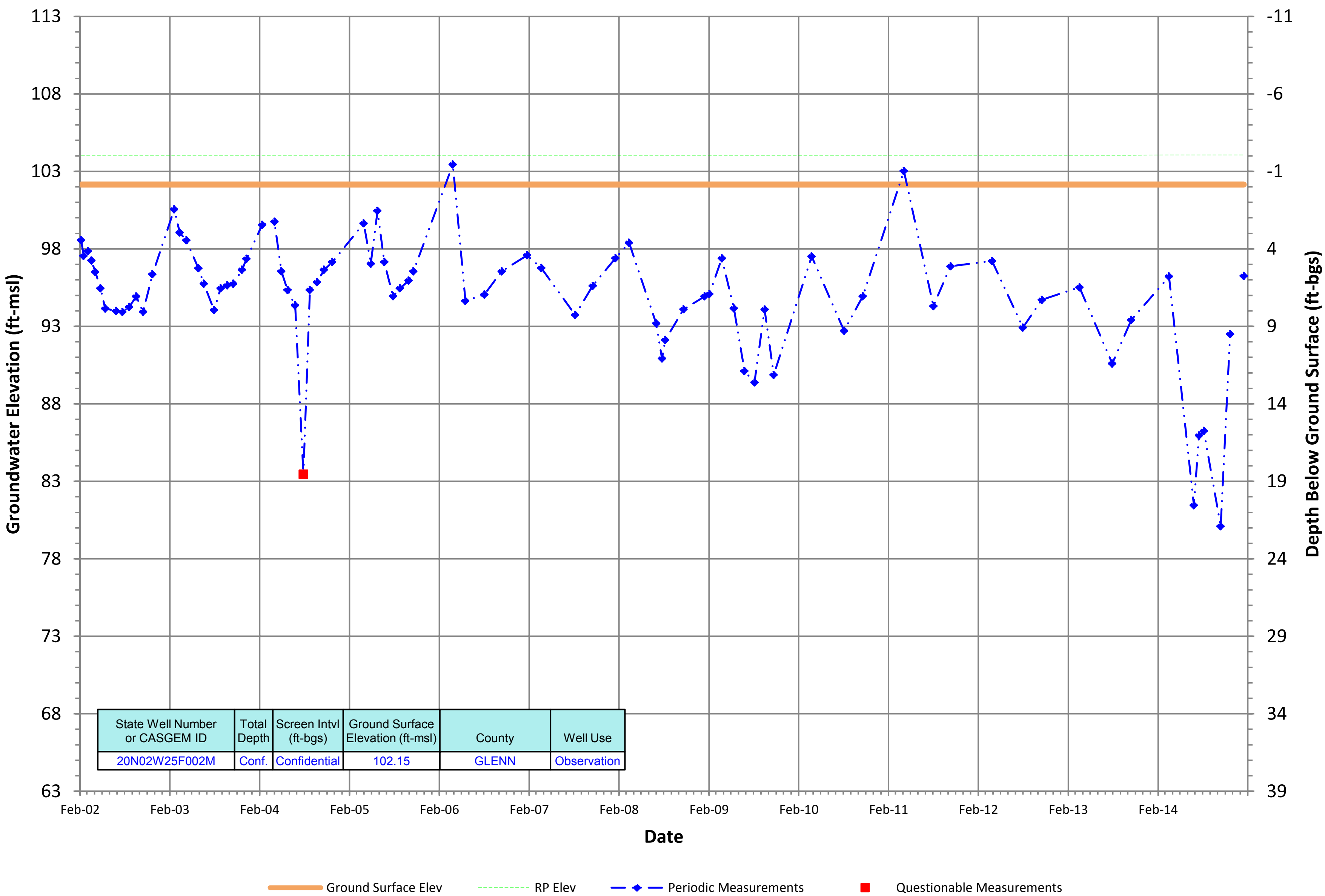
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W18R008M	Conf.	Confidential	131.37	GLENN	Observation

20N02W25F002M
Period Of Record: 02/05/2002 to 01/15/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W25F002M	Conf.	Confidential	102.15	GLENN	Observation

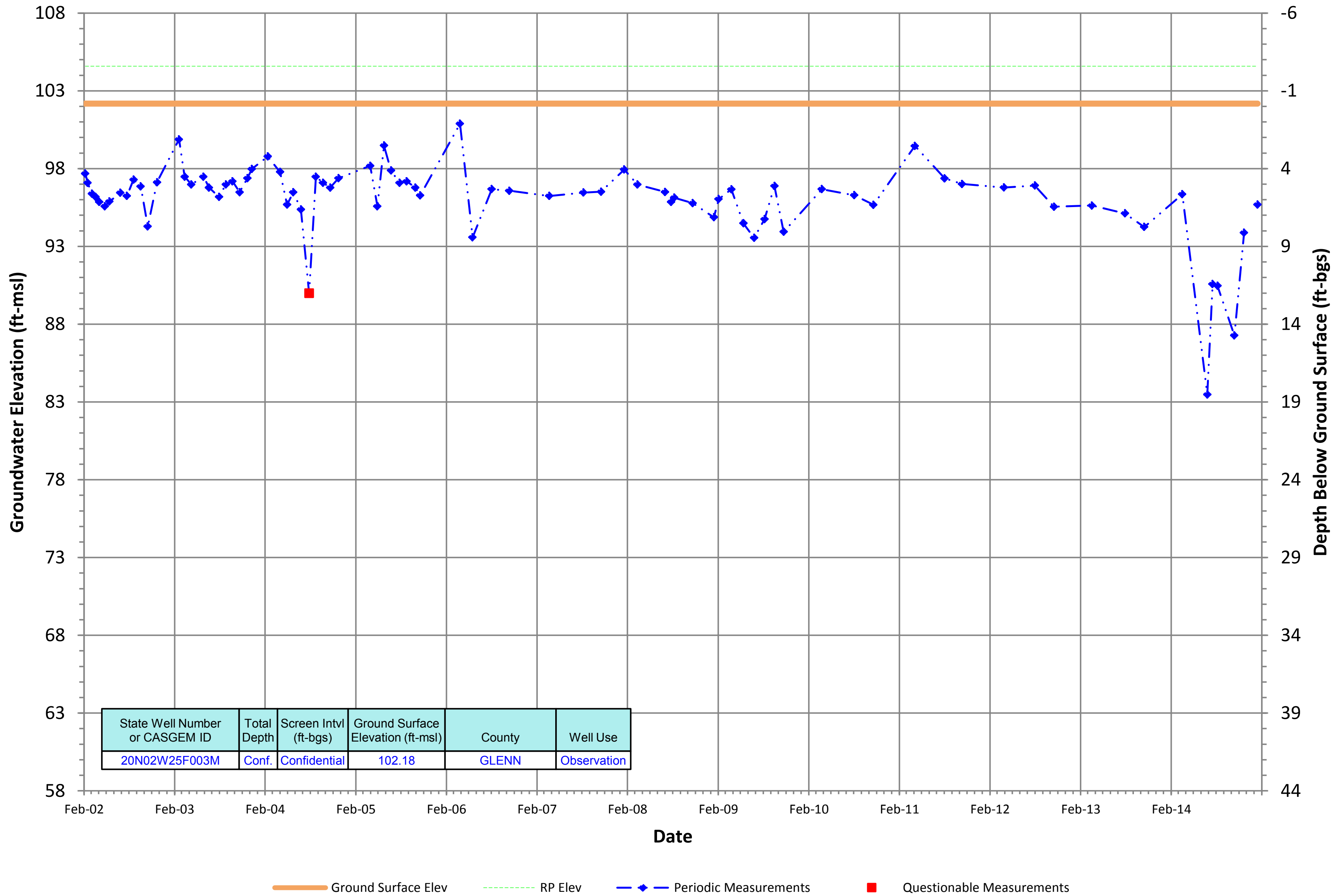
20N02W25F003M

Period Of Record: 02/05/2002 to 01/15/2015

Hydrograph Criteria

Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)

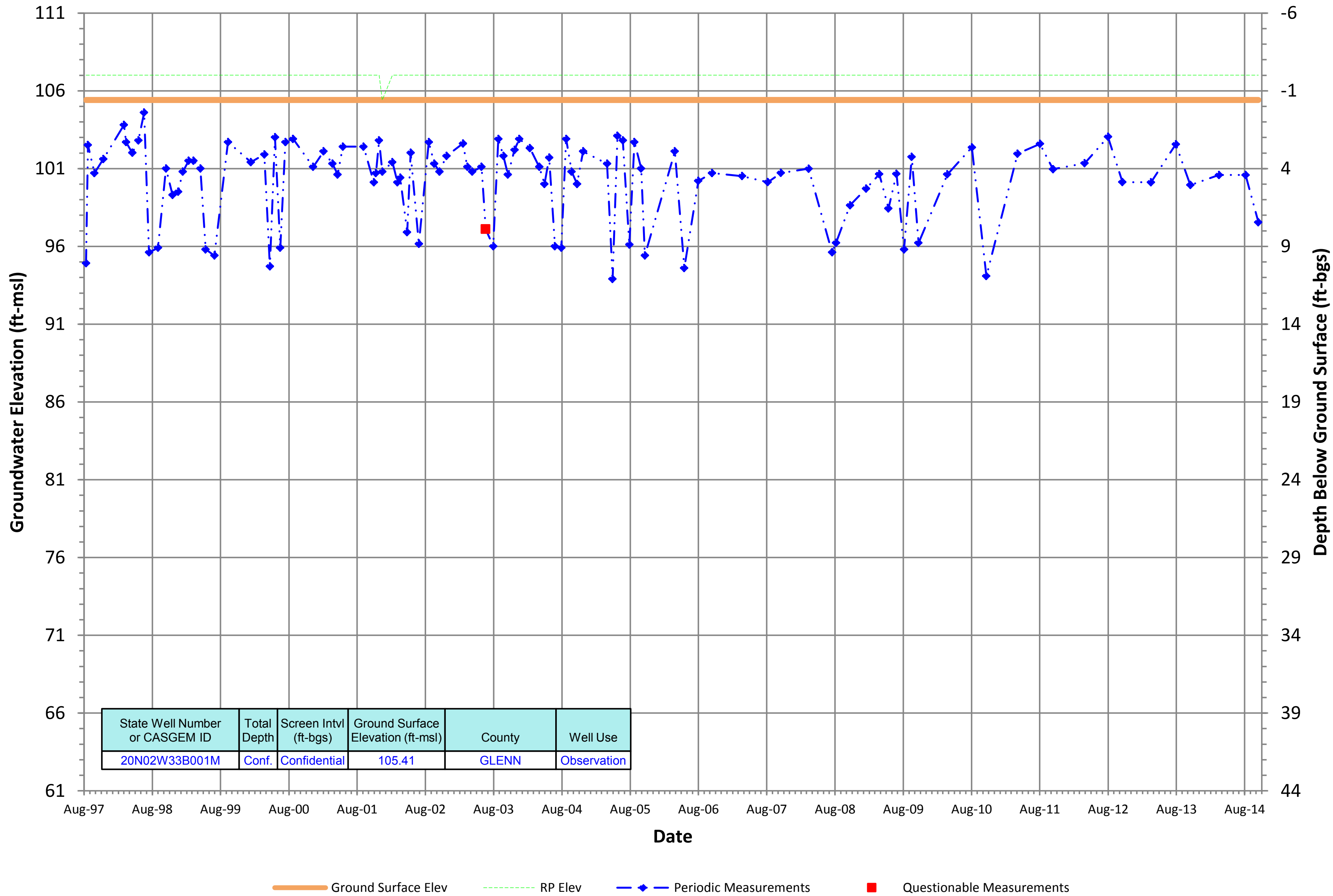
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W25F003M	Conf.	Confidential	102.18	GLENN	Observation

20N02W33B001M
Period Of Record: 08/11/1997 to 10/13/2014

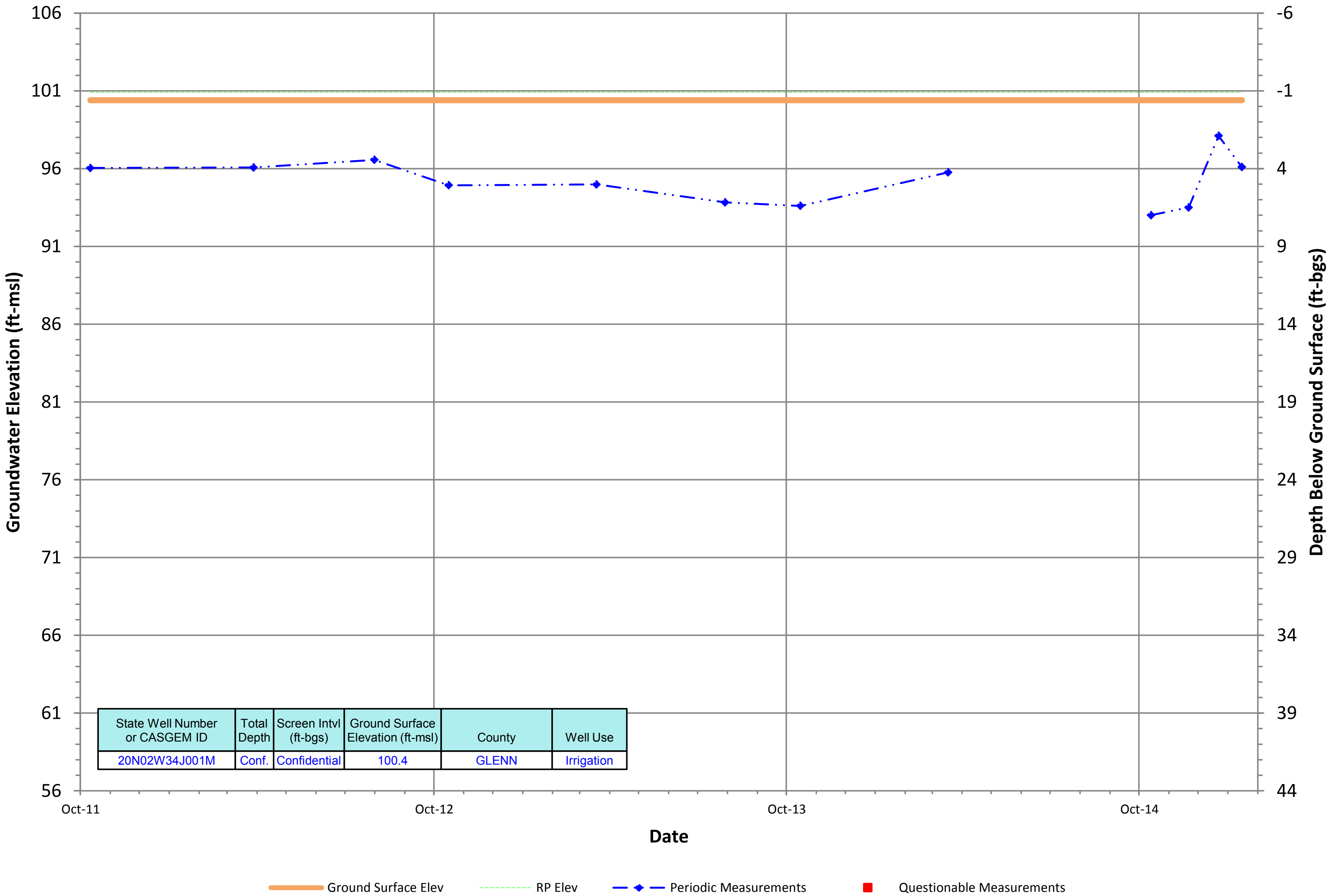
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W33B001M	Conf.	Confidential	105.41	GLENN	Observation

20N02W34J001M
Period Of Record: 10/11/2011 to 01/15/2015

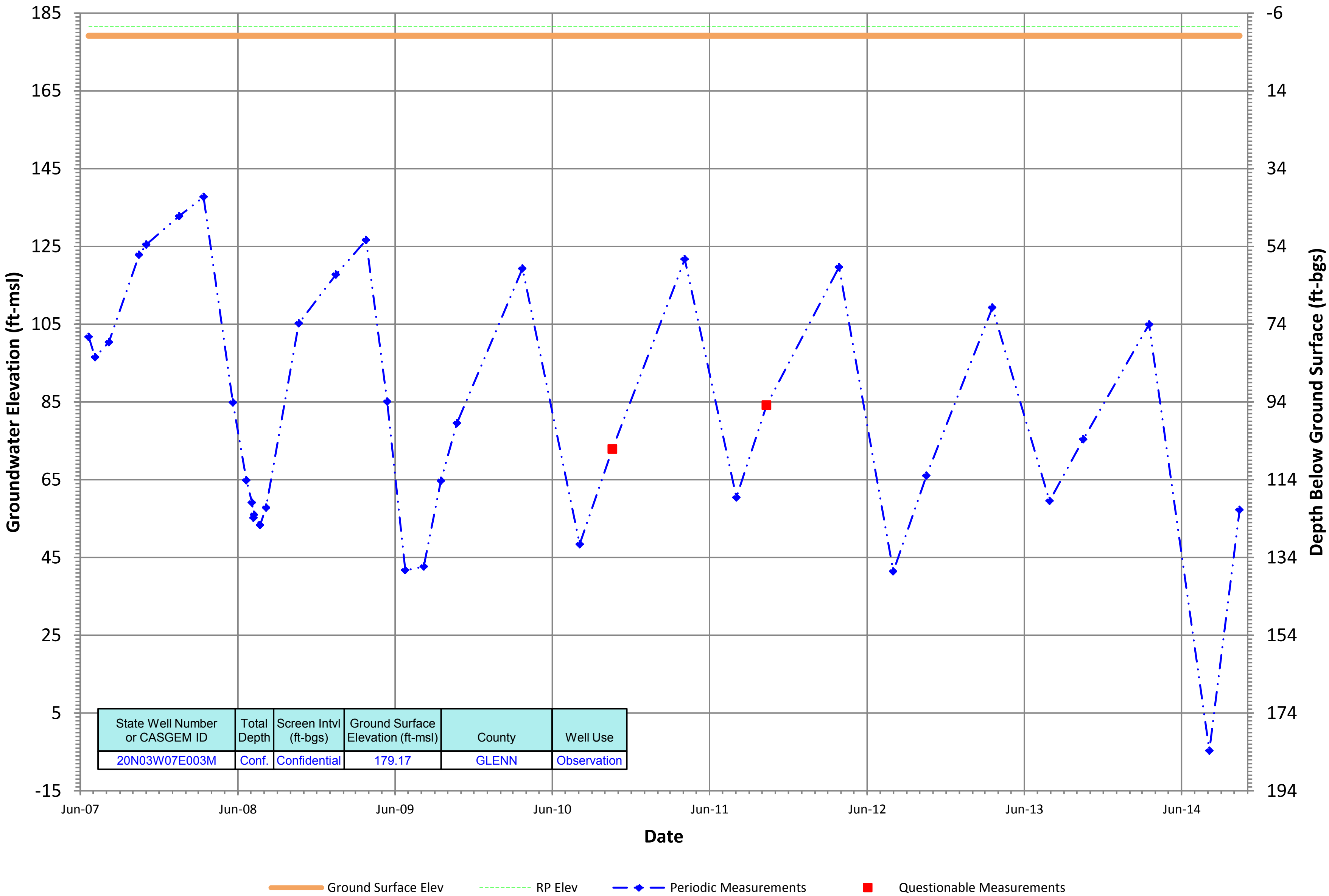
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W34J001M	Conf.	Confidential	100.4	GLENN	Irrigation

20N03W07E003M
Period Of Record: 06/20/2007 to 10/13/2014

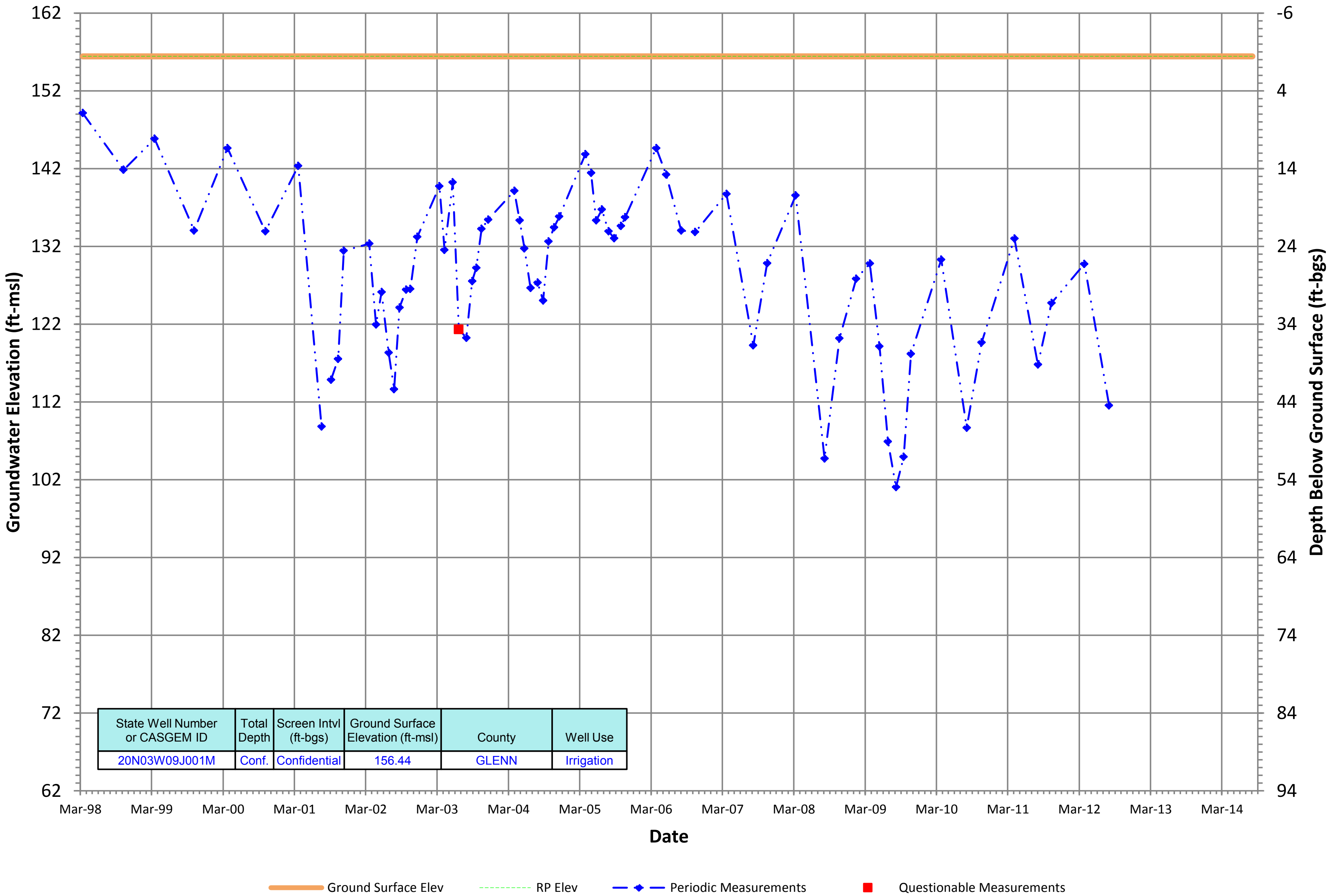
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



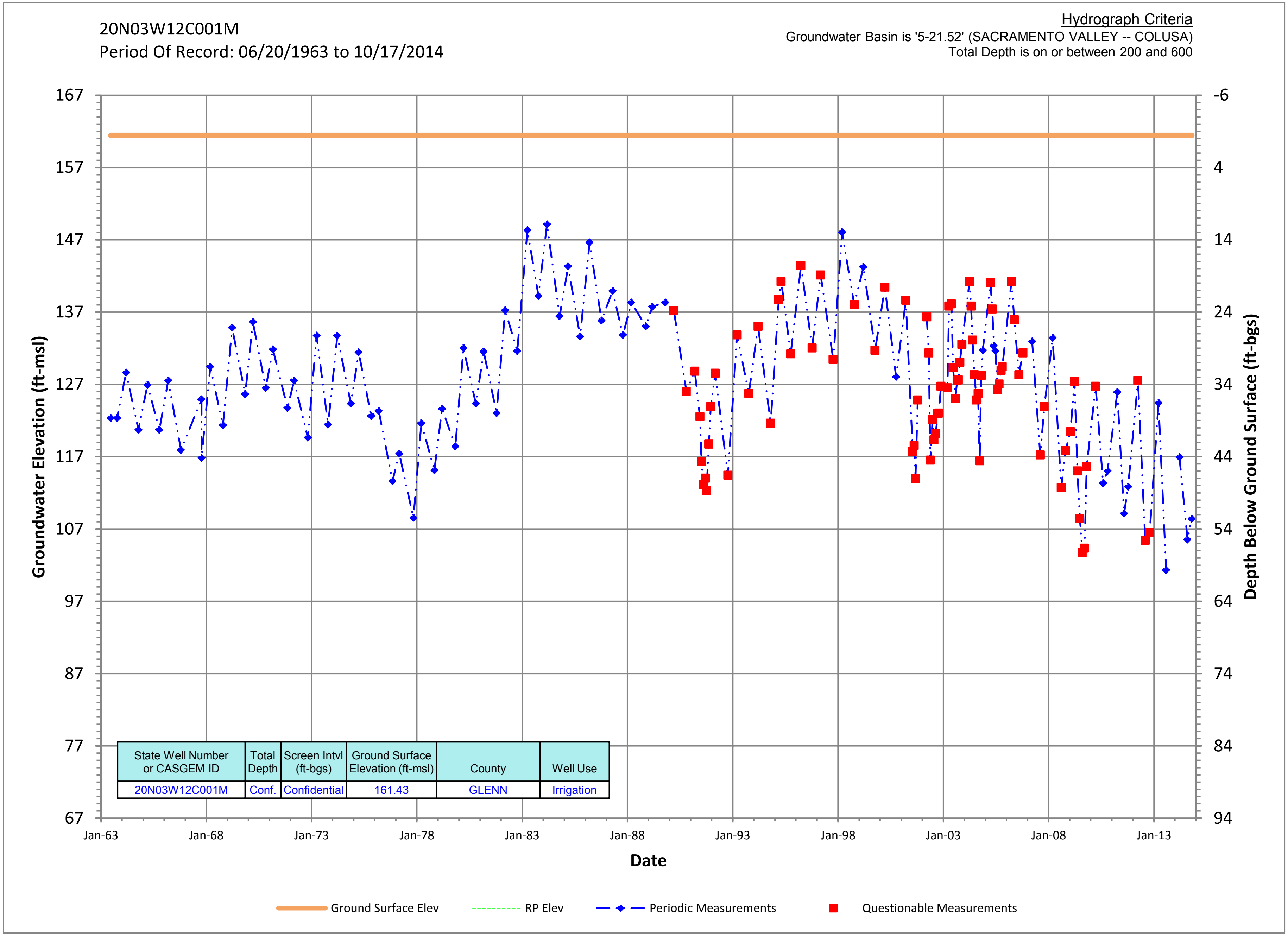
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W07E003M	Conf.	Confidential	179.17	GLENN	Observation

20N03W09J001M
Period Of Record: 03/13/1998 to 08/04/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



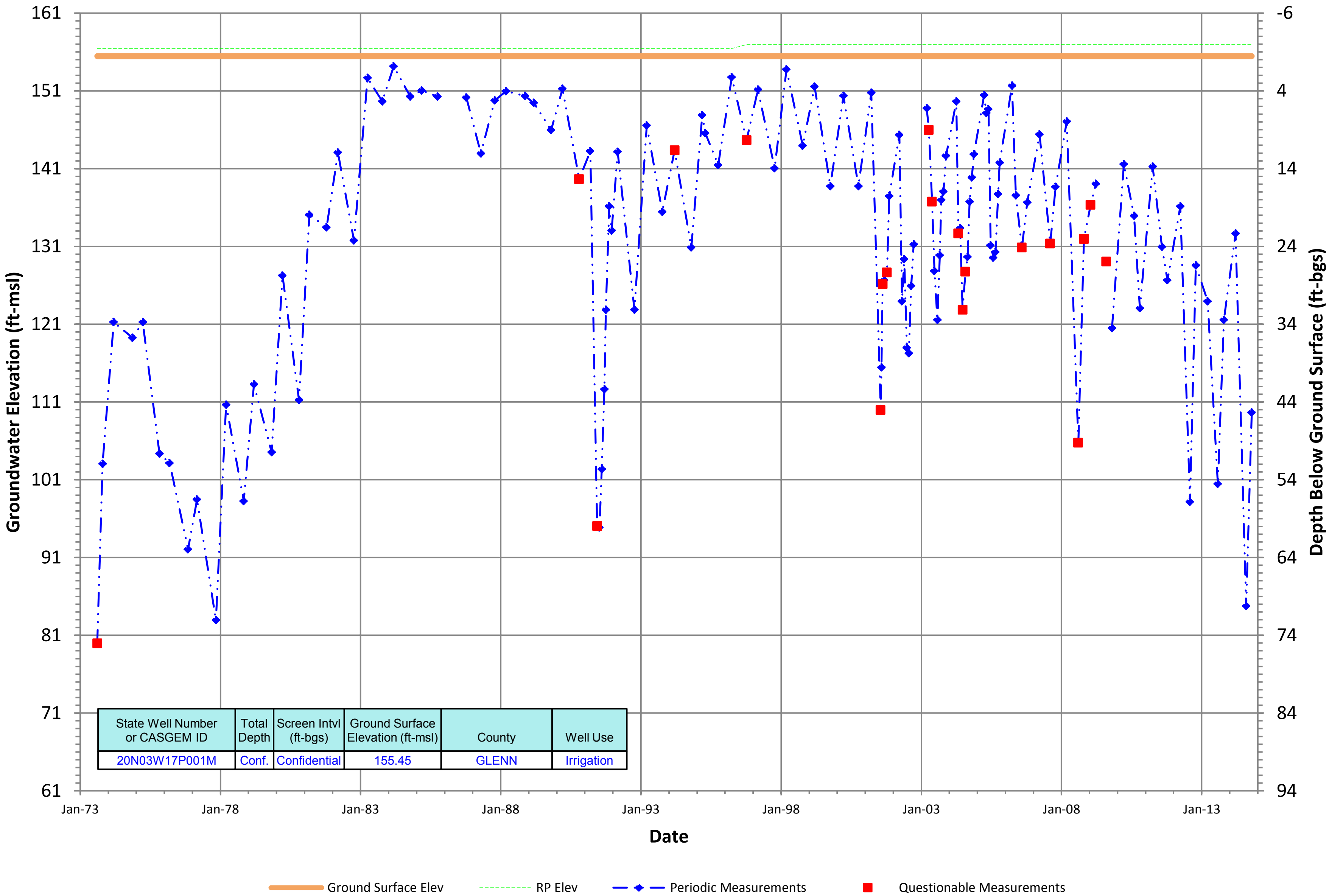
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W09J001M	Conf.	Confidential	156.44	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W12C001M	Conf.	Confidential	161.43	GLENN	Irrigation

20N03W17P001M
Period Of Record: 08/10/1973 to 10/14/2014

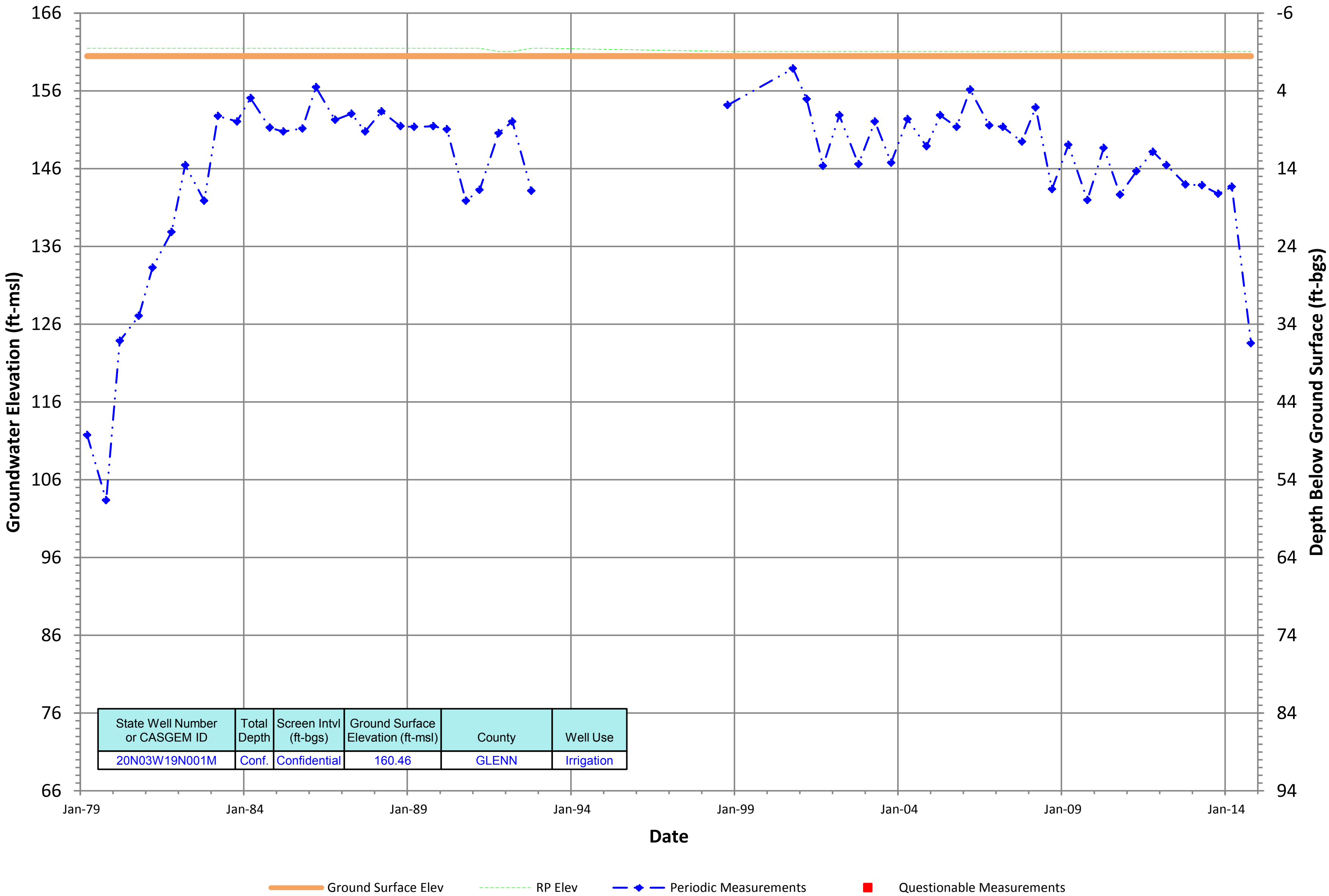
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W17P001M	Conf.	Confidential	155.45	GLENN	Irrigation

20N03W19N001M
Period Of Record: 03/13/1979 to 10/14/2014

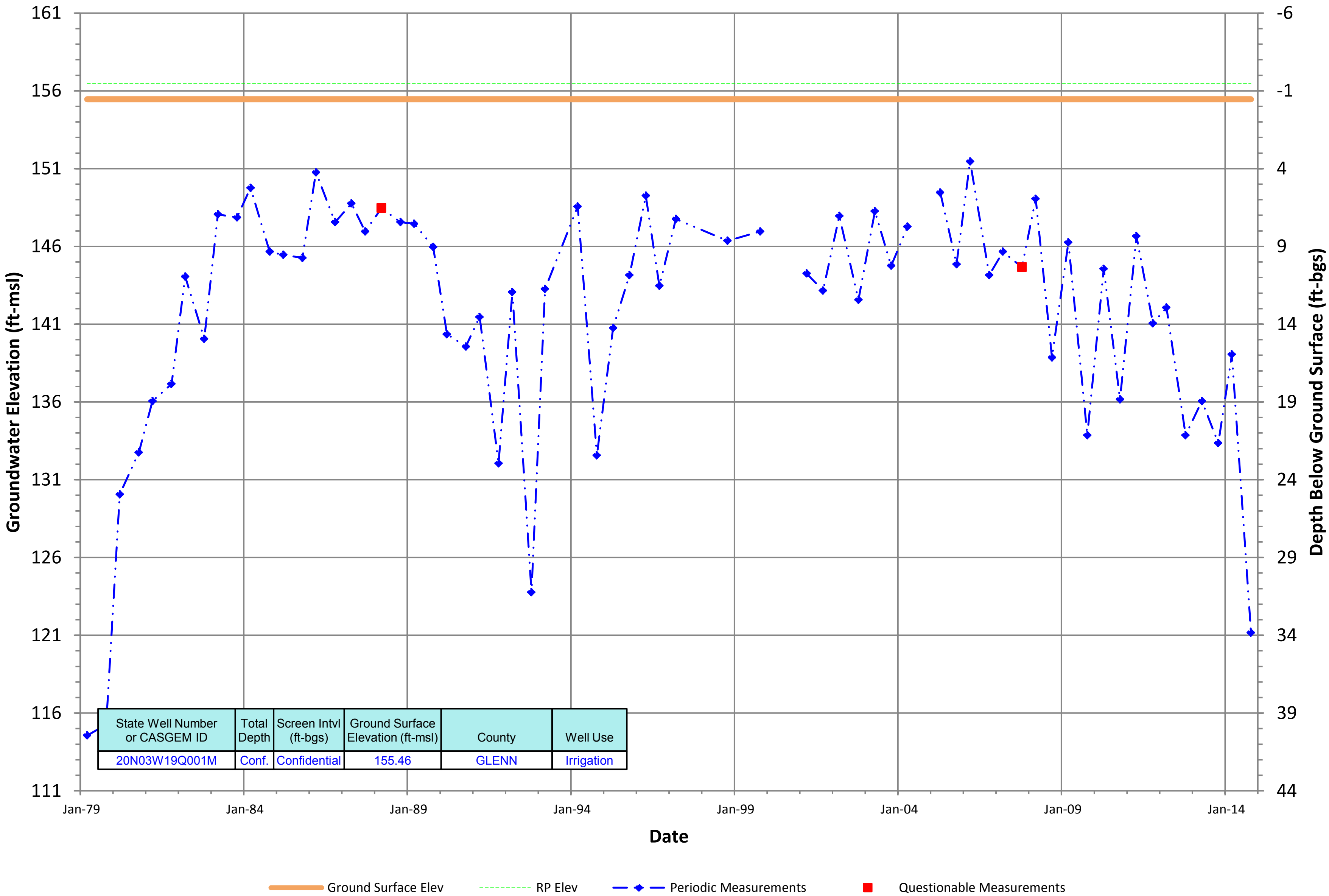
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



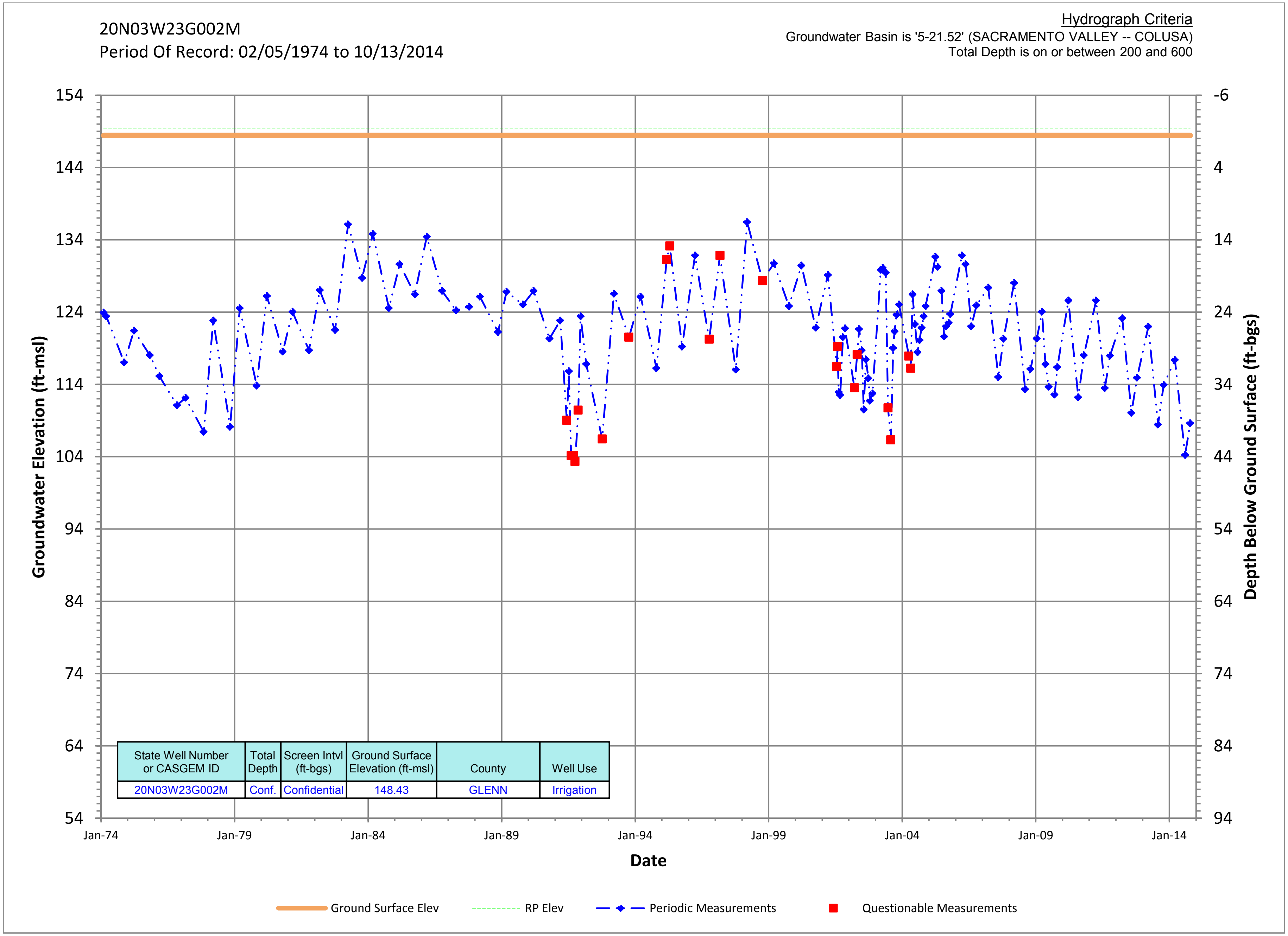
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W19N001M	Conf.	Confidential	160.46	GLENN	Irrigation

20N03W19Q001M
Period Of Record: 03/13/1979 to 10/14/2014

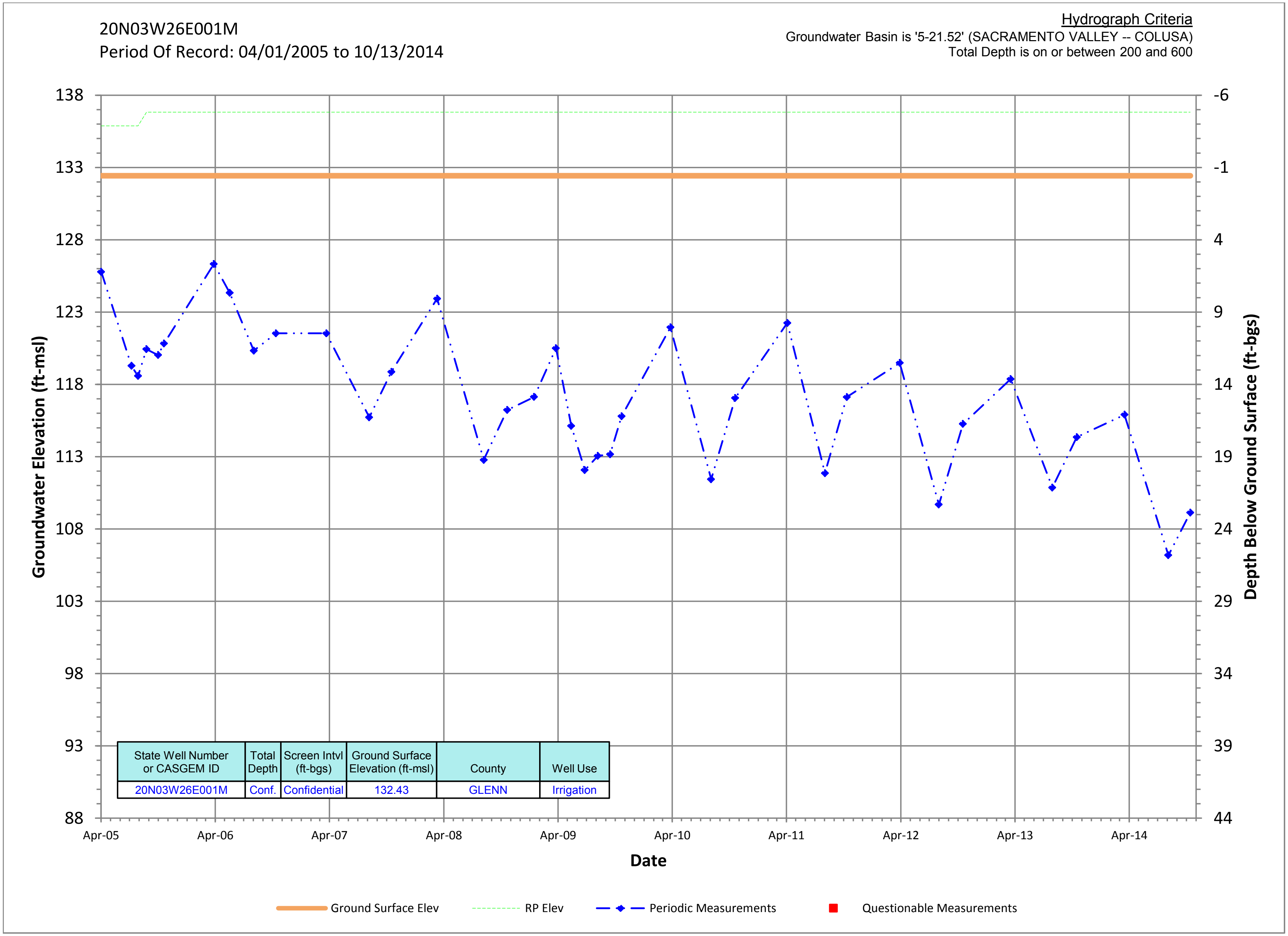
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



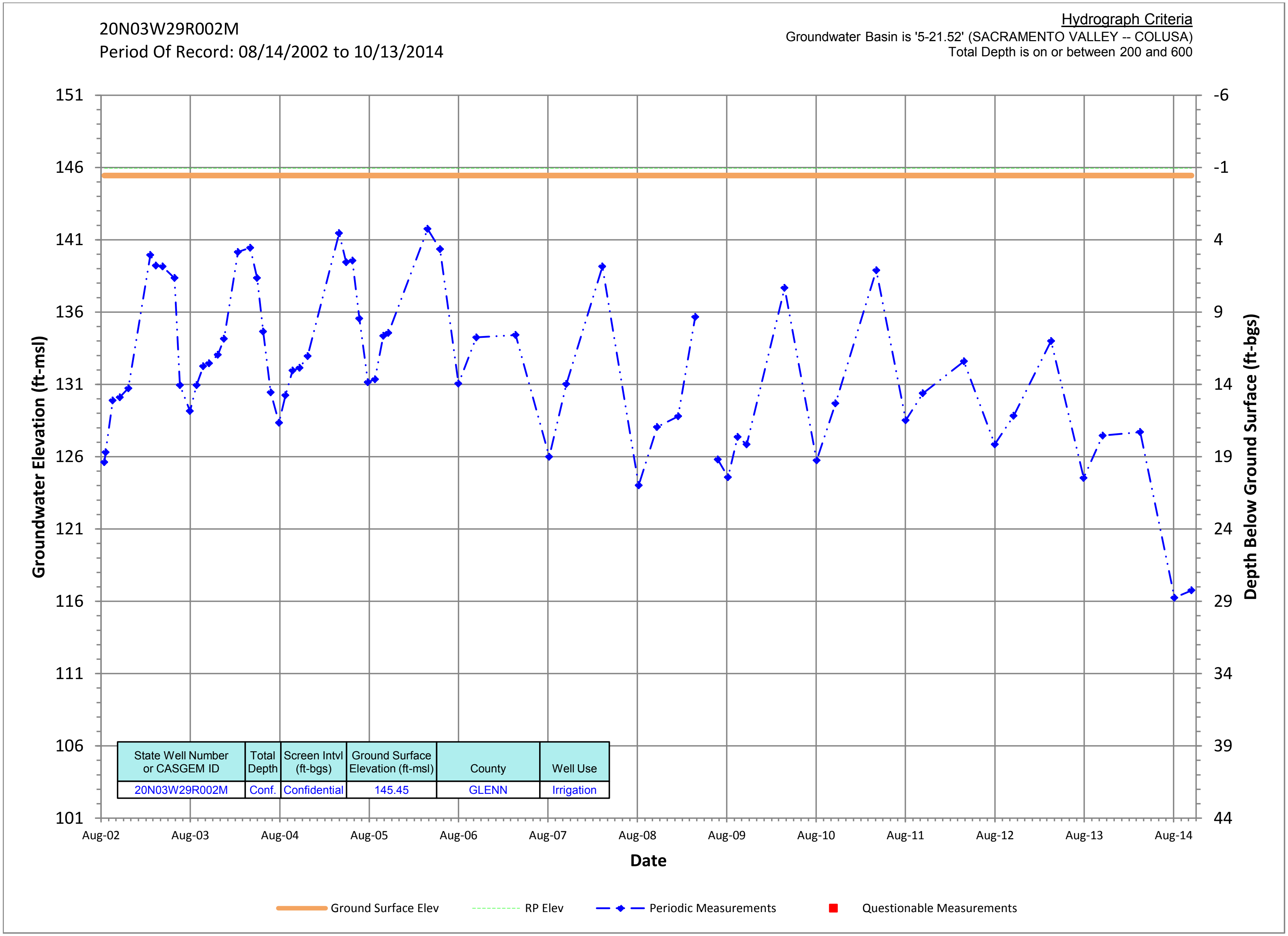
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W19Q001M	Conf.	Confidential	155.46	GLENN	Irrigation



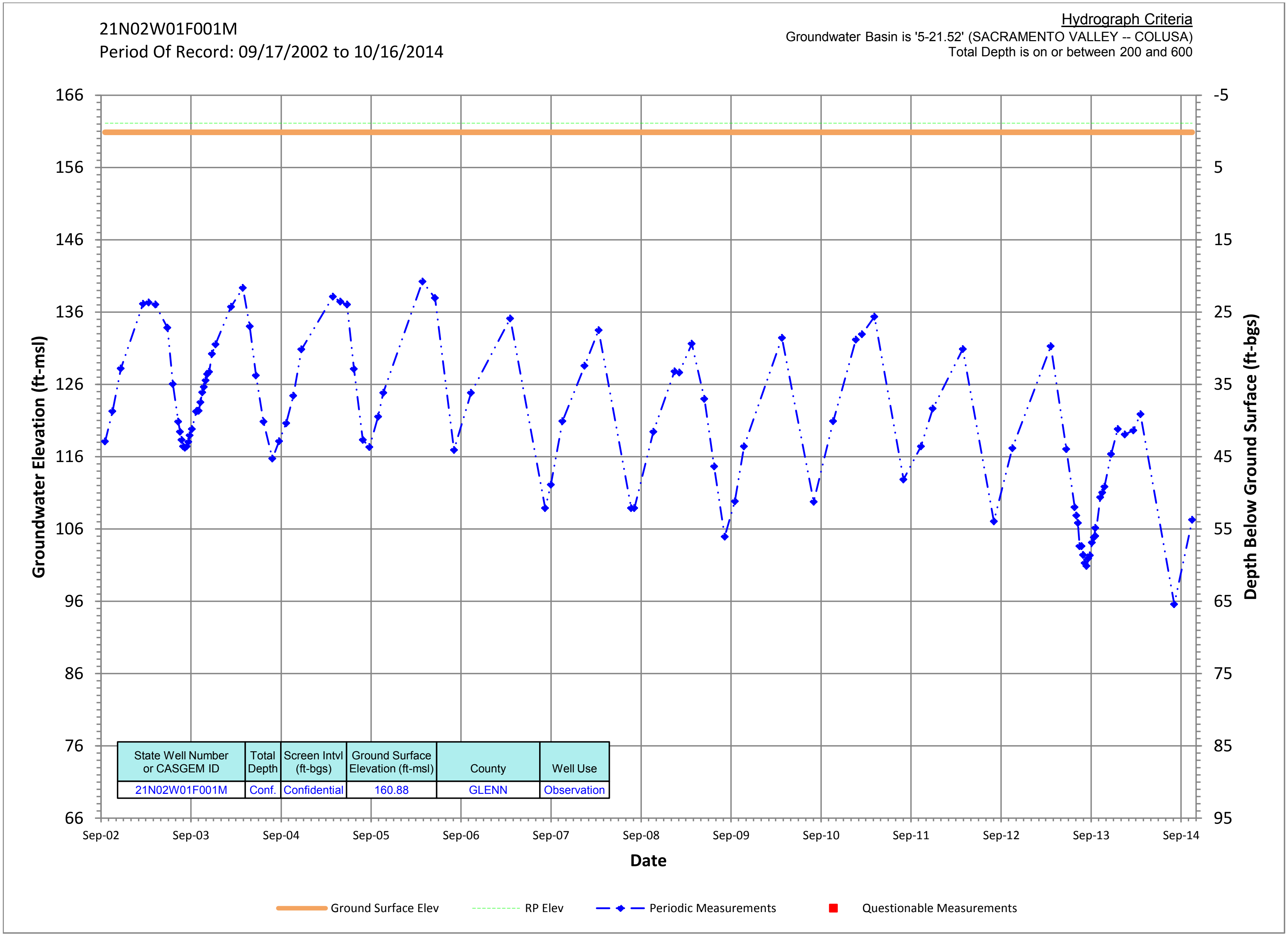
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W23G002M	Conf.	Confidential	148.43	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W26E001M	Conf.	Confidential	132.43	GLENN	Irrigation



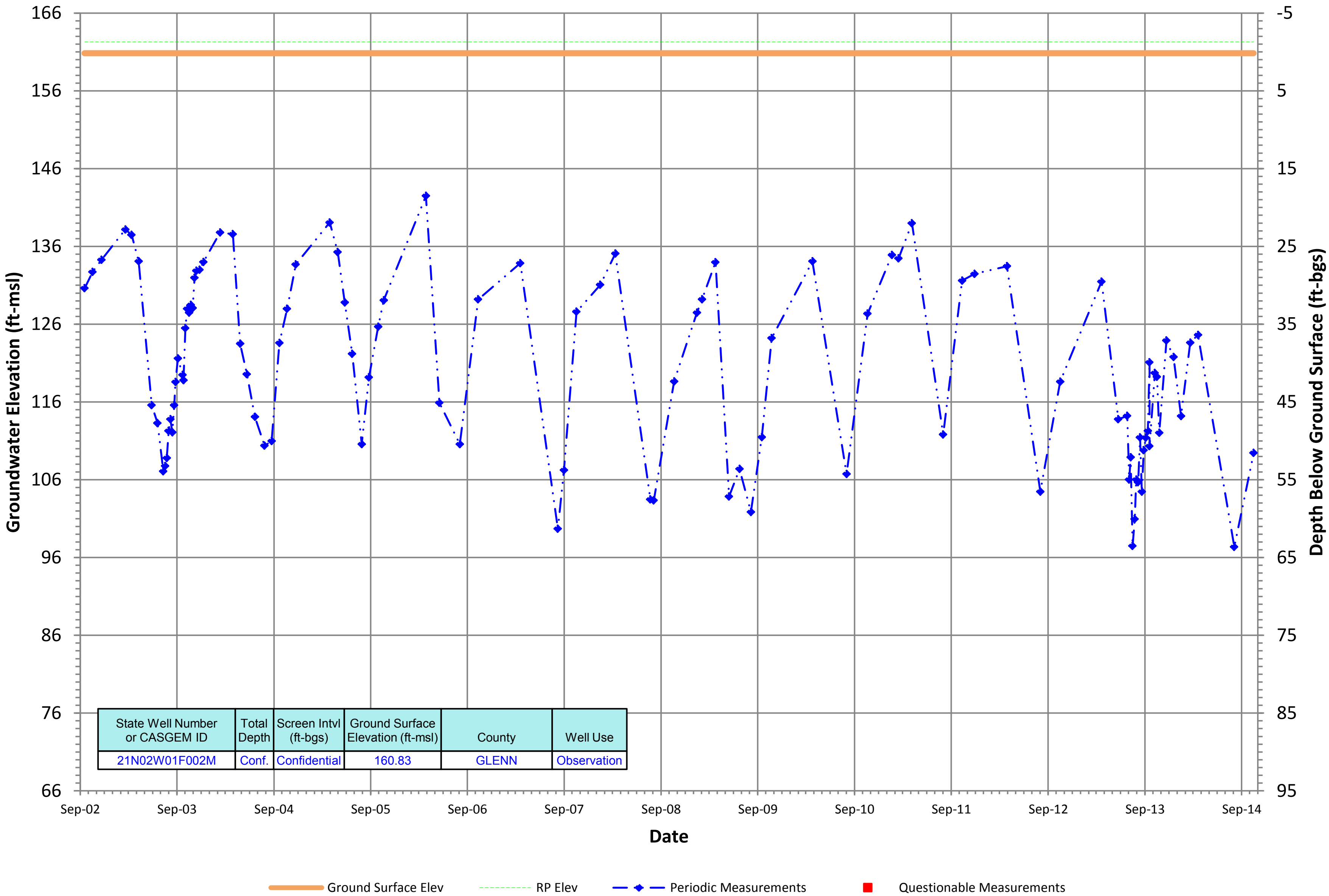
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W29R002M	Conf.	Confidential	145.45	GLENN	Irrigation



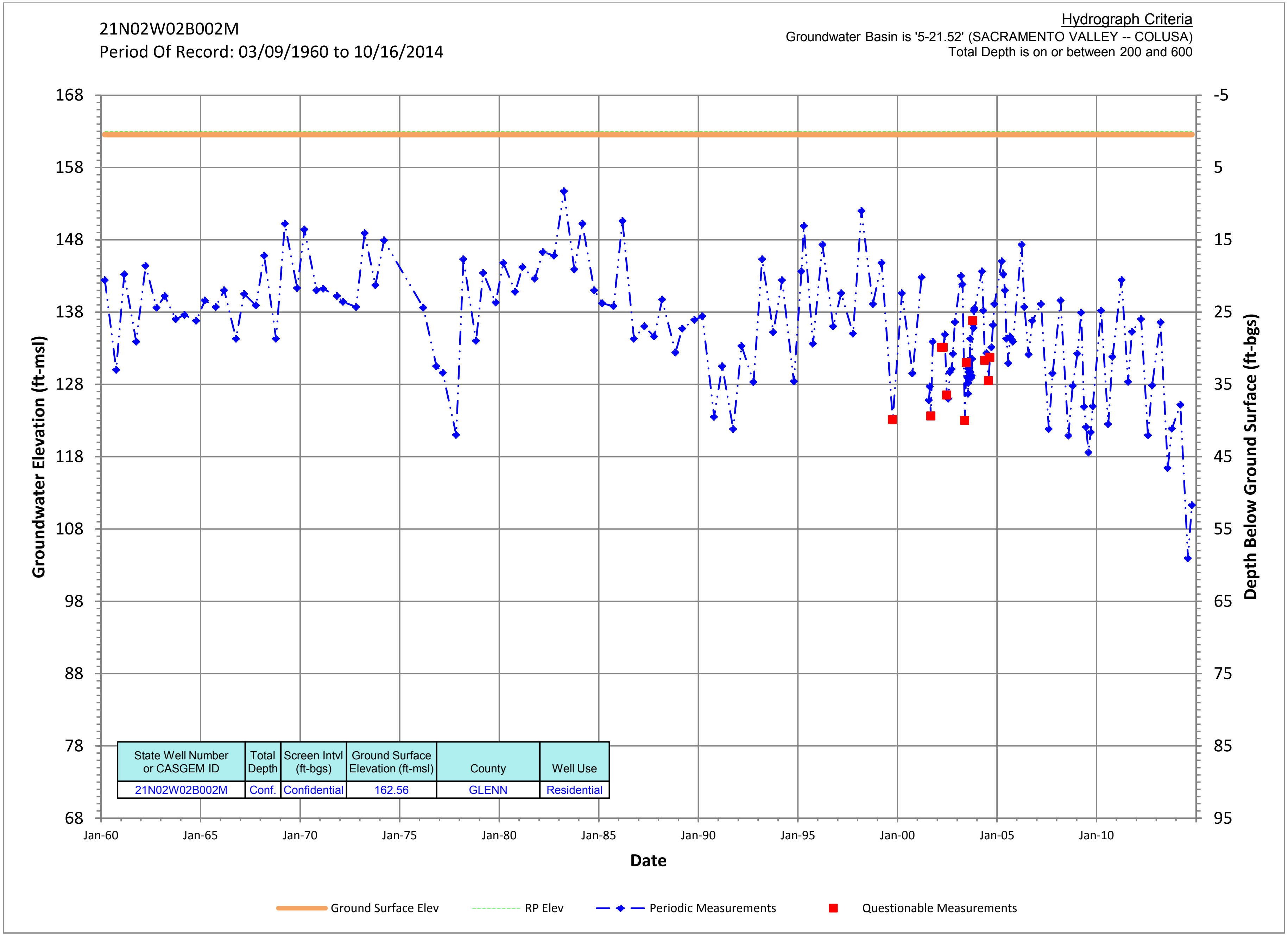
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W01F001M	Conf.	Confidential	160.88	GLENN	Observation

21N02W01F002M
Period Of Record: 09/17/2002 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



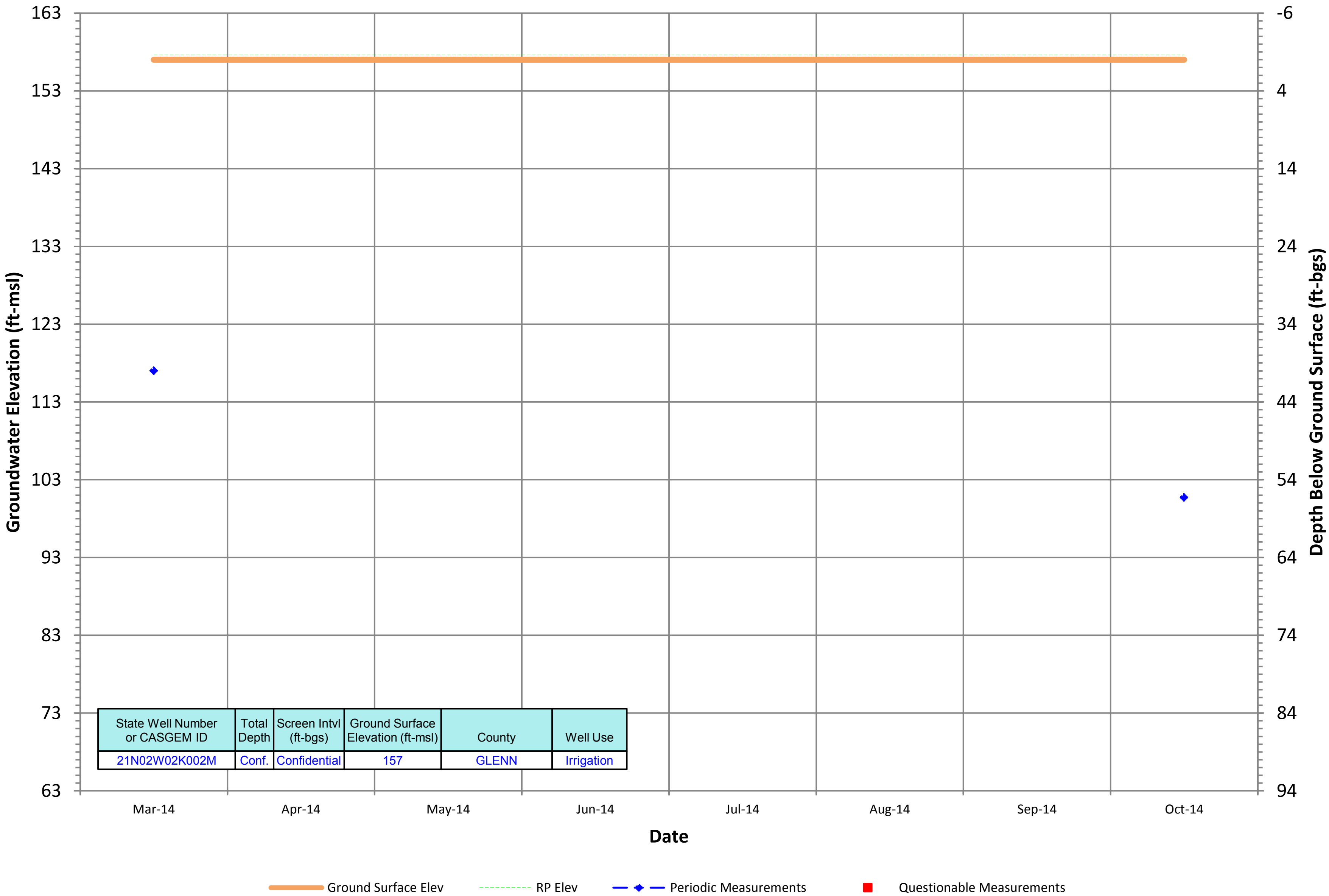
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W01F002M	Conf.	Confidential	160.83	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W02B002M	Conf.	Confidential	162.56	GLENN	Residential

21N02W02K002M
Period Of Record: 03/20/2014 to 10/16/2014

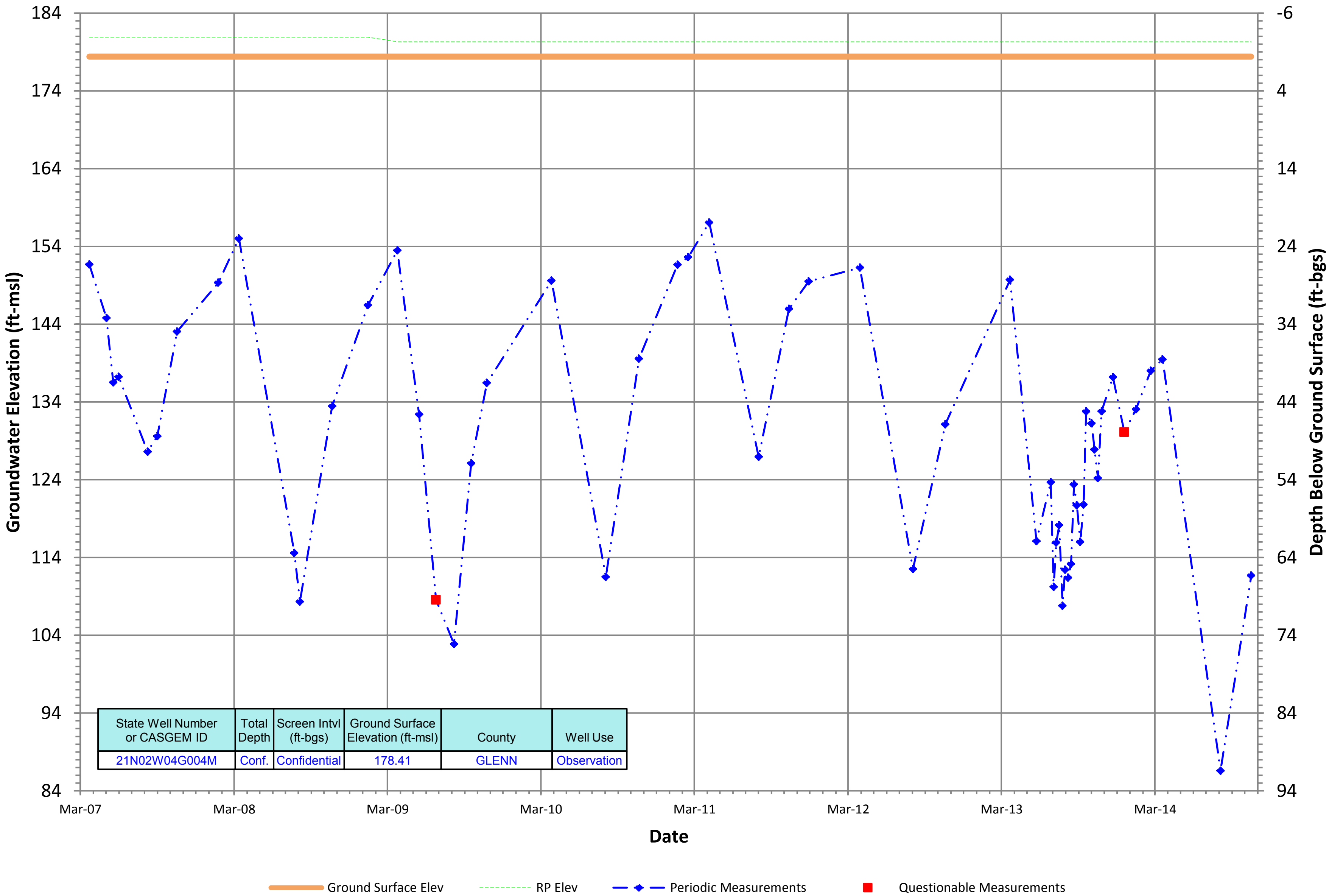
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W02K002M	Conf.	Confidential	157	GLENN	Irrigation

21N02W04G004M
Period Of Record: 03/22/2007 to 10/16/2014

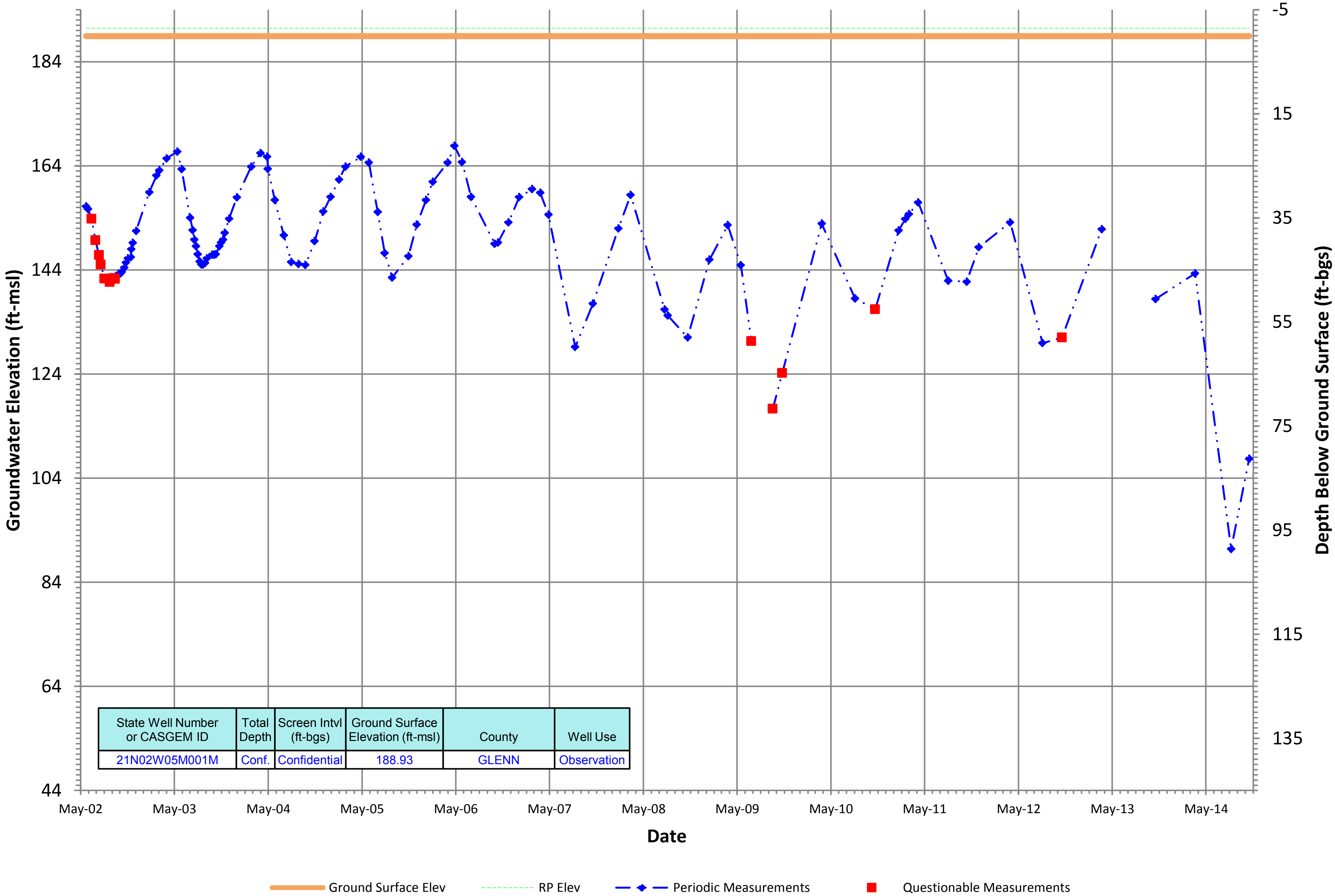
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



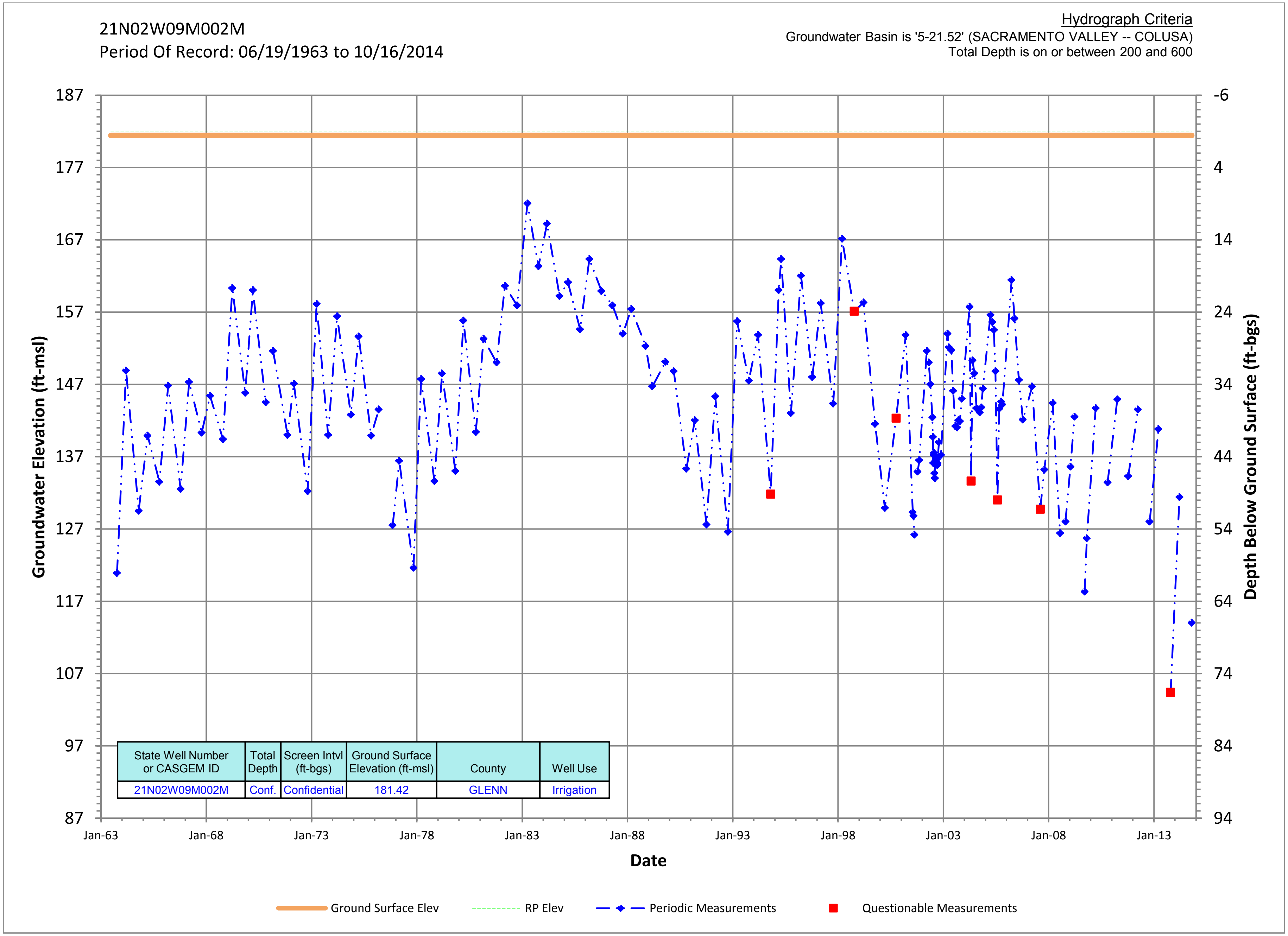
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W04G004M	Conf.	Confidential	178.41	GLENN	Observation

21N02W05M001M
Period Of Record: 05/22/2002 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



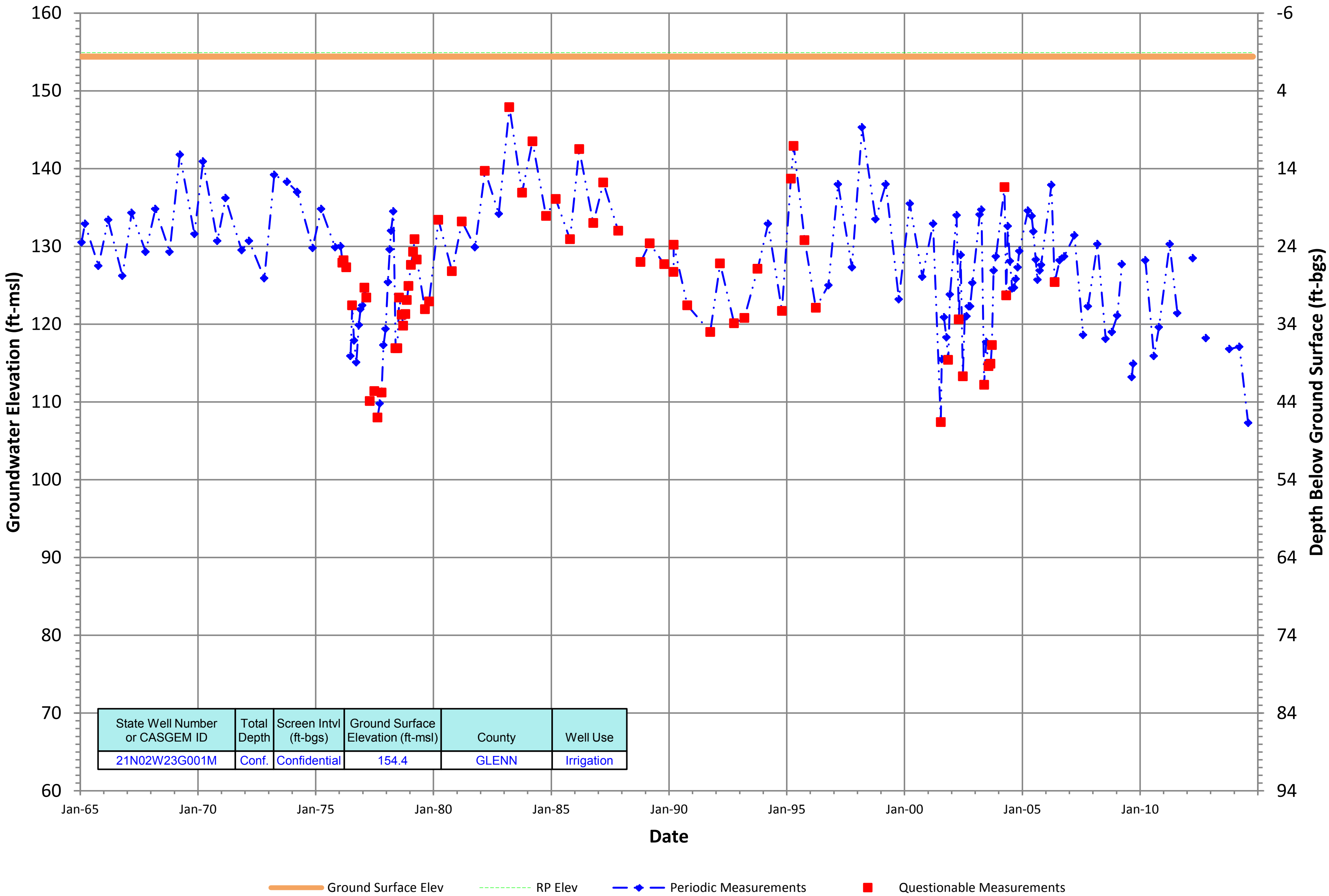
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W05M001M	Conf.	Confidential	188.93	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W09M002M	Conf.	Confidential	181.42	GLENN	Irrigation

21N02W23G001M
Period Of Record: 01/20/1965 to 10/17/2014

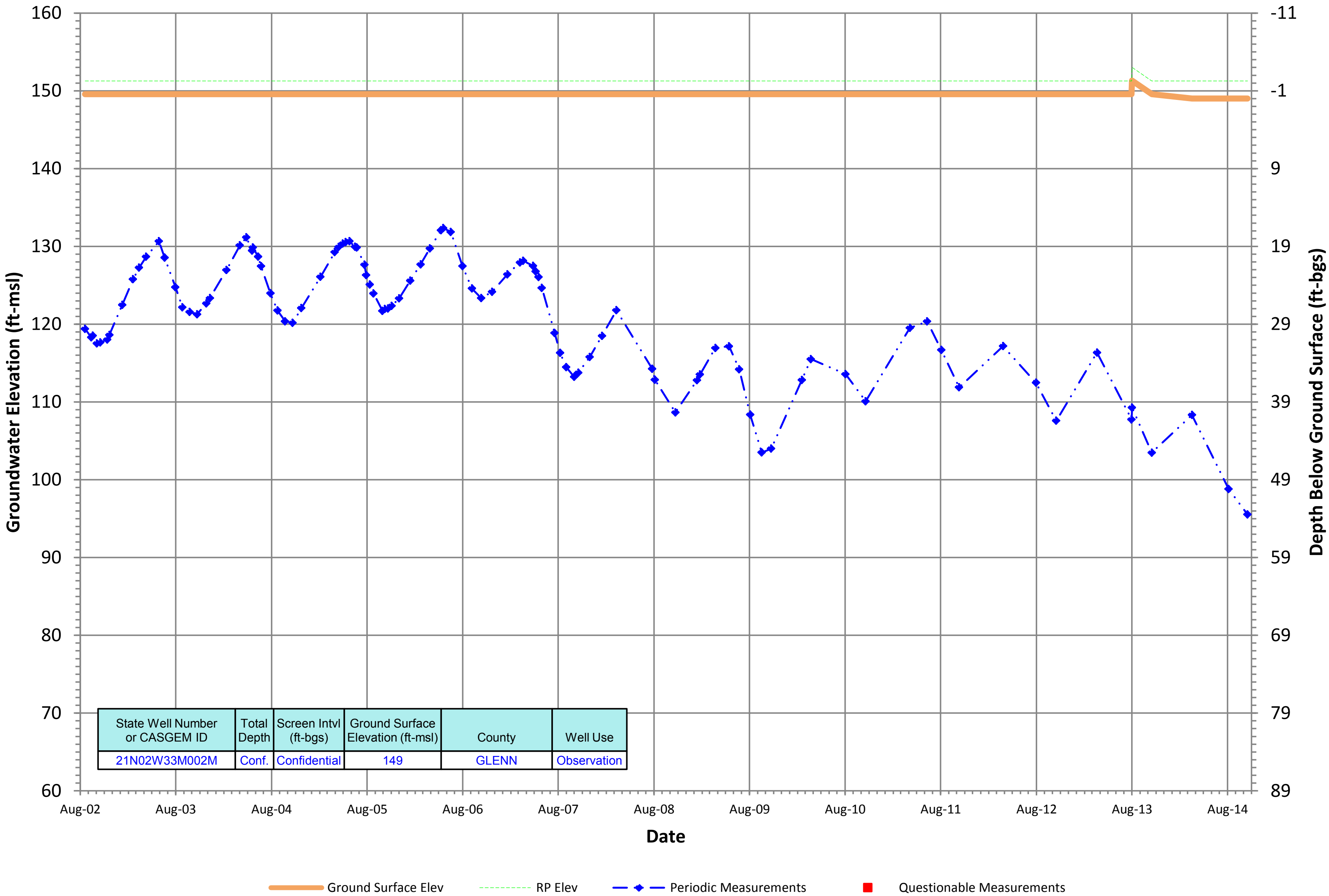
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



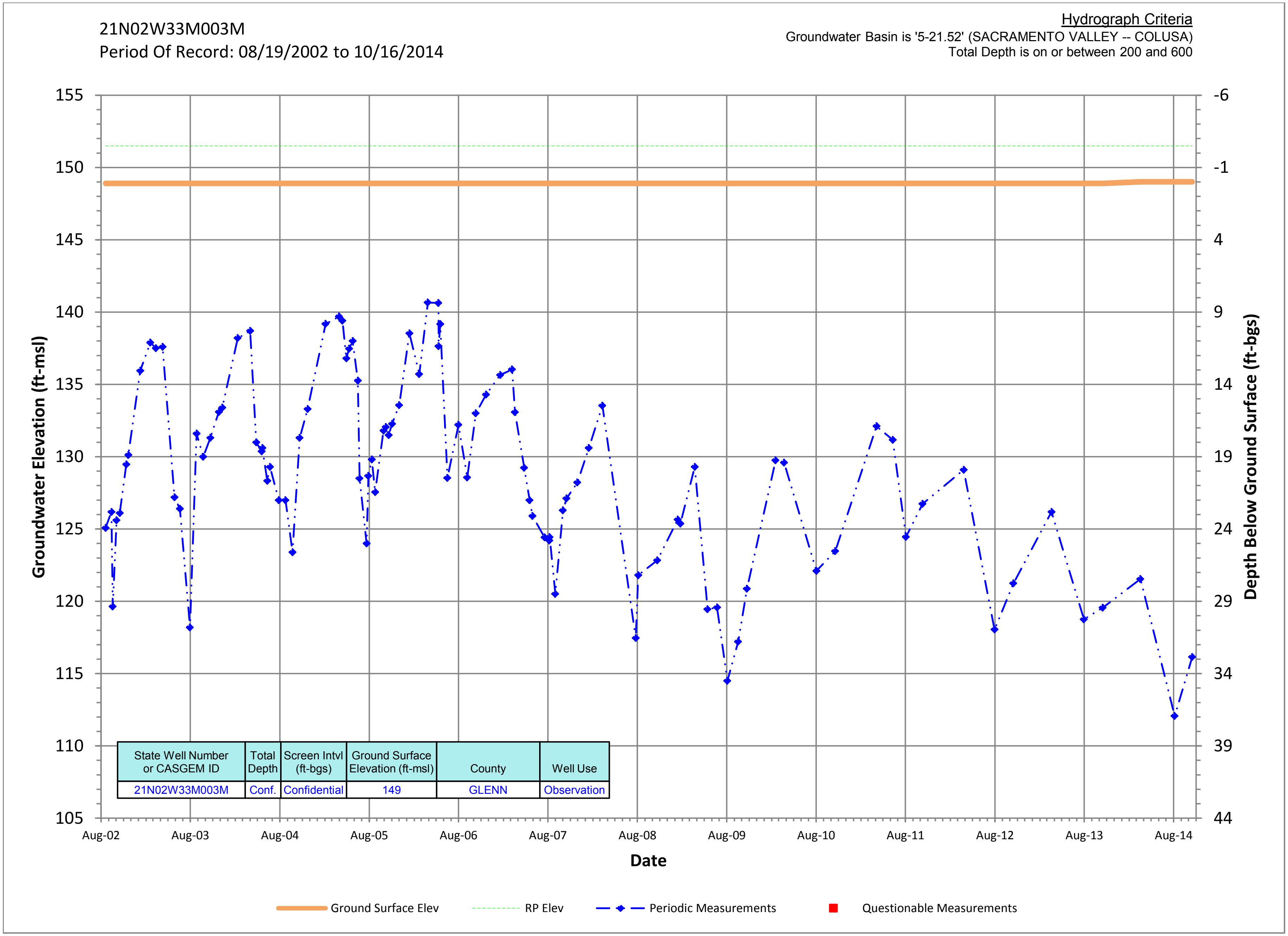
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W23G001M	Conf.	Confidential	154.4	GLENN	Irrigation

21N02W33M002M
Period Of Record: 08/19/2002 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



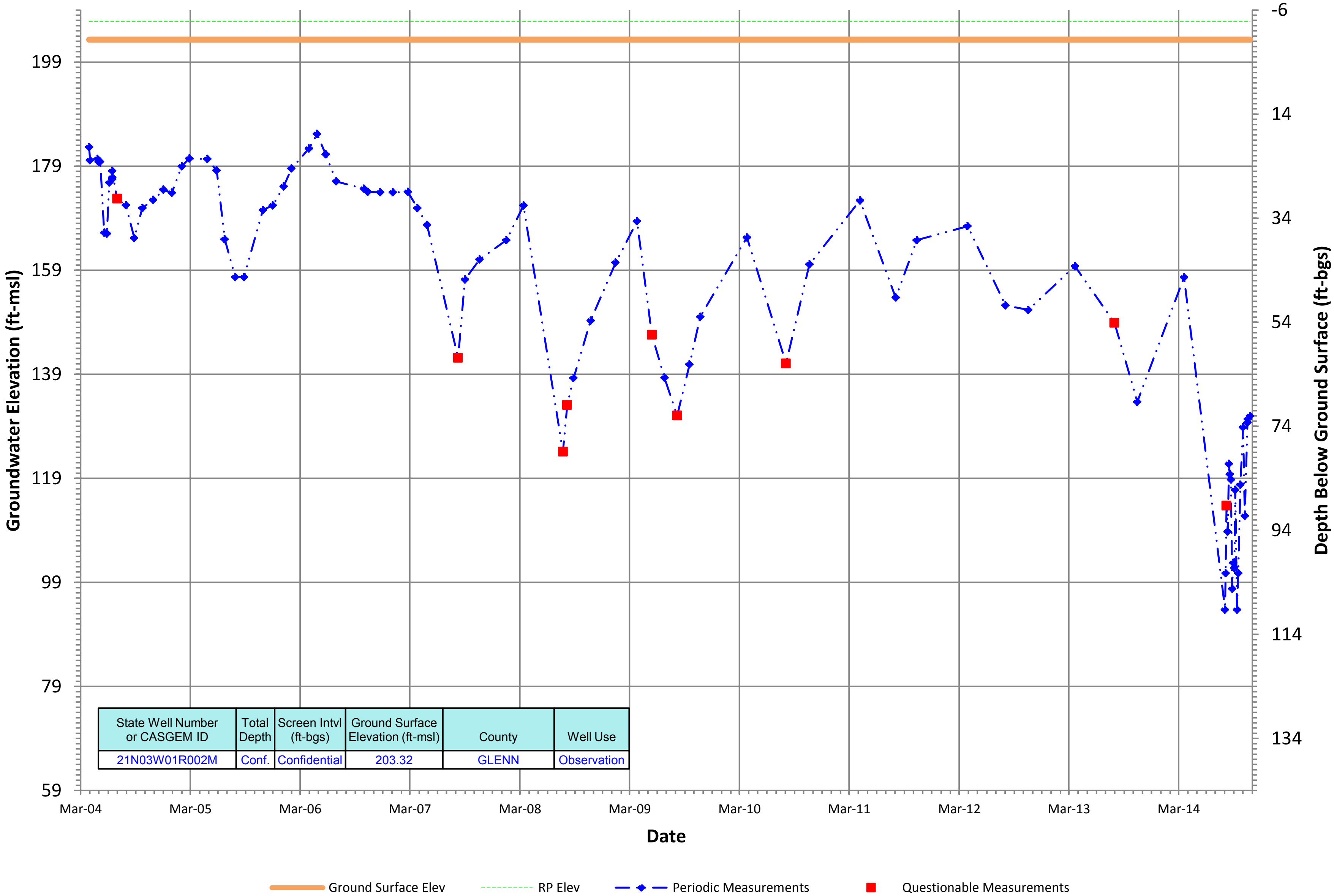
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W33M002M	Conf.	Confidential	149	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W33M003M	Conf.	Confidential	149	GLENN	Observation

21N03W01R002M
Period Of Record: 03/29/2004 to 10/24/2014

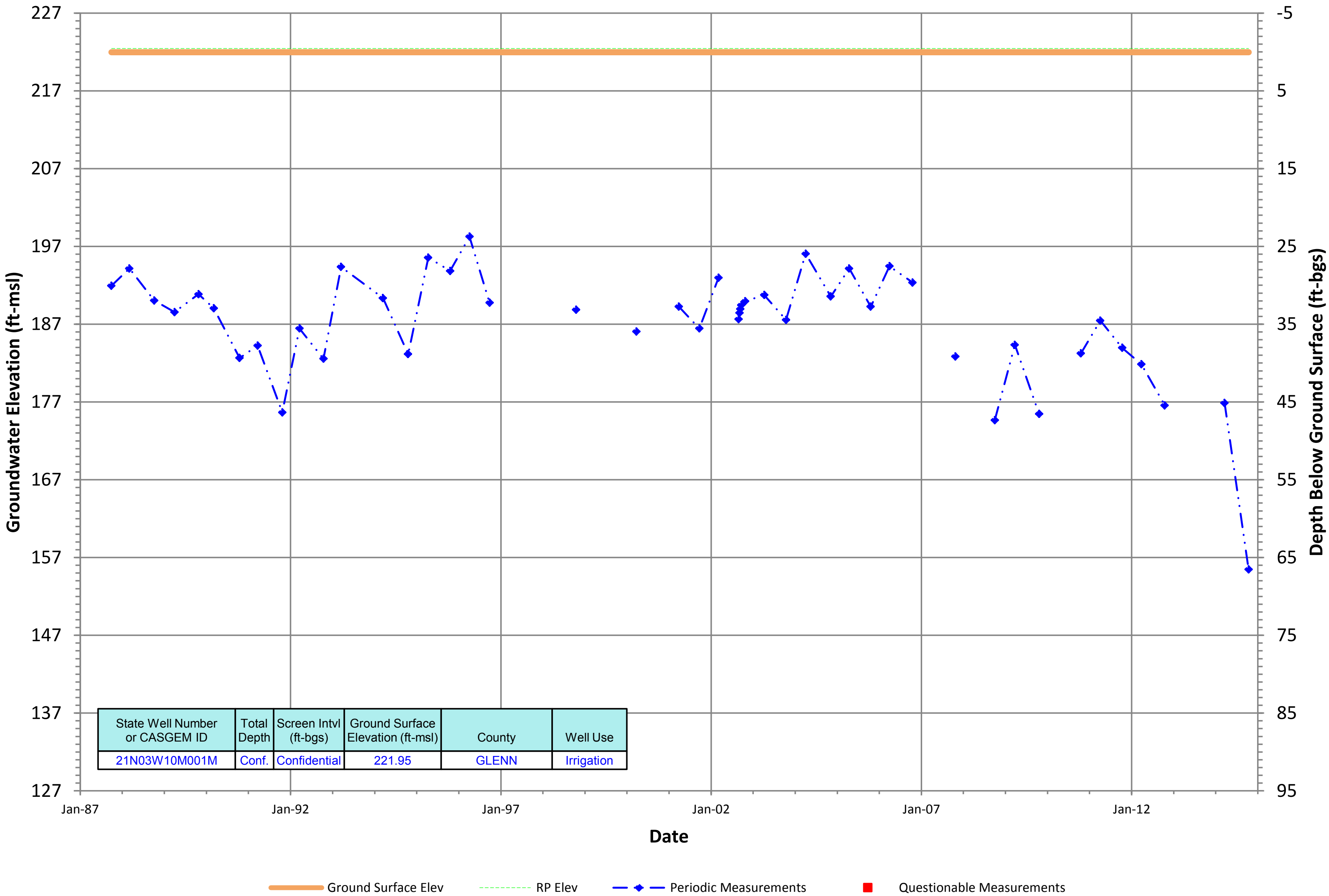
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



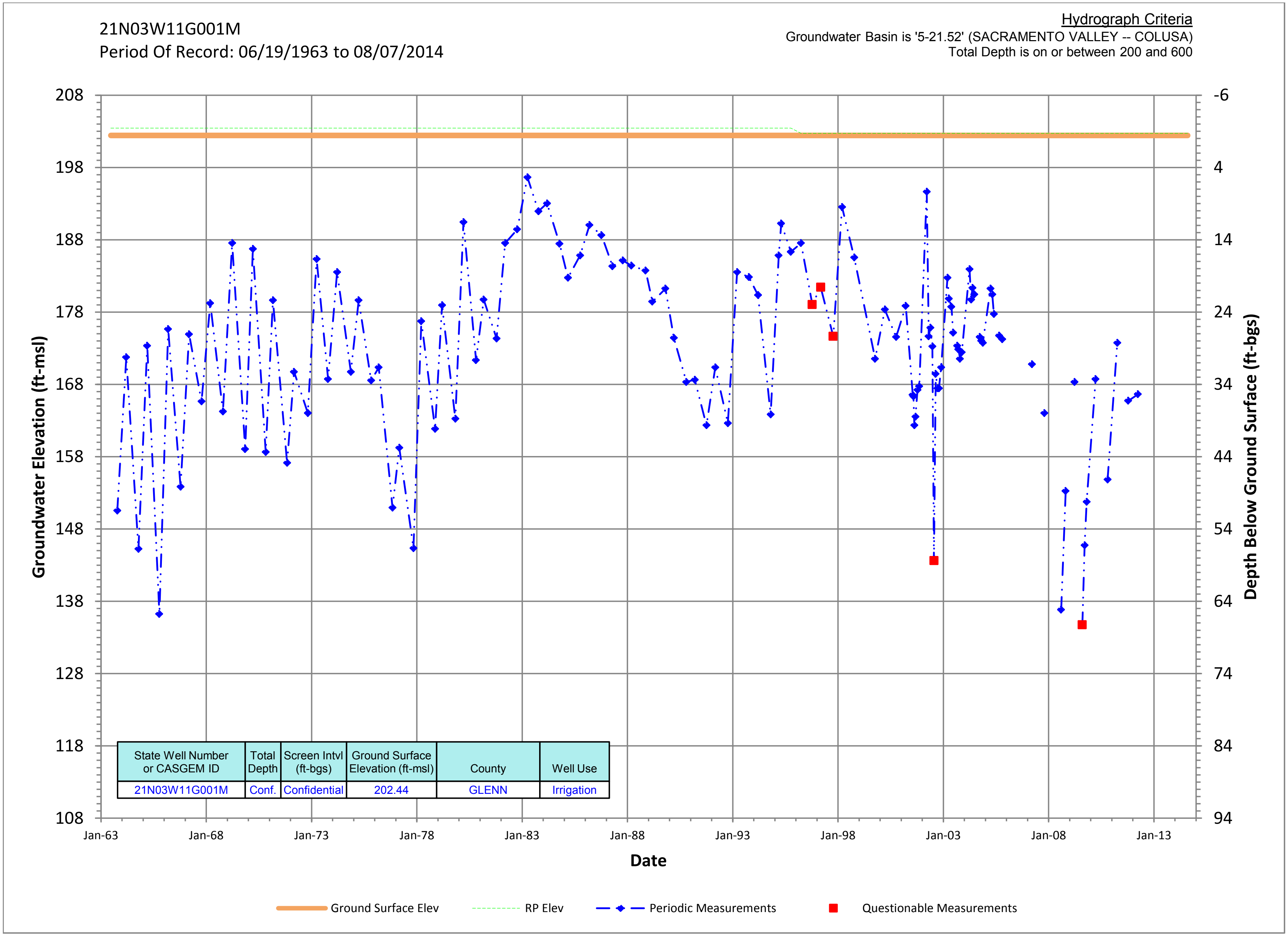
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W01R002M	Conf.	Confidential	203.32	GLENN	Observation

21N03W10M001M
Period Of Record: 09/29/1987 to 10/14/2014

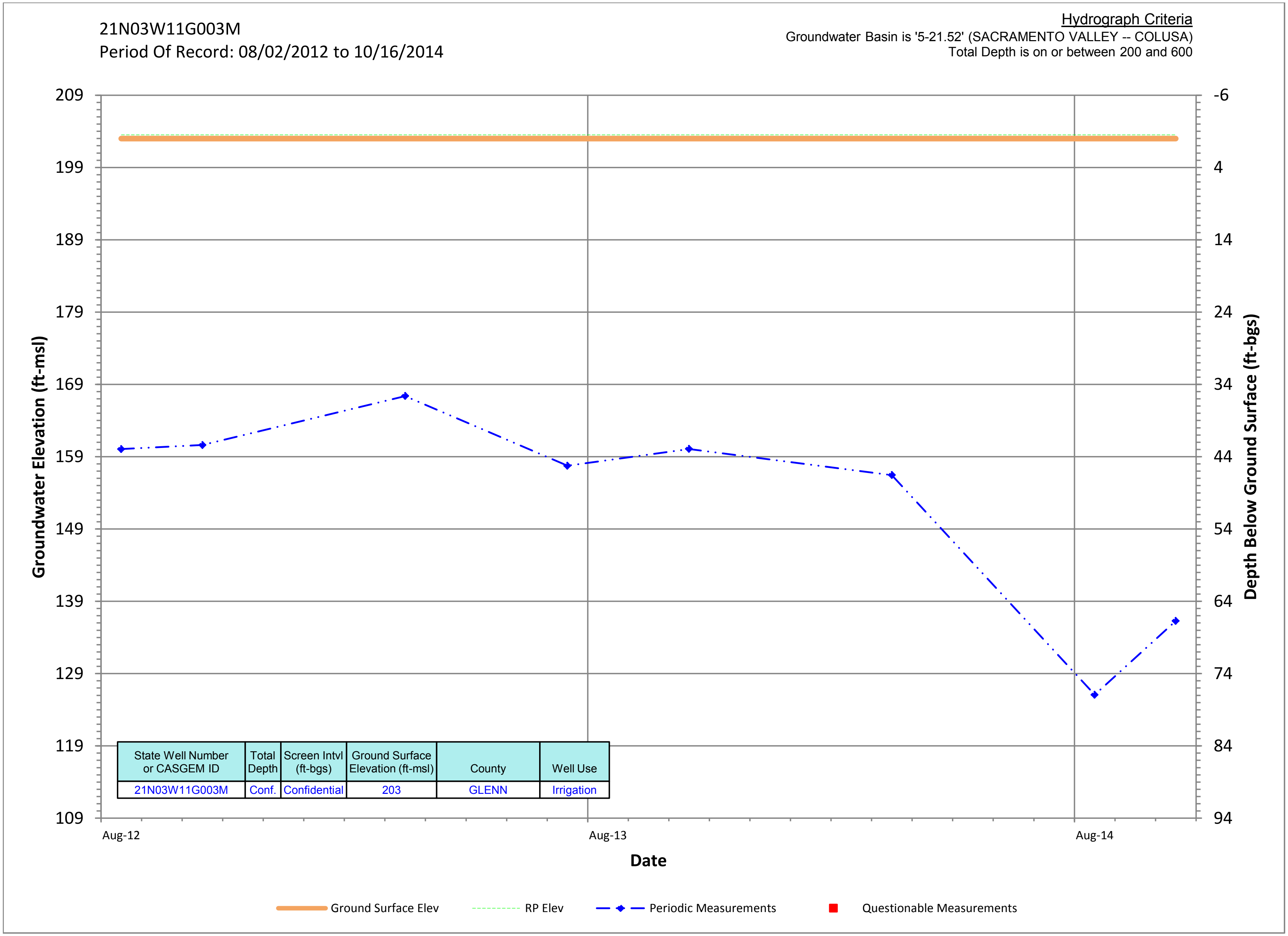
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



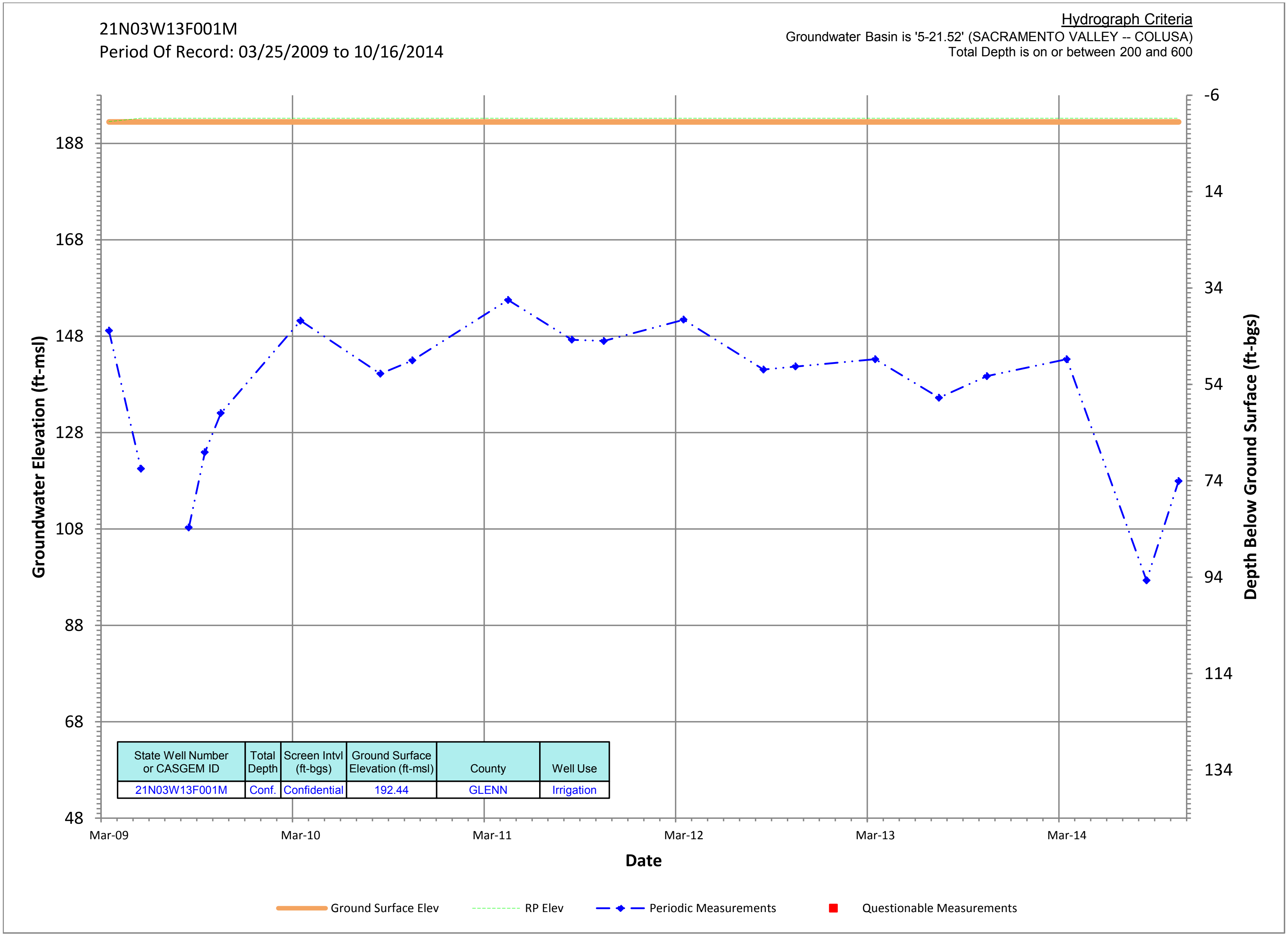
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W10M001M	Conf.	Confidential	221.95	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W11G001M	Conf.	Confidential	202.44	GLENN	Irrigation



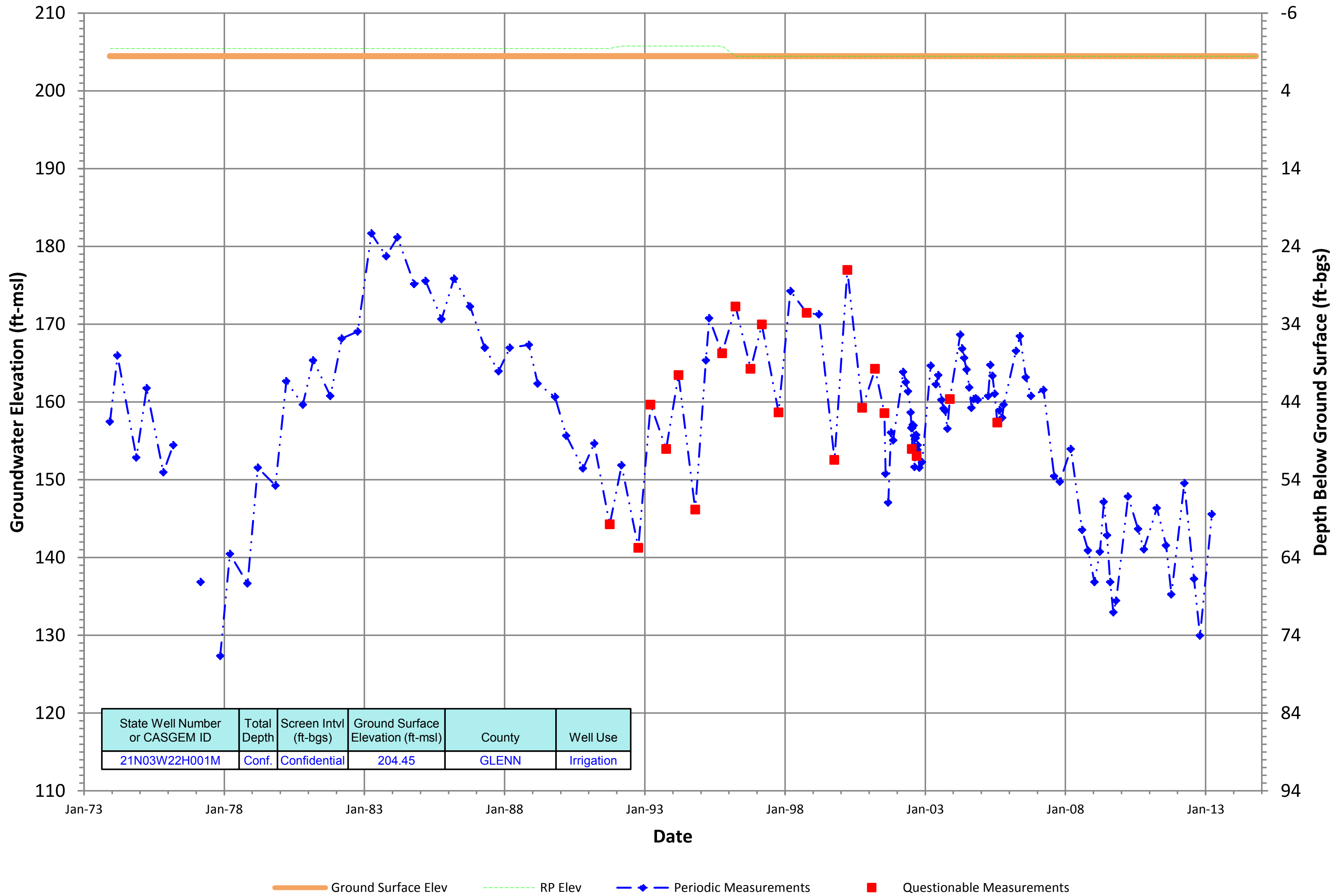
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W11G003M	Conf.	Confidential	203	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W13F001M	Conf.	Confidential	192.44	GLENN	Irrigation

21N03W22H001M
Period Of Record: 12/03/1973 to 10/16/2014

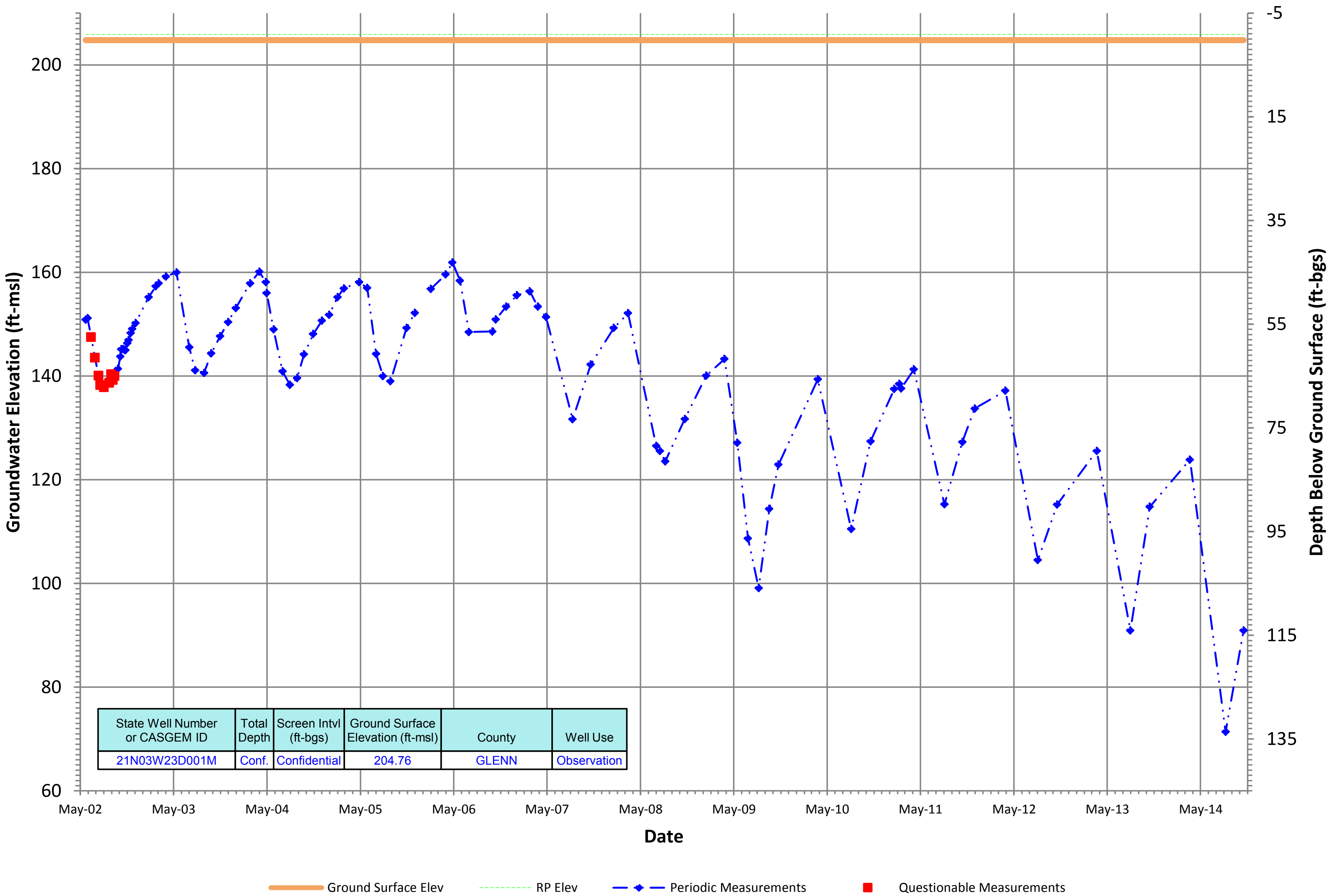
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



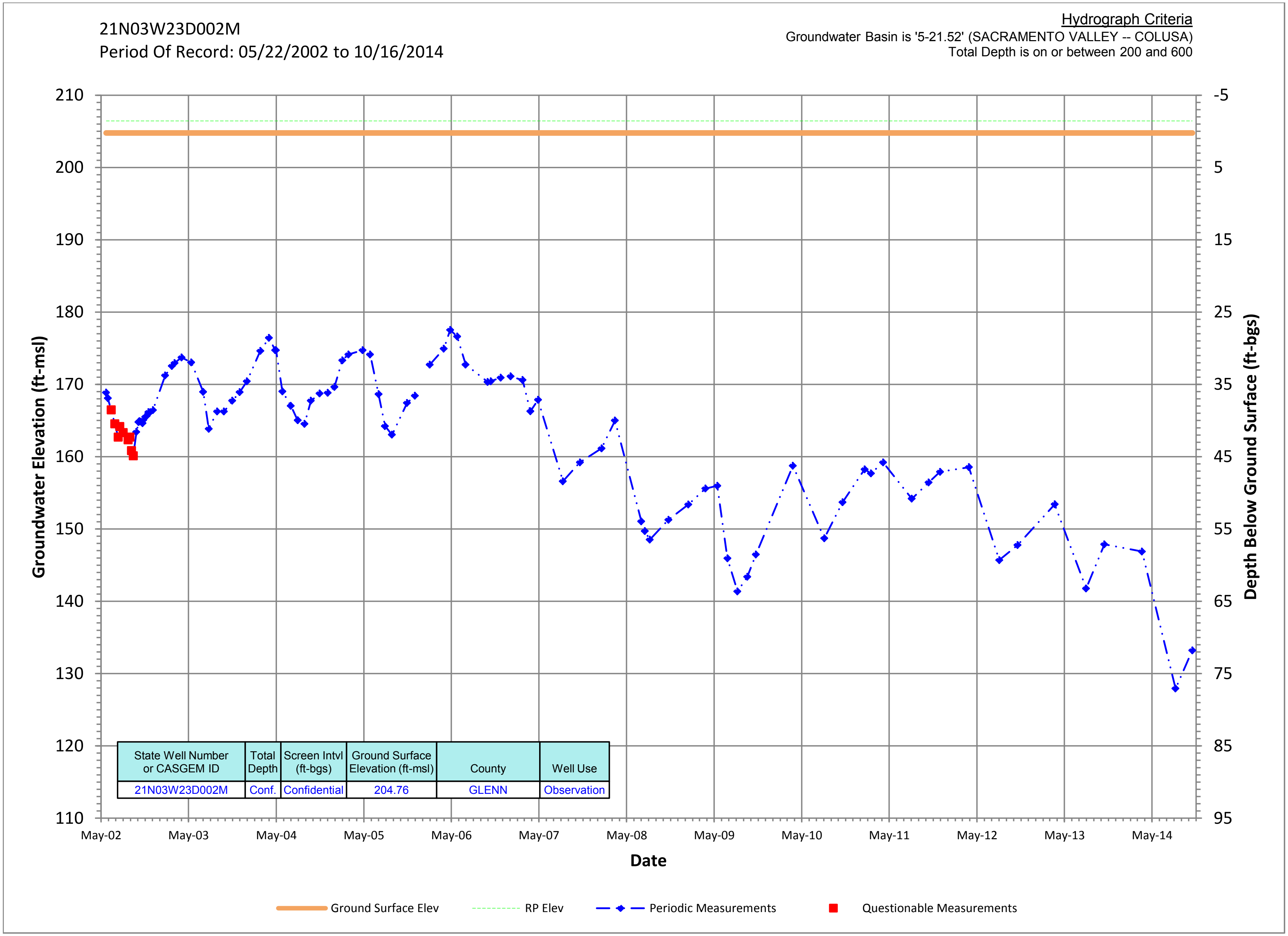
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W22H001M	Conf.	Confidential	204.45	GLENN	Irrigation

21N03W23D001M
Period Of Record: 05/22/2002 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W23D001M	Conf.	Confidential	204.76	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W23D002M	Conf.	Confidential	204.76	GLENN	Observation

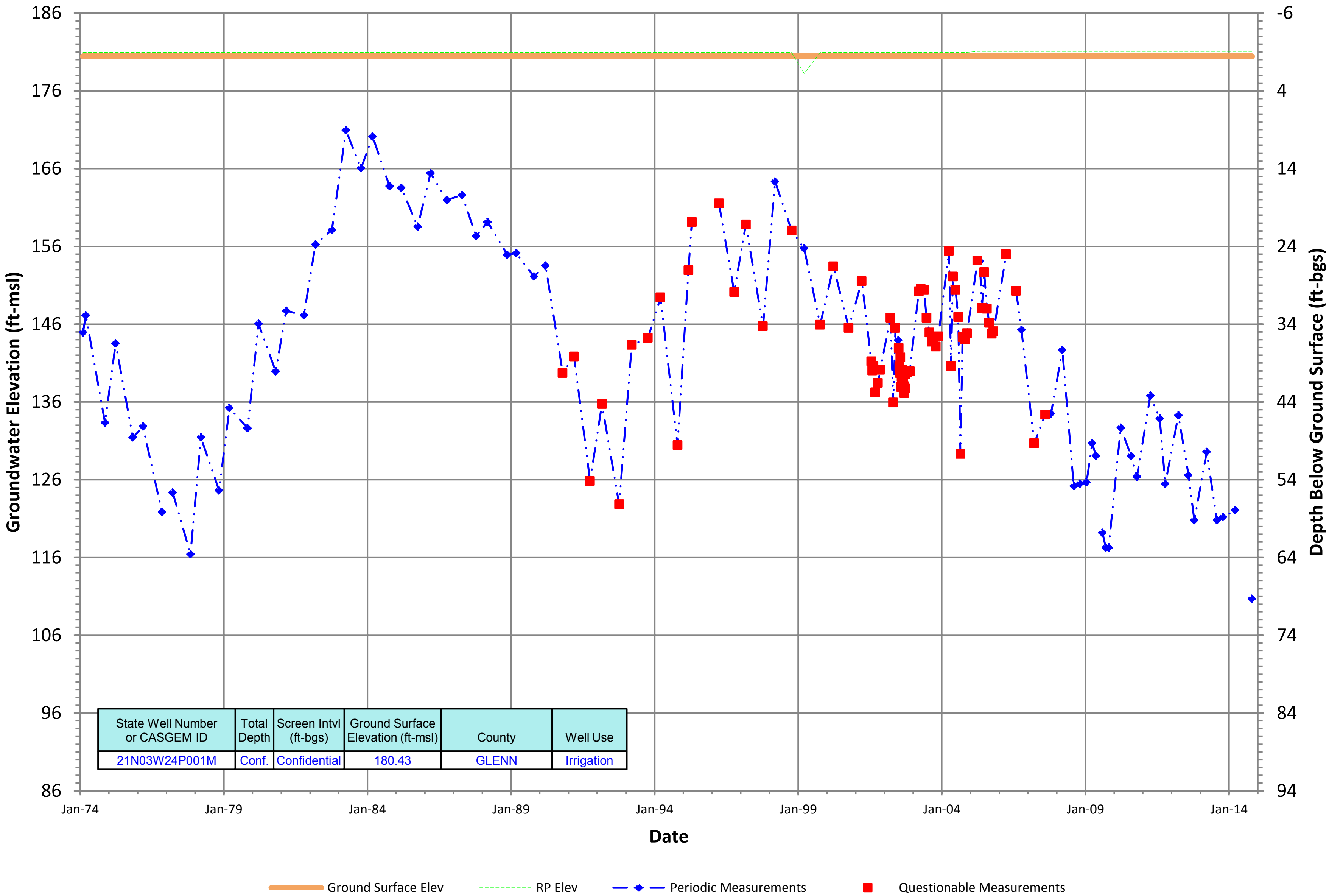
21N03W24P001M

Period Of Record: 02/05/1974 to 10/17/2014

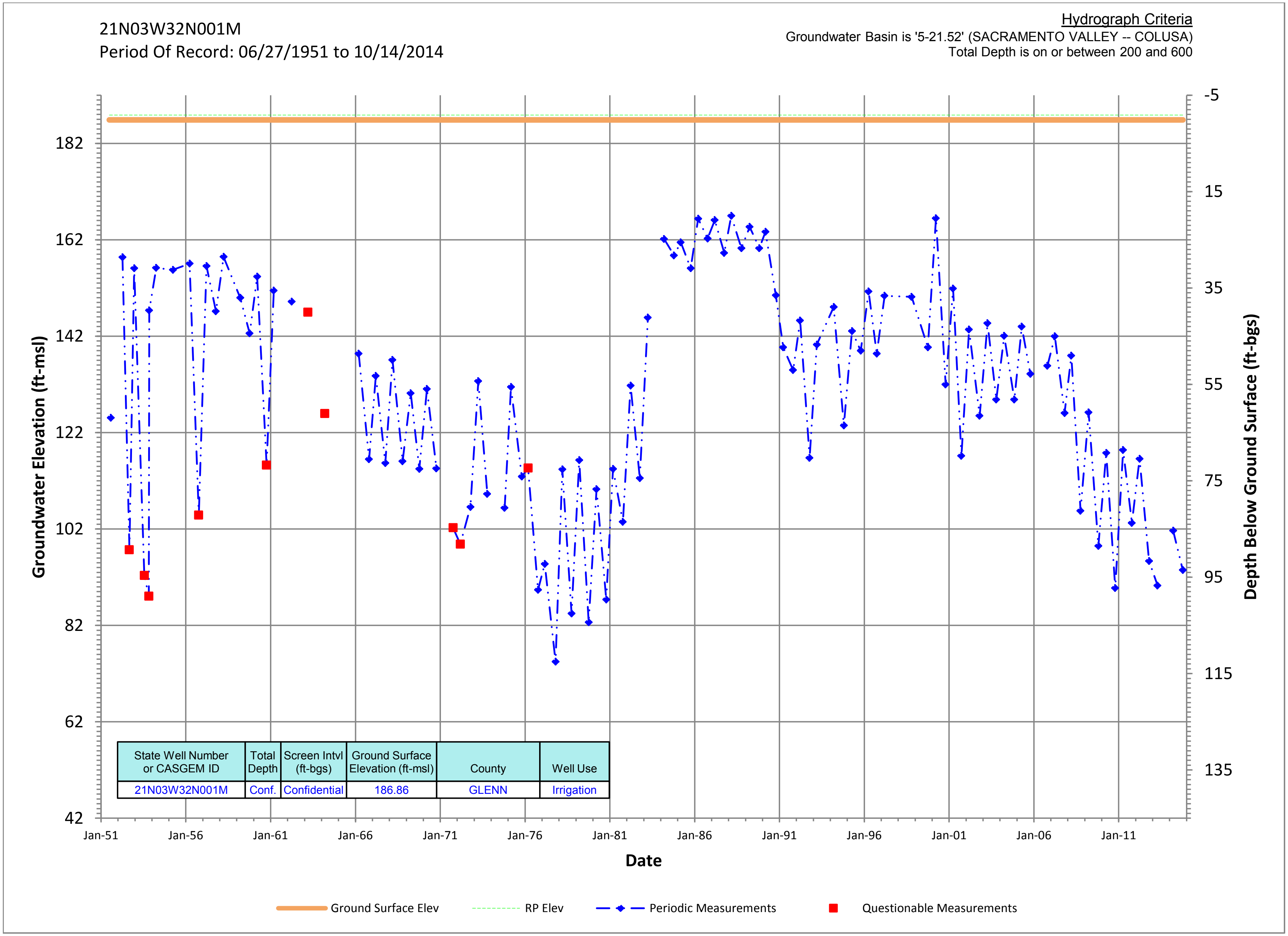
Hydrograph Criteria

Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)

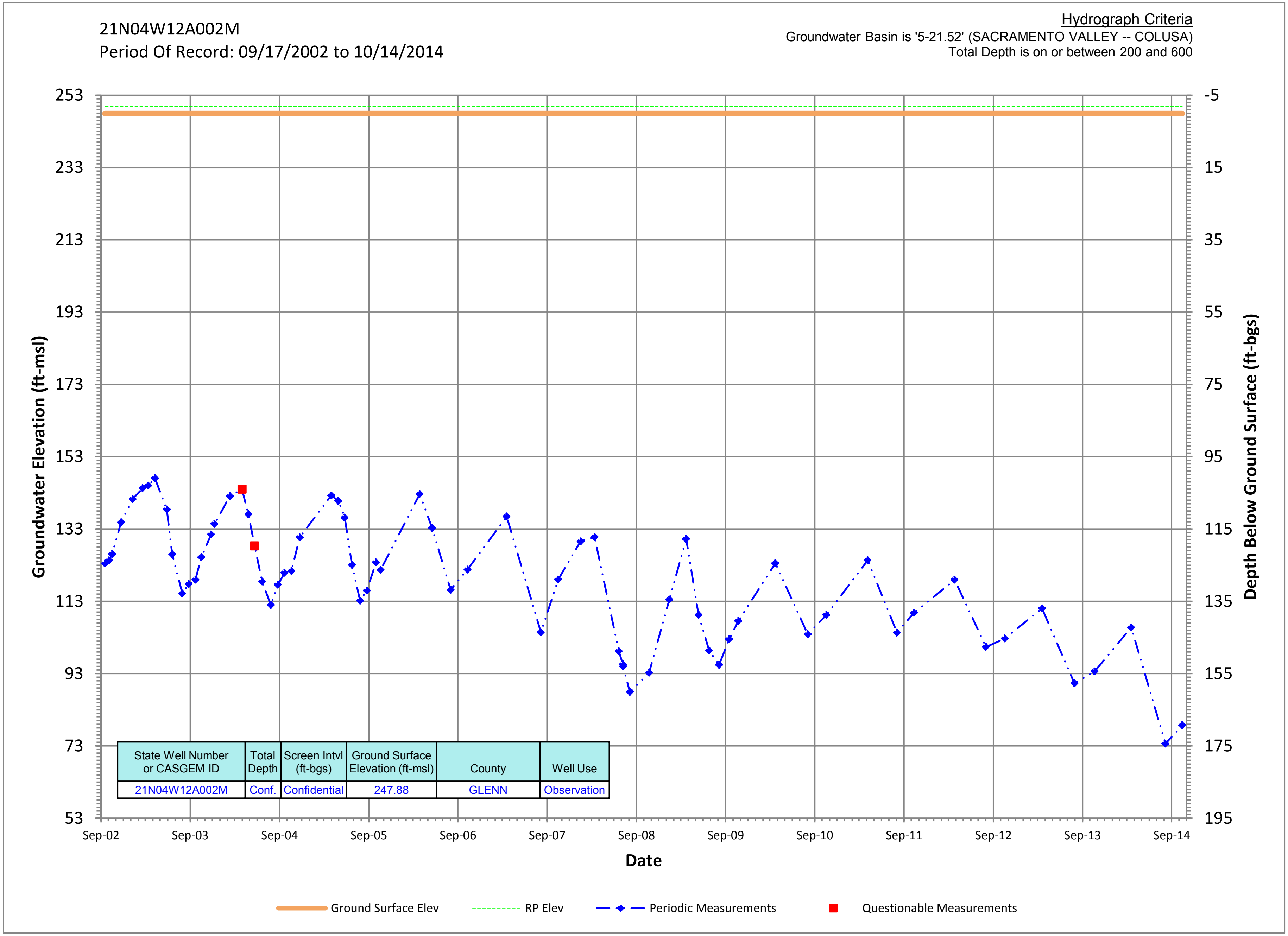
Total Depth is on or between 200 and 600



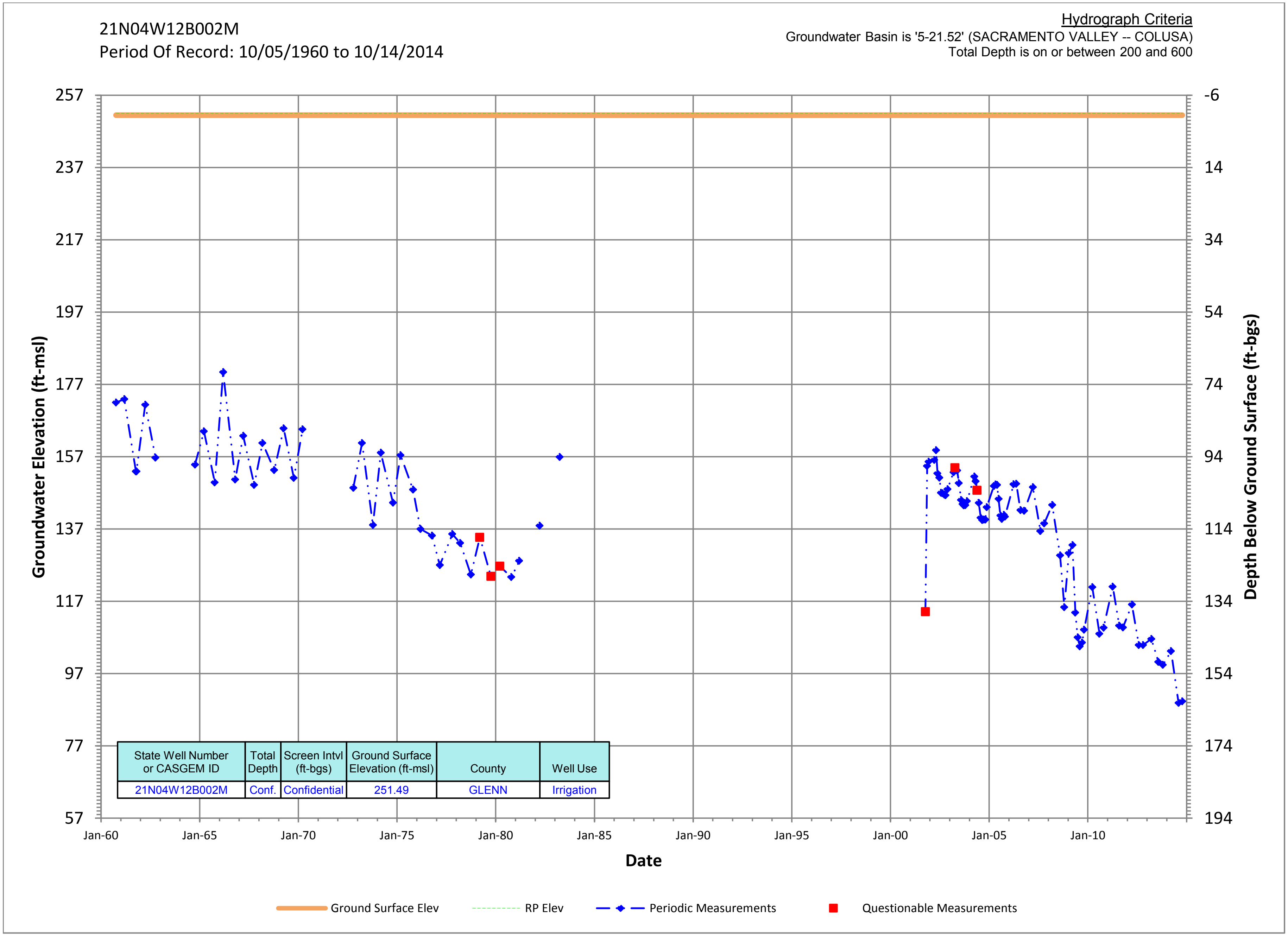
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W24P001M	Conf.	Confidential	180.43	GLENN	Irrigation



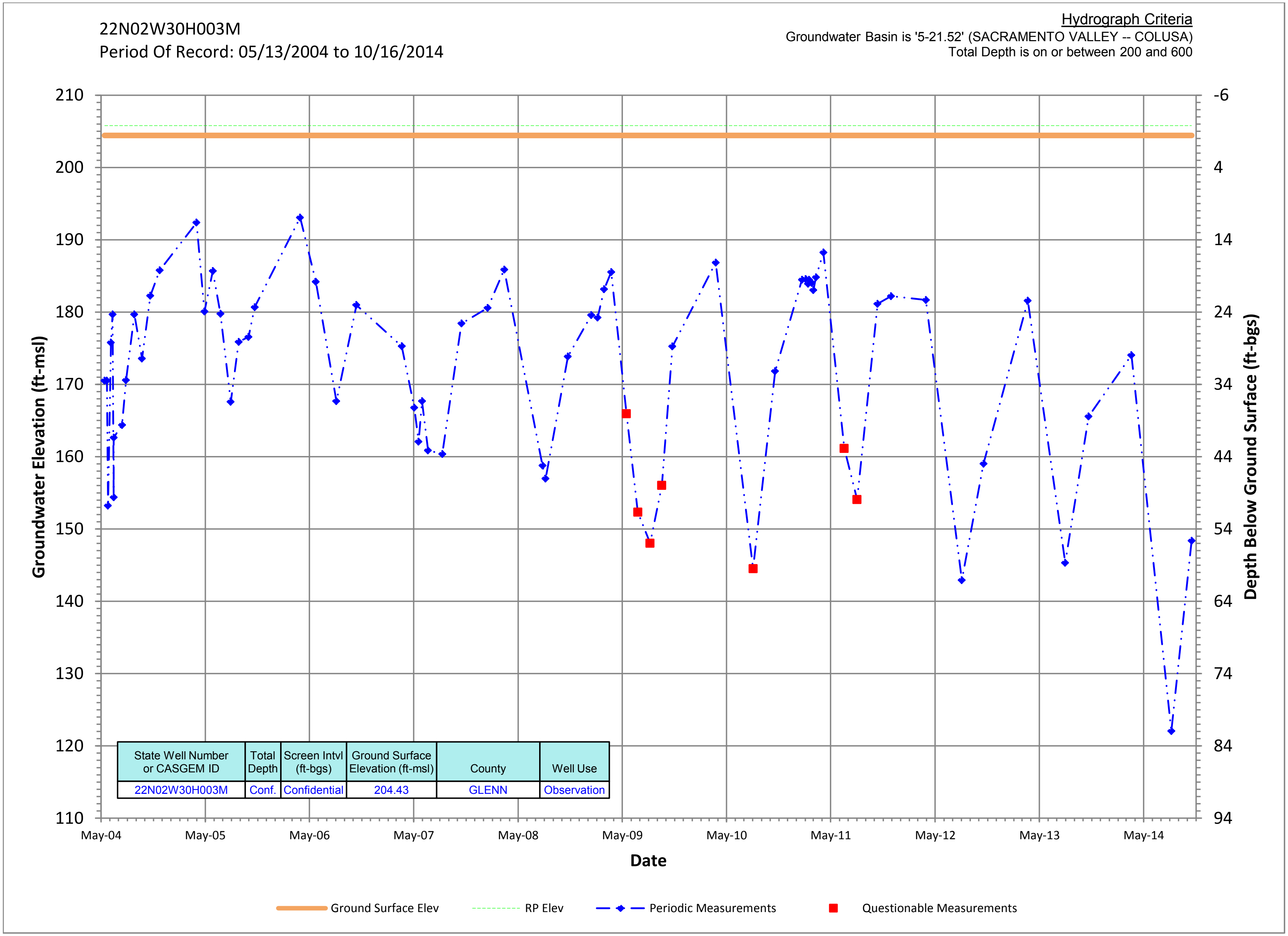
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W32N001M	Conf.	Confidential	186.86	GLENN	Irrigation



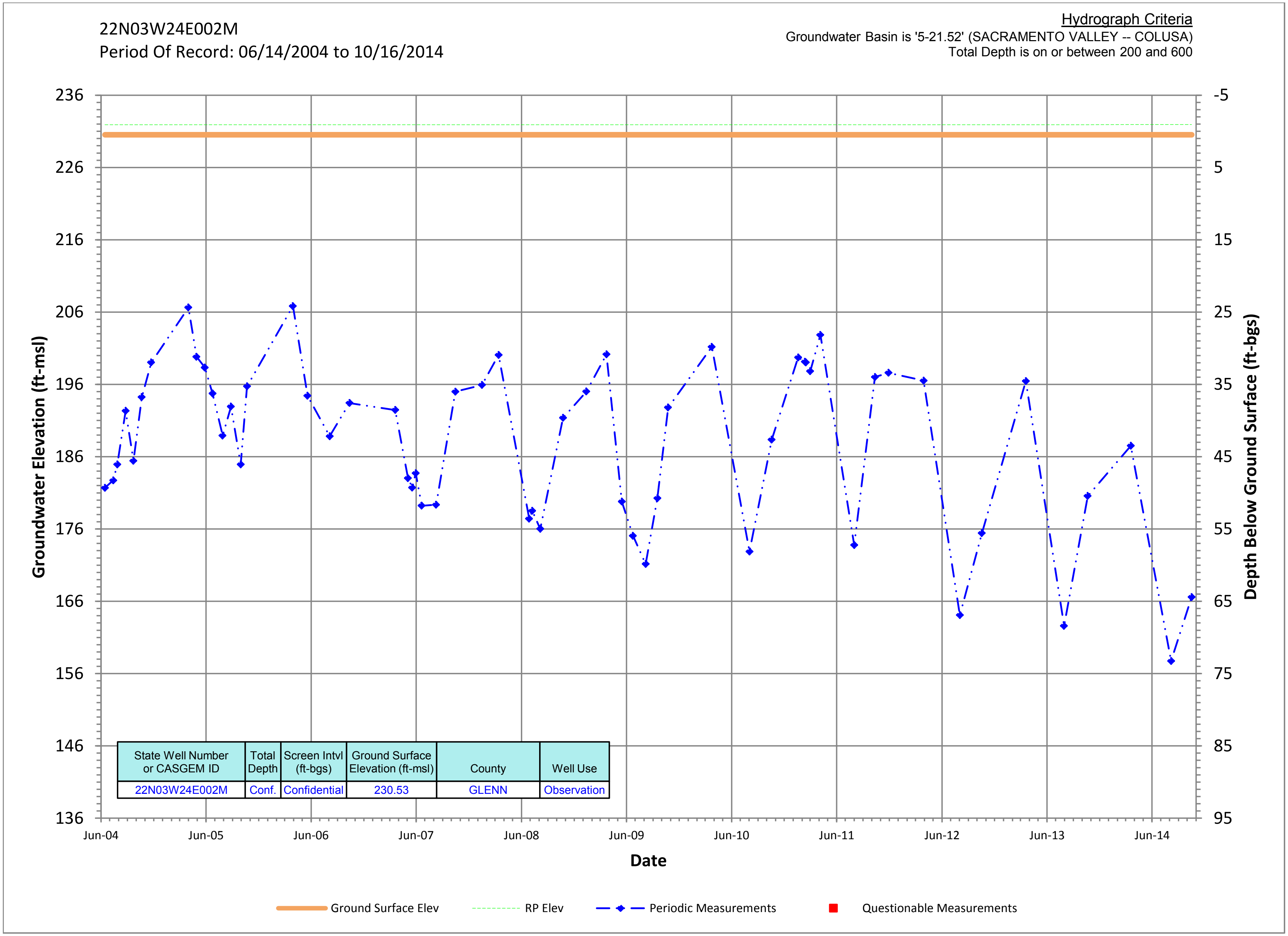
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N04W12A002M	Conf.	Confidential	247.88	GLENN	Observation

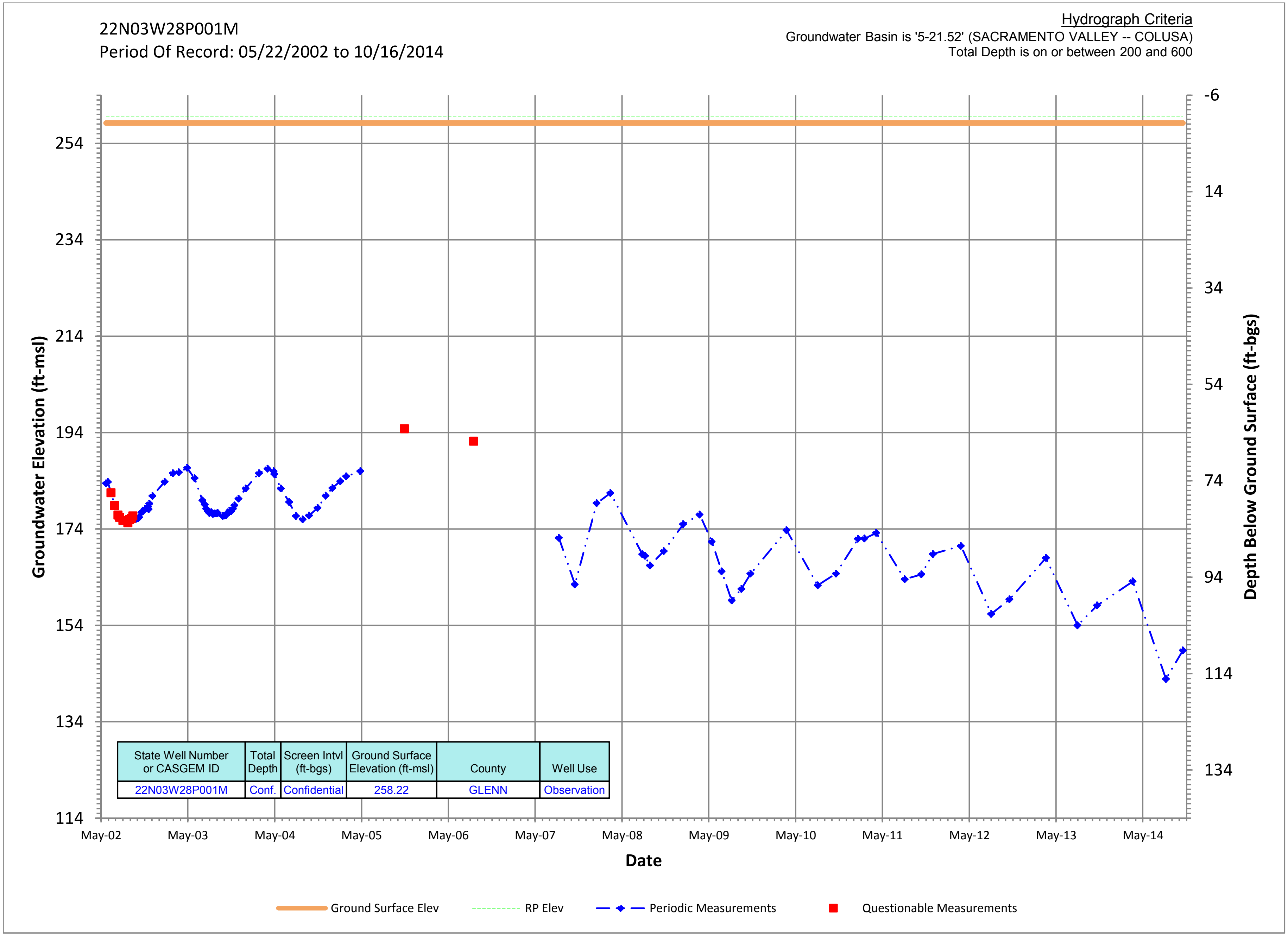


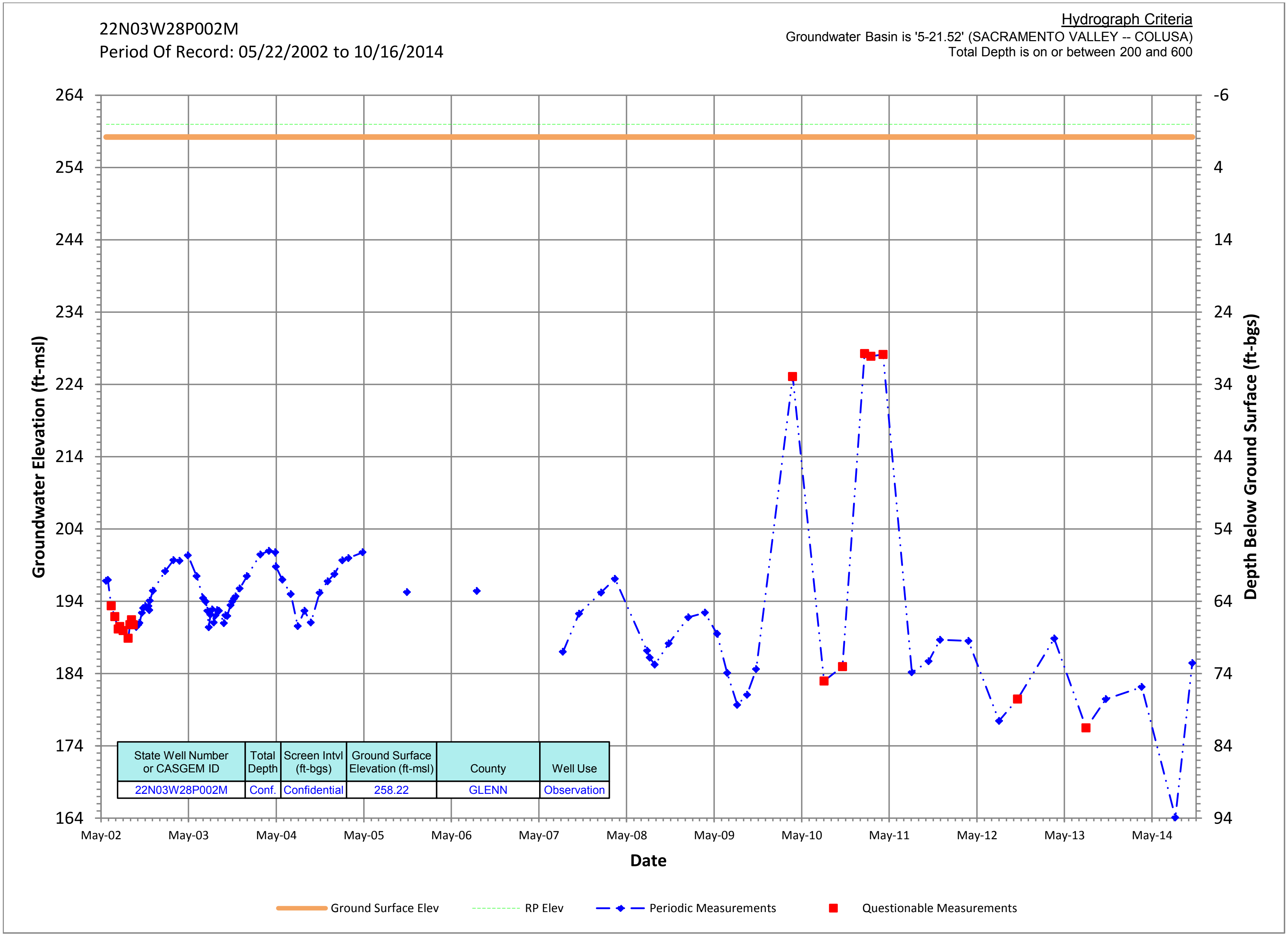
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N04W12B002M	Conf.	Confidential	251.49	GLENN	Irrigation



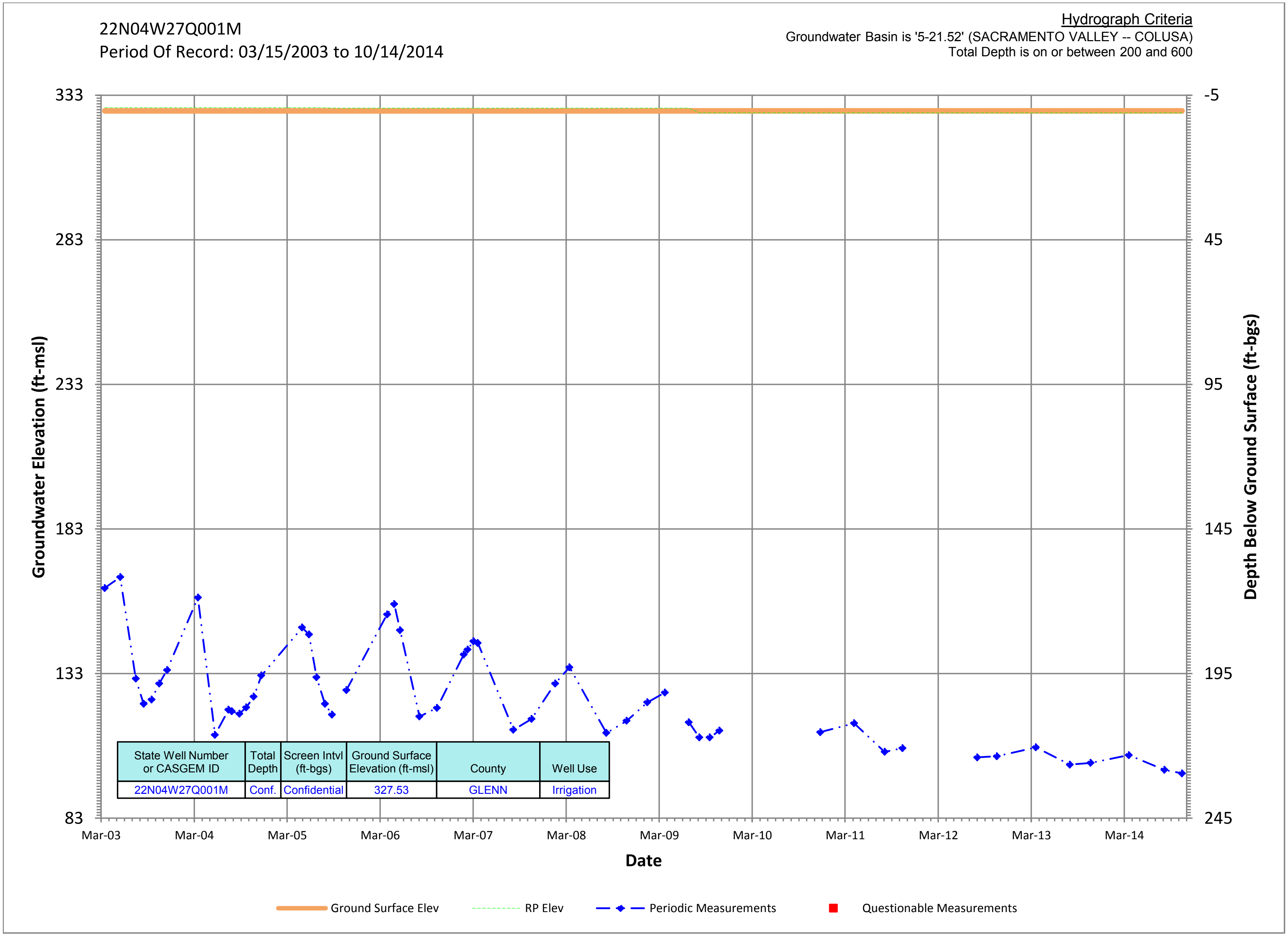
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W30H003M	Conf.	Confidential	204.43	GLENN	Observation


22N03W24E002M
Period Of Record: 06/14/2004 to 10/16/2014
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
236
226
216
206
196
186
176
166
156
146
136
-5
5
15
25
35
45
55
65
75
85
95
Jun-04
Jun-05
Jun-06
Jun-07
Jun-08
Jun-09
Jun-10
Jun-11
Jun-12
Jun-13
Jun-14
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
22N03W24E002M
Conf.
Confidential
230.53
GLENN
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements


22N03W28P001M
Period Of Record: 05/22/2002 to 10/16/2014
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
254
234
214
194
174
154
134
114
Depth Below Ground Surface (ft-bgs)
-6
14
34
54
74
94
114
134
May-02
May-03
May-04
May-05
May-06
May-07
May-08
May-09
May-10
May-11
May-12
May-13
May-14
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
22N03W28P001M
Conf.
Confidential
258.22
GLENN
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W28P002M	Conf.	Confidential	258.22	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N04W27Q001M	Conf.	Confidential	327.53	GLENN	Irrigation

Deep Groundwater Monitoring Well Hydrographs- Colusa Subbasin

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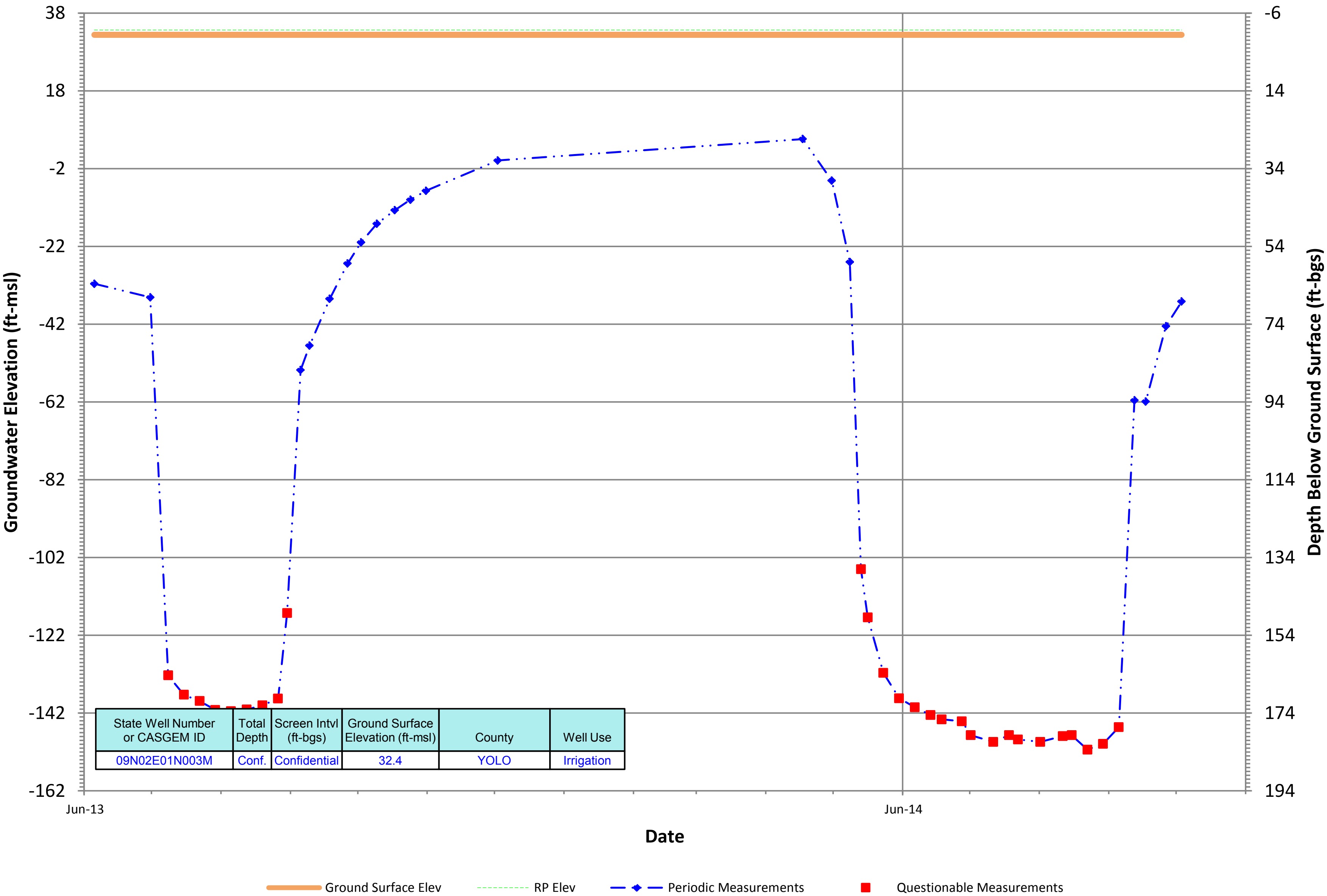
09N02E01N003M
Period Of Record: 06/05/2013 to 10/03/2014

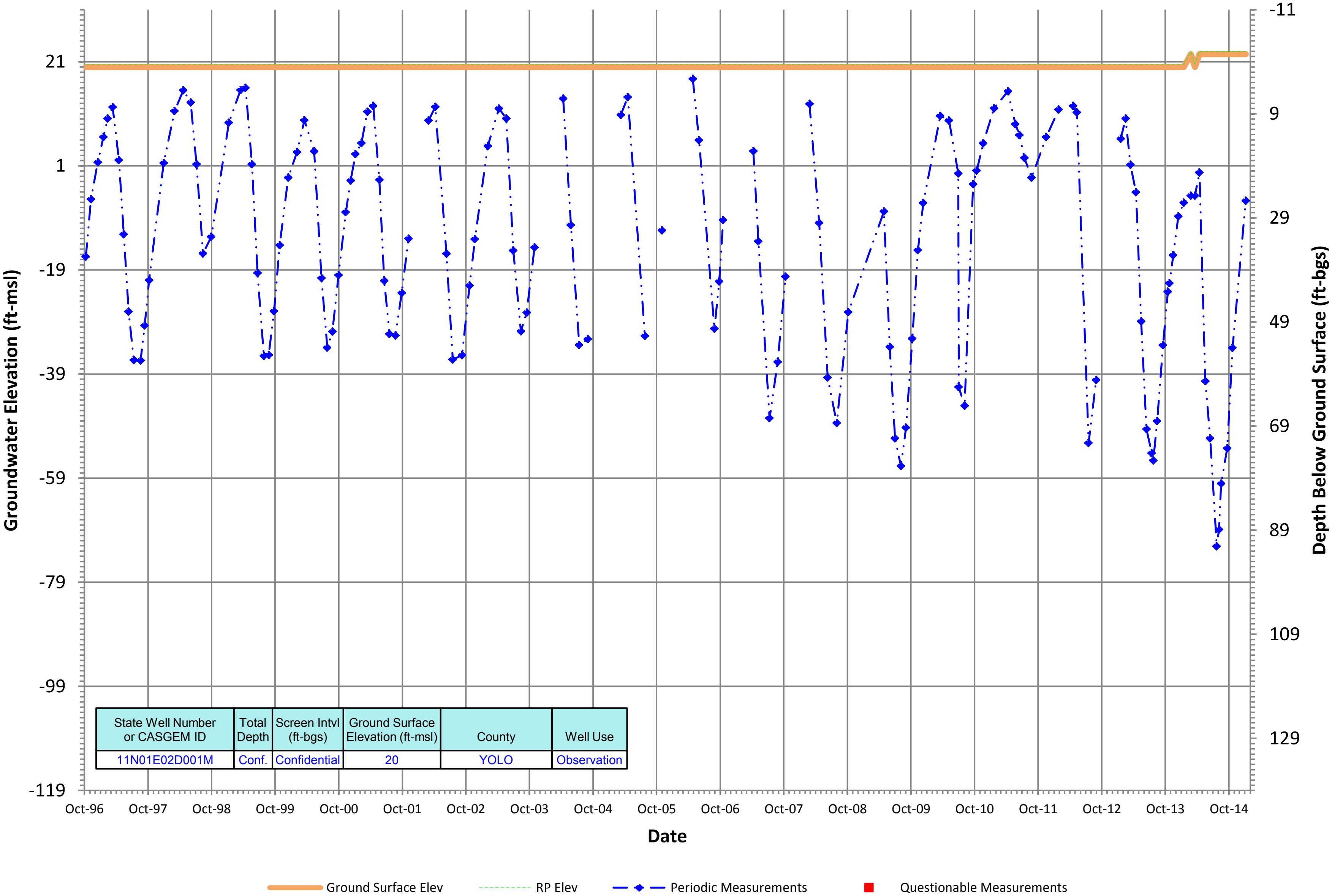
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



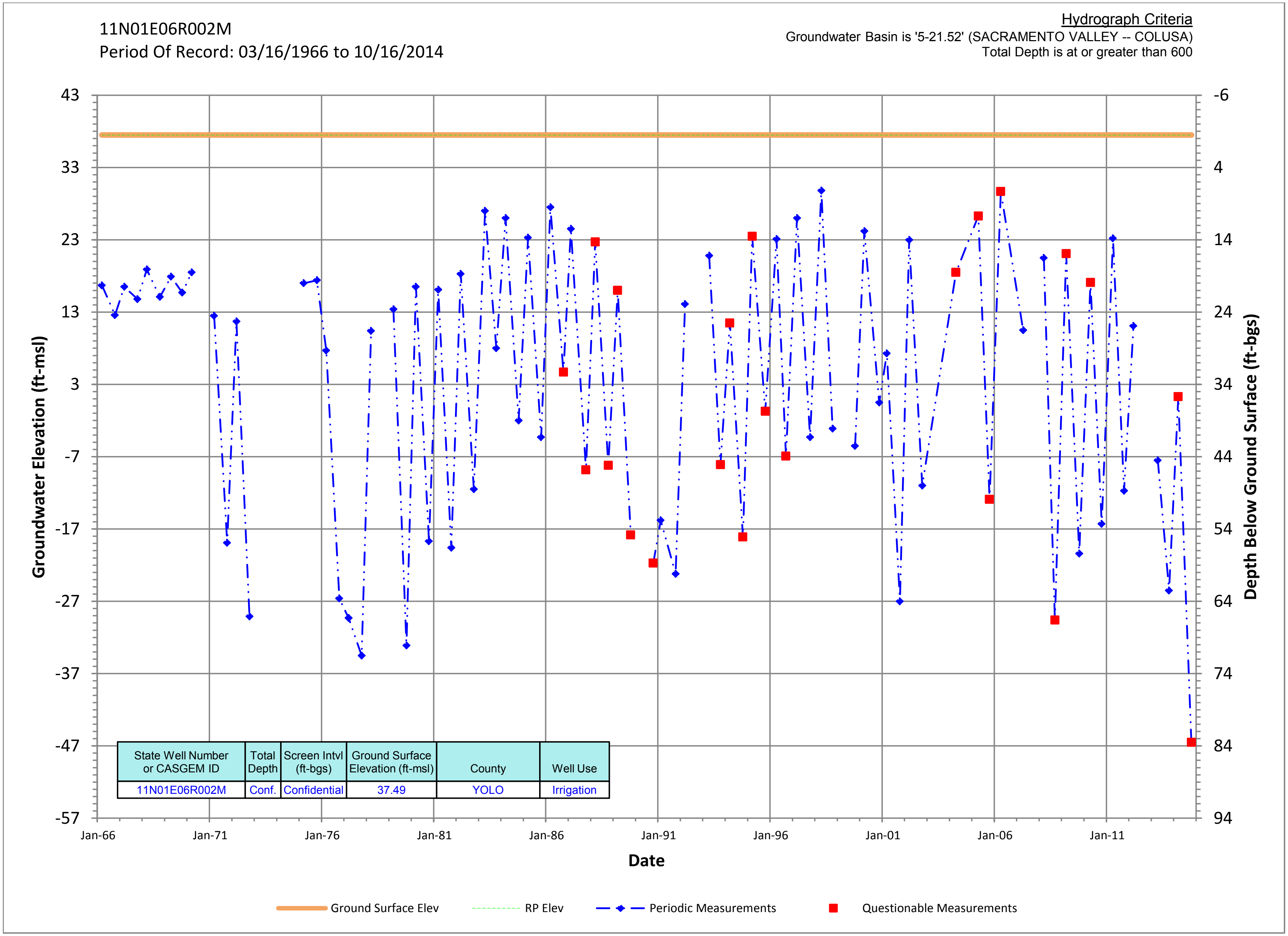
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E01N003M	Conf.	Confidential	32.4	YOLO	Irrigation

11N01E02D001M
Period Of Record: 10/08/1996 to 01/06/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



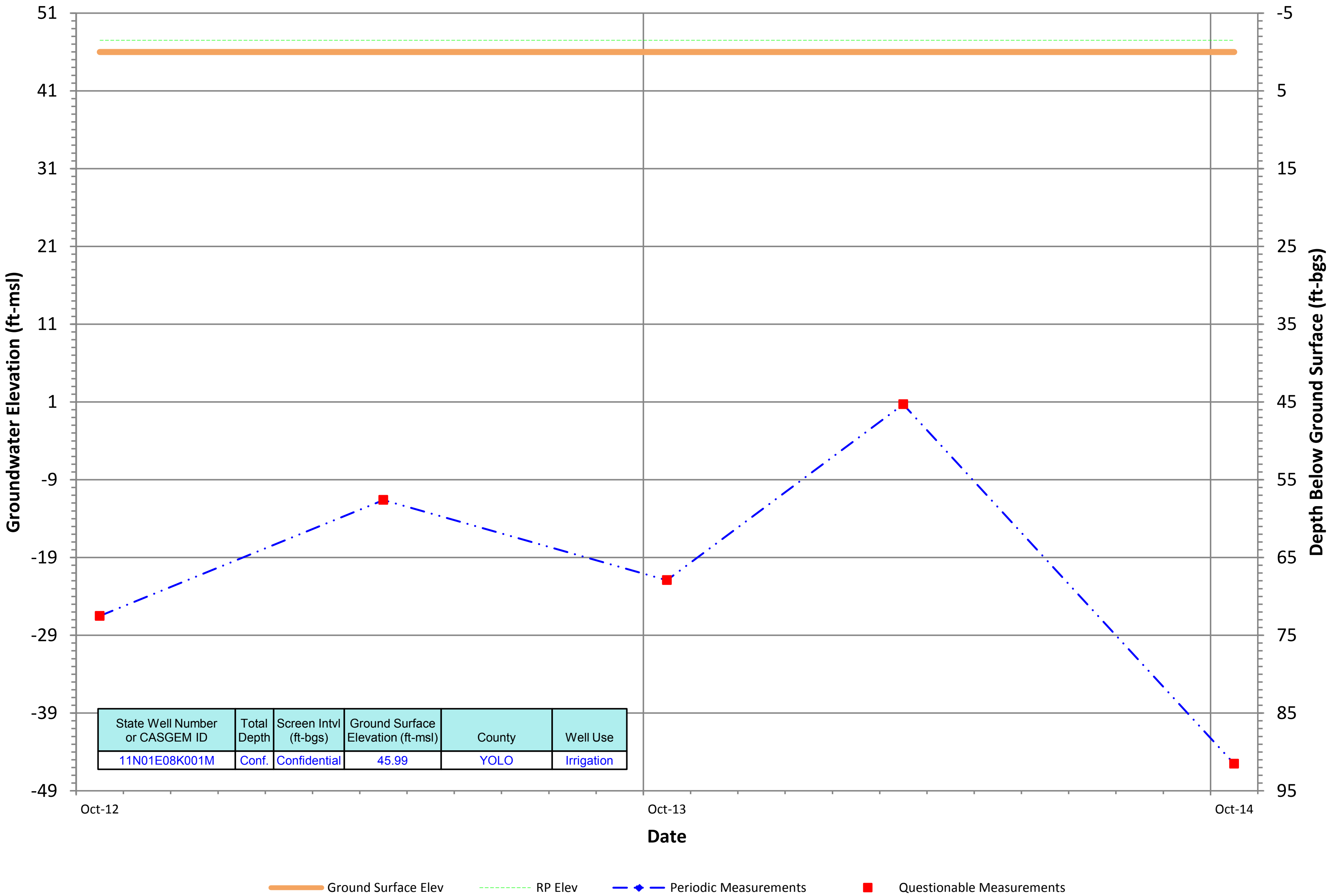
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E02D001M	Conf.	Confidential	20	YOLO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E06R002M	Conf.	Confidential	37.49	YOLO	Irrigation

11N01E08K001M
Period Of Record: 10/17/2012 to 10/16/2014

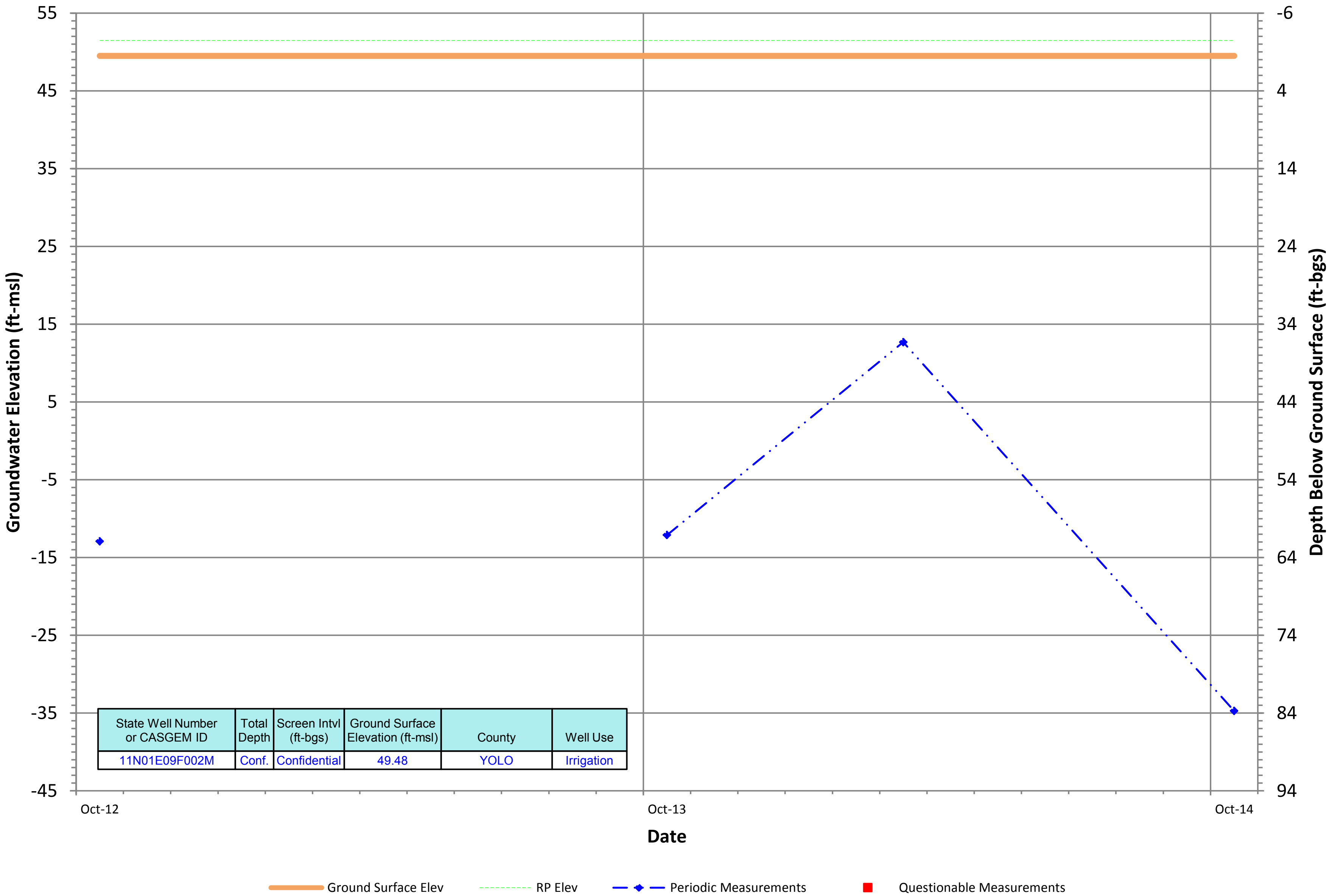
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E08K001M	Conf.	Confidential	45.99	YOLO	Irrigation

11N01E09F002M
Period Of Record: 10/17/2012 to 10/16/2014

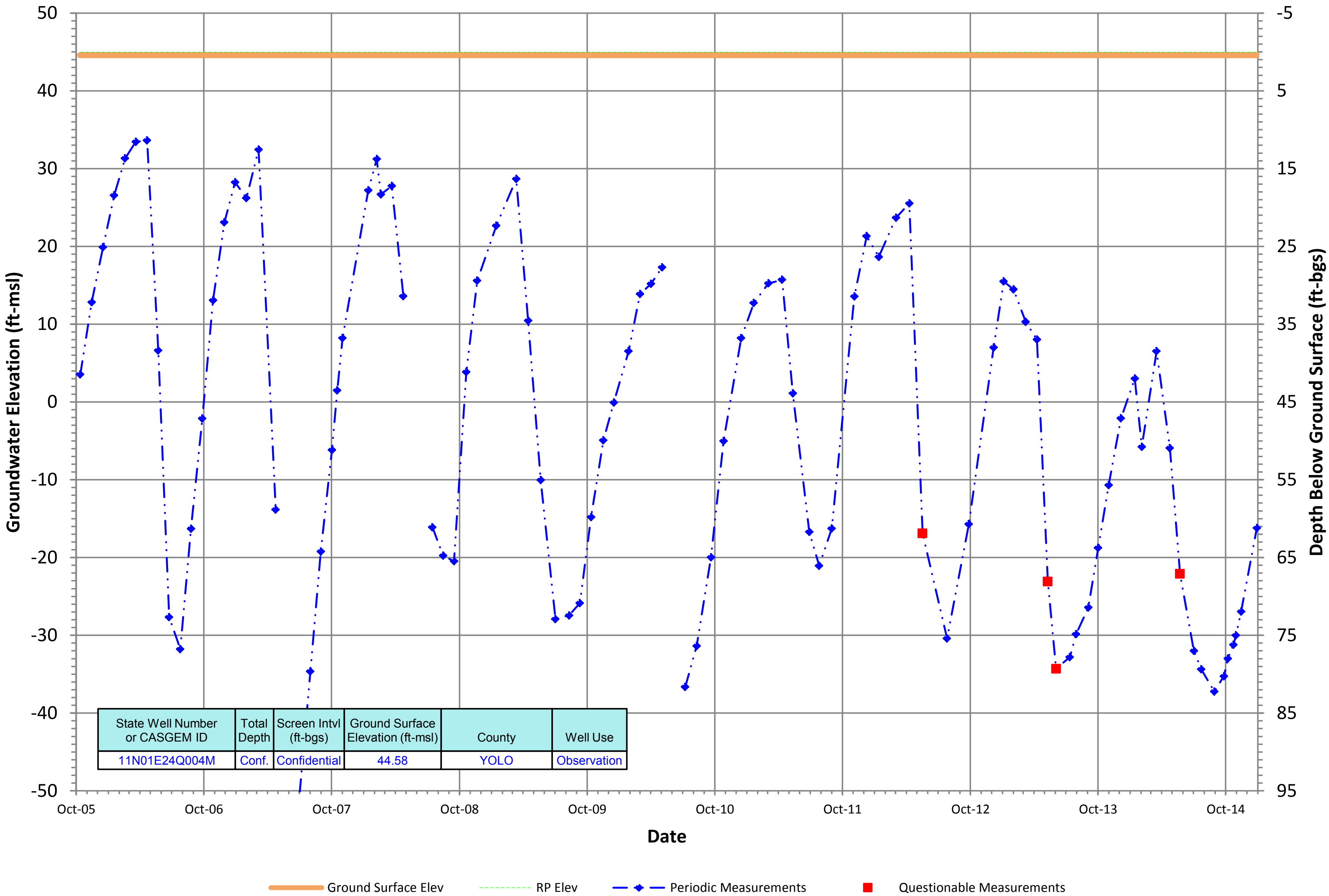
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E09F002M	Conf.	Confidential	49.48	YOLO	Irrigation

11N01E24Q004M
Period Of Record: 10/12/2005 to 12/29/2014

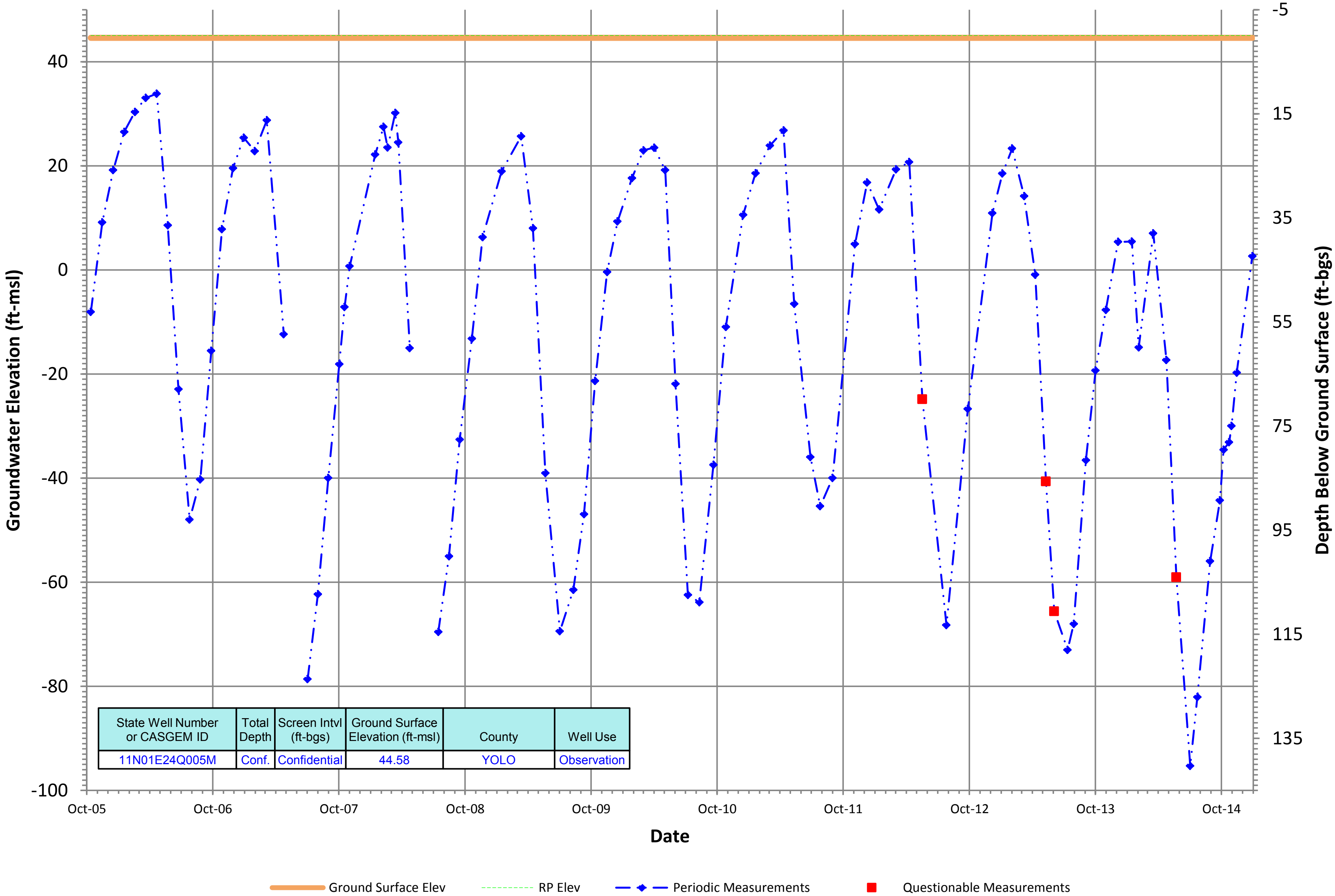
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



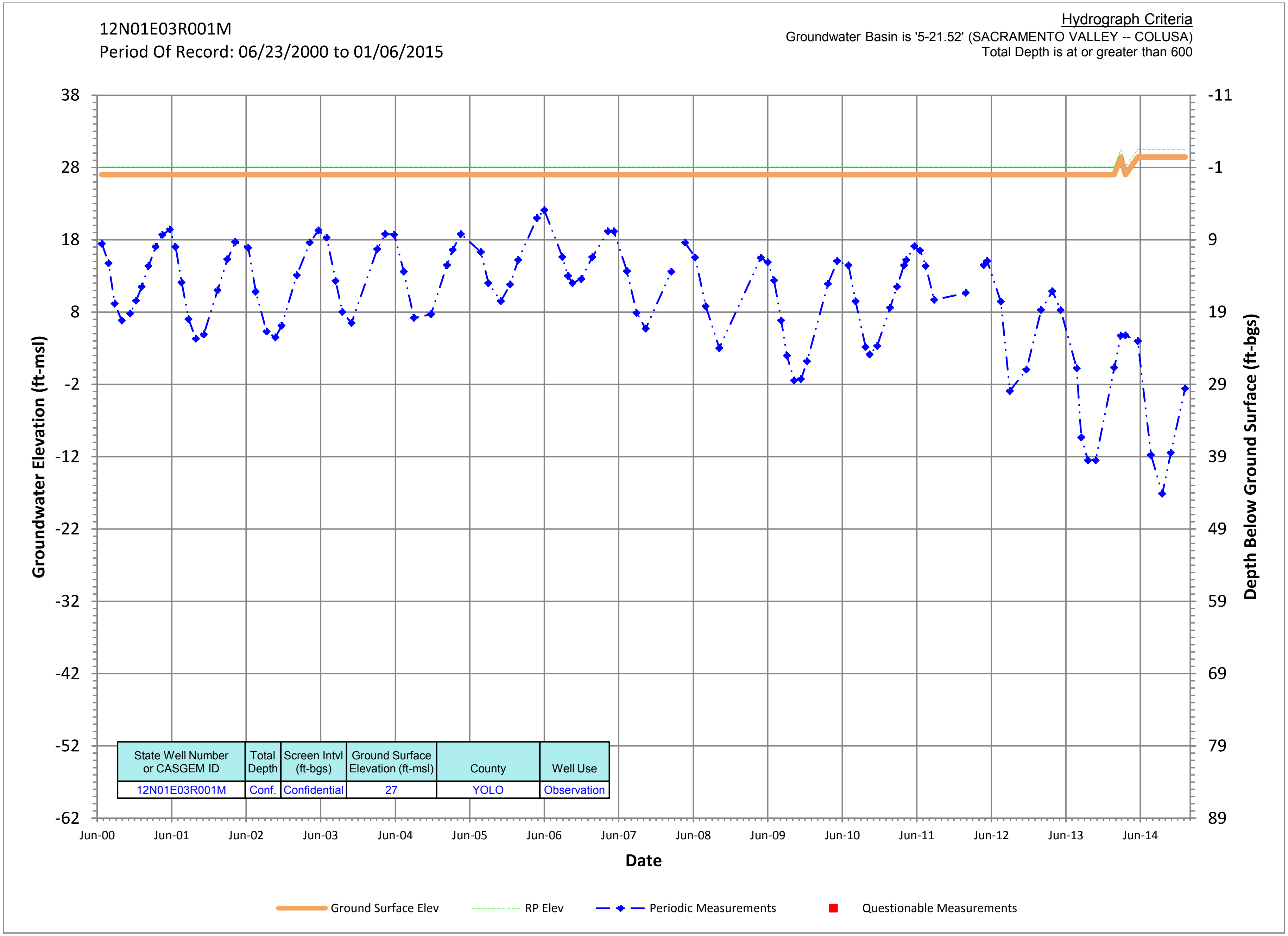
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E24Q004M	Conf.	Confidential	44.58	YOLO	Observation

11N01E24Q005M
Period Of Record: 10/12/2005 to 12/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



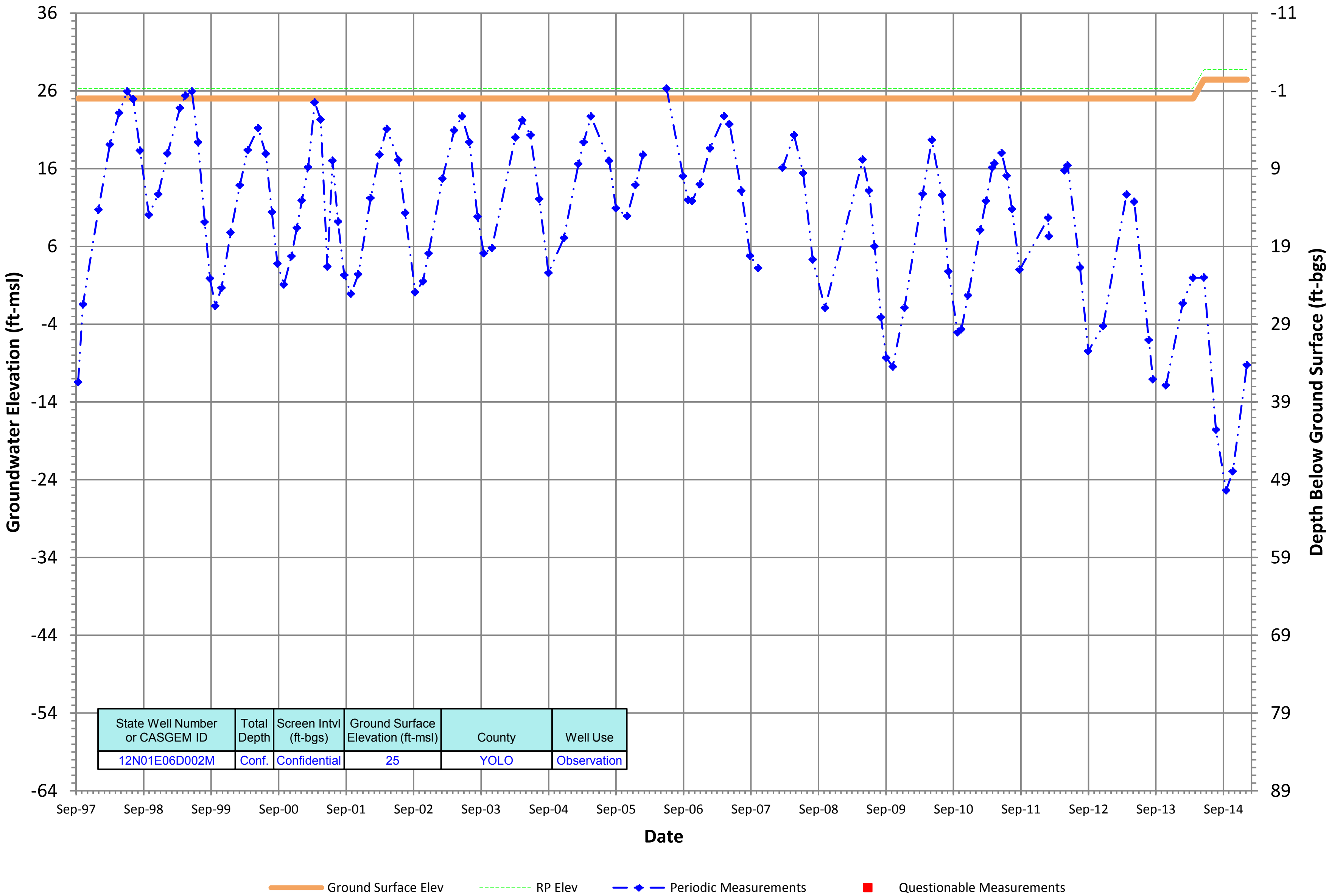
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N01E24Q005M	Conf.	Confidential	44.58	YOLO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E03R001M	Conf.	Confidential	27	YOLO	Observation

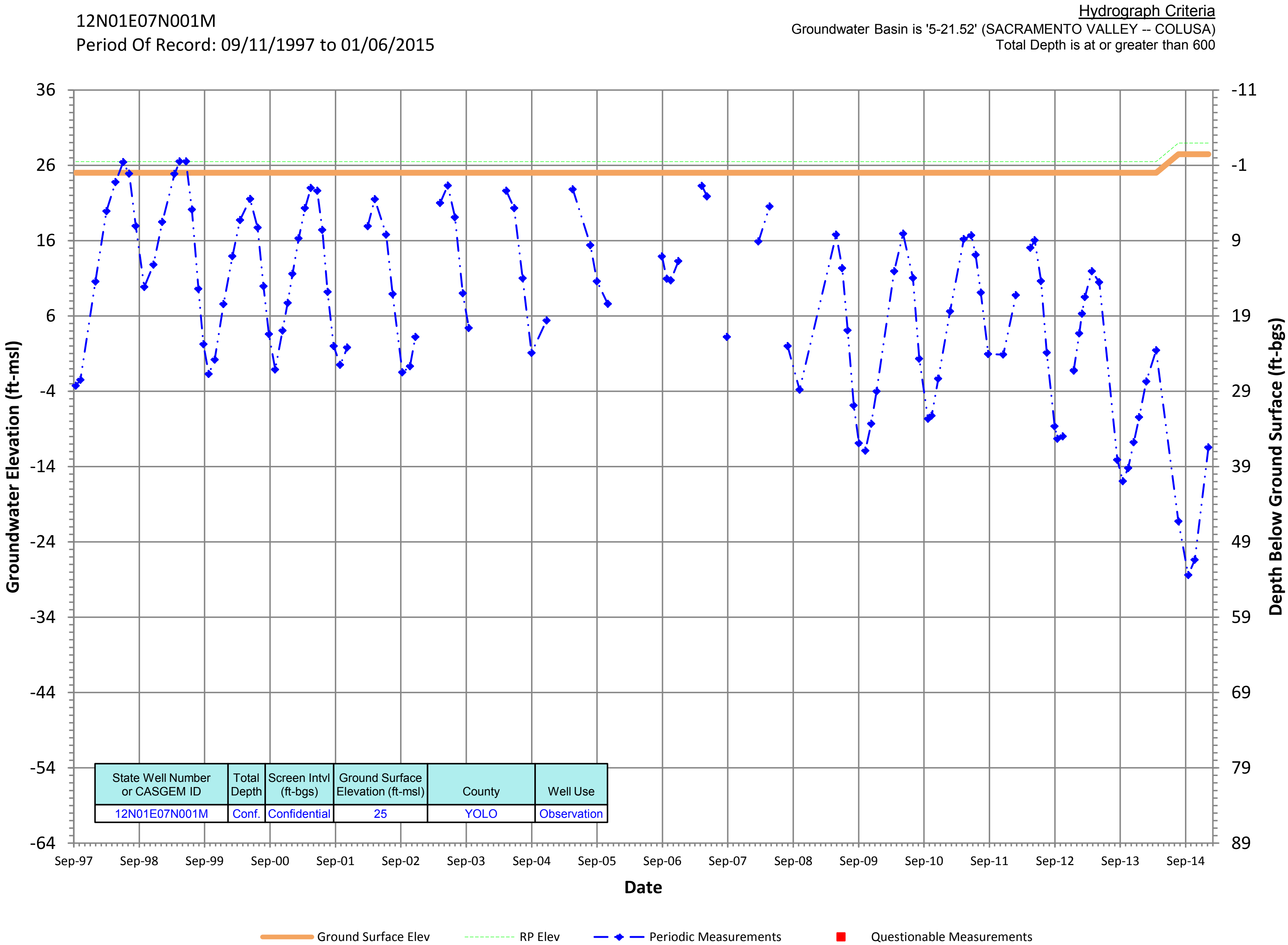
12N01E06D002M
Period Of Record: 09/11/1997 to 01/06/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600

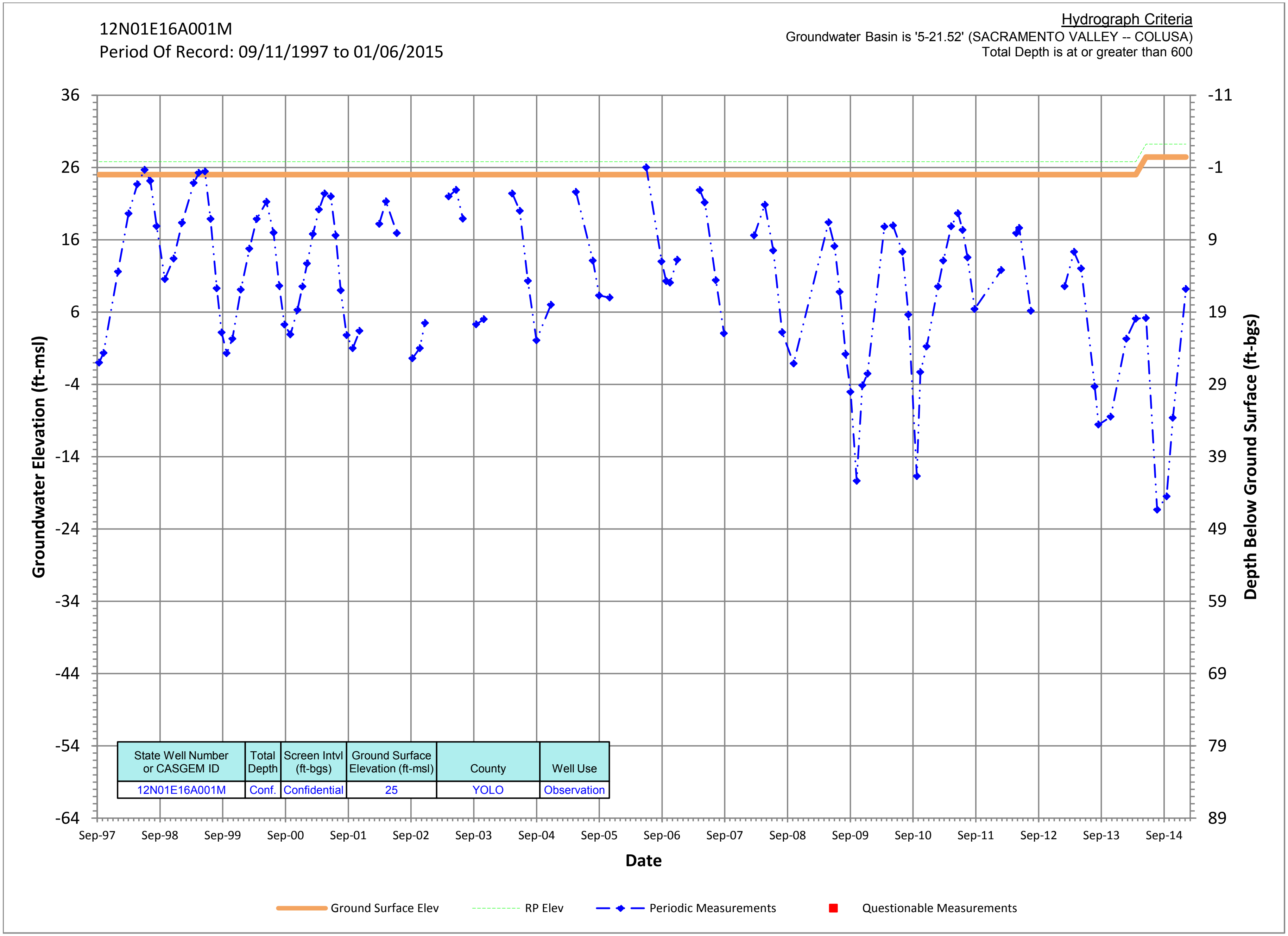


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E06D002M	Conf.	Confidential	25	YOLO	Observation

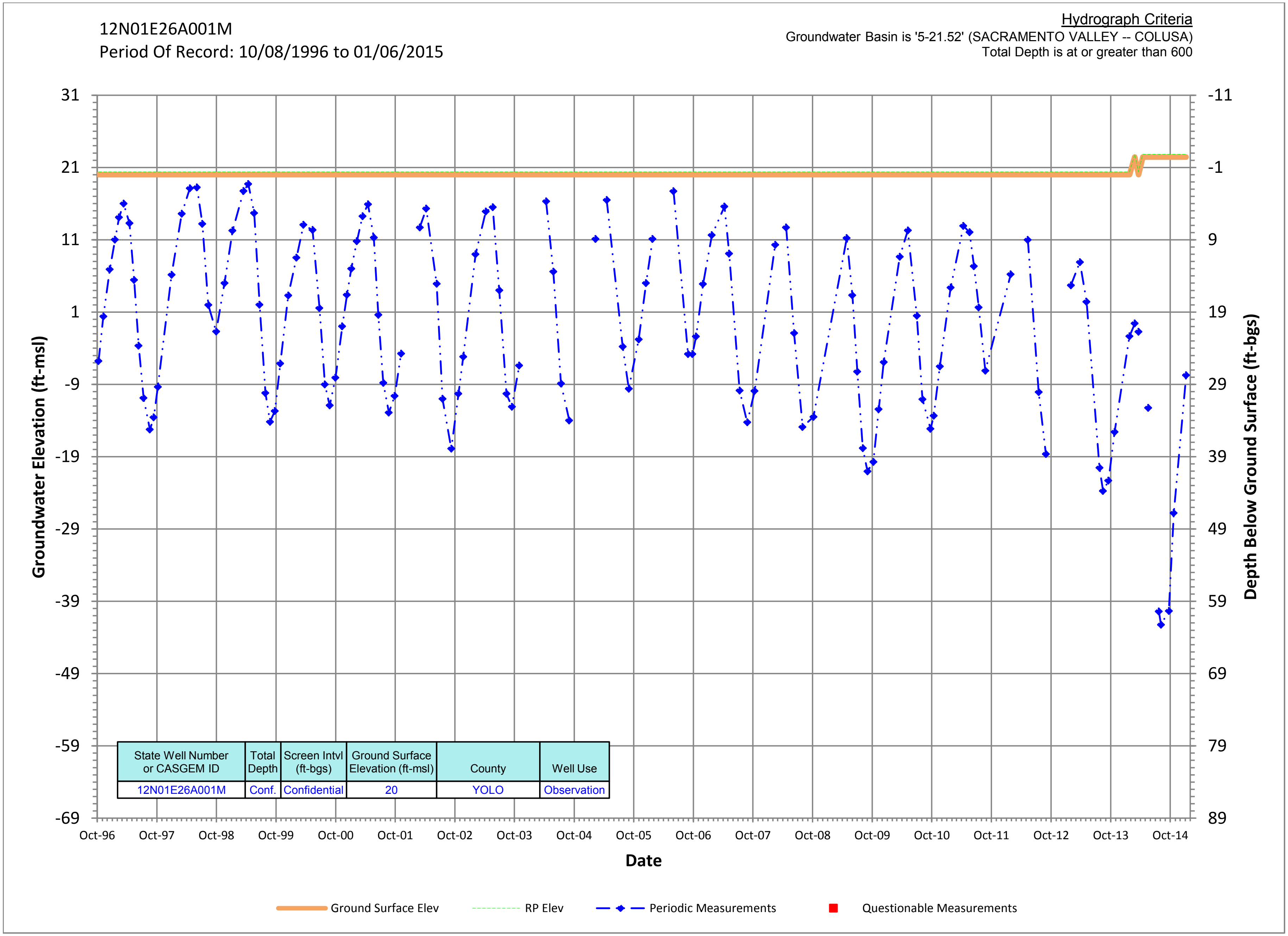
12N01E07N001M
Period Of Record: 09/11/1997 to 01/06/2015



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E07N001M	Conf.	Confidential	25	YOLO	Observation



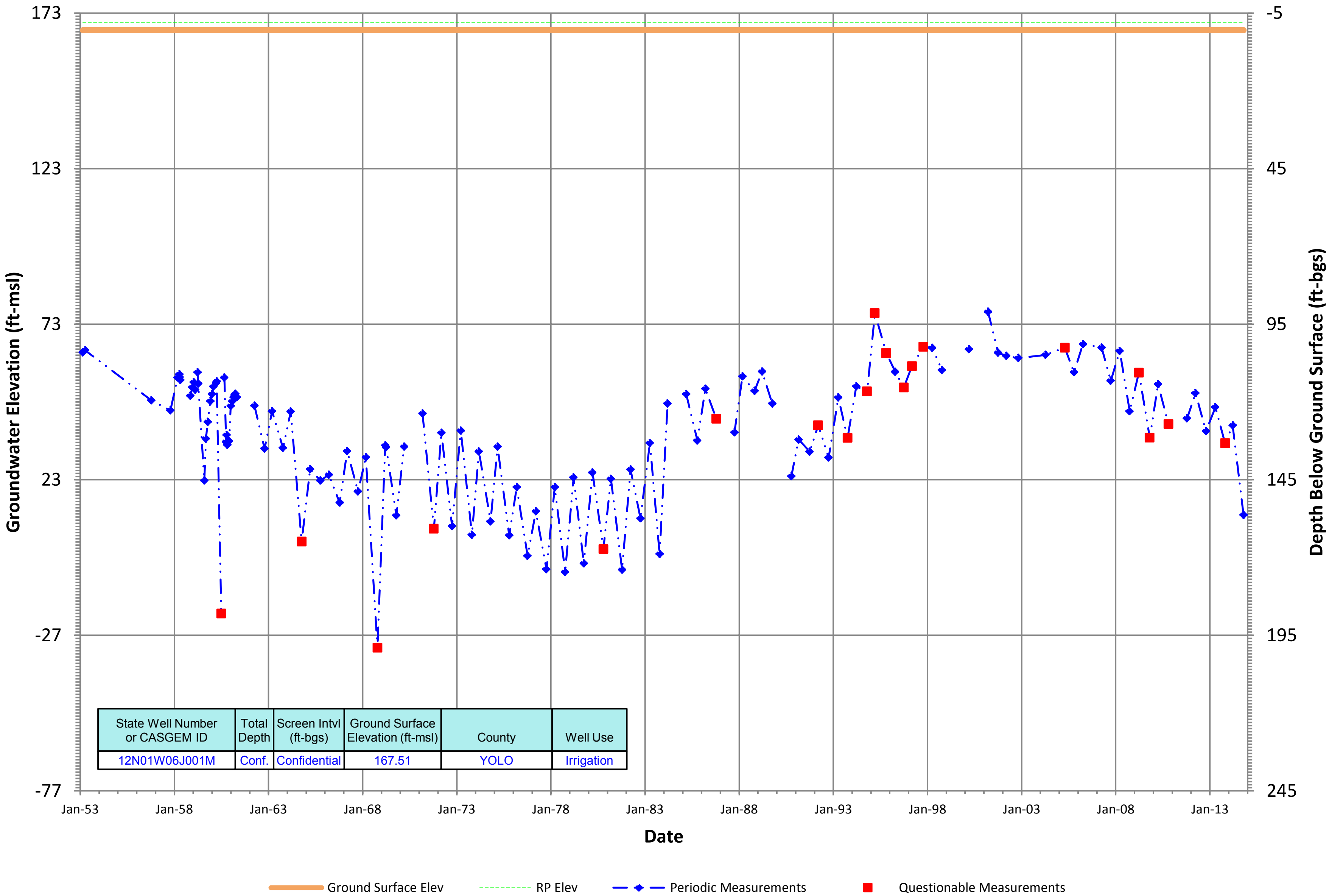
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E16A001M	Conf.	Confidential	25	YOLO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01E26A001M	Conf.	Confidential	20	YOLO	Observation

12N01W06J001M
Period Of Record: 02/18/1953 to 10/15/2014

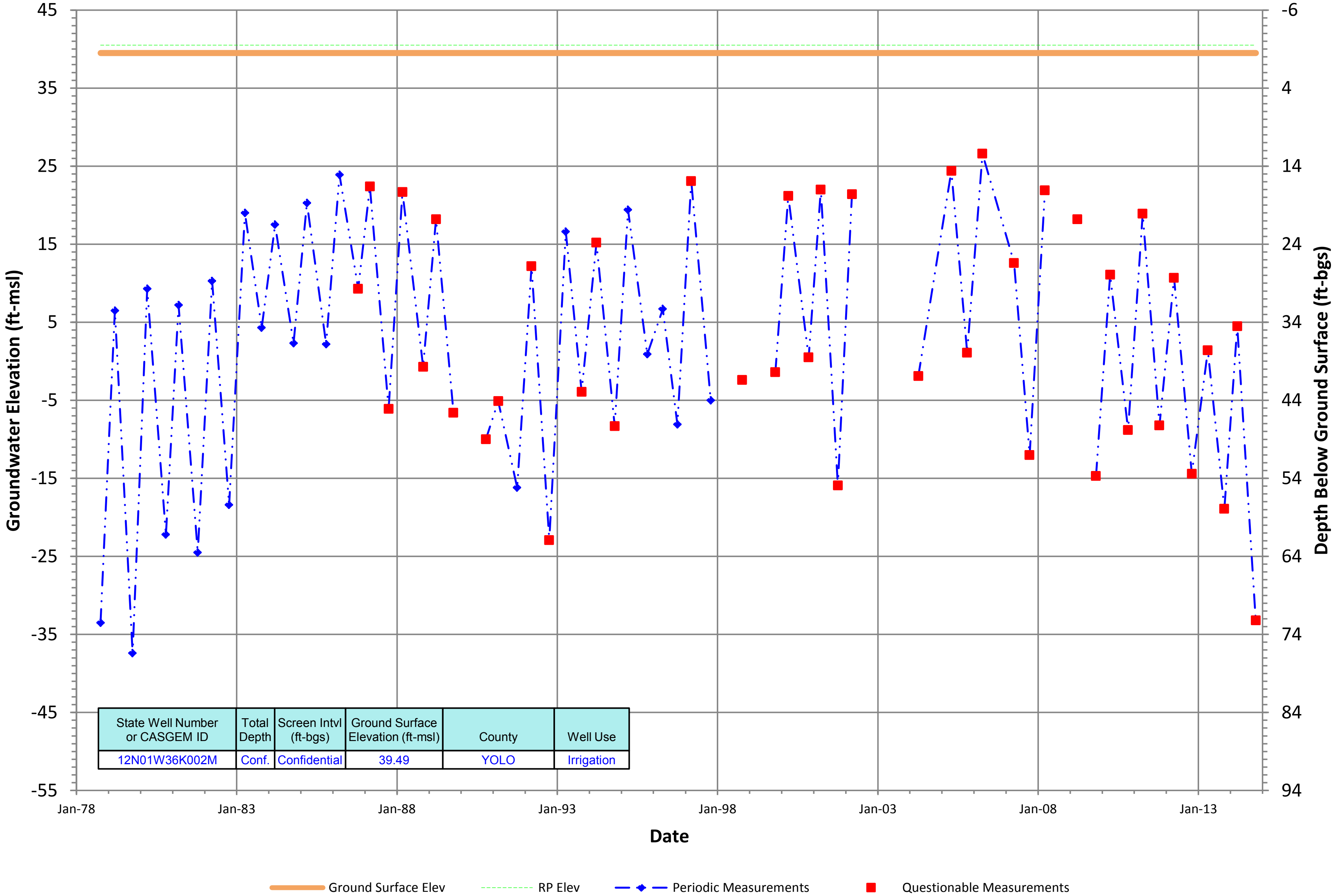
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



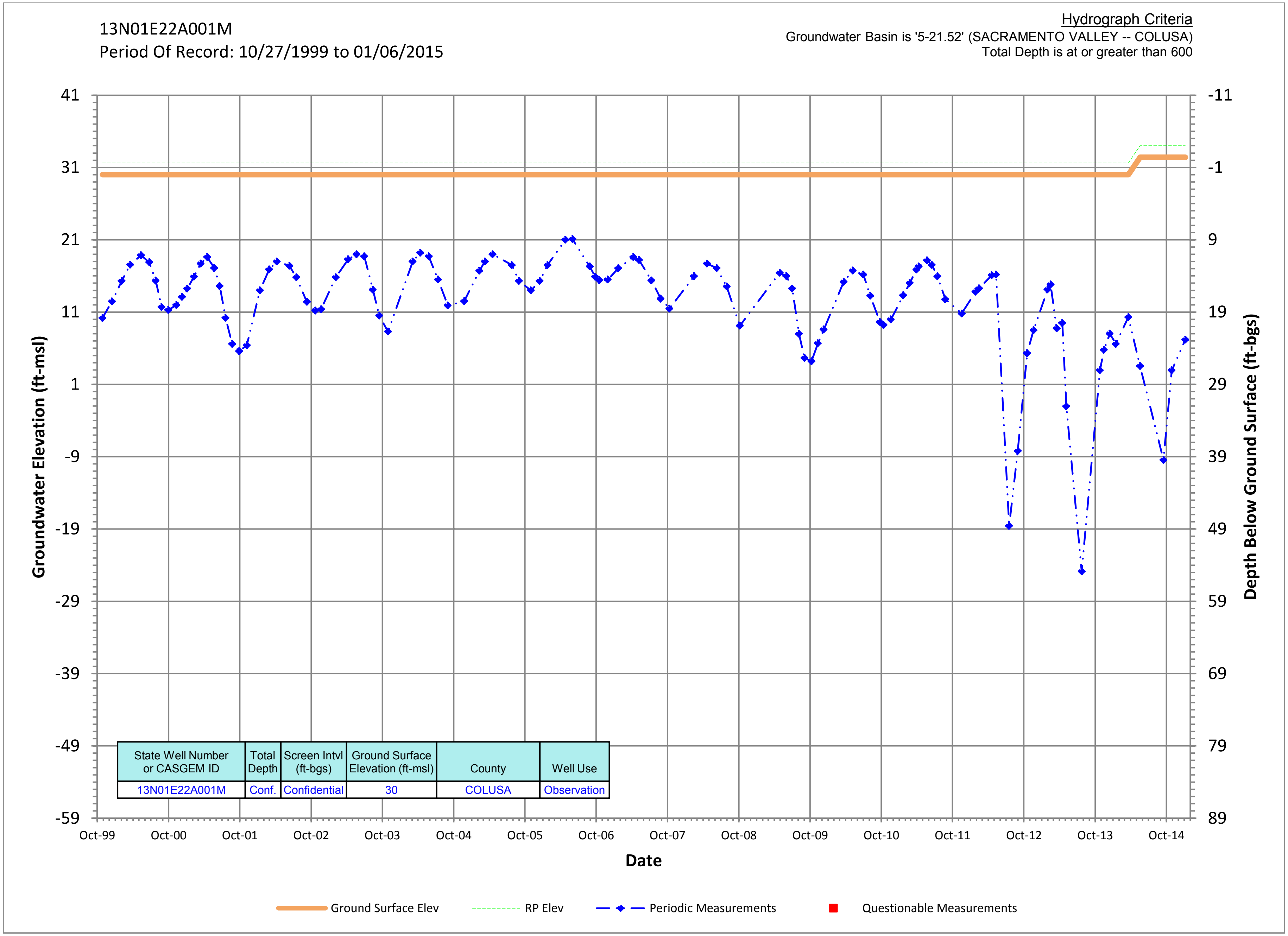
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01W06J001M	Conf.	Confidential	167.51	YOLO	Irrigation

12N01W36K002M
Period Of Record: 10/02/1978 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



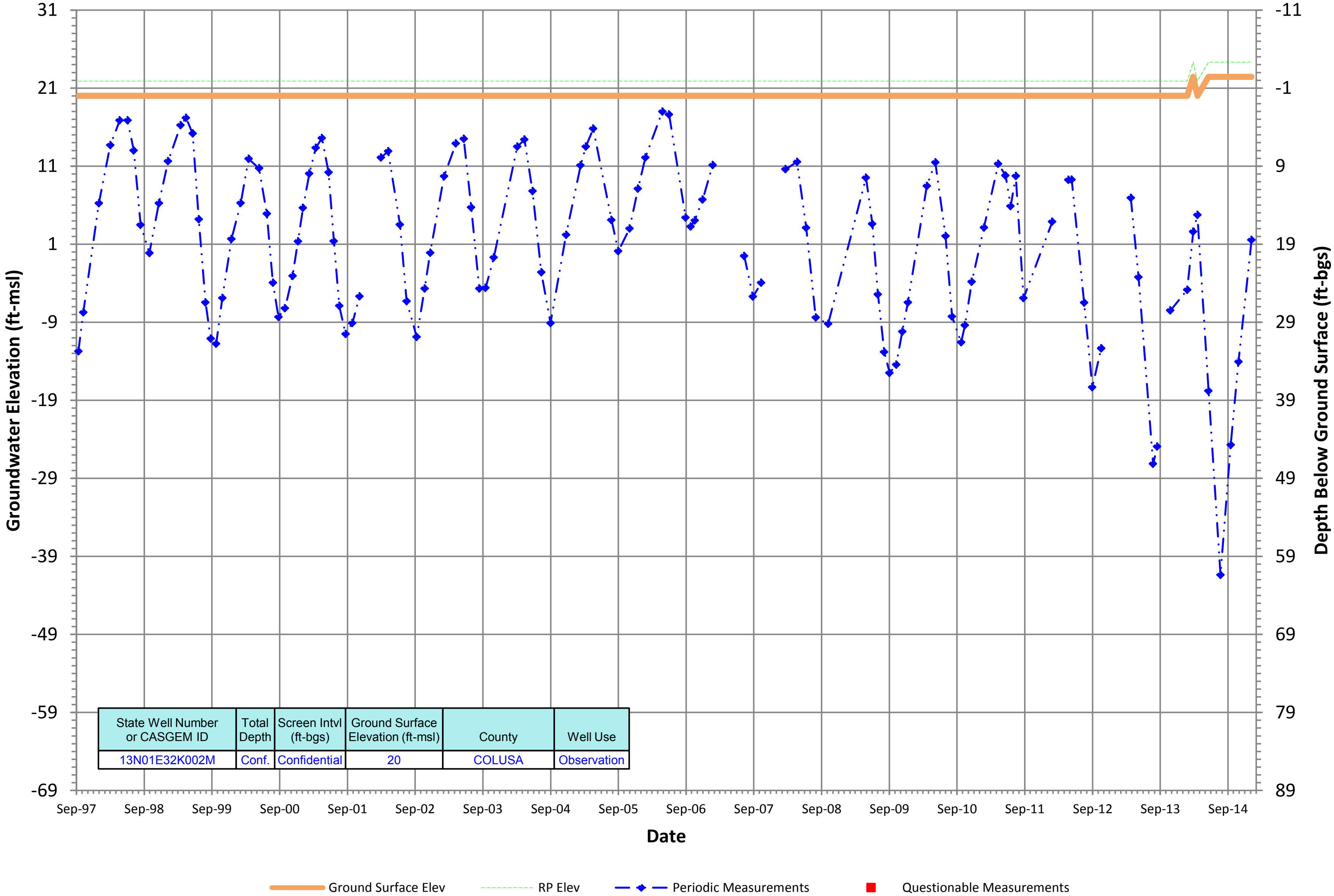
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N01W36K002M	Conf.	Confidential	39.49	YOLO	Irrigation



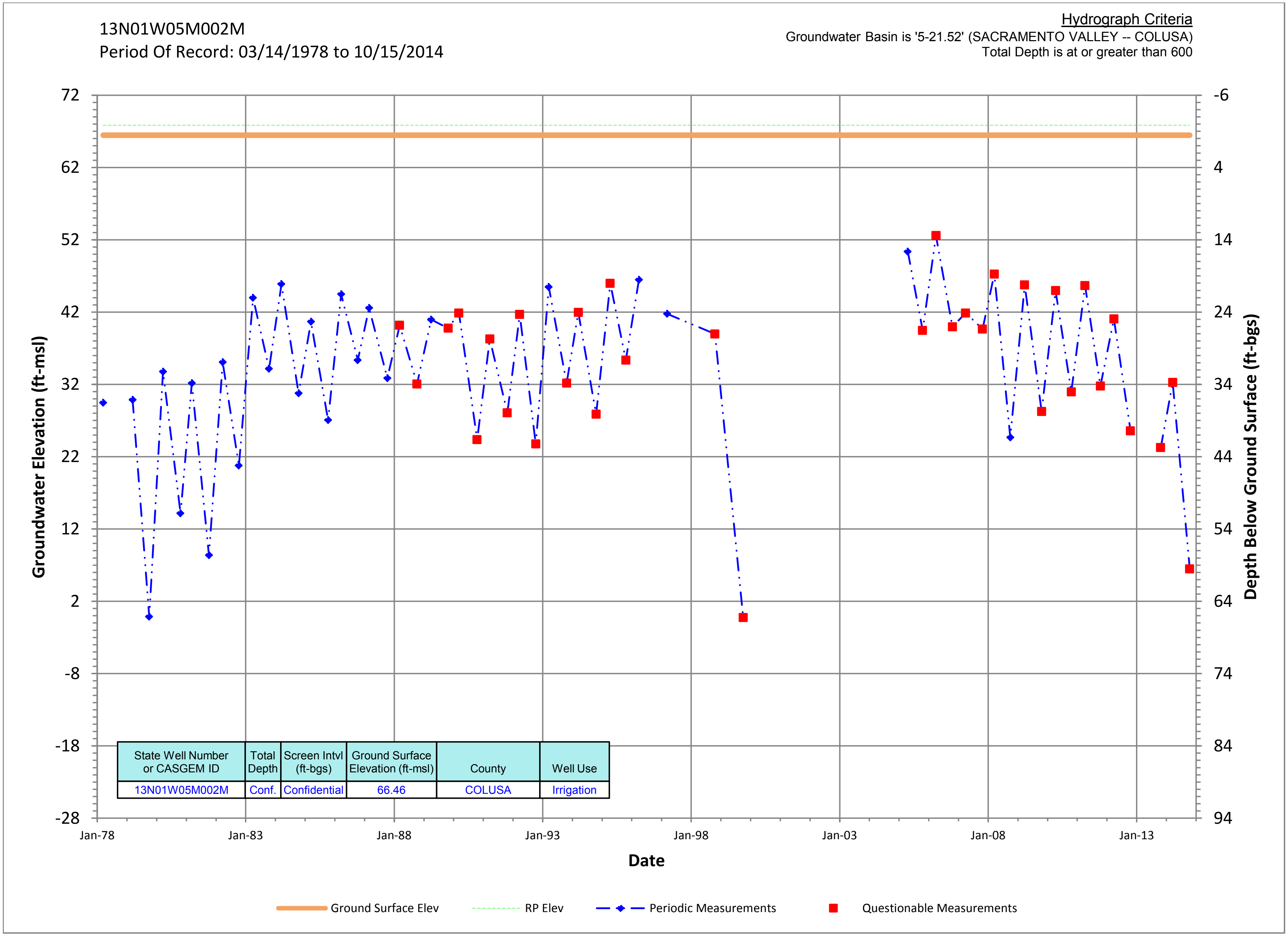
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E22A001M	Conf.	Confidential	30	COLUSA	Observation

13N01E32K002M
Period Of Record: 09/11/1997 to 01/06/2015

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



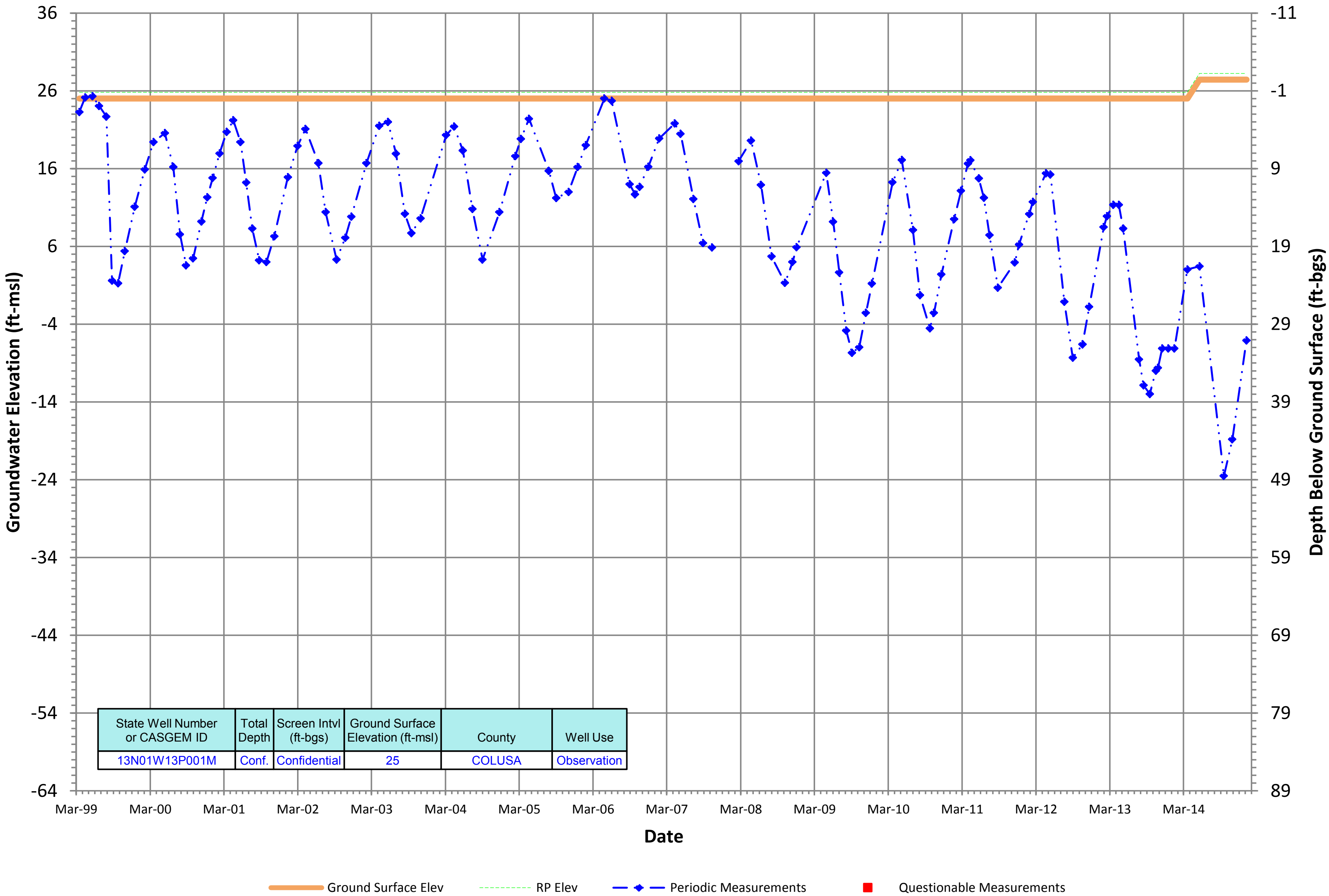
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E32K002M	Conf.	Confidential	20	COLUSA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W05M002M	Conf.	Confidential	66.46	COLUSA	Irrigation

13N01W13P001M
Period Of Record: 03/16/1999 to 01/06/2015

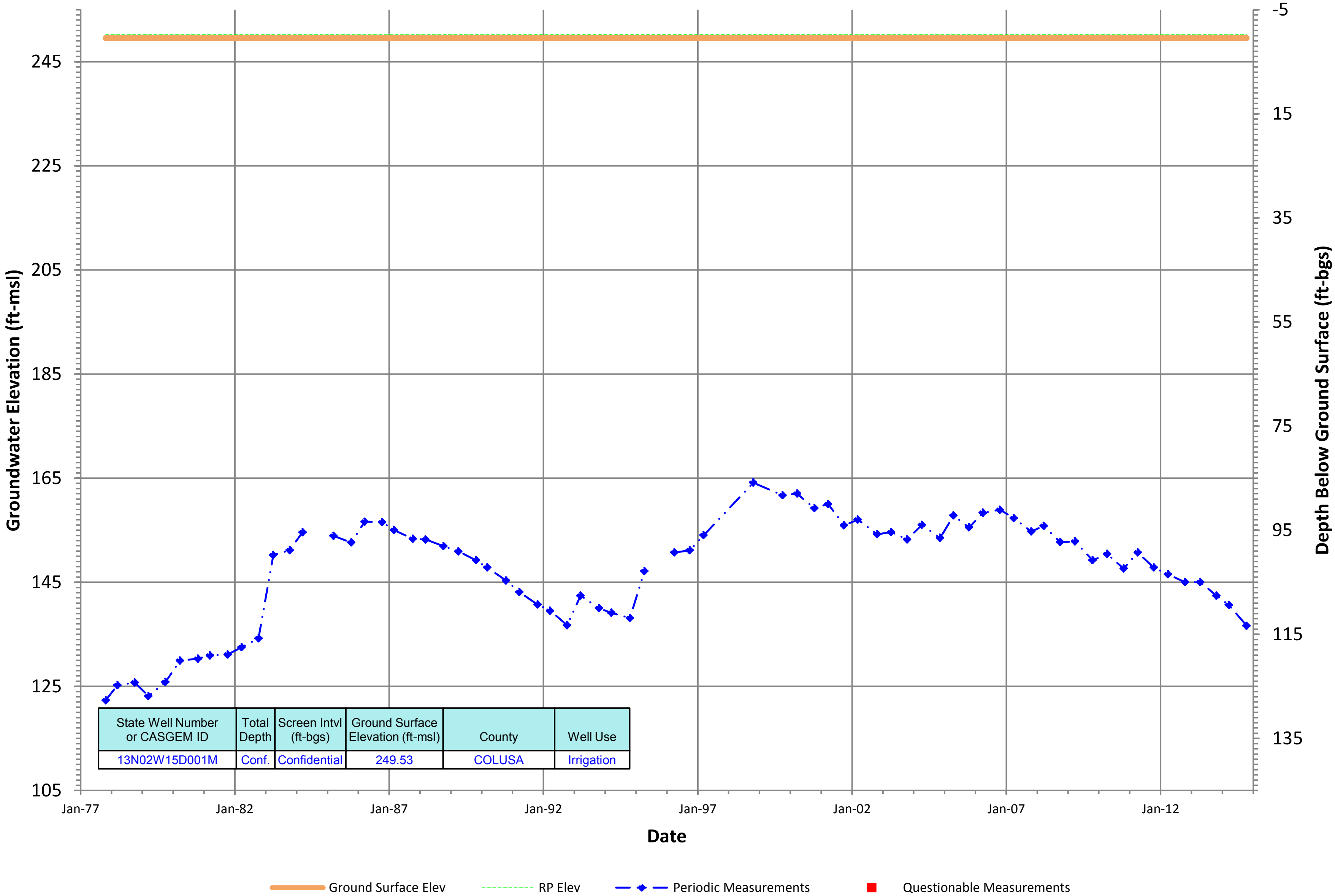
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01W13P001M	Conf.	Confidential	25	COLUSA	Observation

13N02W15D001M
Period Of Record: 10/25/1977 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W15D001M	Conf.	Confidential	249.53	COLUSA	Irrigation

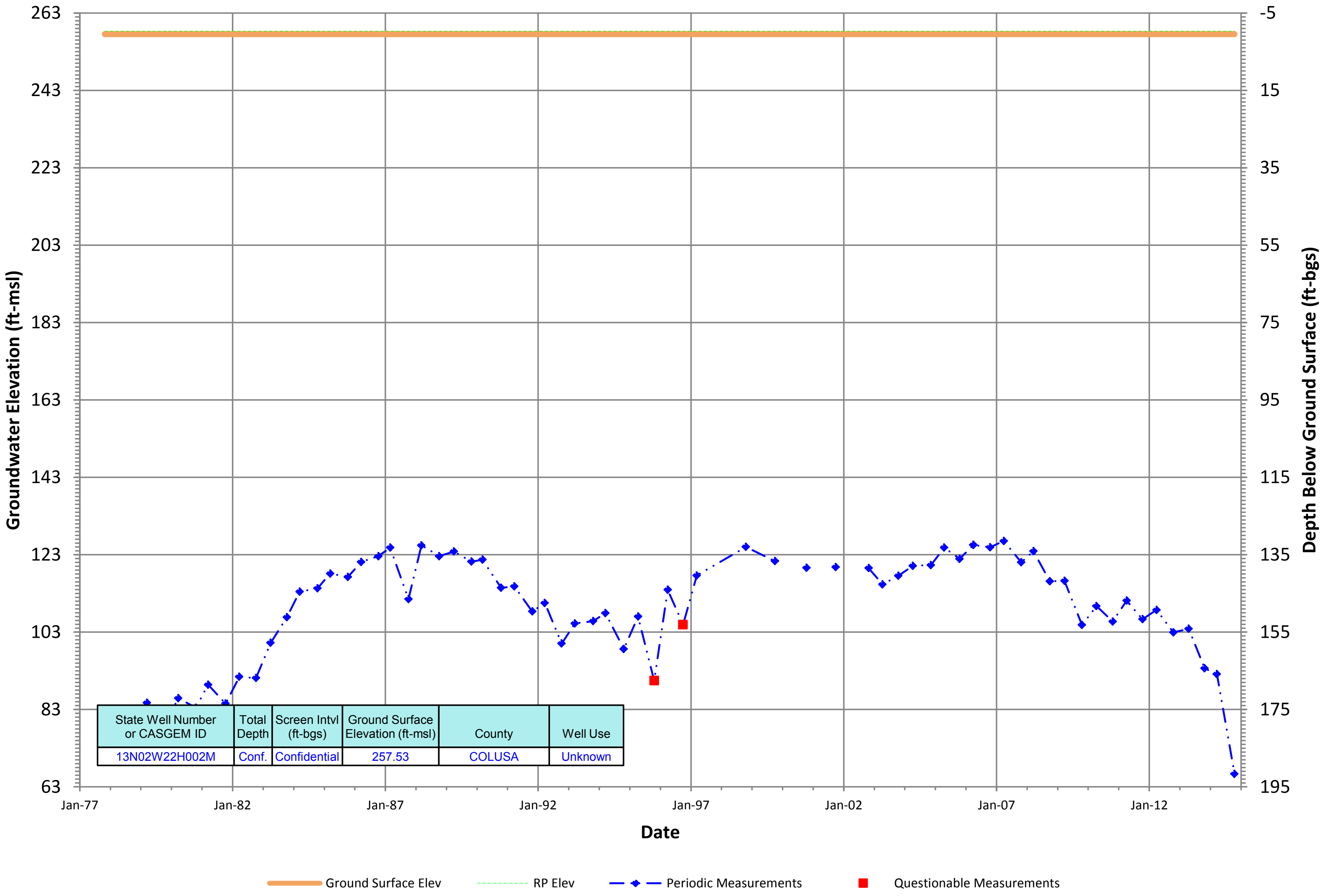
13N02W22H002M

Period Of Record: 10/25/1977 to 10/15/2014

Hydrograph Criteria

Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)

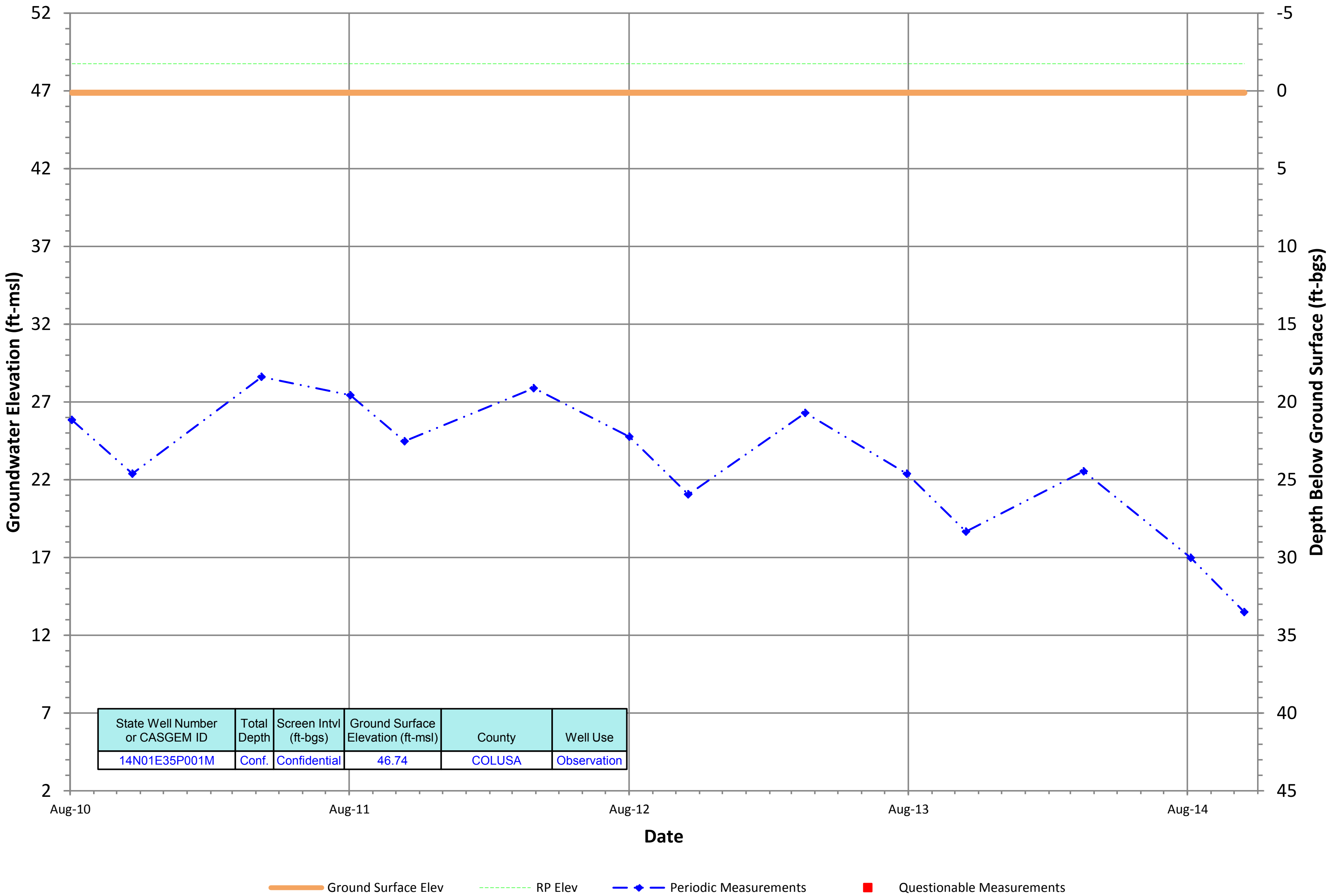
Total Depth is at or greater than 600



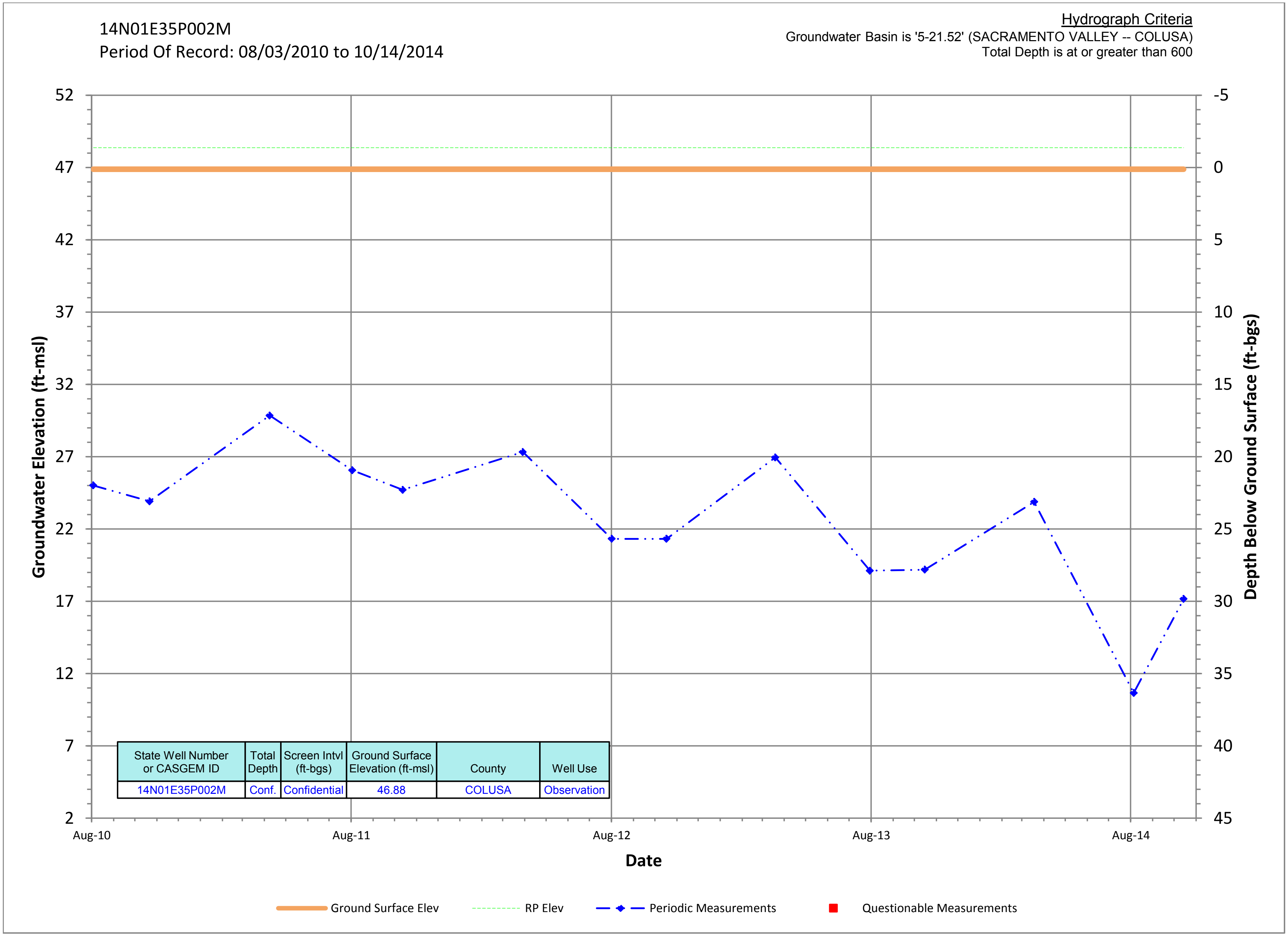
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N02W22H002M	Conf.	Confidential	257.53	COLUSA	Unknown

14N01E35P001M
Period Of Record: 08/03/2010 to 10/14/2014

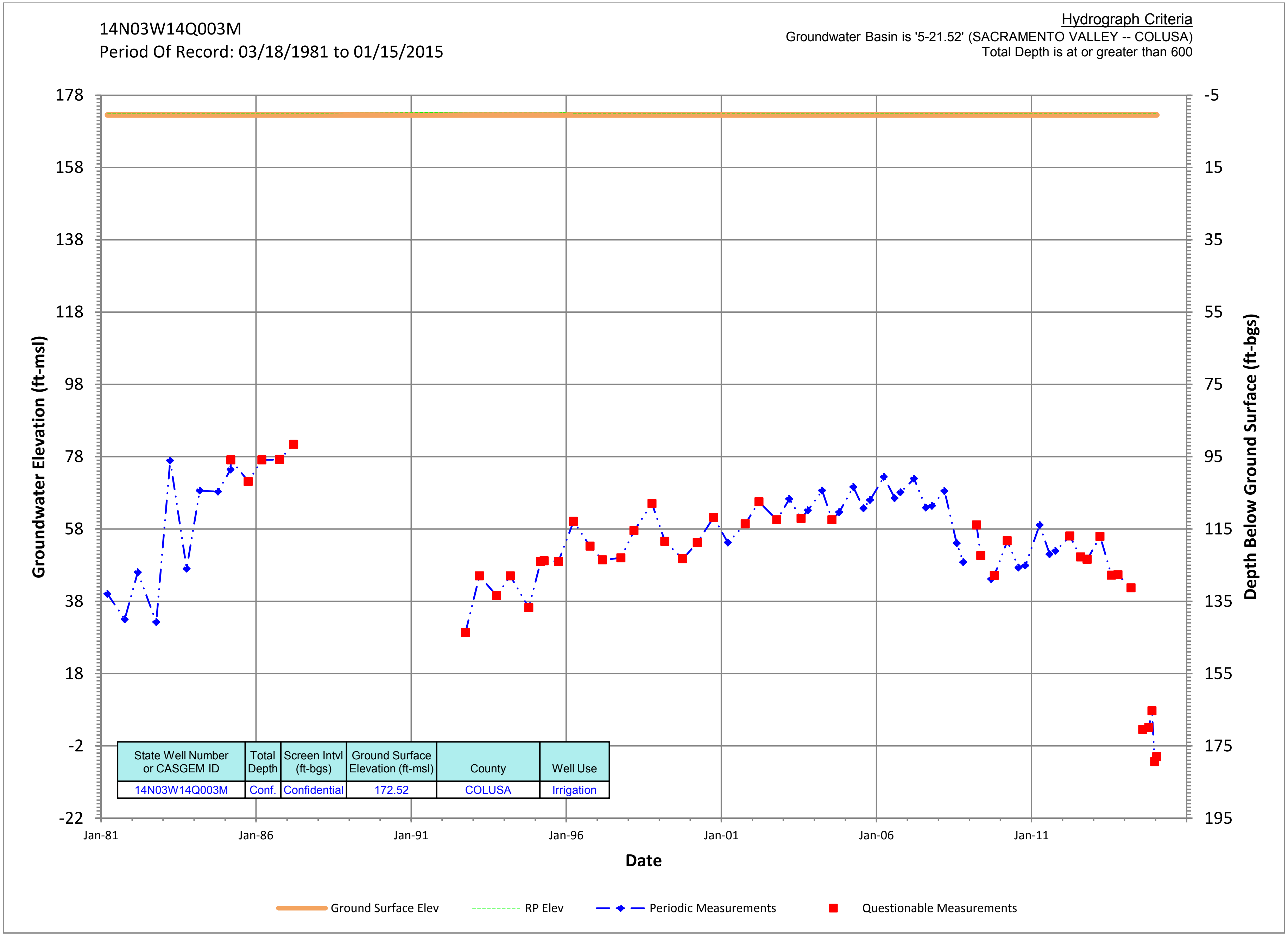
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01E35P001M	Conf.	Confidential	46.74	COLUSA	Observation



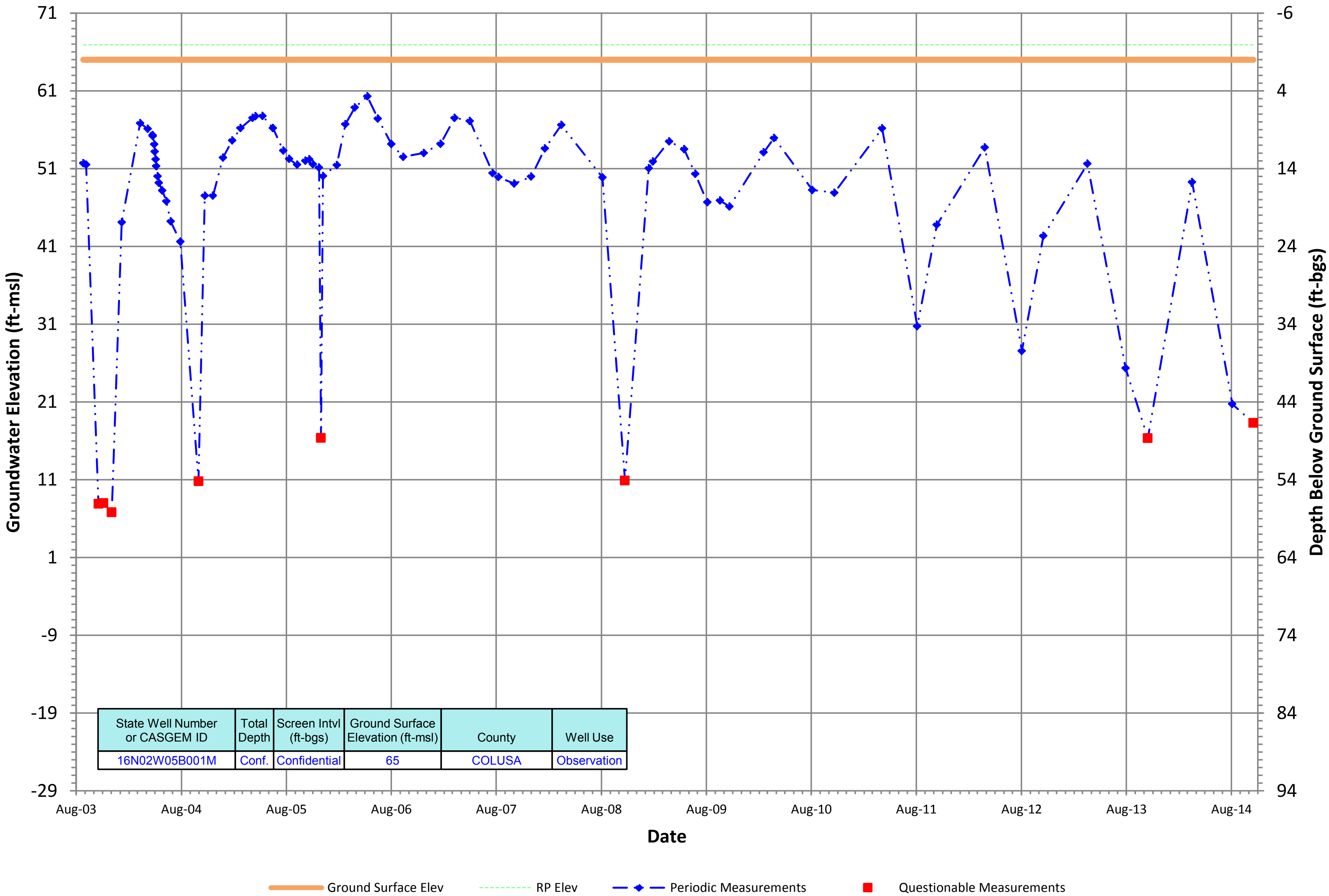
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N01E35P002M	Conf.	Confidential	46.88	COLUSA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03W14Q003M	Conf.	Confidential	172.52	COLUSA	Irrigation

16N02W05B001M
Period Of Record: 08/25/2003 to 10/16/2014

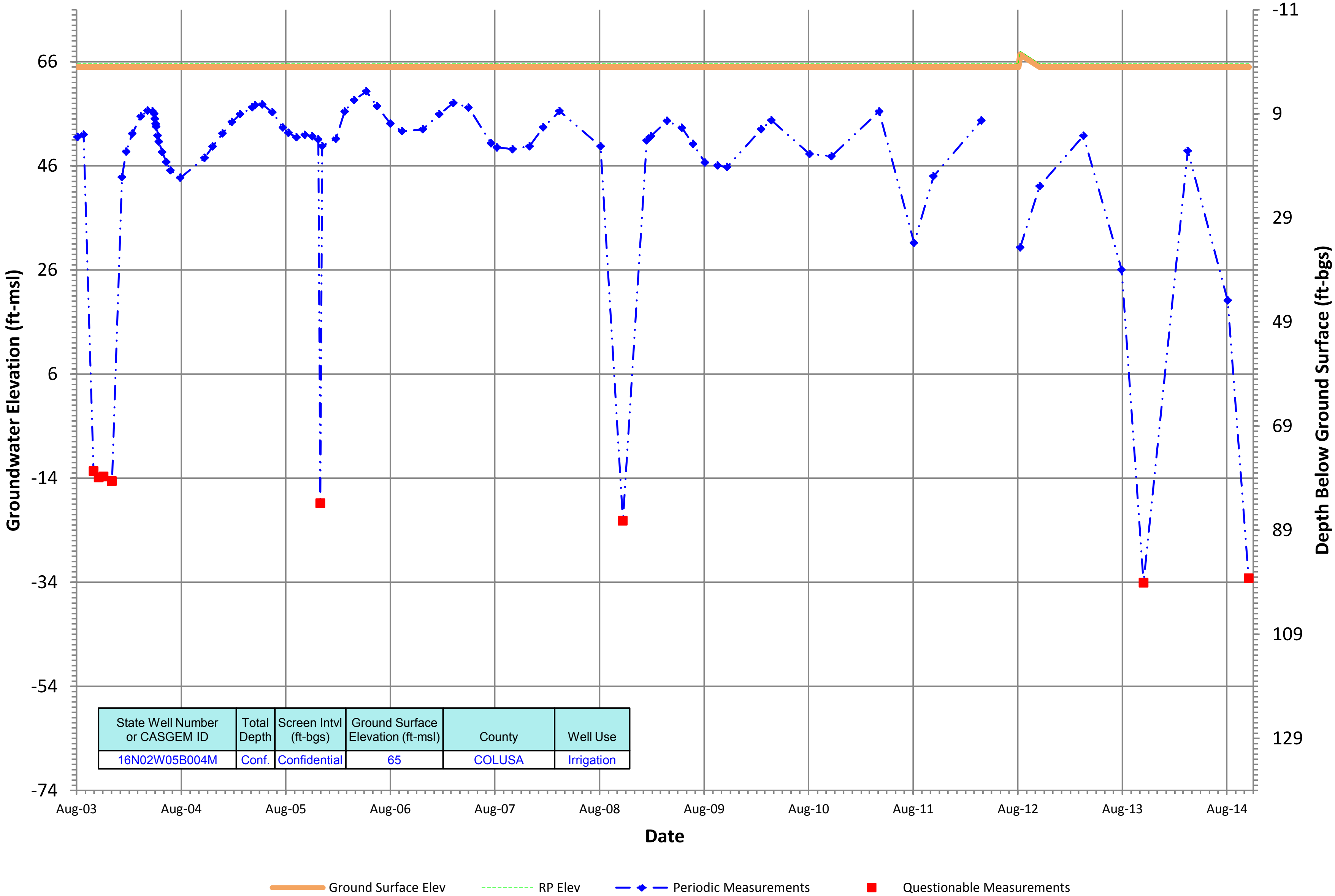
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N02W05B001M	Conf.	Confidential	65	COLUSA	Observation

16N02W05B004M
Period Of Record: 08/04/2003 to 10/16/2014

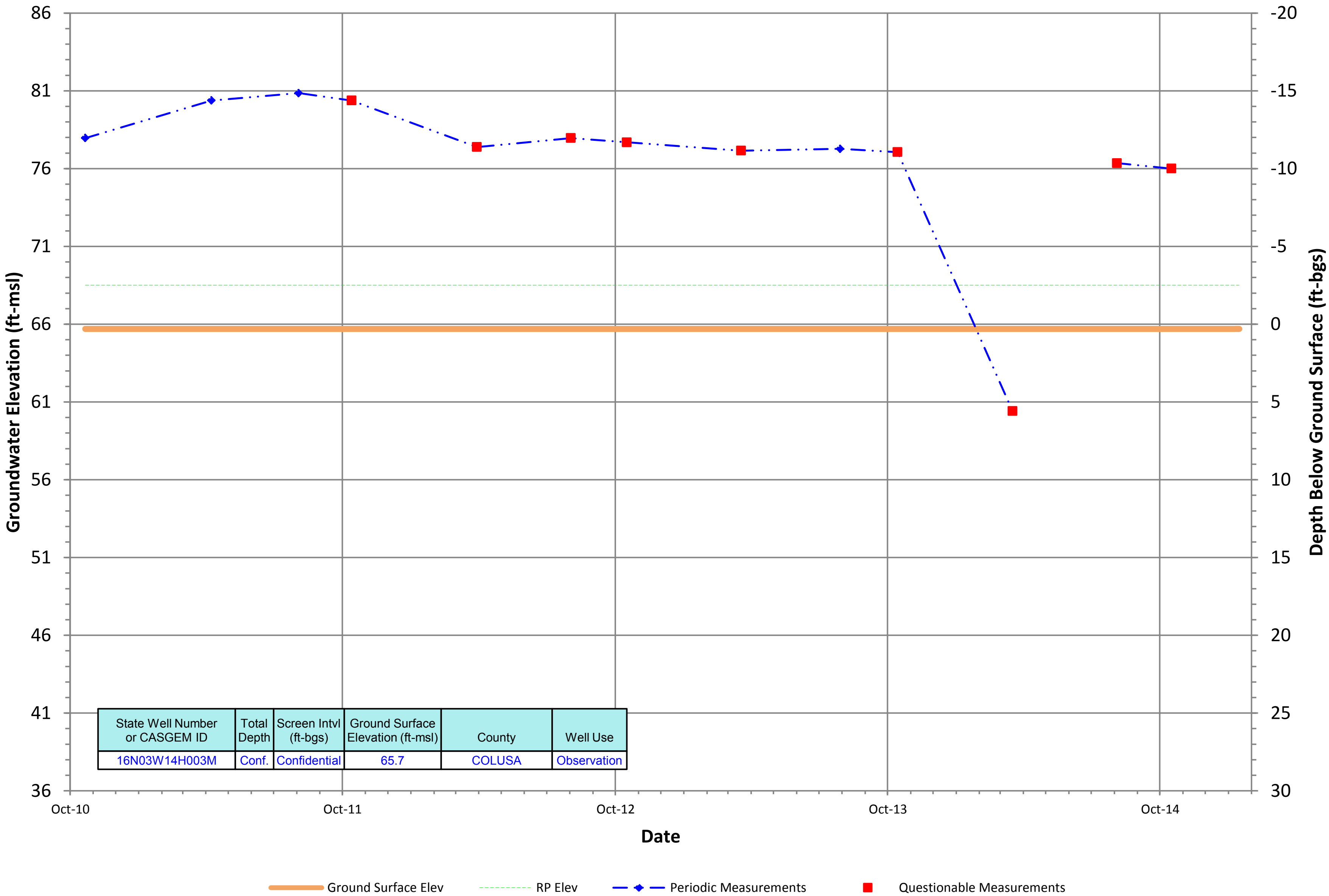
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N02W05B004M	Conf.	Confidential	65	COLUSA	Irrigation

16N03W14H003M
Period Of Record: 10/21/2010 to 01/15/2015

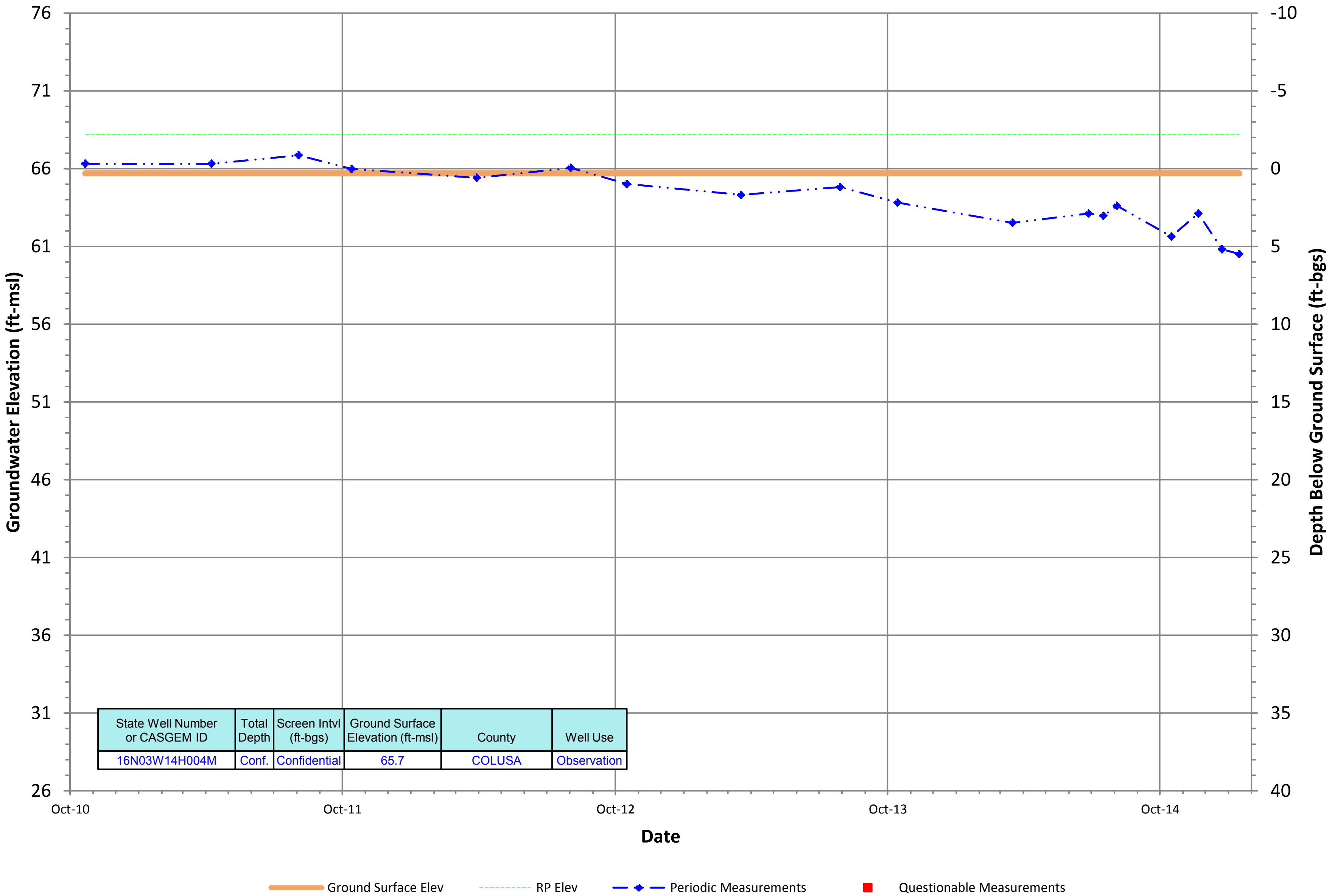
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03W14H003M	Conf.	Confidential	65.7	COLUSA	Observation

16N03W14H004M
Period Of Record: 10/21/2010 to 01/15/2015

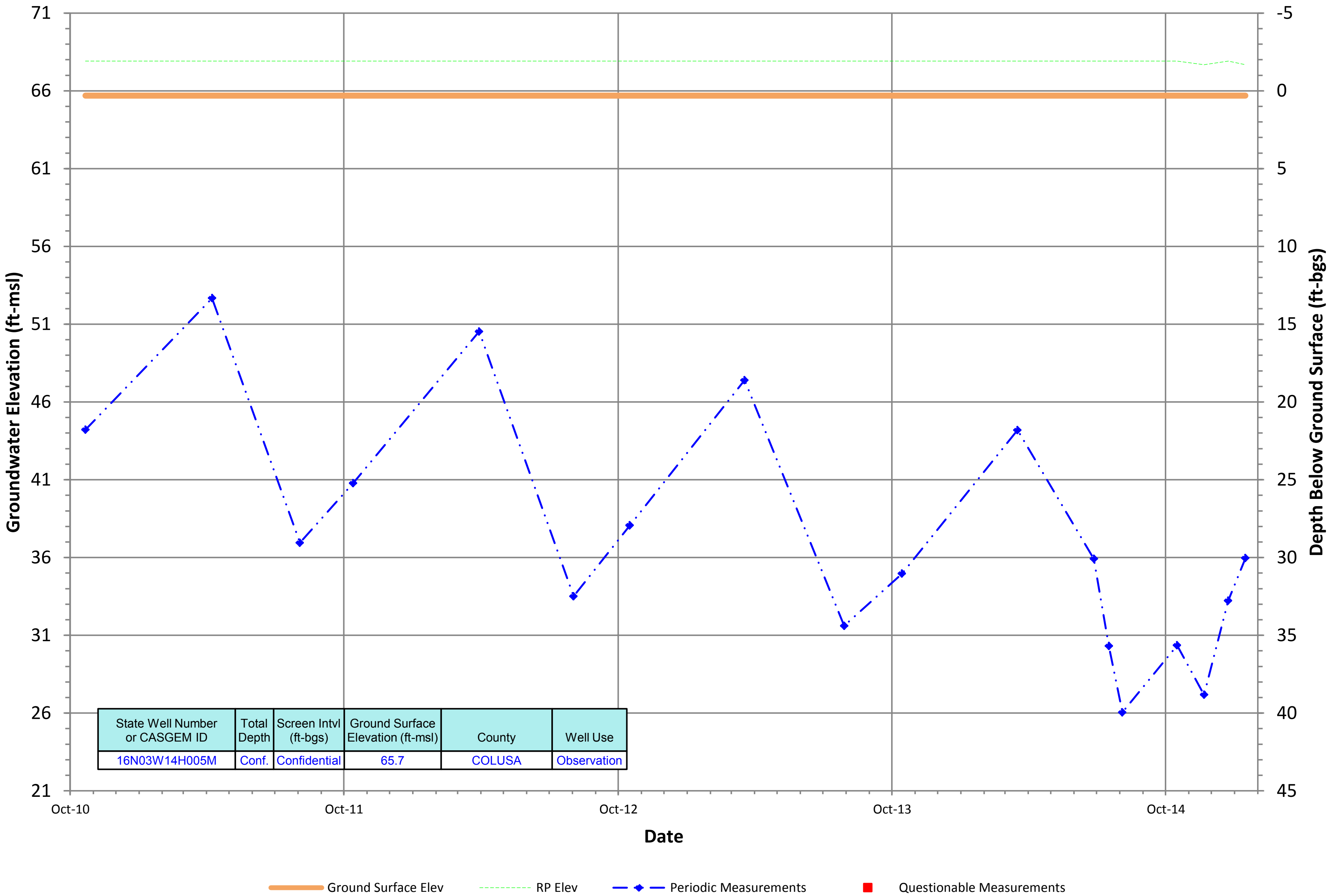
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03W14H004M	Conf.	Confidential	65.7	COLUSA	Observation

16N03W14H005M
Period Of Record: 10/21/2010 to 01/15/2015

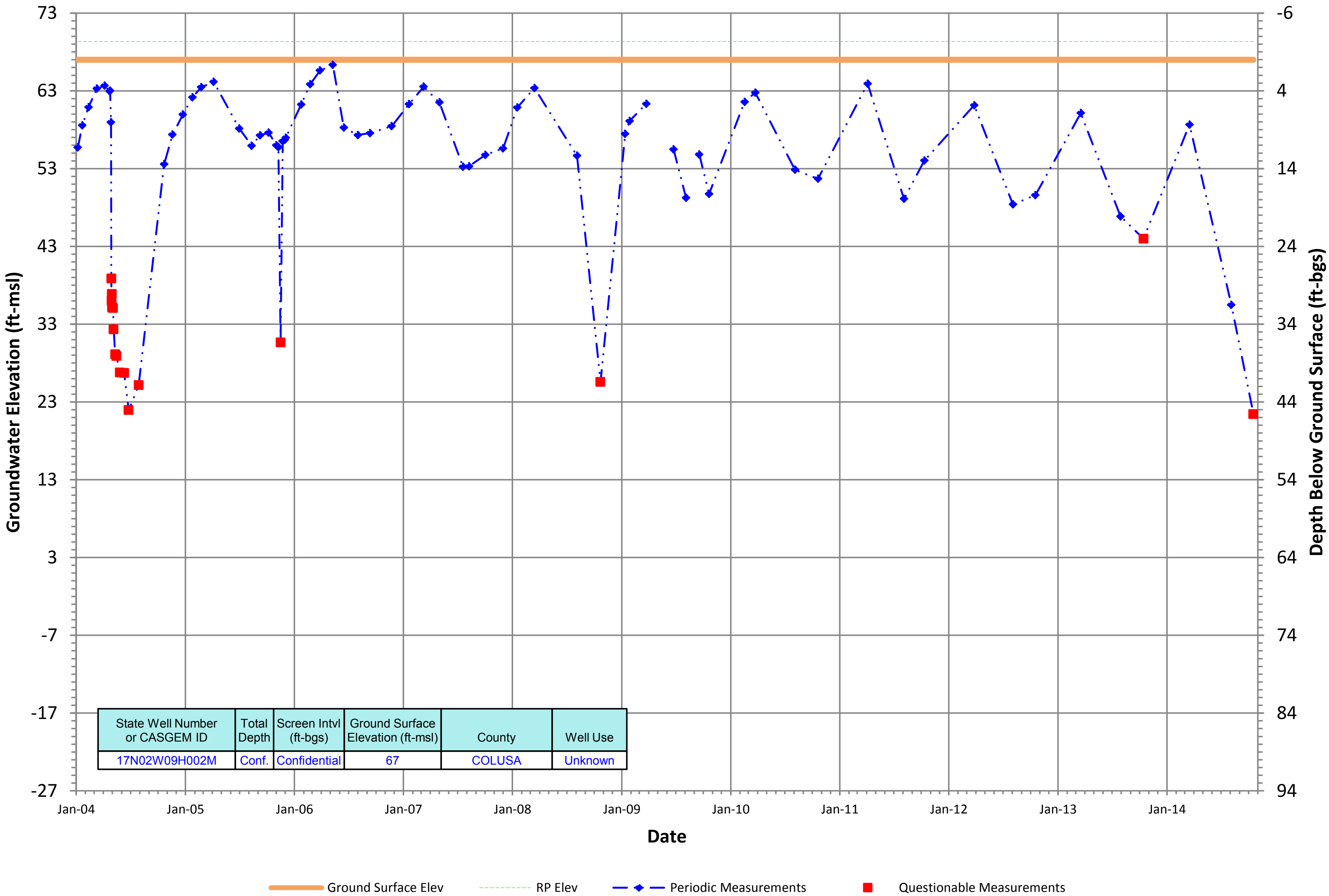
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03W14H005M	Conf.	Confidential	65.7	COLUSA	Observation

17N02W09H002M
Period Of Record: 01/06/2004 to 10/17/2014

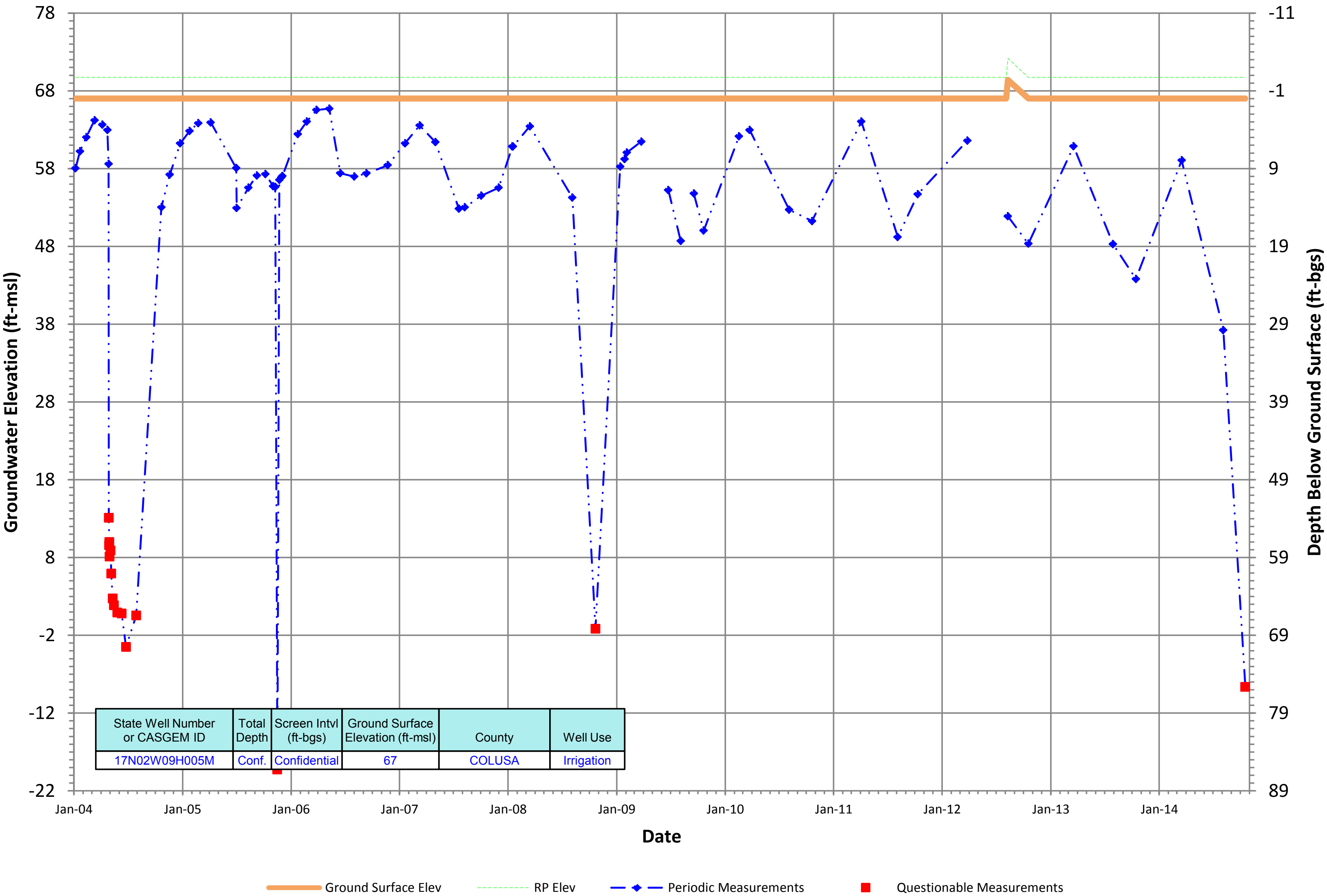
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02W09H002M	Conf.	Confidential	67	COLUSA	Unknown

17N02W09H005M
Period Of Record: 01/06/2004 to 10/17/2014

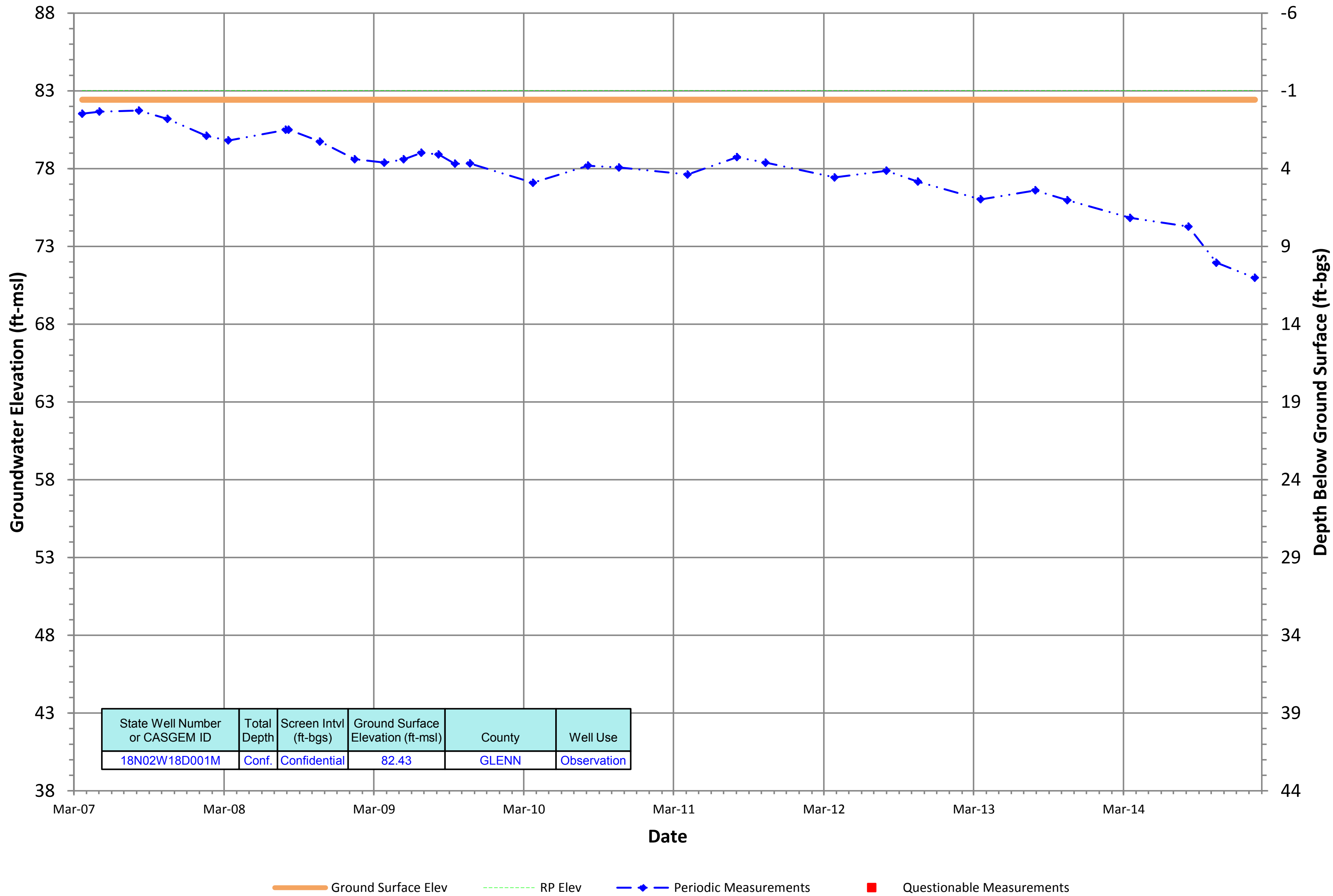
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02W09H005M	Conf.	Confidential	67	COLUSA	Irrigation

18N02W18D001M
Period Of Record: 03/21/2007 to 01/15/2015

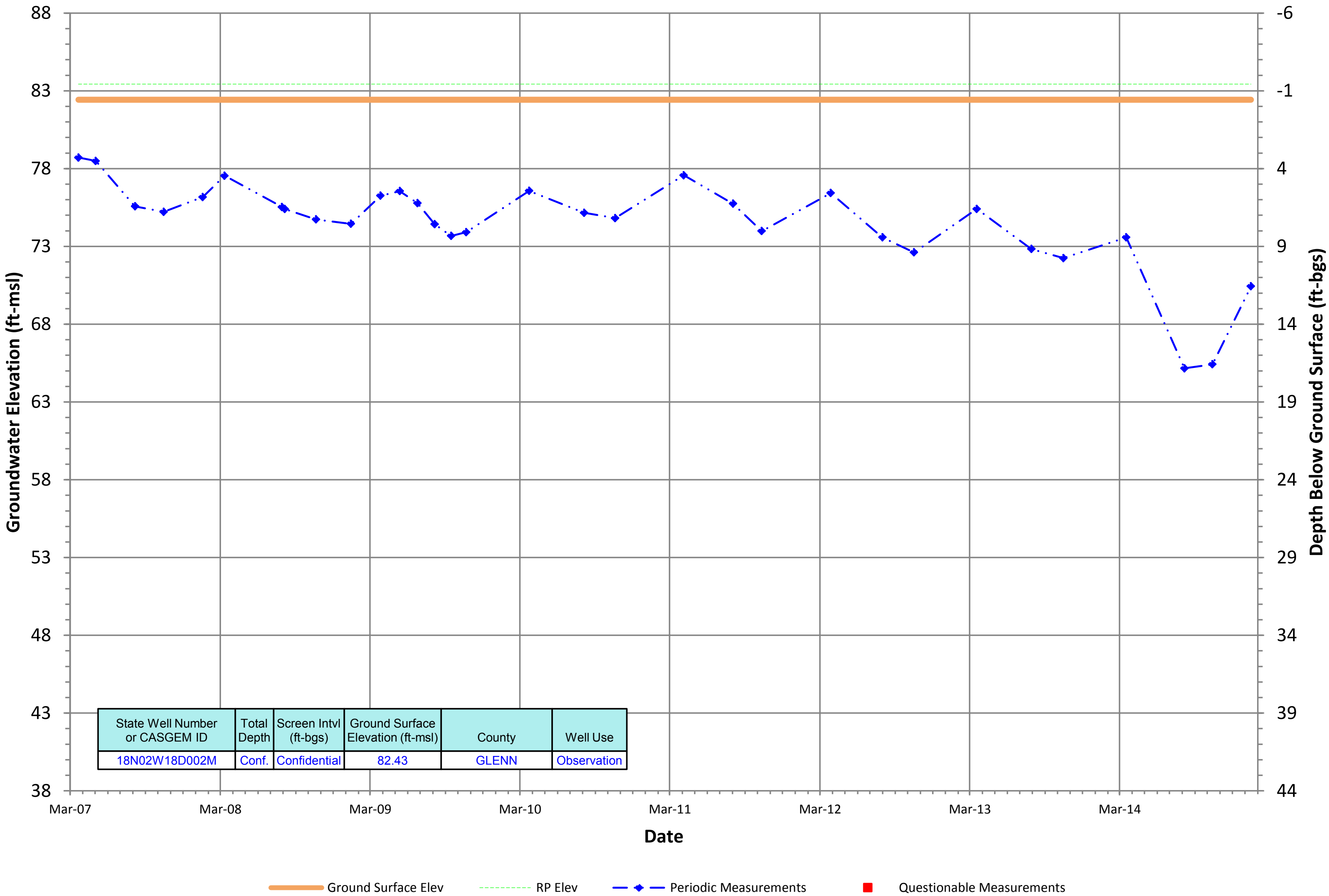
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



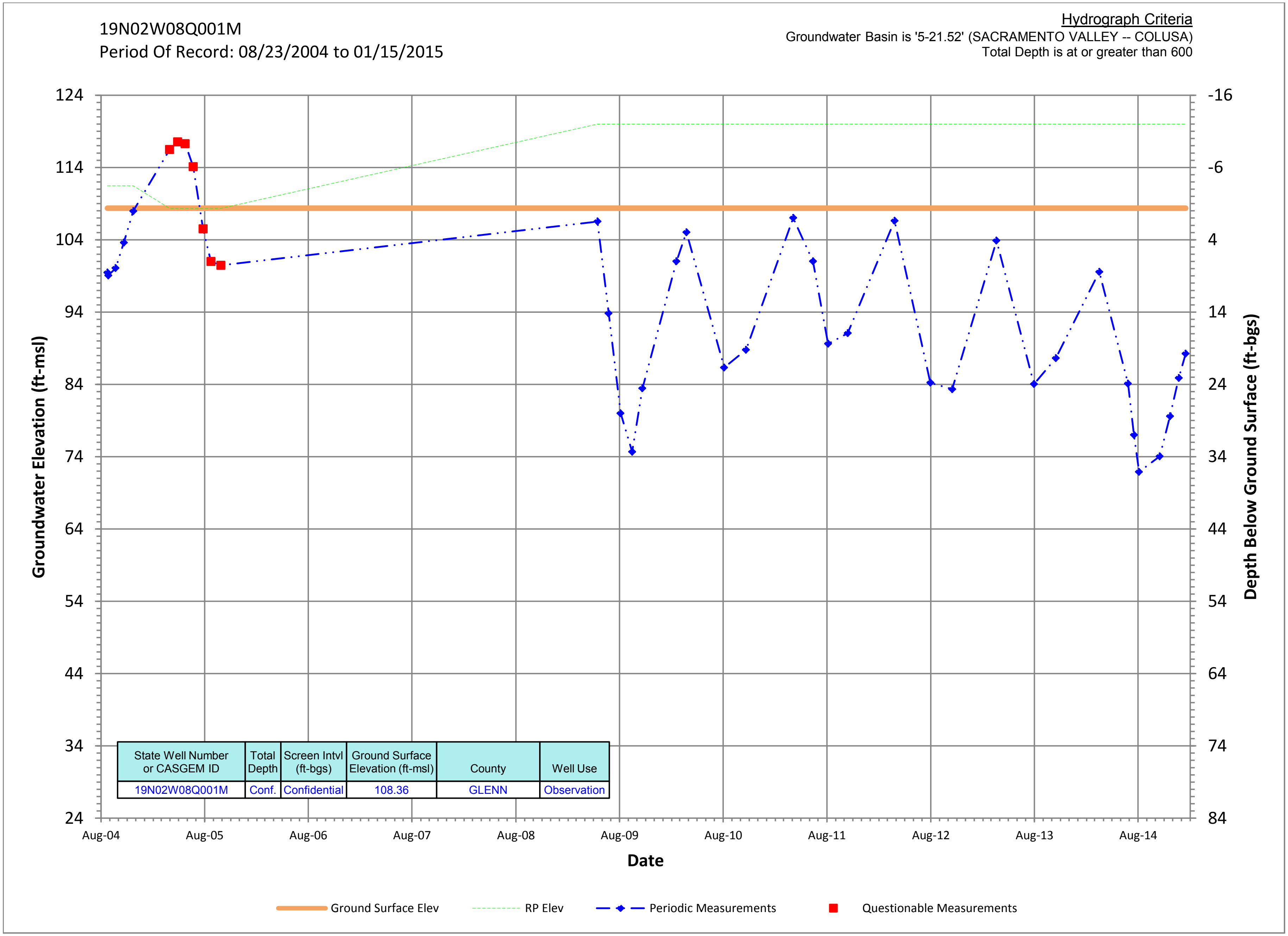
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02W18D001M	Conf.	Confidential	82.43	GLENN	Observation

18N02W18D002M
Period Of Record: 03/21/2007 to 01/15/2015

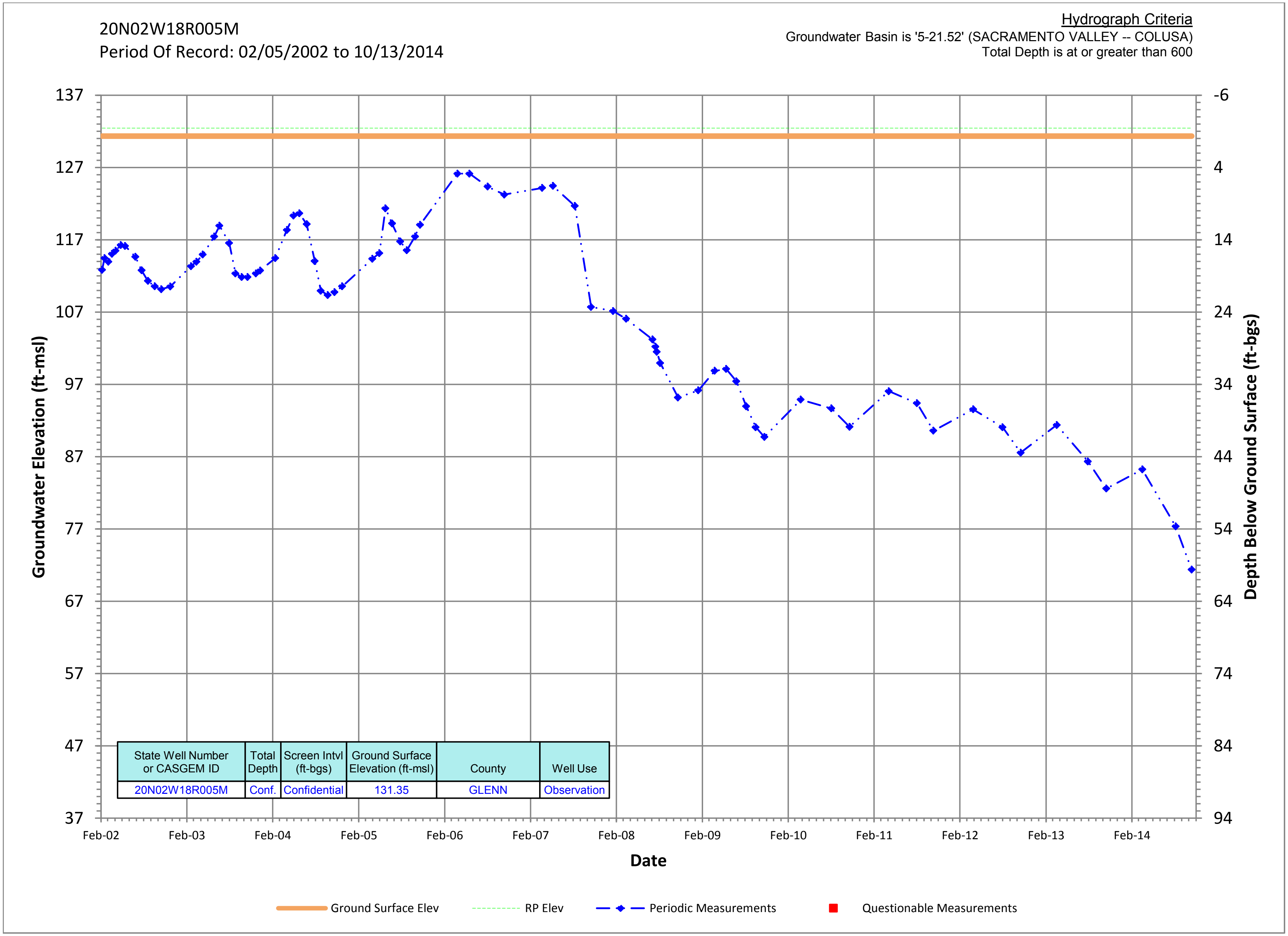
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02W18D002M	Conf.	Confidential	82.43	GLENN	Observation



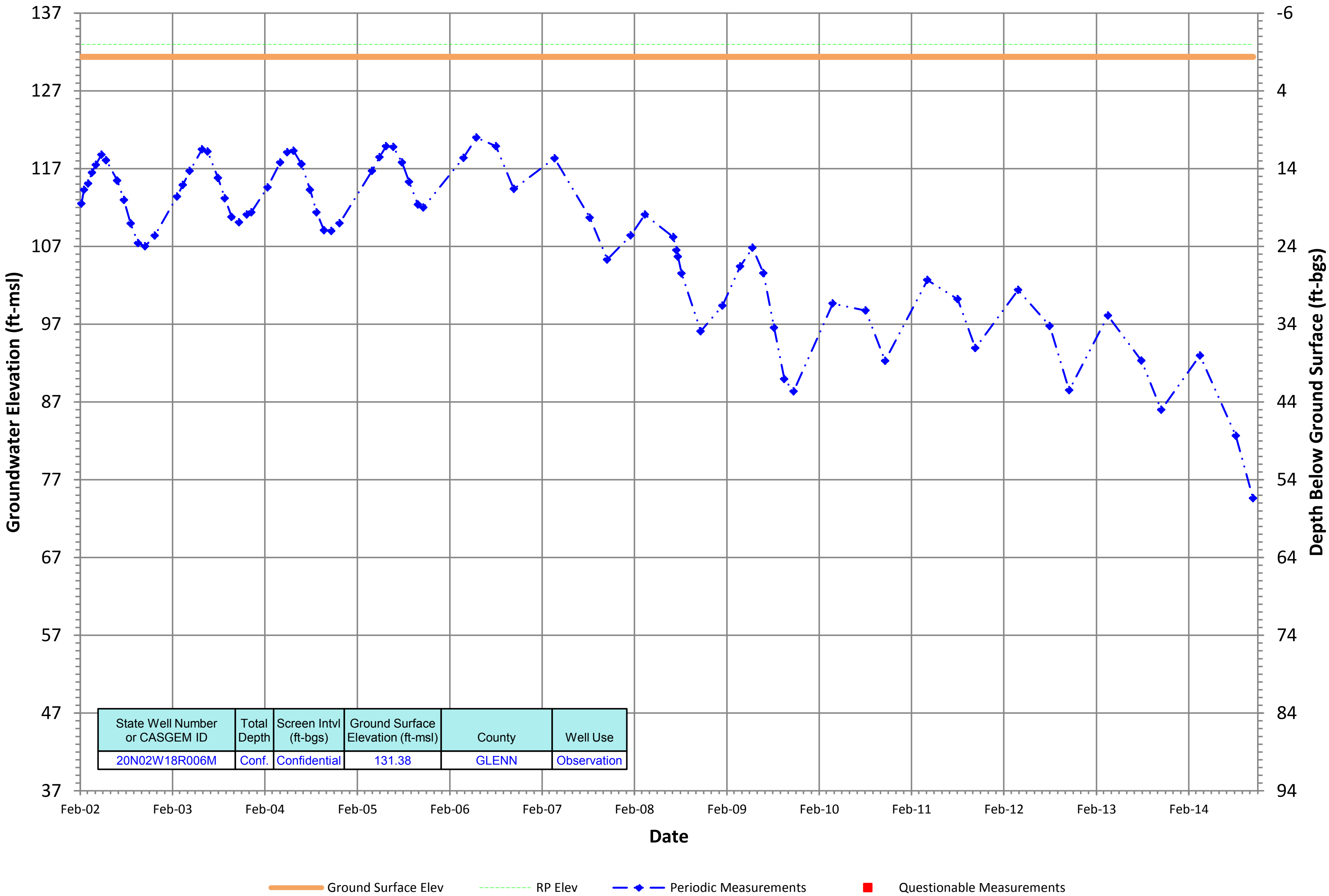
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02W08Q001M	Conf.	Confidential	108.36	GLENN	Observation



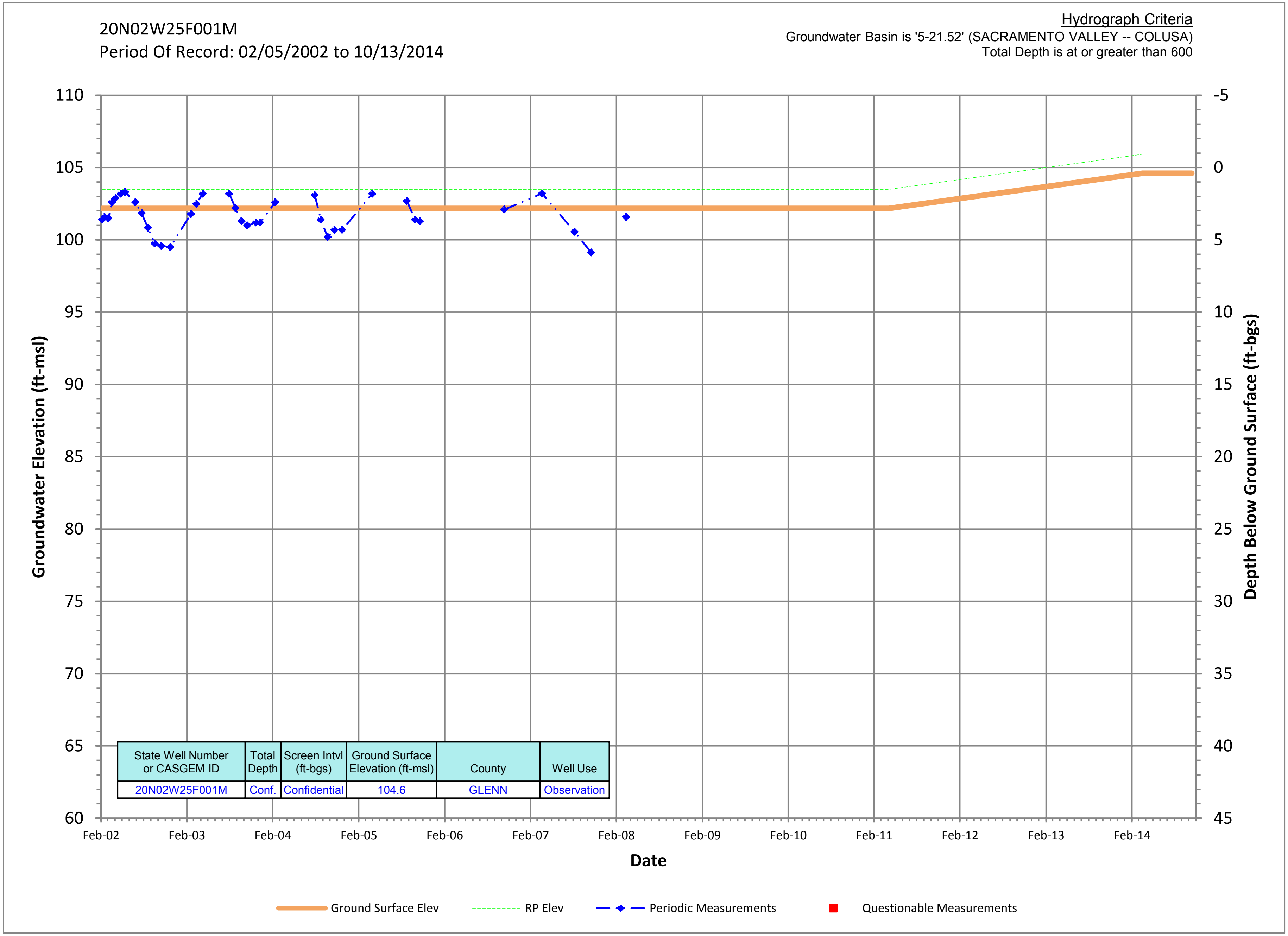
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W18R005M	Conf.	Confidential	131.35	GLENN	Observation

20N02W18R006M
Period Of Record: 02/05/2002 to 10/13/2014

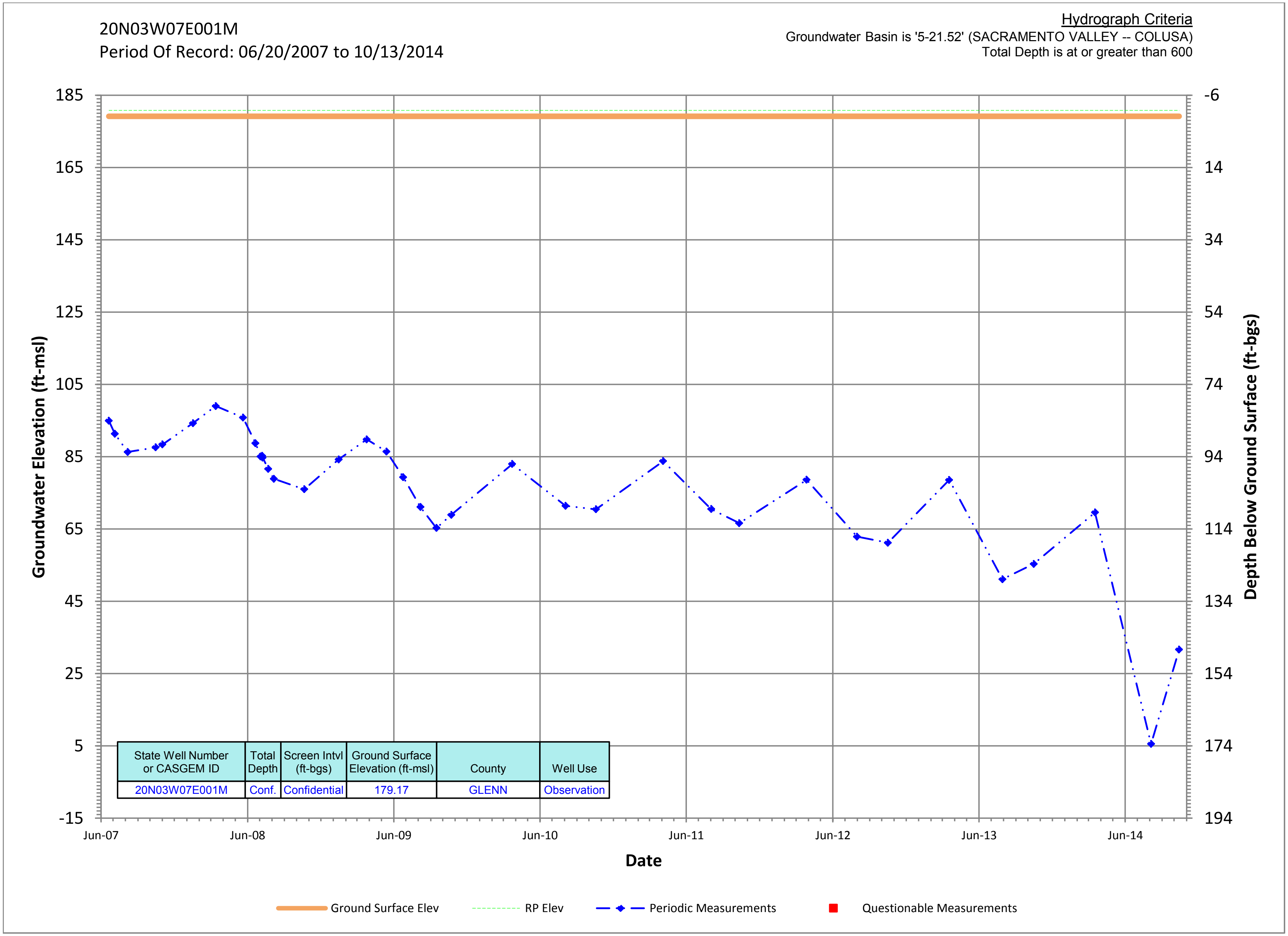
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W18R006M	Conf.	Confidential	131.38	GLENN	Observation



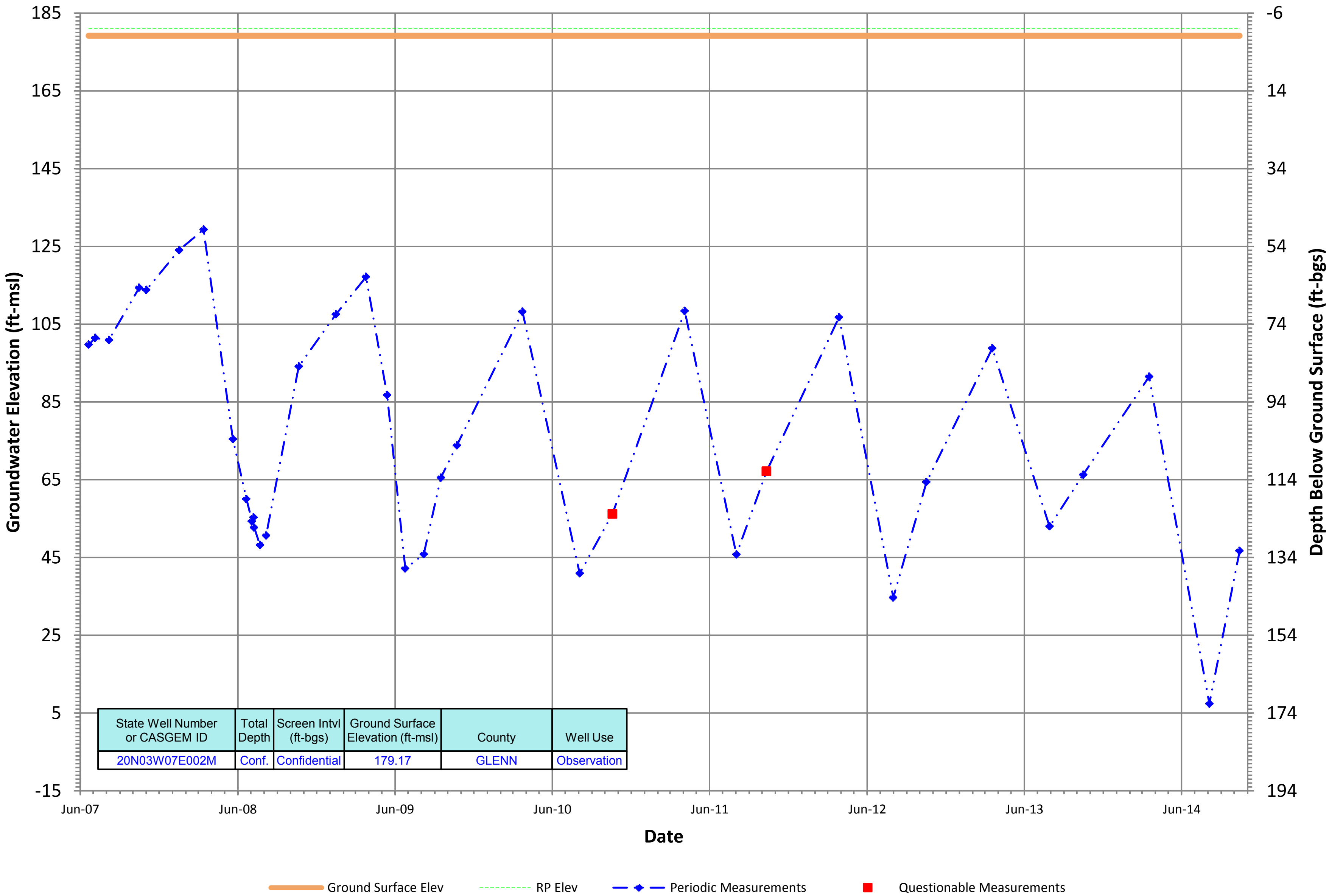
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02W25F001M	Conf.	Confidential	104.6	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W07E001M	Conf.	Confidential	179.17	GLENN	Observation

20N03W07E002M
Period Of Record: 06/20/2007 to 10/13/2014

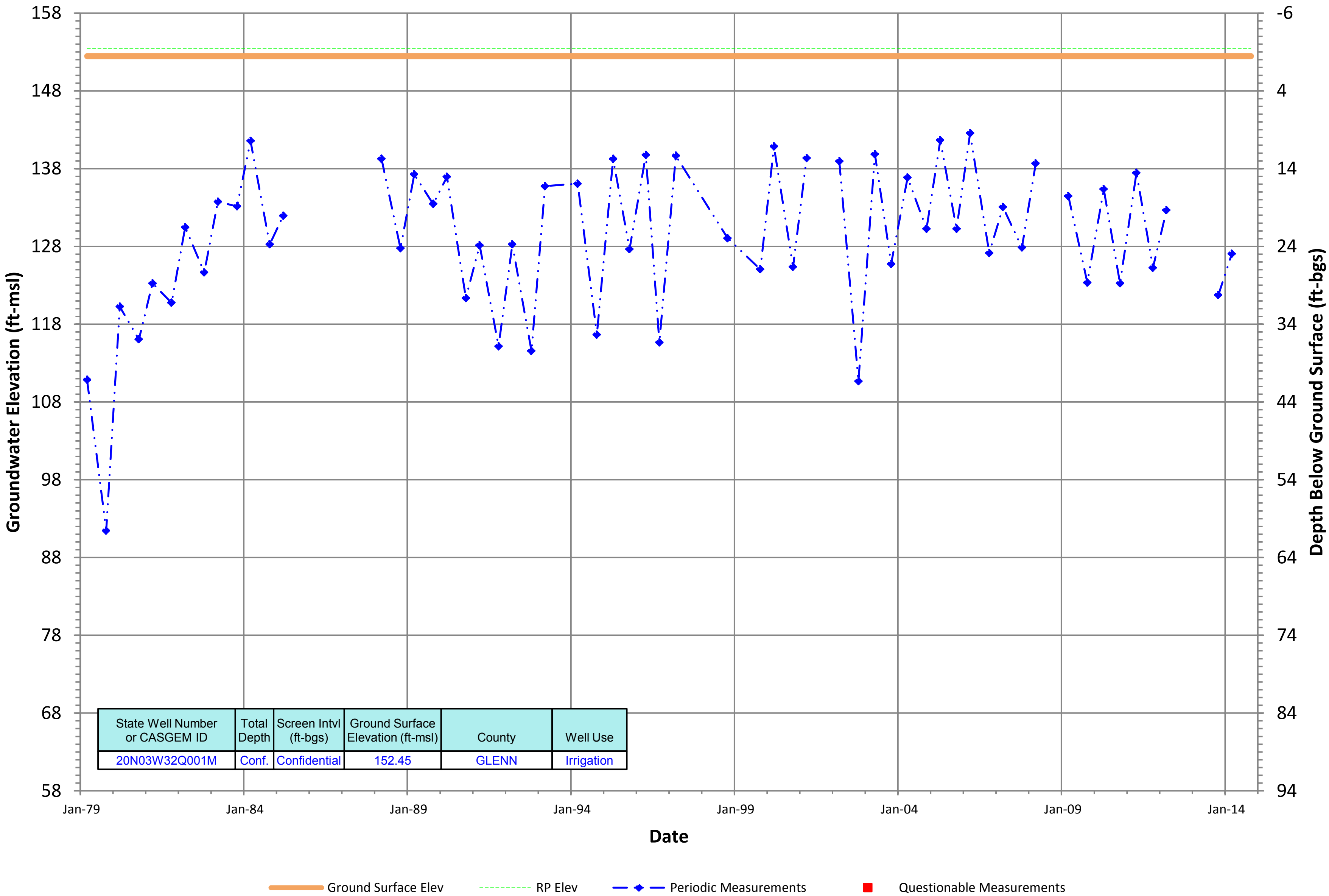
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



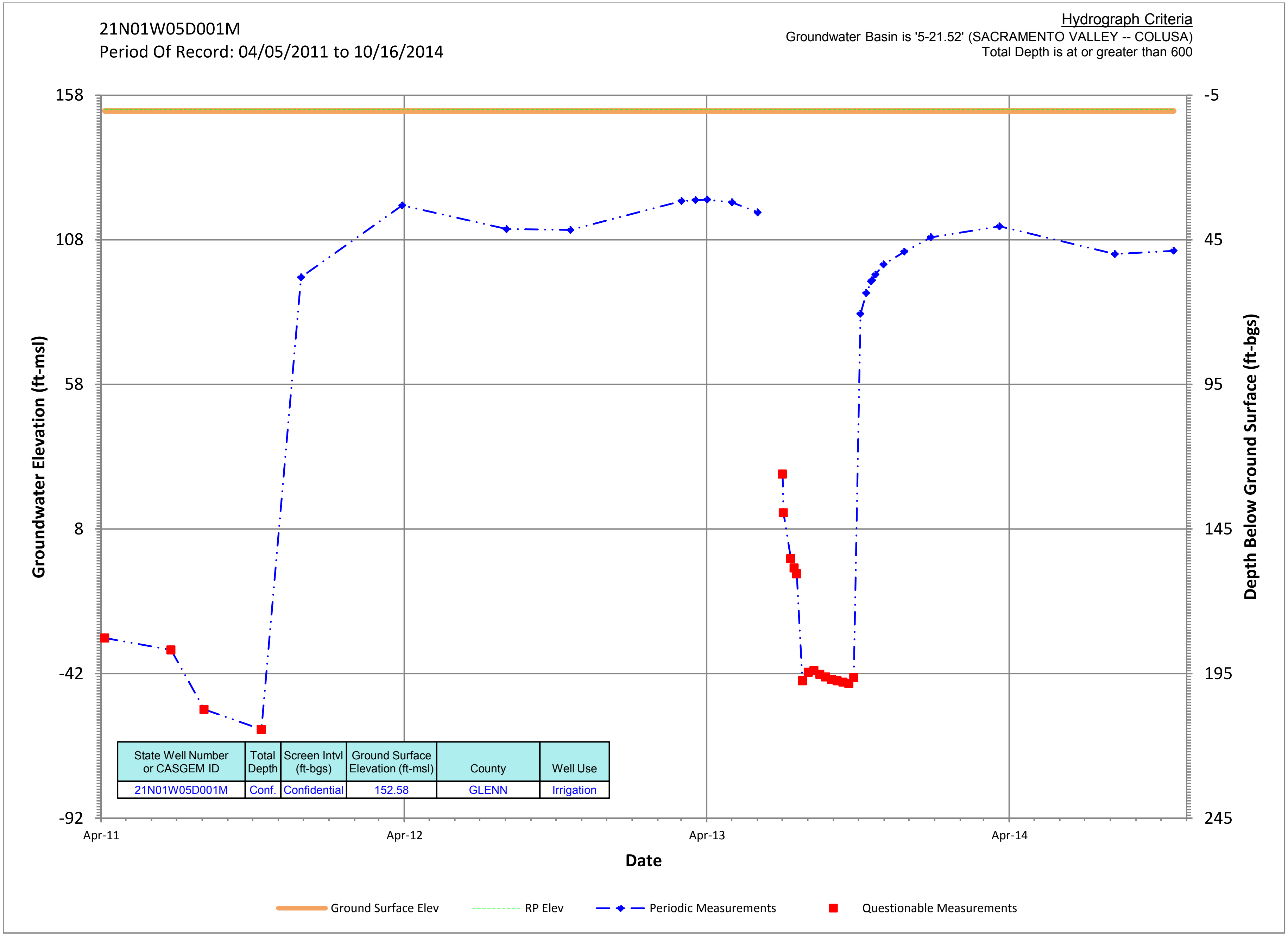
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W07E002M	Conf.	Confidential	179.17	GLENN	Observation

20N03W32Q001M
Period Of Record: 03/13/1979 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



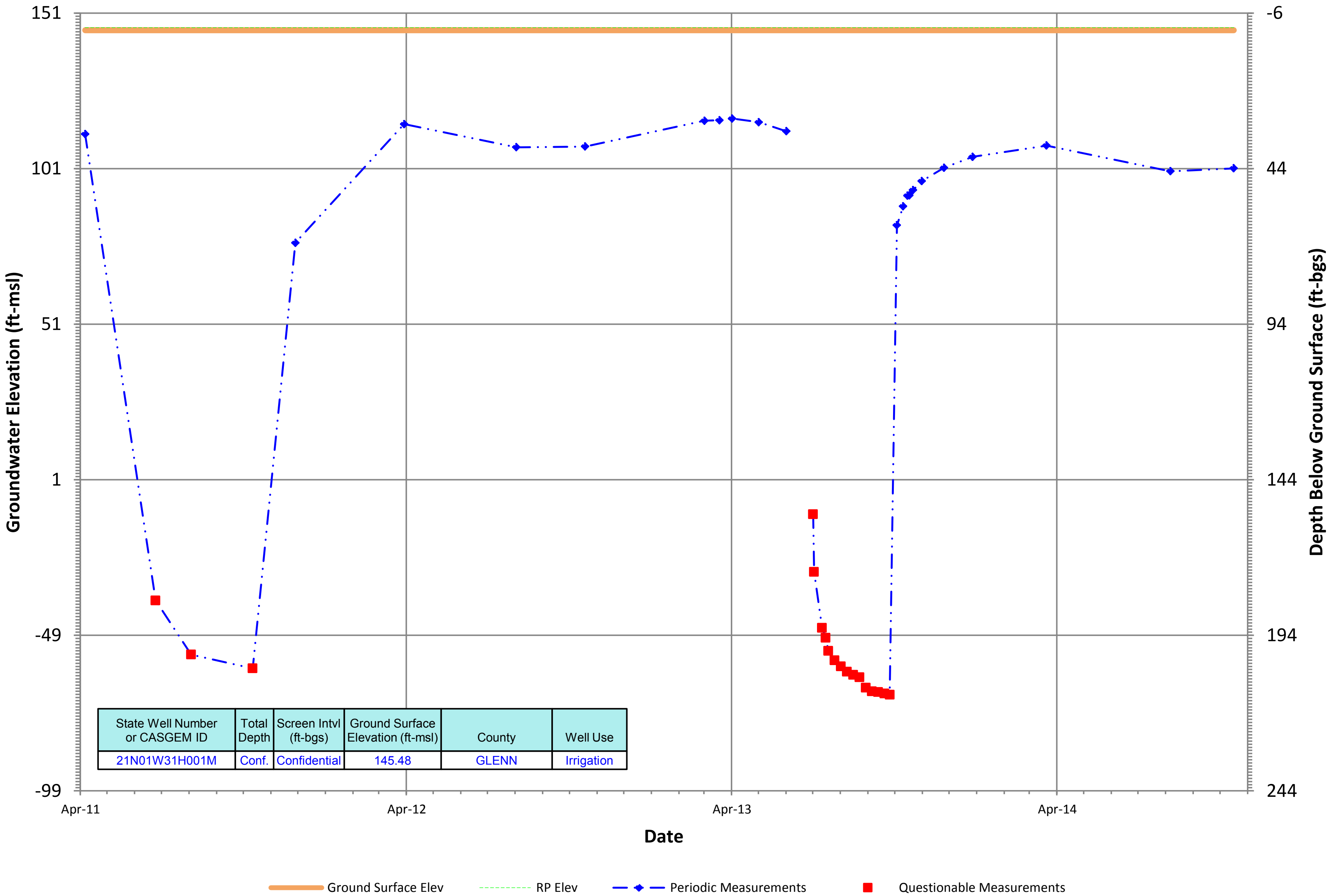
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03W32Q001M	Conf.	Confidential	152.45	GLENN	Irrigation



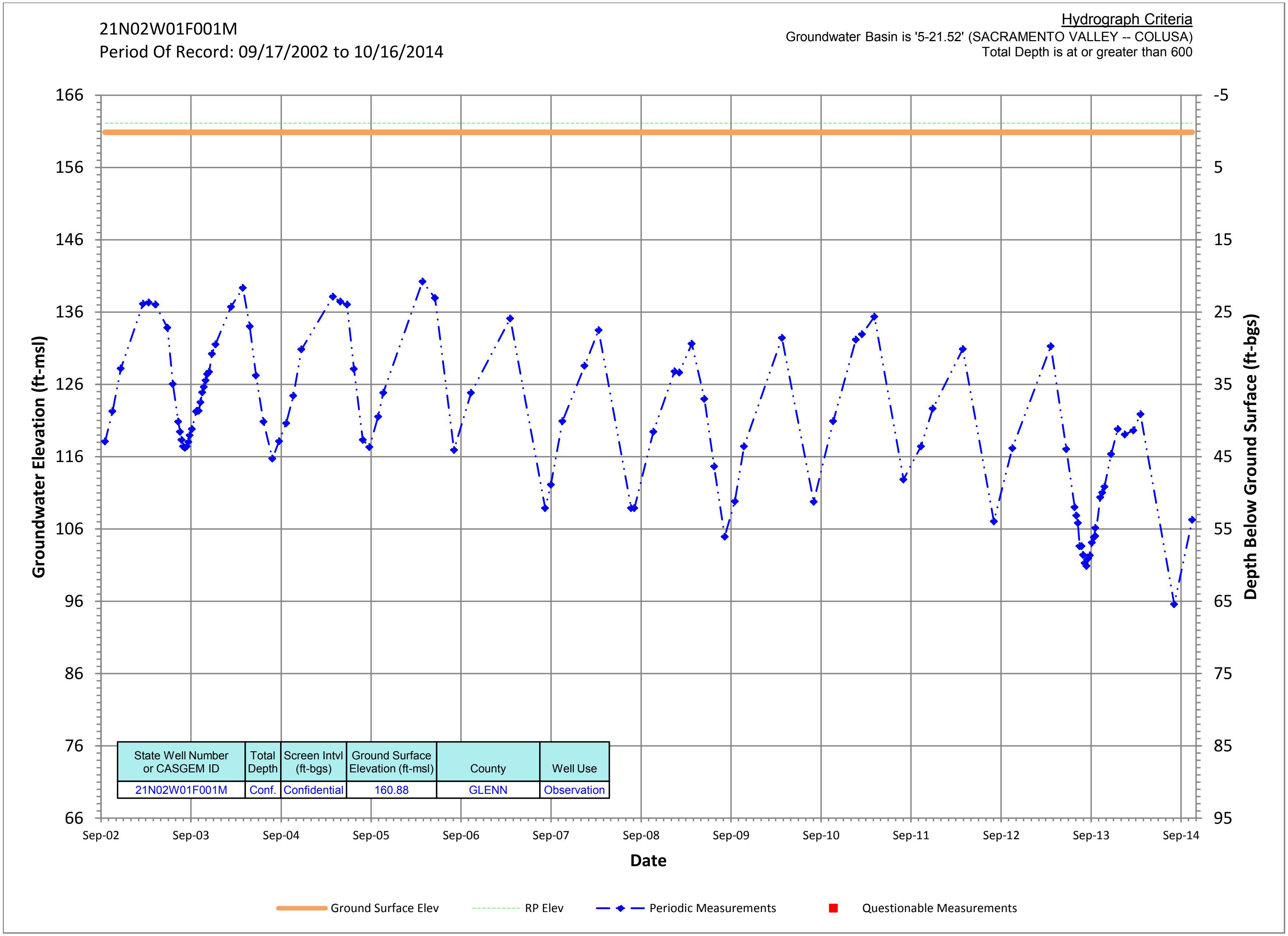
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W05D001M	Conf.	Confidential	152.58	GLENN	Irrigation

21N01W31H001M
Period Of Record: 04/06/2011 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



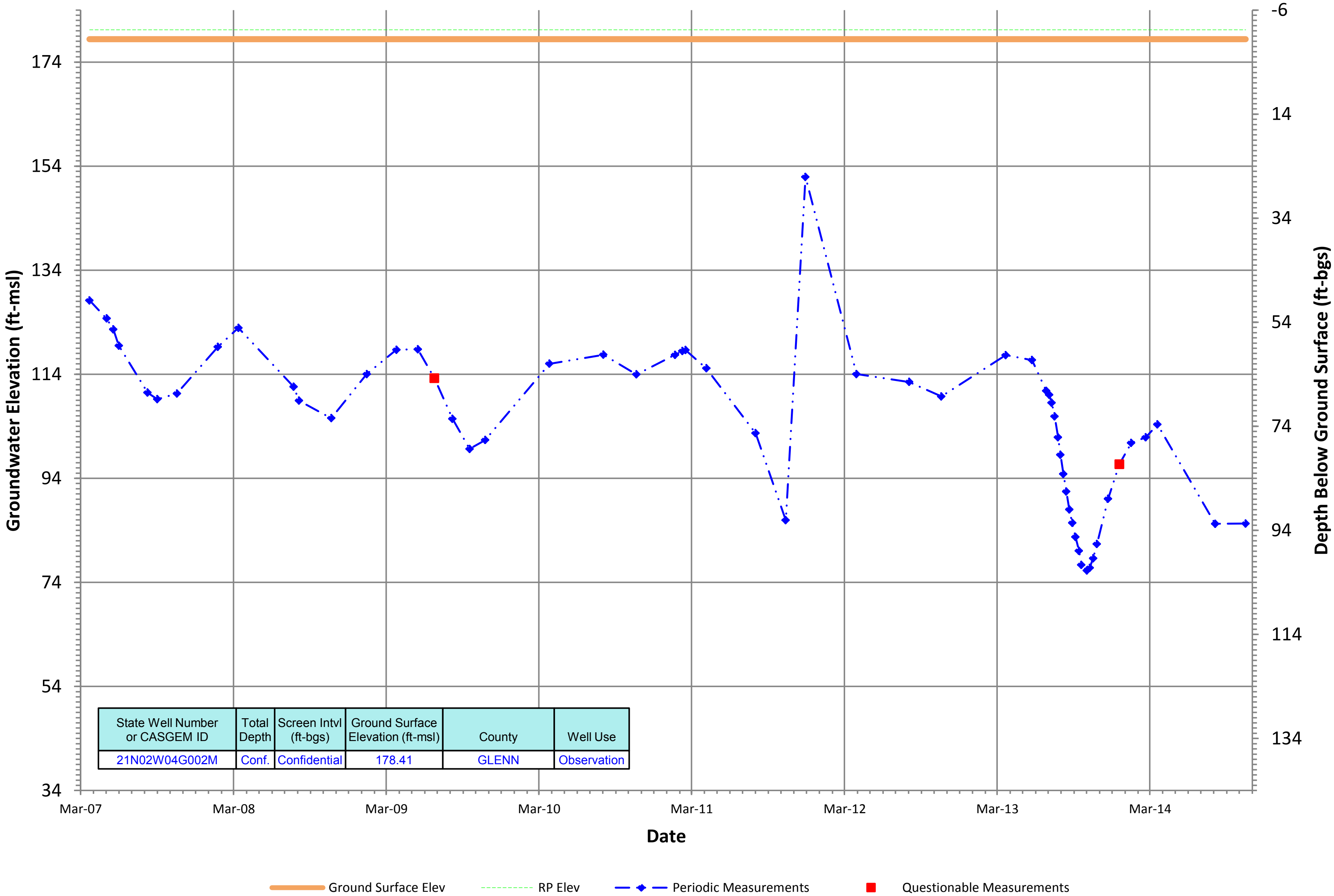
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W31H001M	Conf.	Confidential	145.48	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W01F001M	Conf.	Confidential	160.88	GLENN	Observation

21N02W04G002M
Period Of Record: 03/22/2007 to 10/16/2014

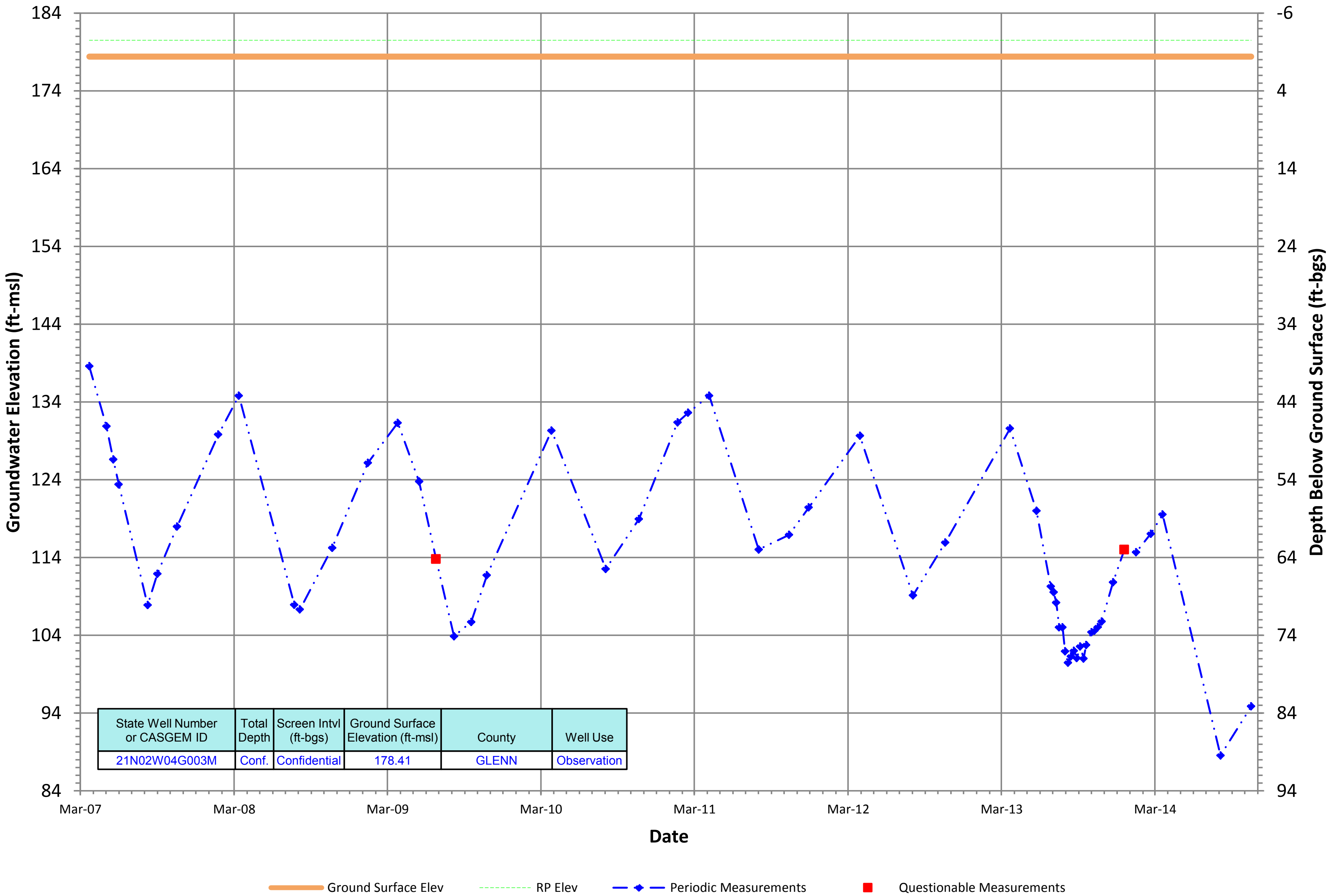
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



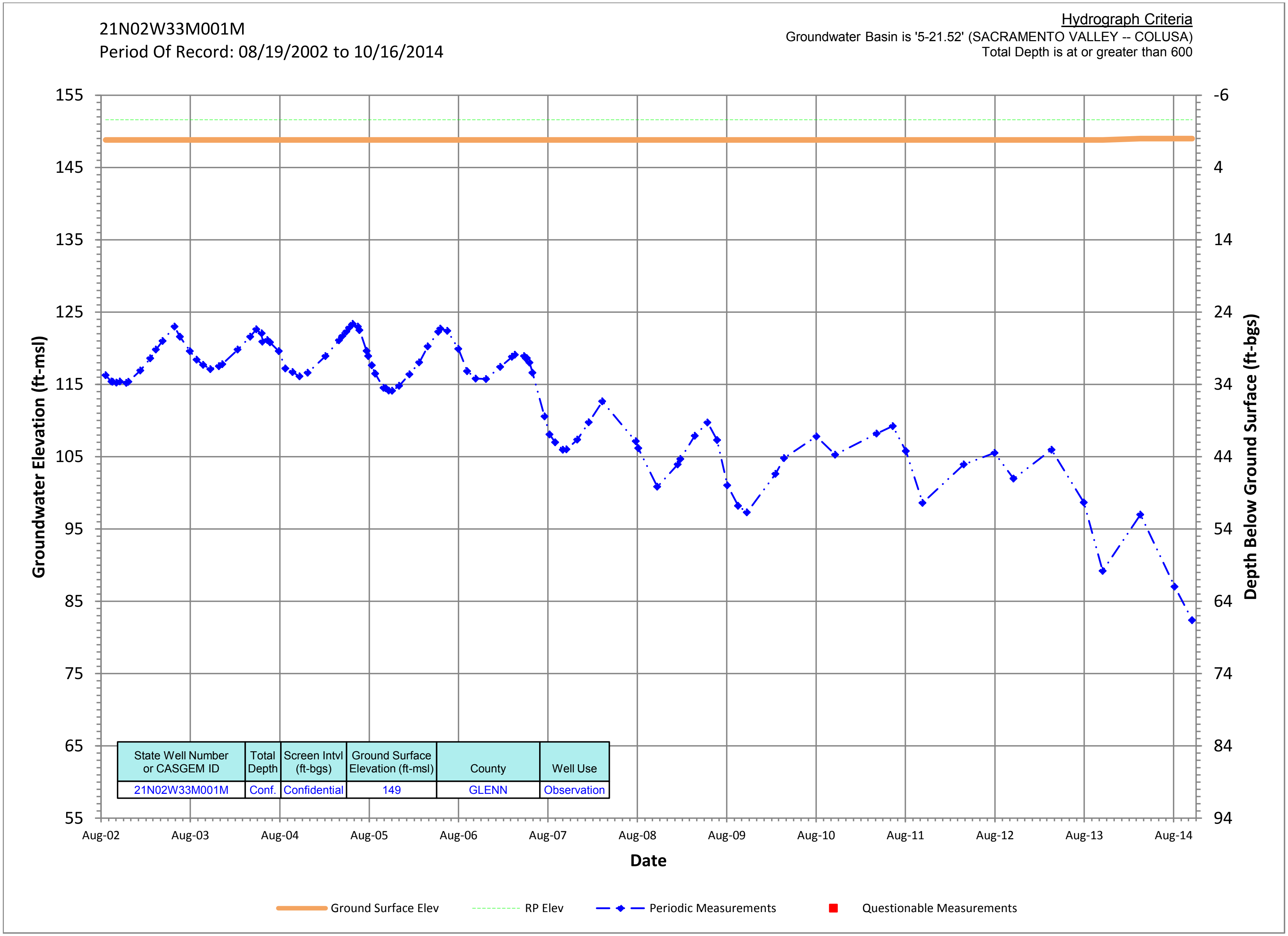
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W04G002M	Conf.	Confidential	178.41	GLENN	Observation

21N02W04G003M
Period Of Record: 03/22/2007 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



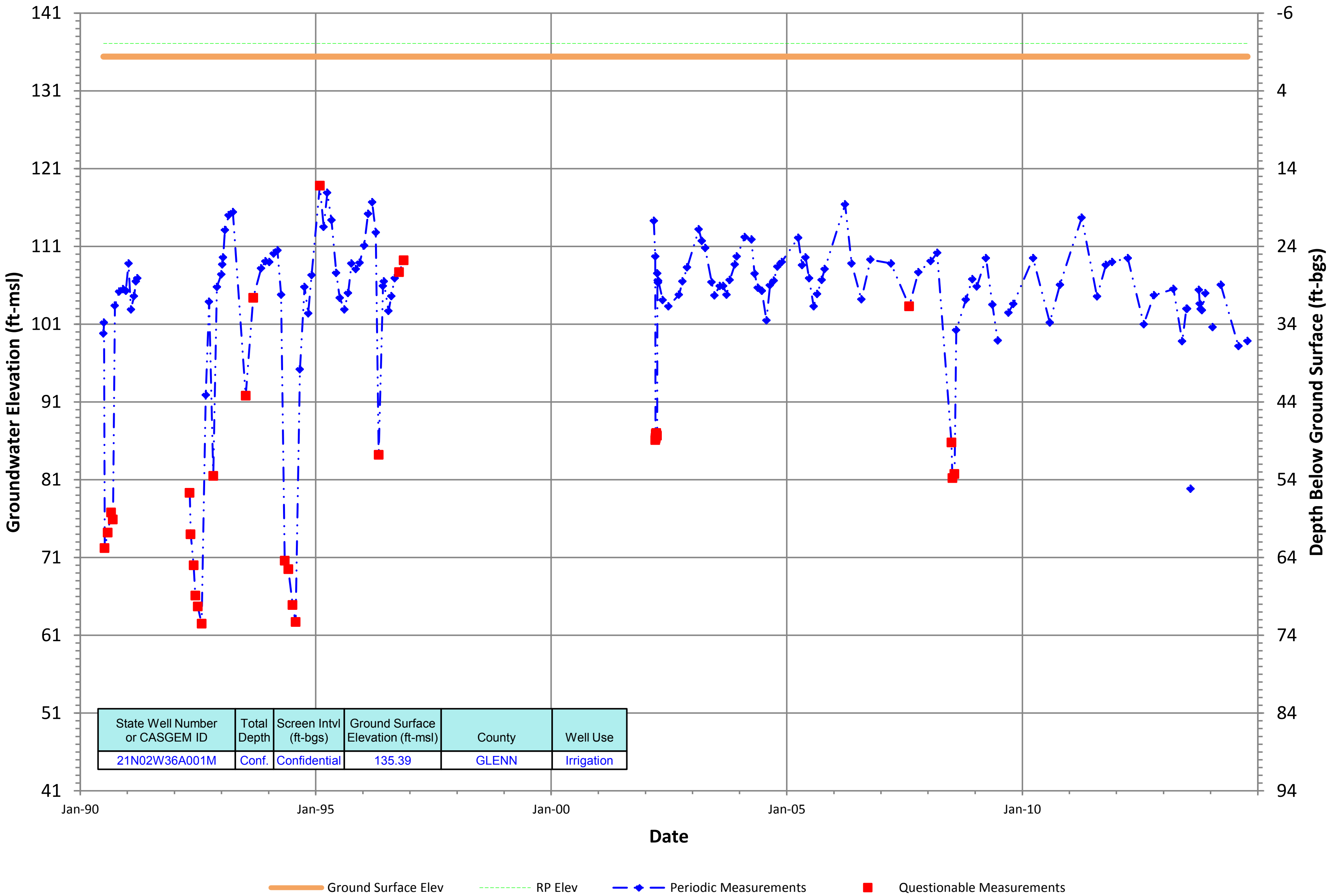
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W04G003M	Conf.	Confidential	178.41	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W33M001M	Conf.	Confidential	149	GLENN	Observation

21N02W36A001M
Period Of Record: 06/29/1990 to 10/13/2014

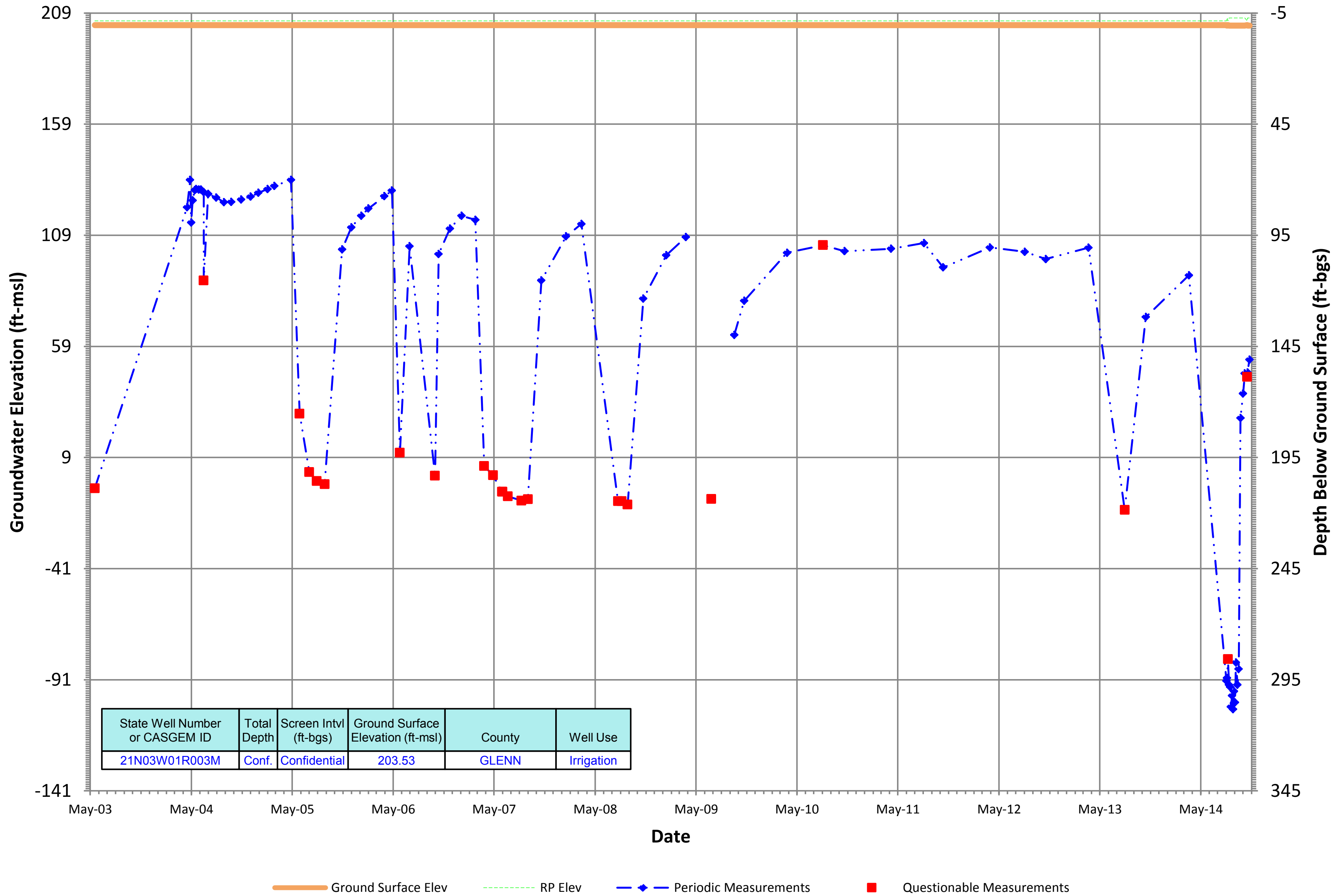
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02W36A001M	Conf.	Confidential	135.39	GLENN	Irrigation

21N03W01R003M
Period Of Record: 05/17/2003 to 10/24/2014

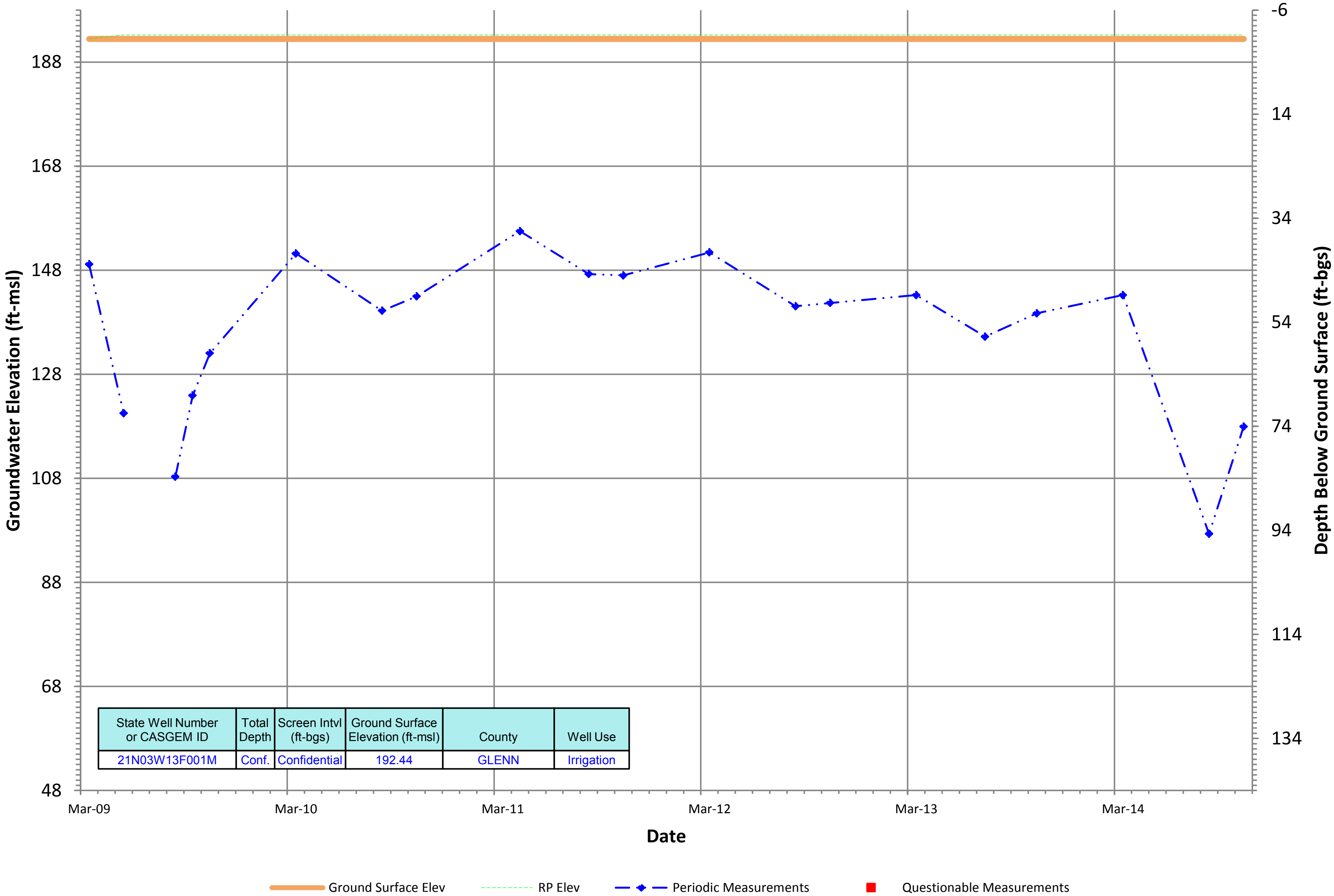
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W01R003M	Conf.	Confidential	203.53	GLENN	Irrigation

21N03W13F001M
Period Of Record: 03/25/2009 to 10/16/2014

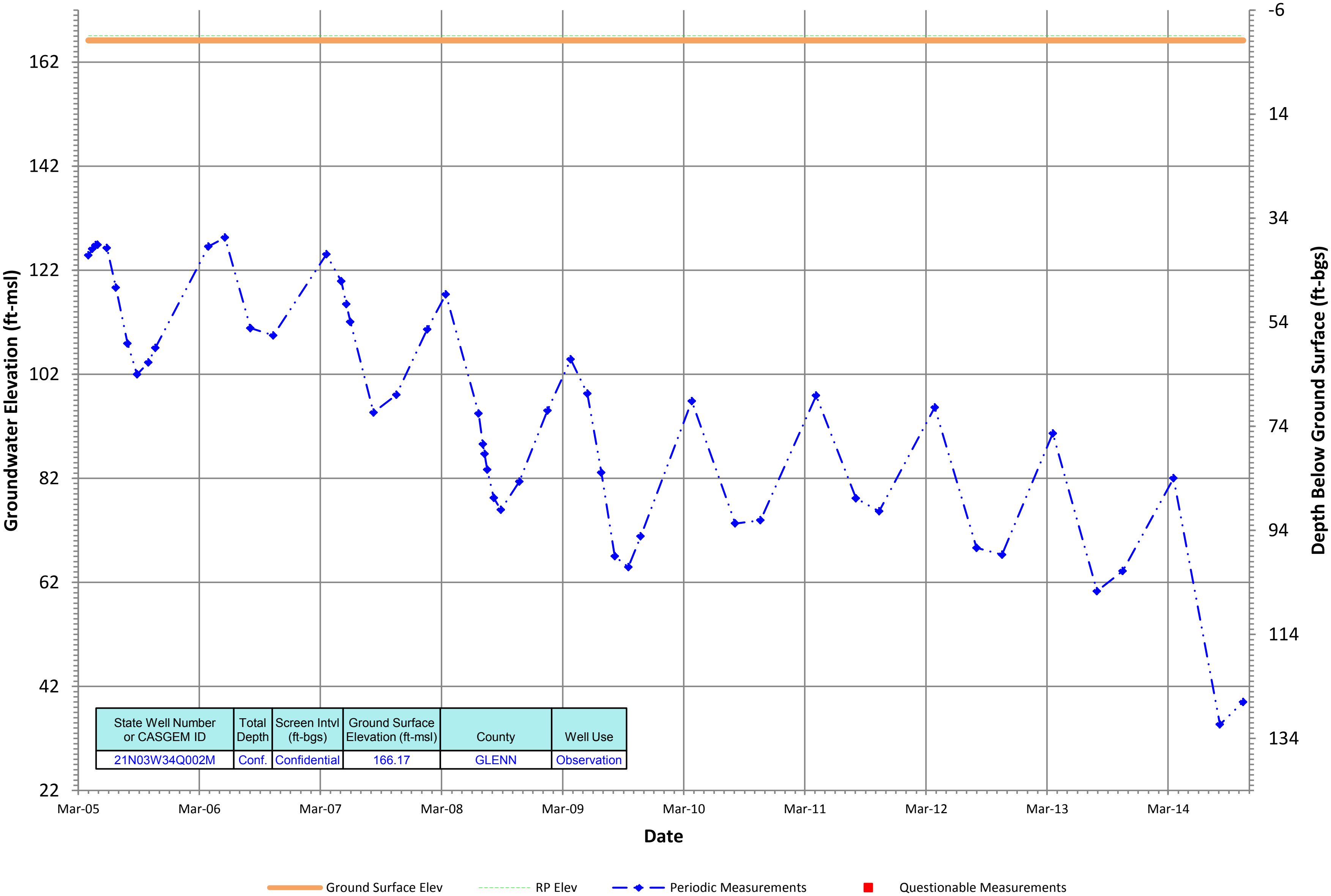
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



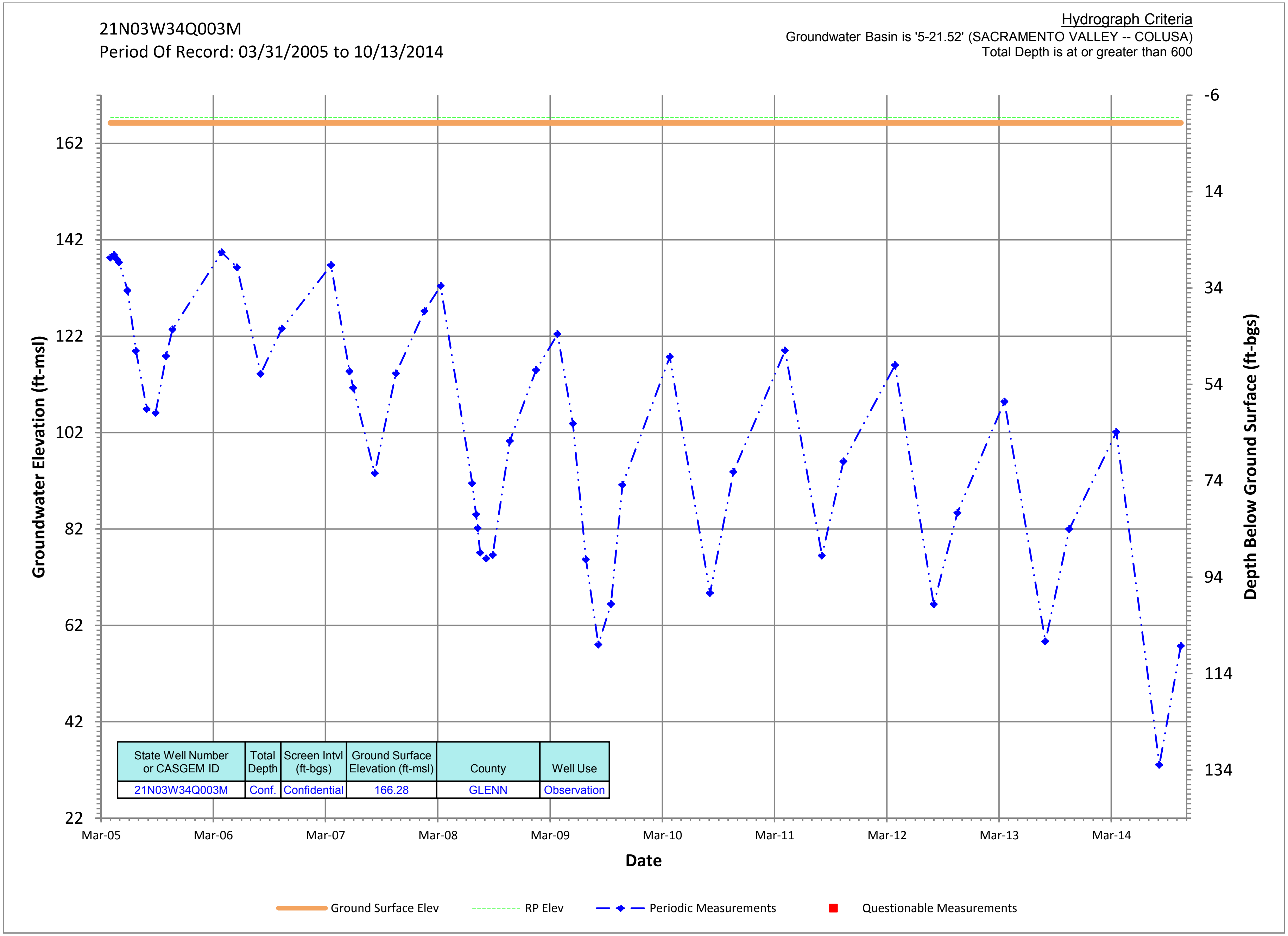
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W13F001M	Conf.	Confidential	192.44	GLENN	Irrigation

21N03W34Q002M
Period Of Record: 03/31/2005 to 10/13/2014

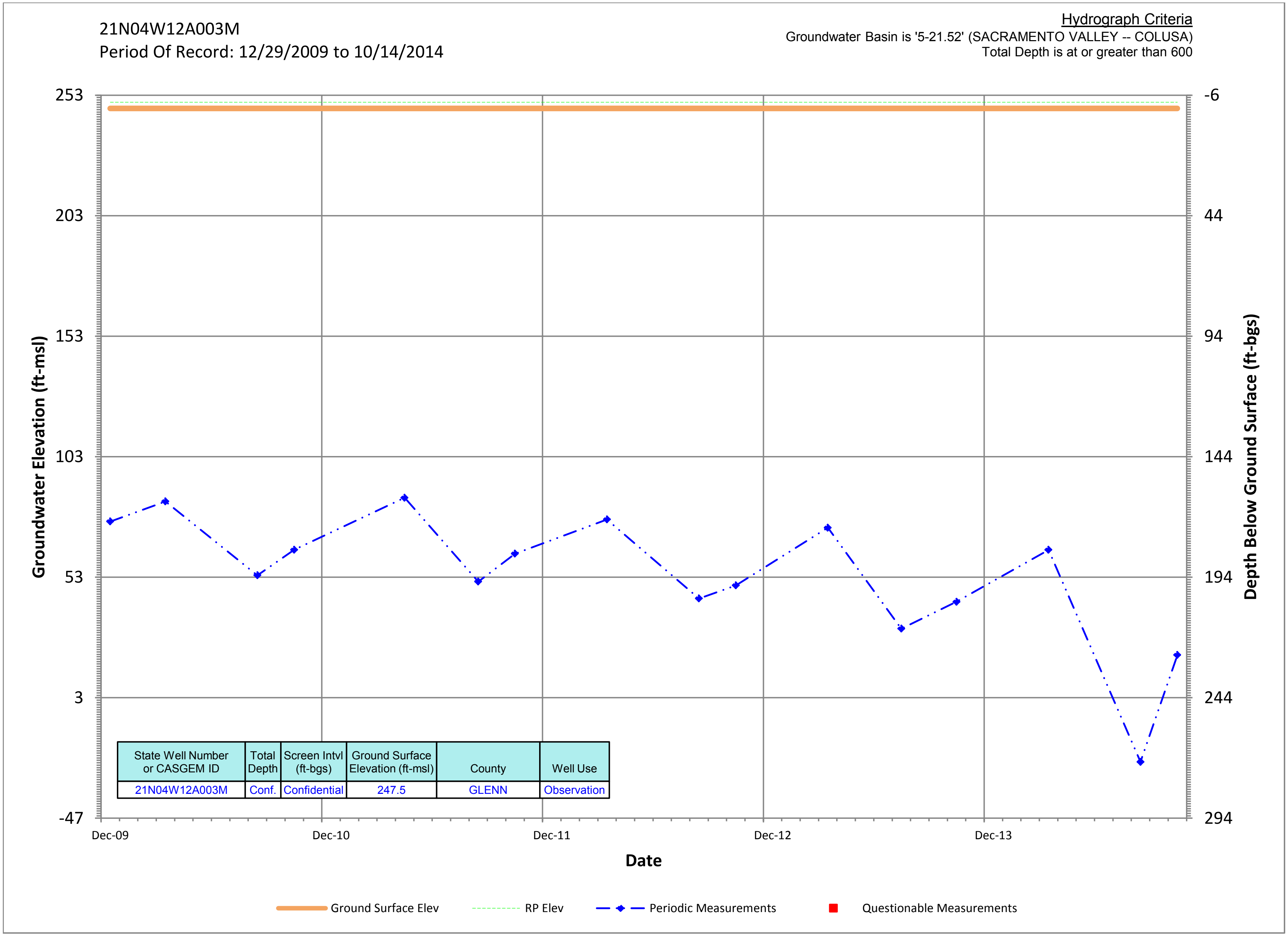
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W34Q002M	Conf.	Confidential	166.17	GLENN	Observation



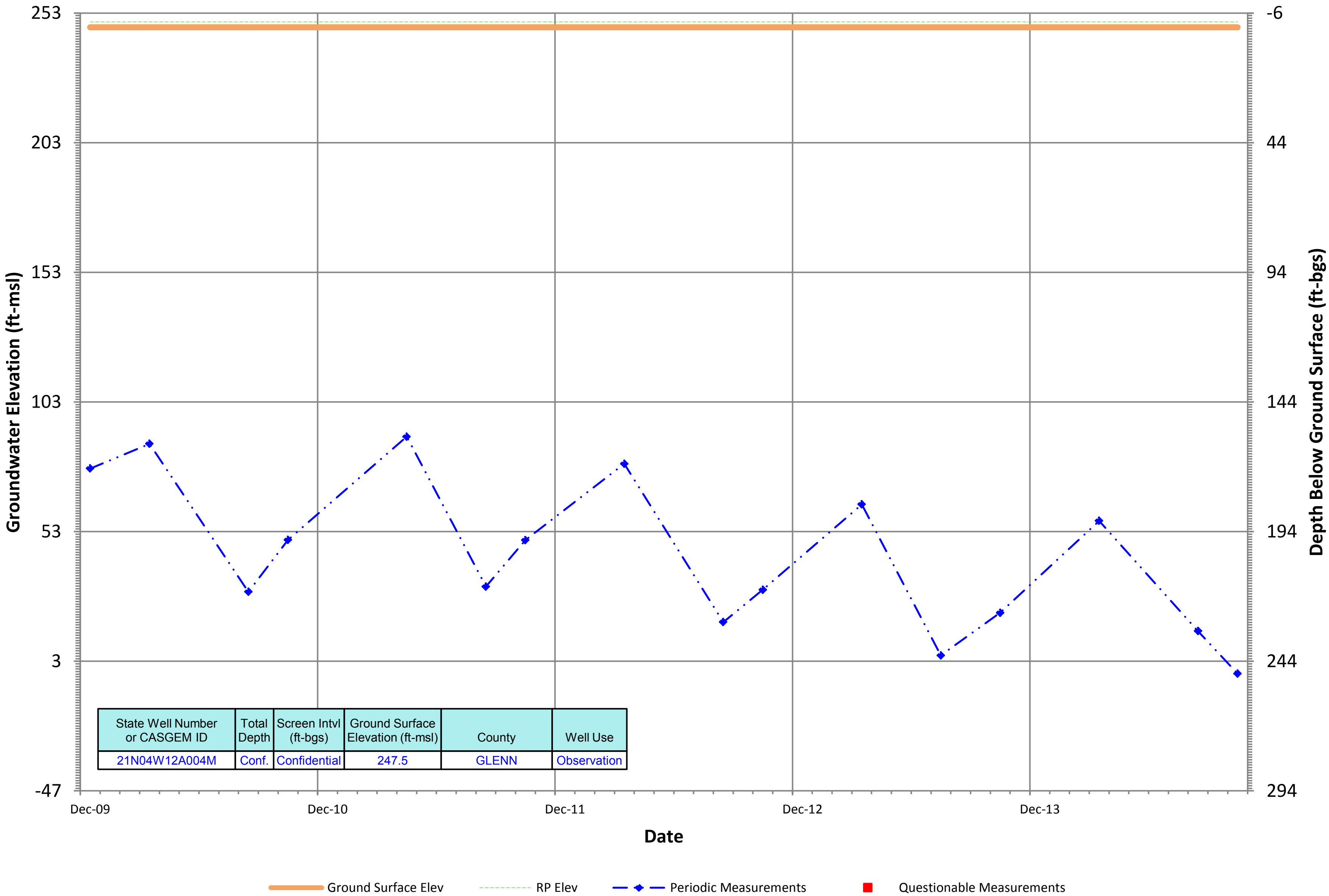
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03W34Q003M	Conf.	Confidential	166.28	GLENN	Observation



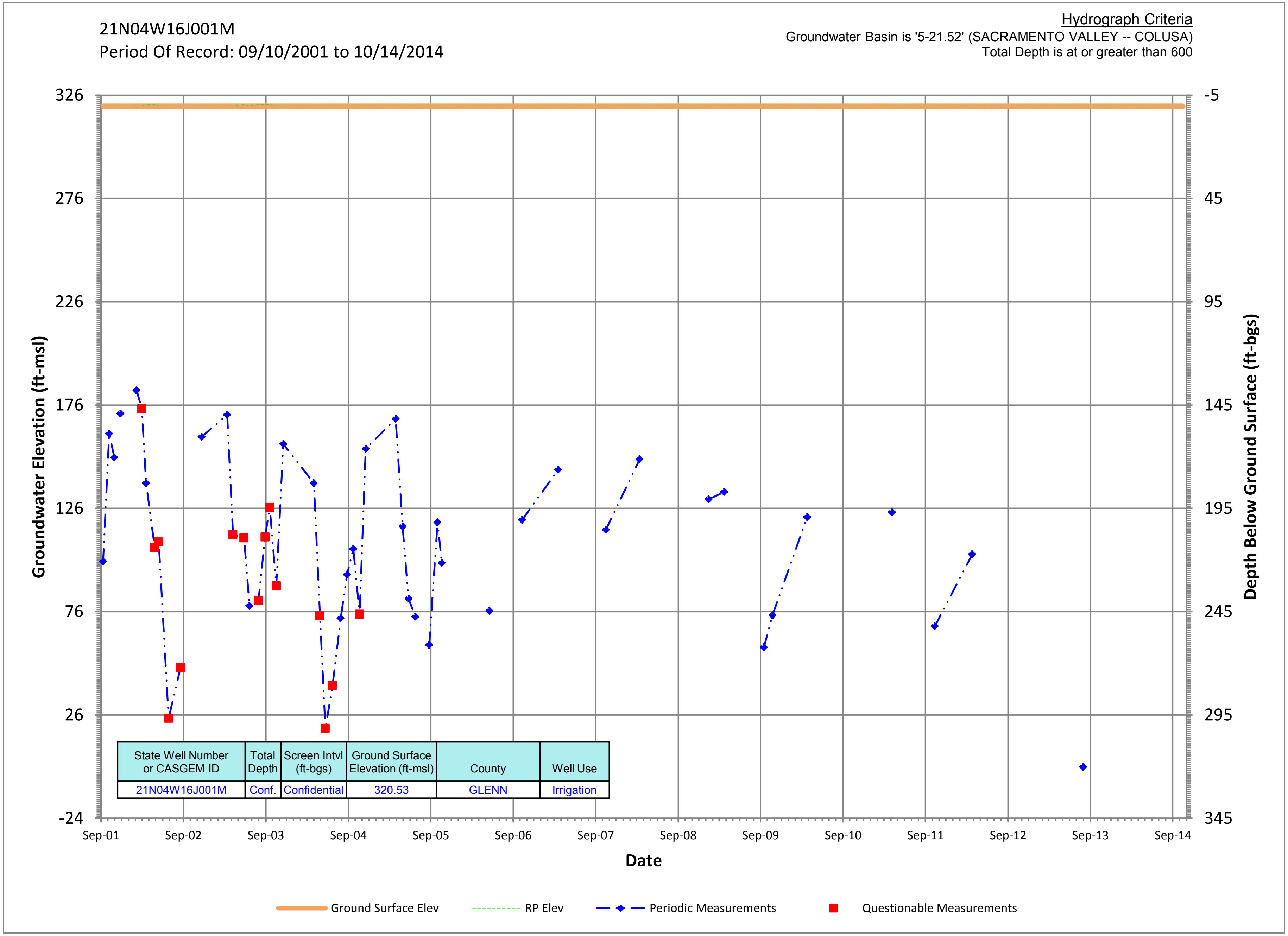
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N04W12A003M	Conf.	Confidential	247.5	GLENN	Observation

21N04W12A004M
Period Of Record: 12/29/2009 to 10/14/2014

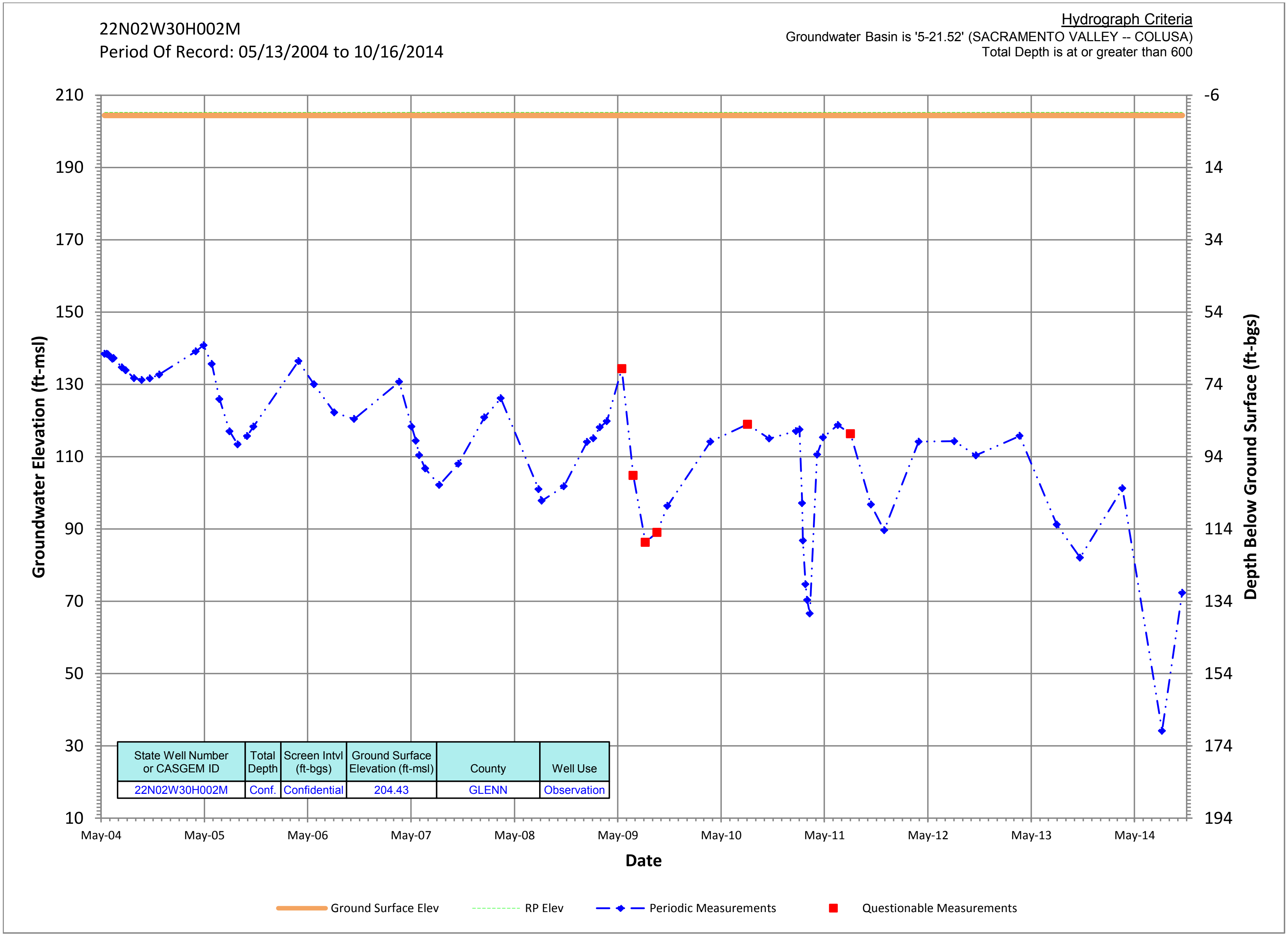
Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N04W12A004M	Conf.	Confidential	247.5	GLENN	Observation



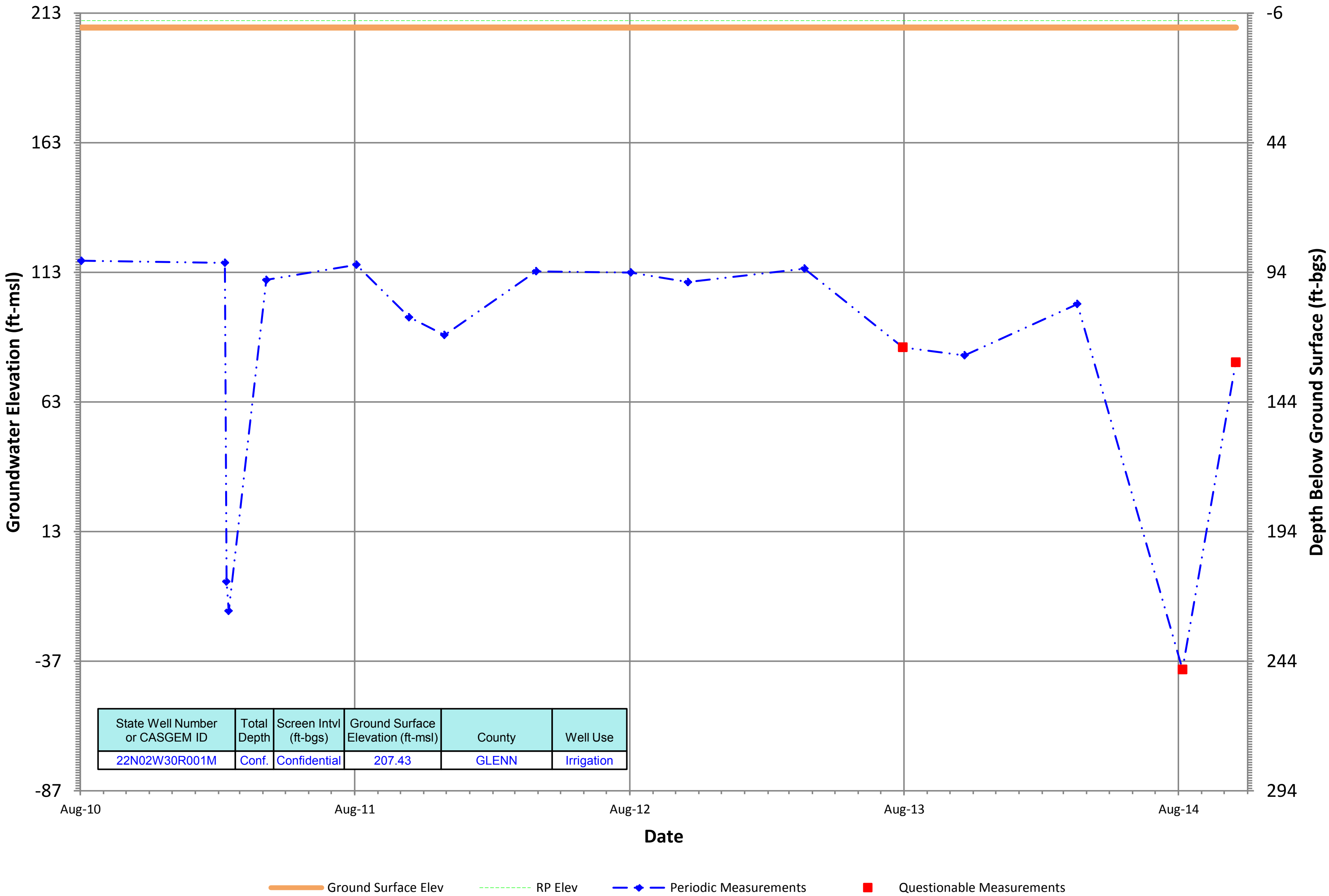
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N04W16J001M	Conf.	Confidential	320.53	GLENN	Irrigation



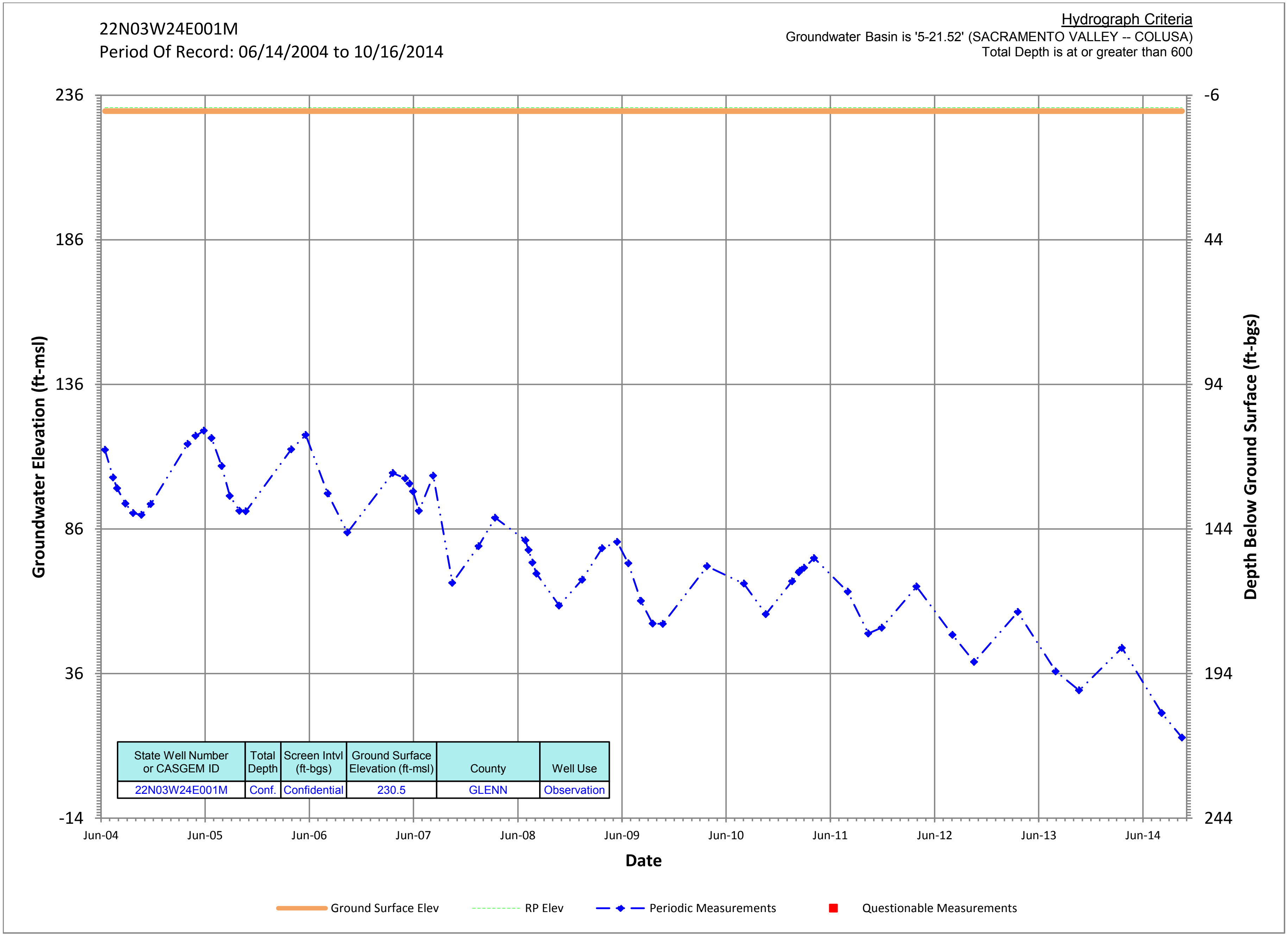
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W30H002M	Conf.	Confidential	204.43	GLENN	Observation

22N02W30R001M
Period Of Record: 08/02/2010 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.52' (SACRAMENTO VALLEY -- COLUSA)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W30R001M	Conf.	Confidential	207.43	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W24E001M	Conf.	Confidential	230.5	GLENN	Observation

Shallow Groundwater Monitoring Well Hydrographs- Corning Subbasin

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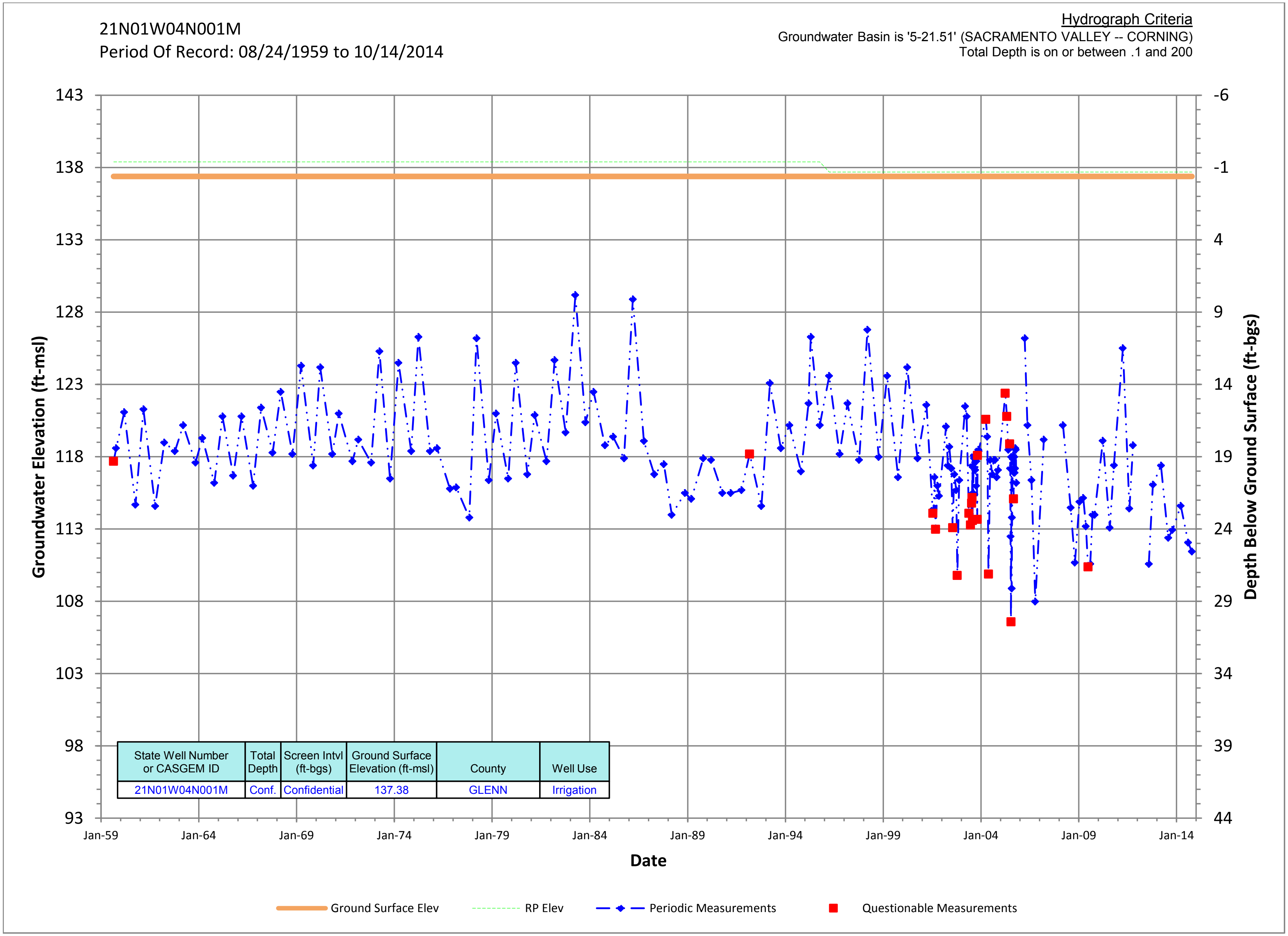
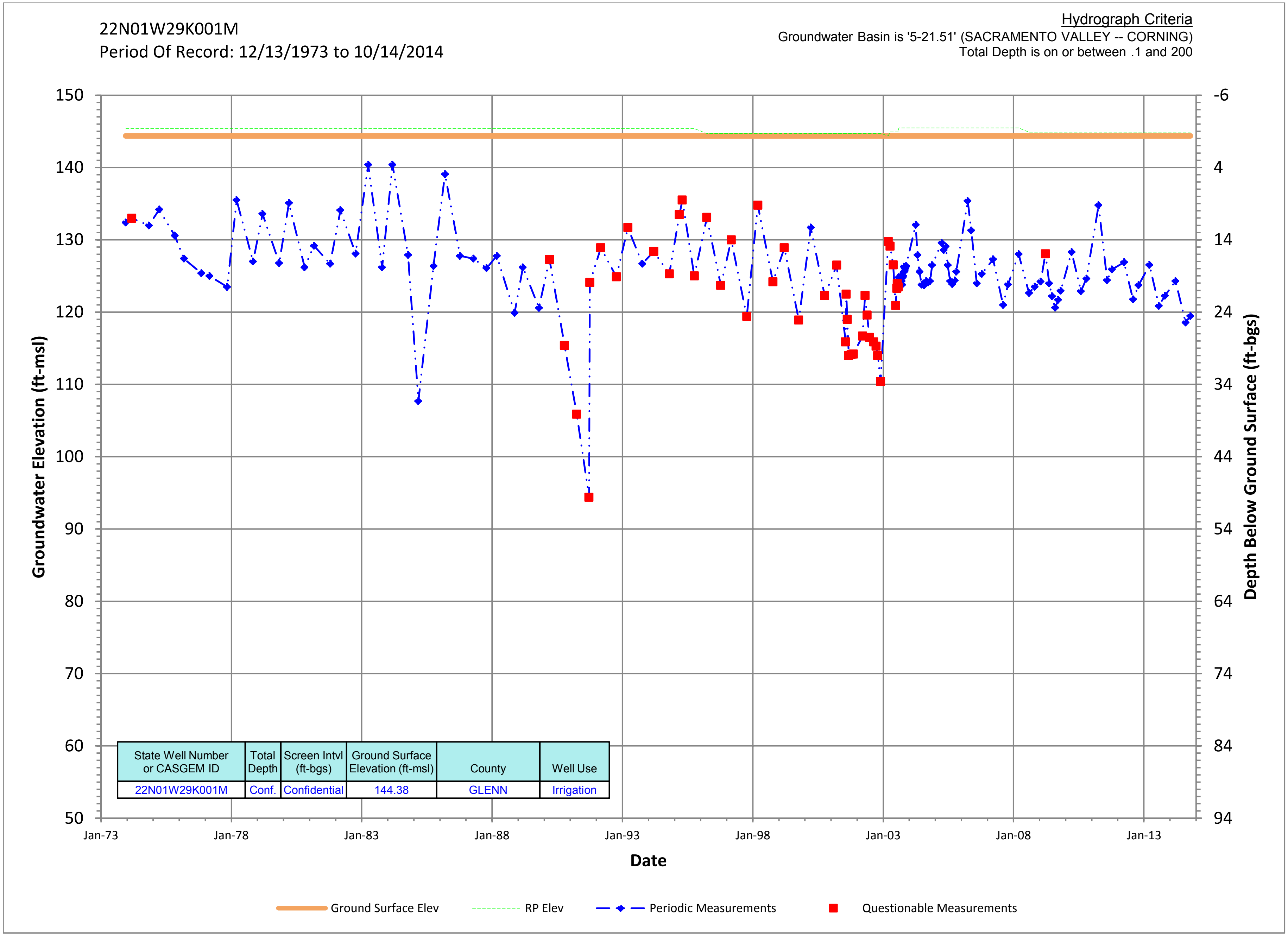
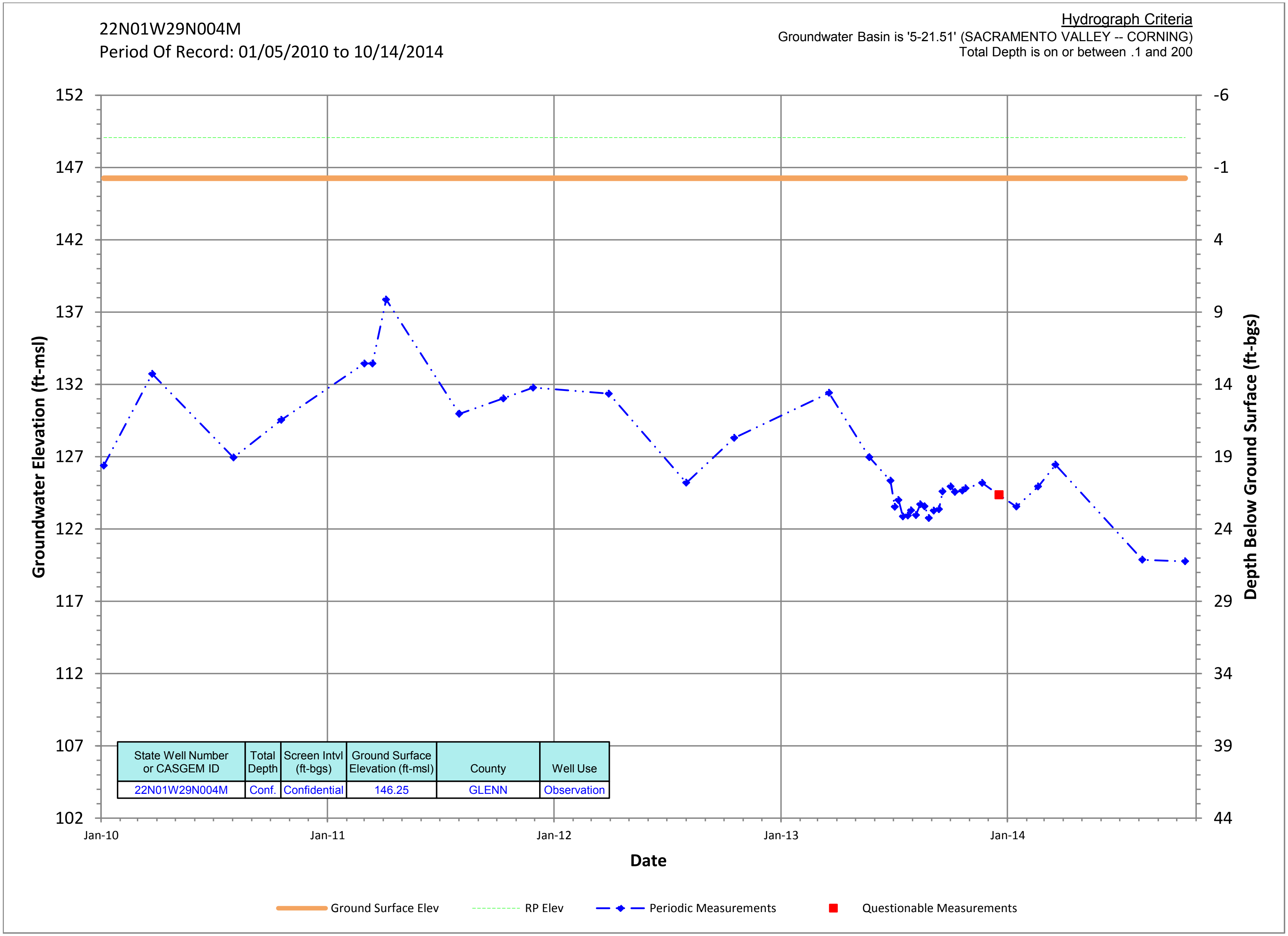


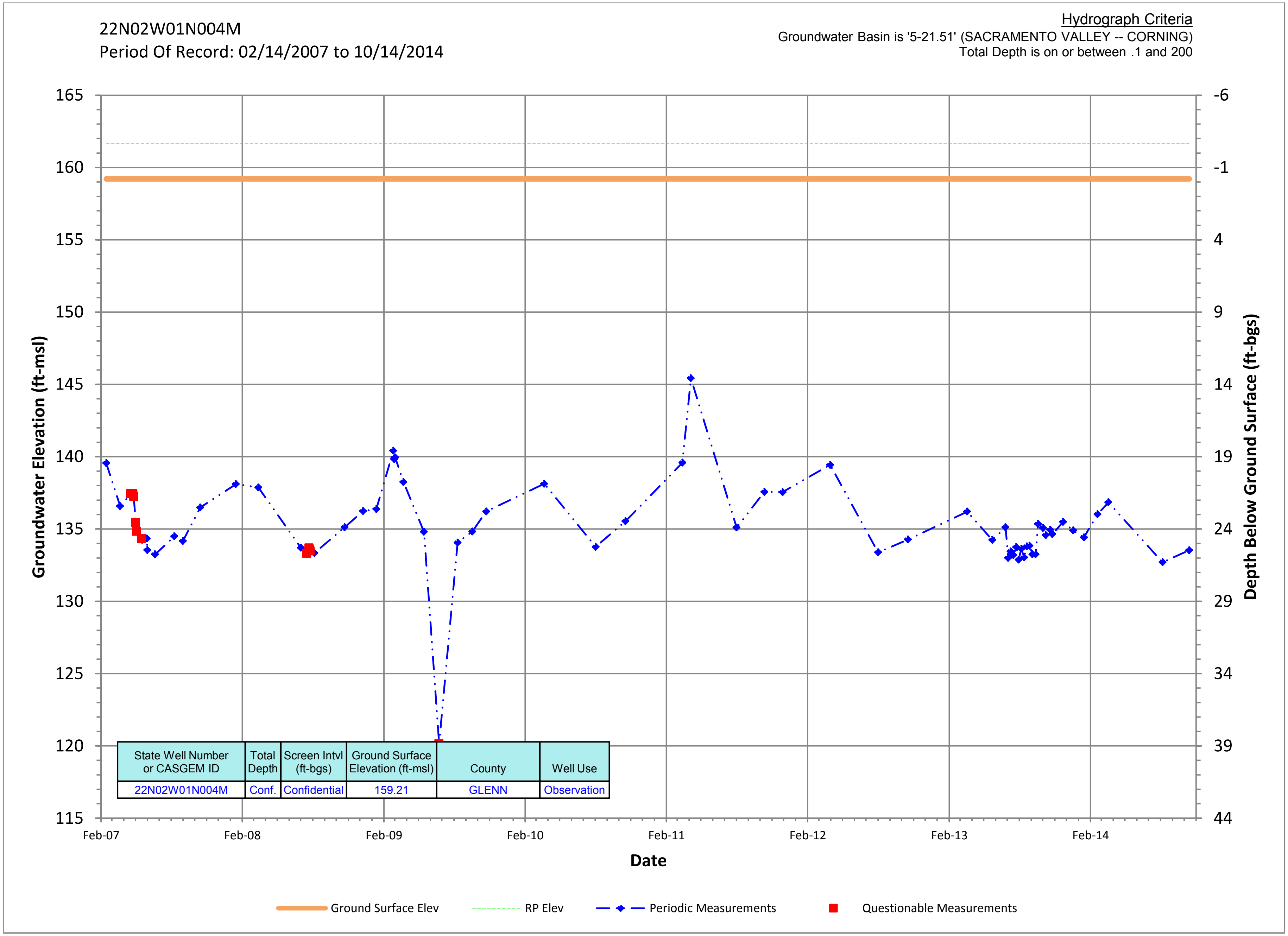
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W04N001M	Conf.	Confidential	137.38	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N01W29K001M	Conf.	Confidential	144.38	GLENN	Irrigation



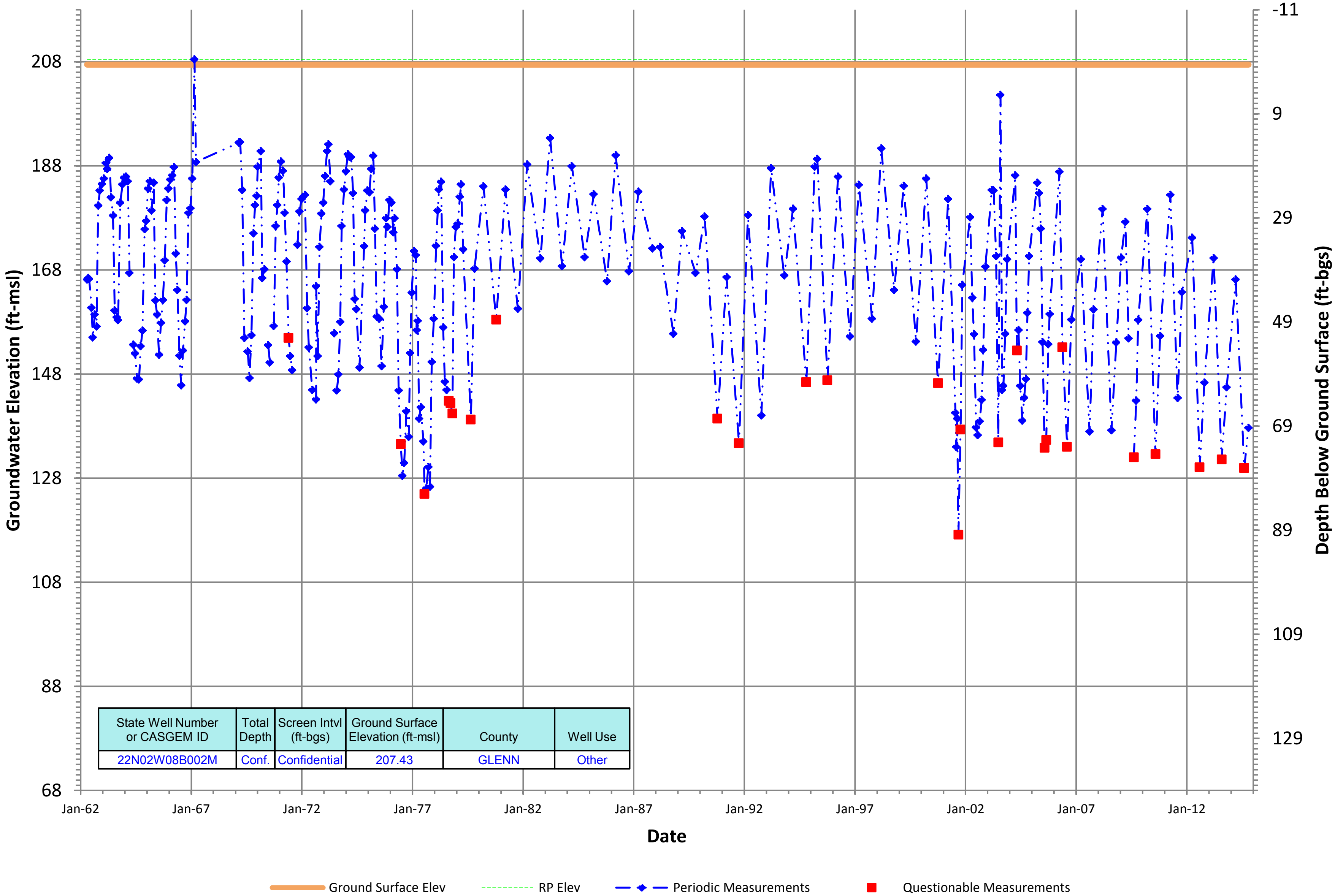
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N01W29N004M	Conf.	Confidential	146.25	GLENN	Observation



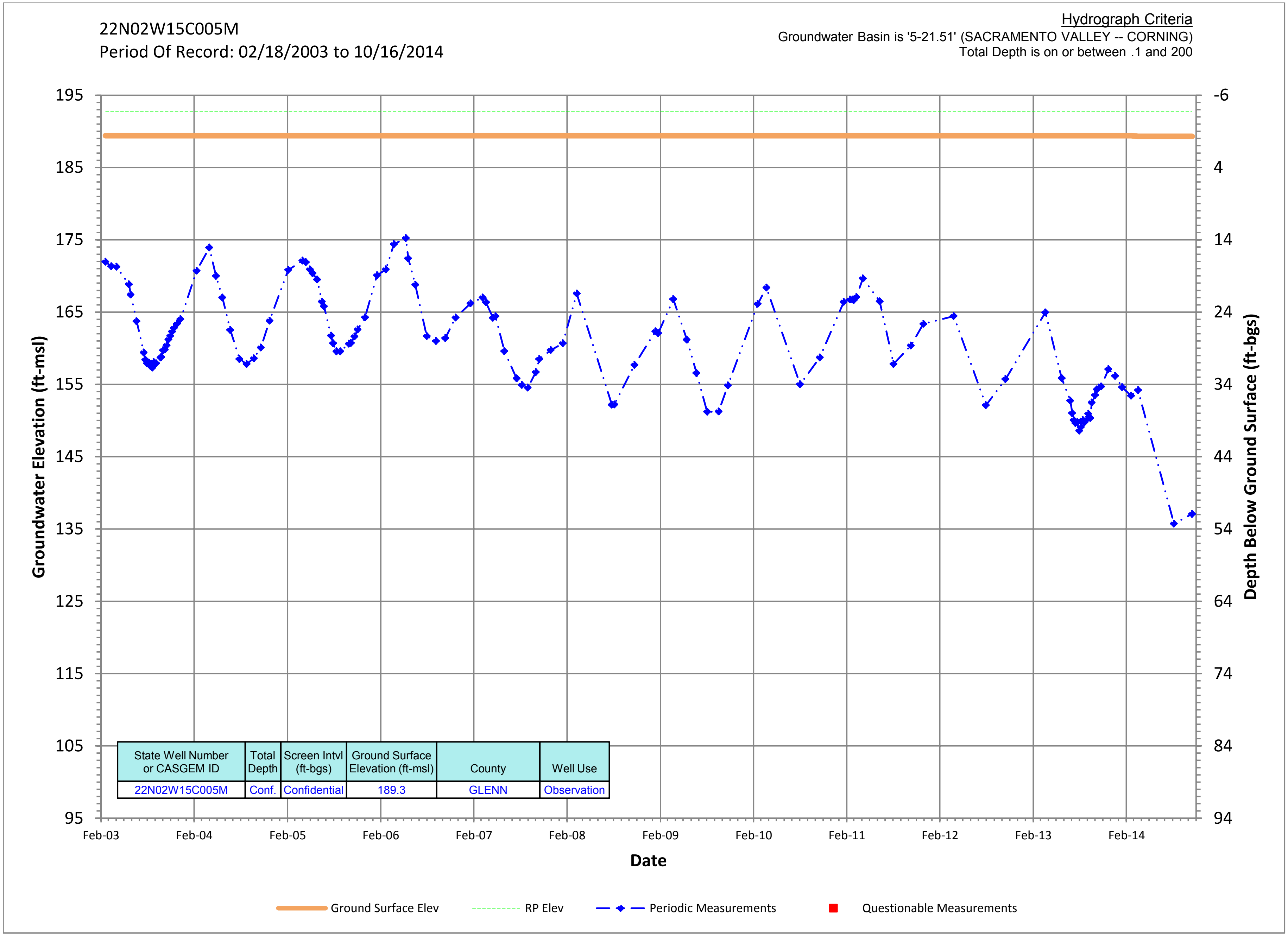
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W01N004M	Conf.	Confidential	159.21	GLENN	Observation

22N02W08B002M
Period Of Record: 04/18/1962 to 10/14/2014

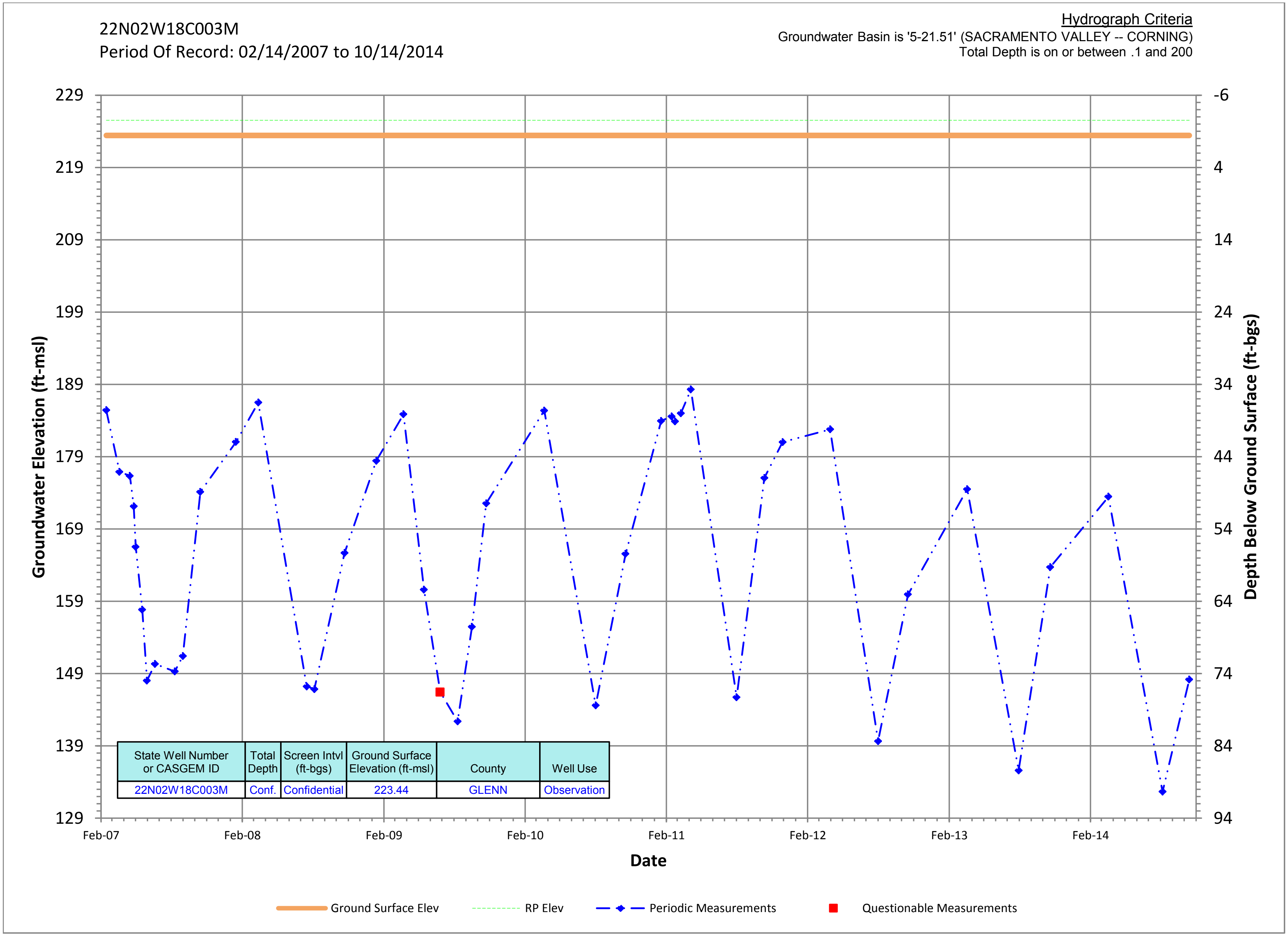
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W08B002M	Conf.	Confidential	207.43	GLENN	Other



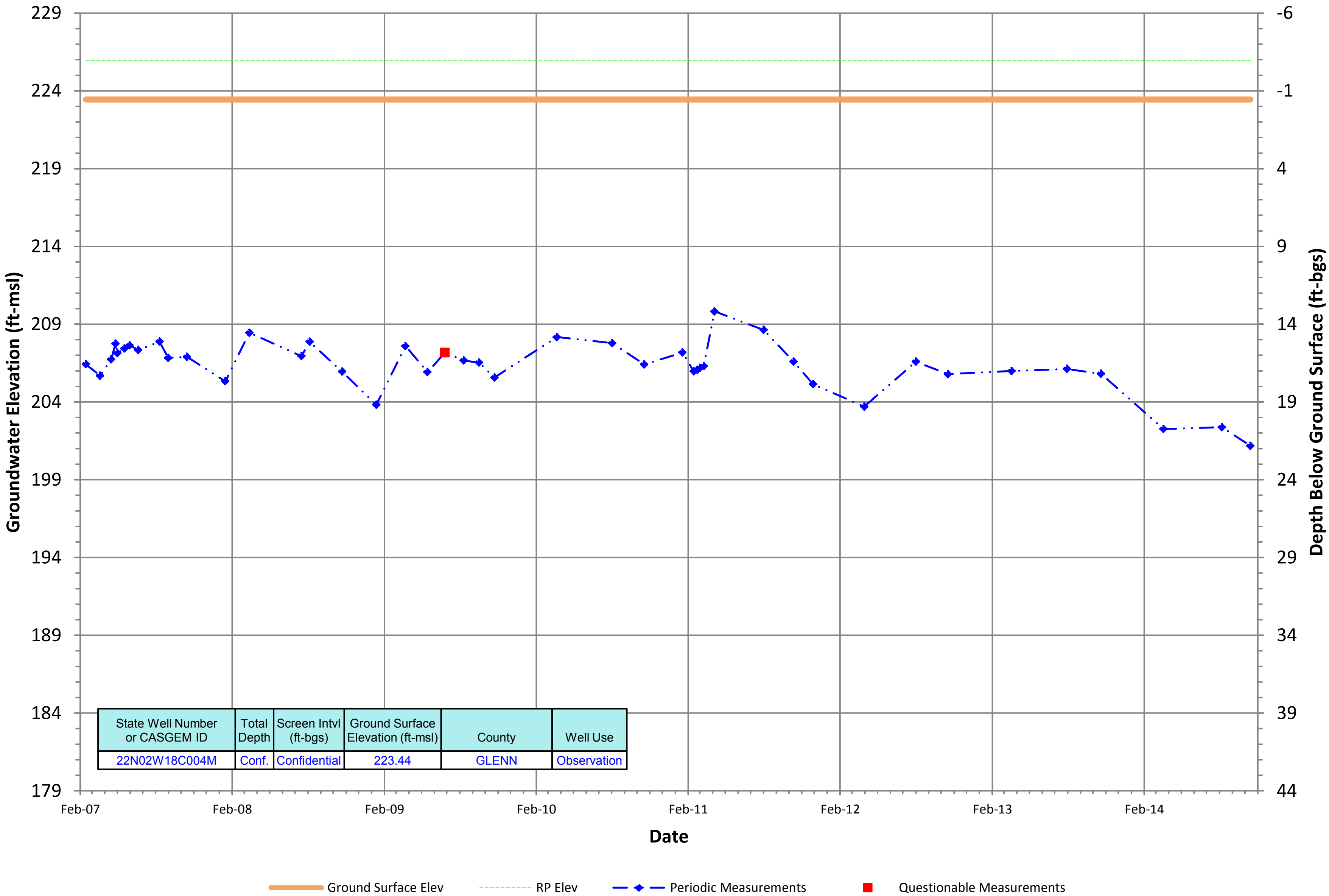
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W15C005M	Conf.	Confidential	189.3	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W18C003M	Conf.	Confidential	223.44	GLENN	Observation

22N02W18C004M
Period Of Record: 02/14/2007 to 10/14/2014

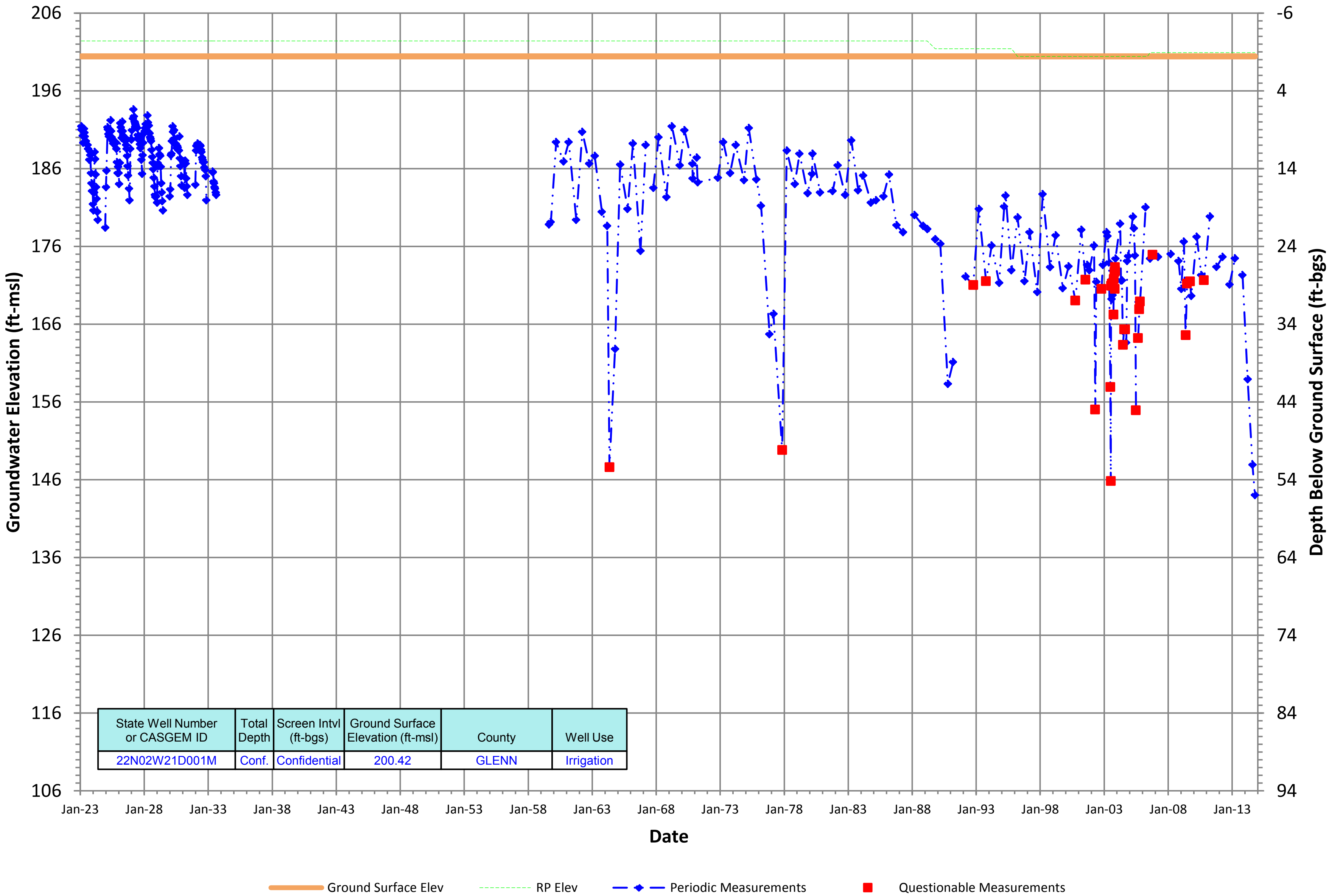
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W18C004M	Conf.	Confidential	223.44	GLENN	Observation

22N02W21D001M
Period Of Record: 01/31/1923 to 10/14/2014

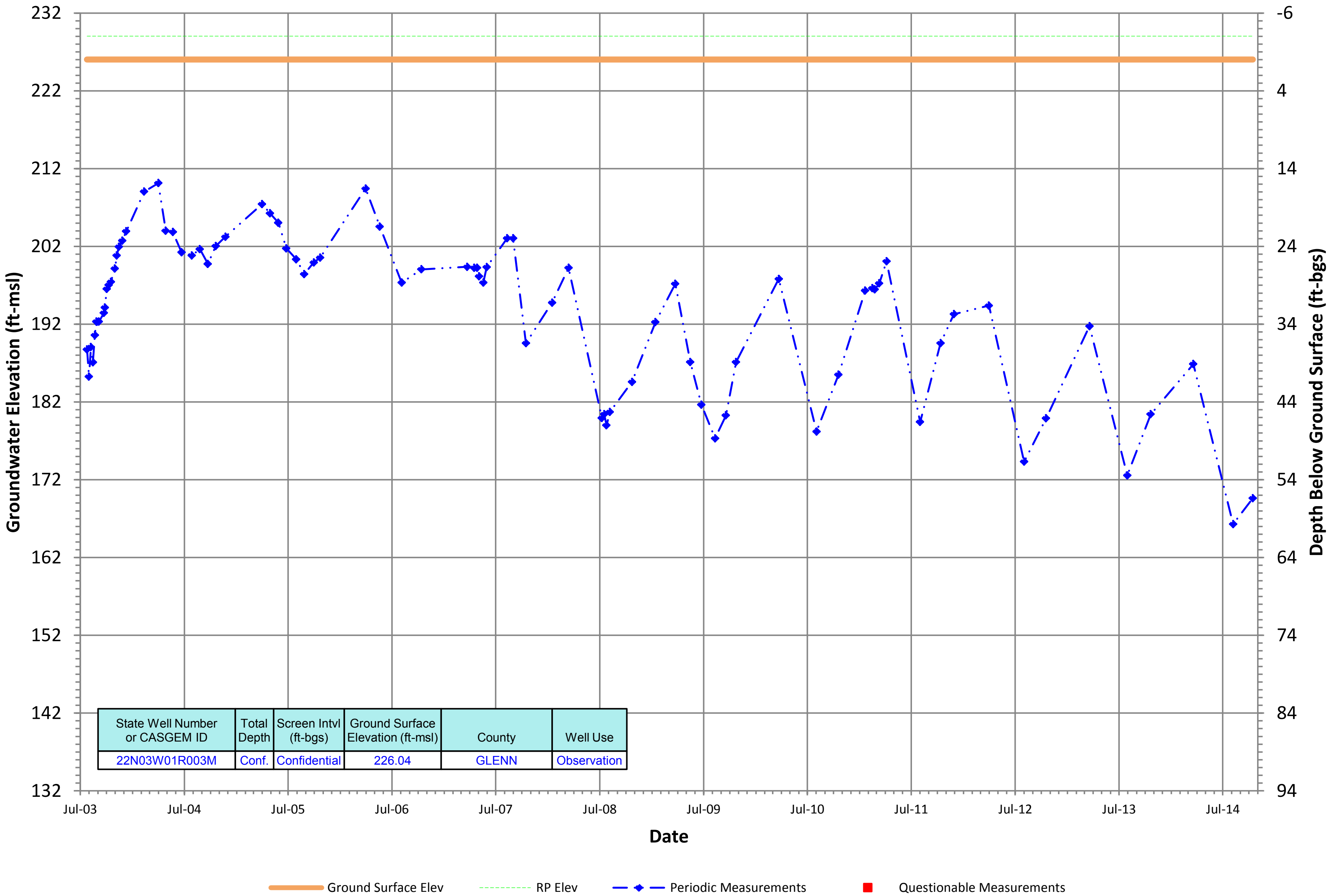
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W21D001M	Conf.	Confidential	200.42	GLENN	Irrigation

22N03W01R003M
Period Of Record: 07/24/2003 to 10/14/2014

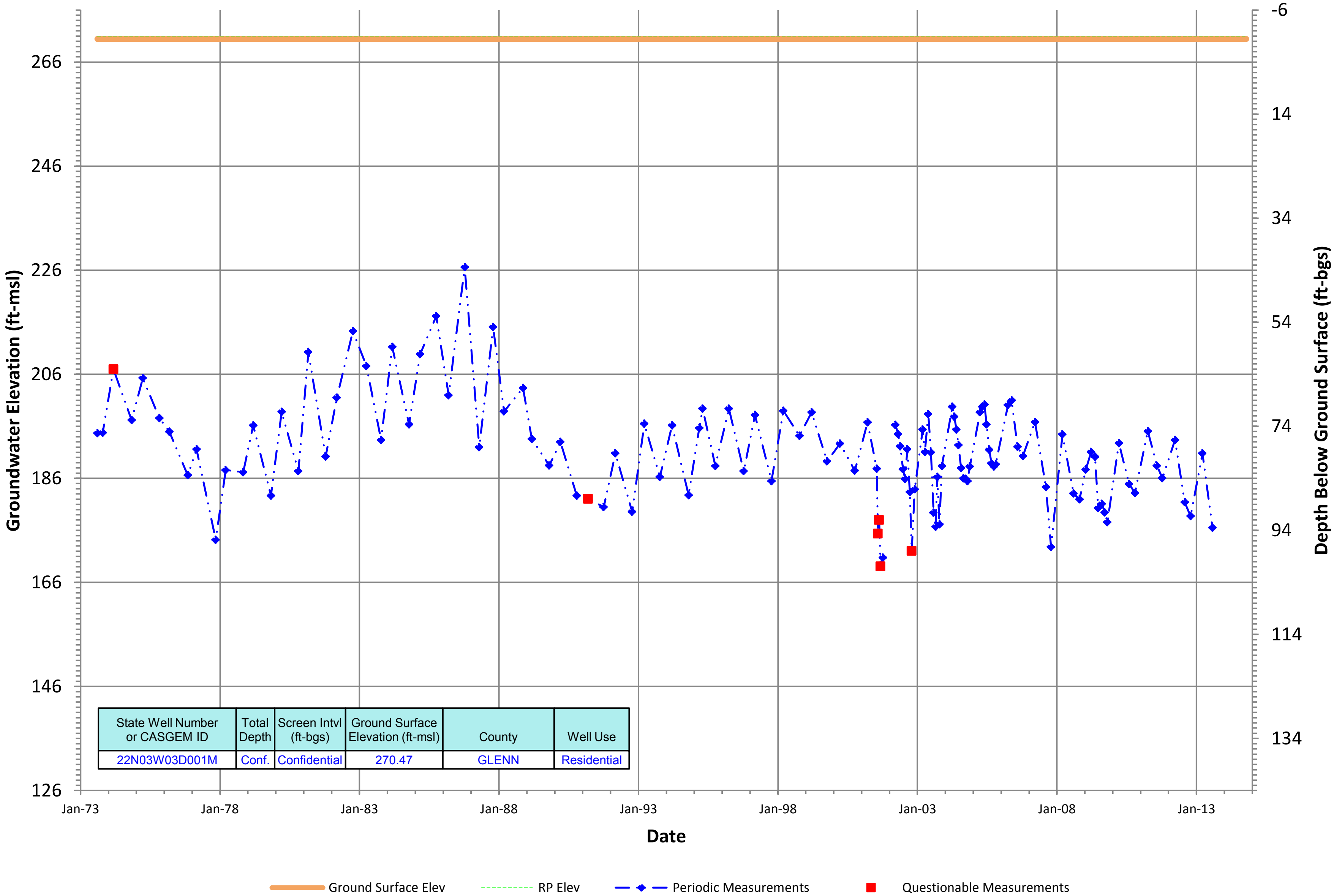
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W01R003M	Conf.	Confidential	226.04	GLENN	Observation

22N03W03D001M
Period Of Record: 08/09/1973 to 10/14/2014

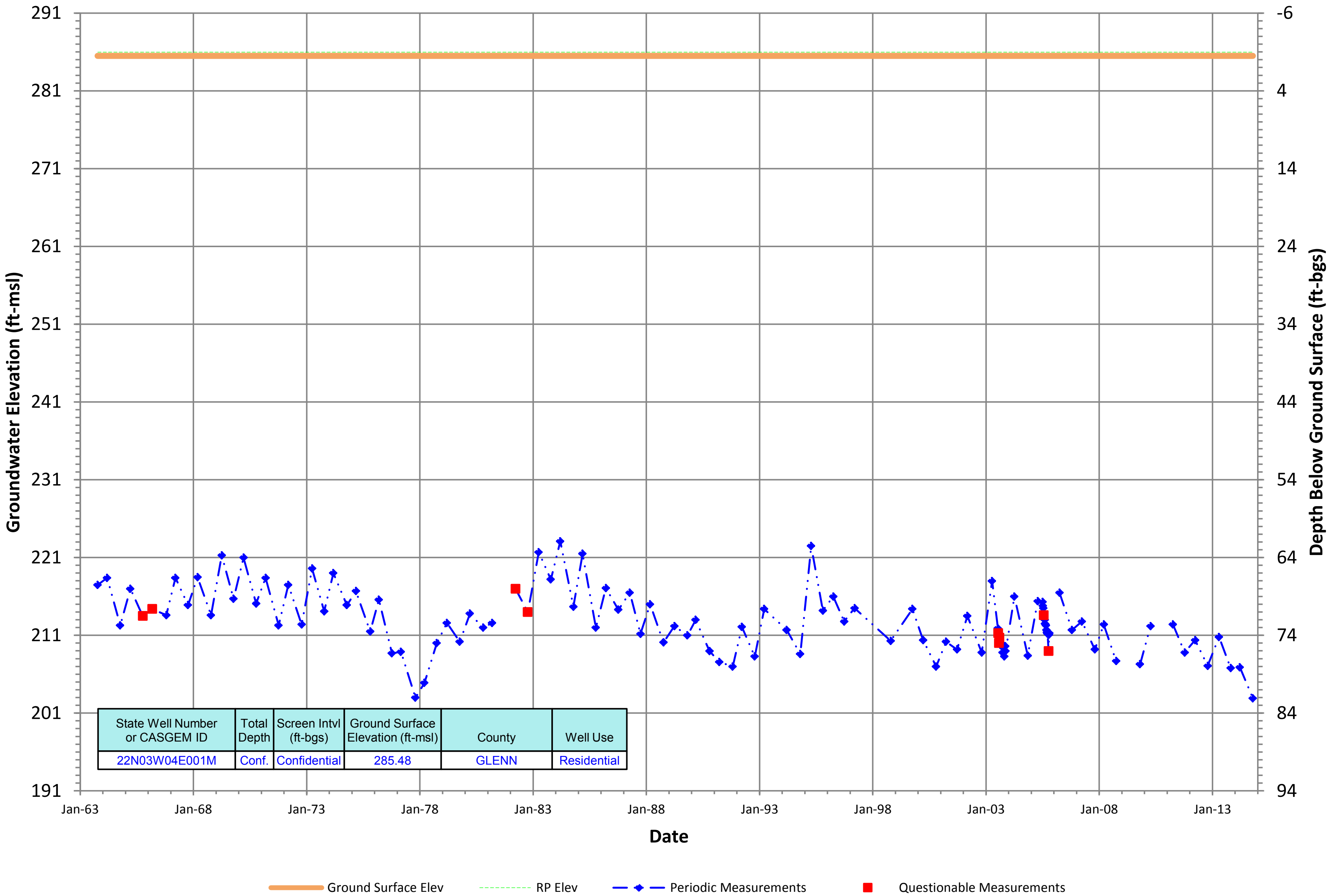
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



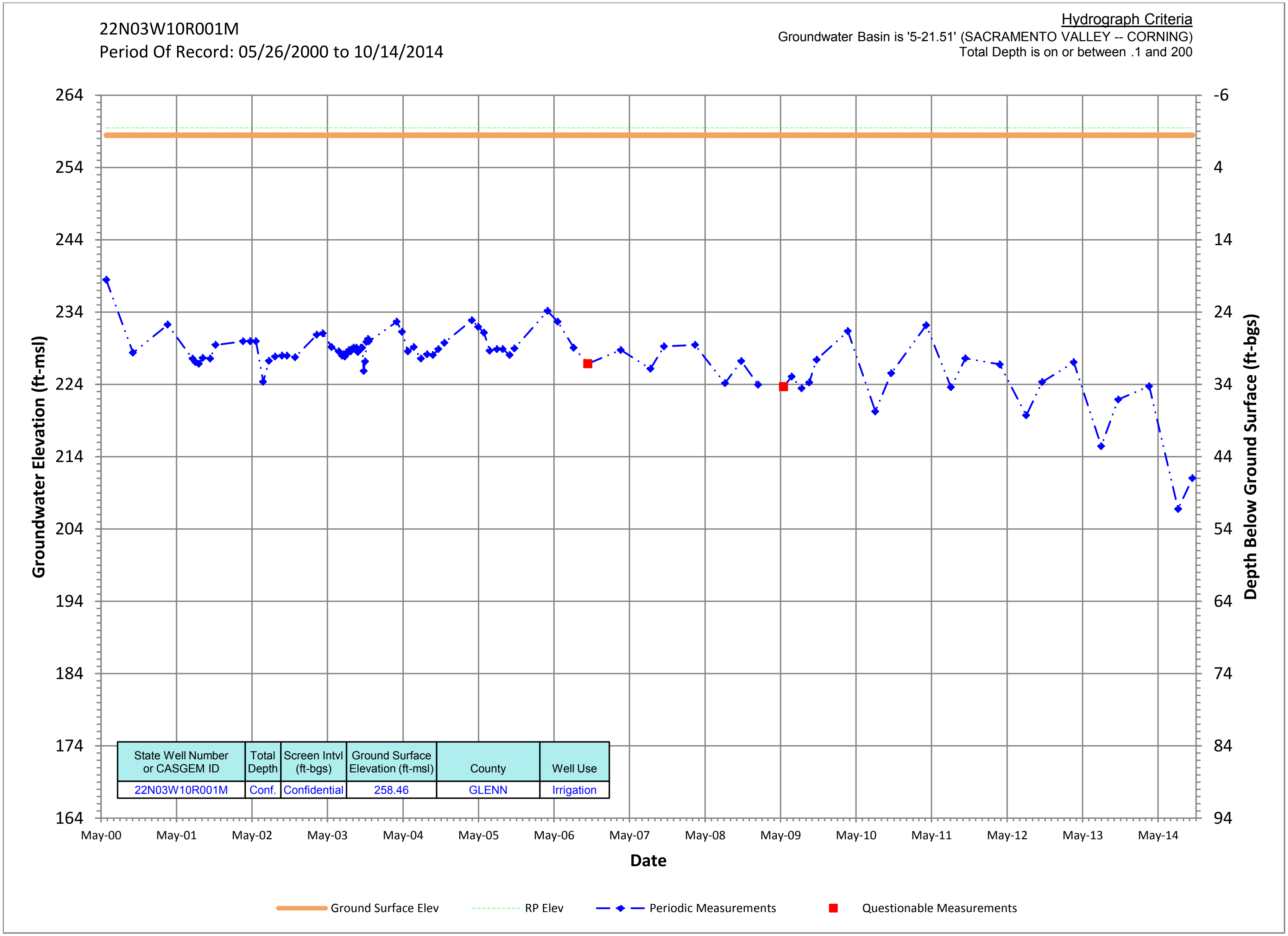
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W03D001M	Conf.	Confidential	270.47	GLENN	Residential

22N03W04E001M
Period Of Record: 10/09/1963 to 10/14/2014

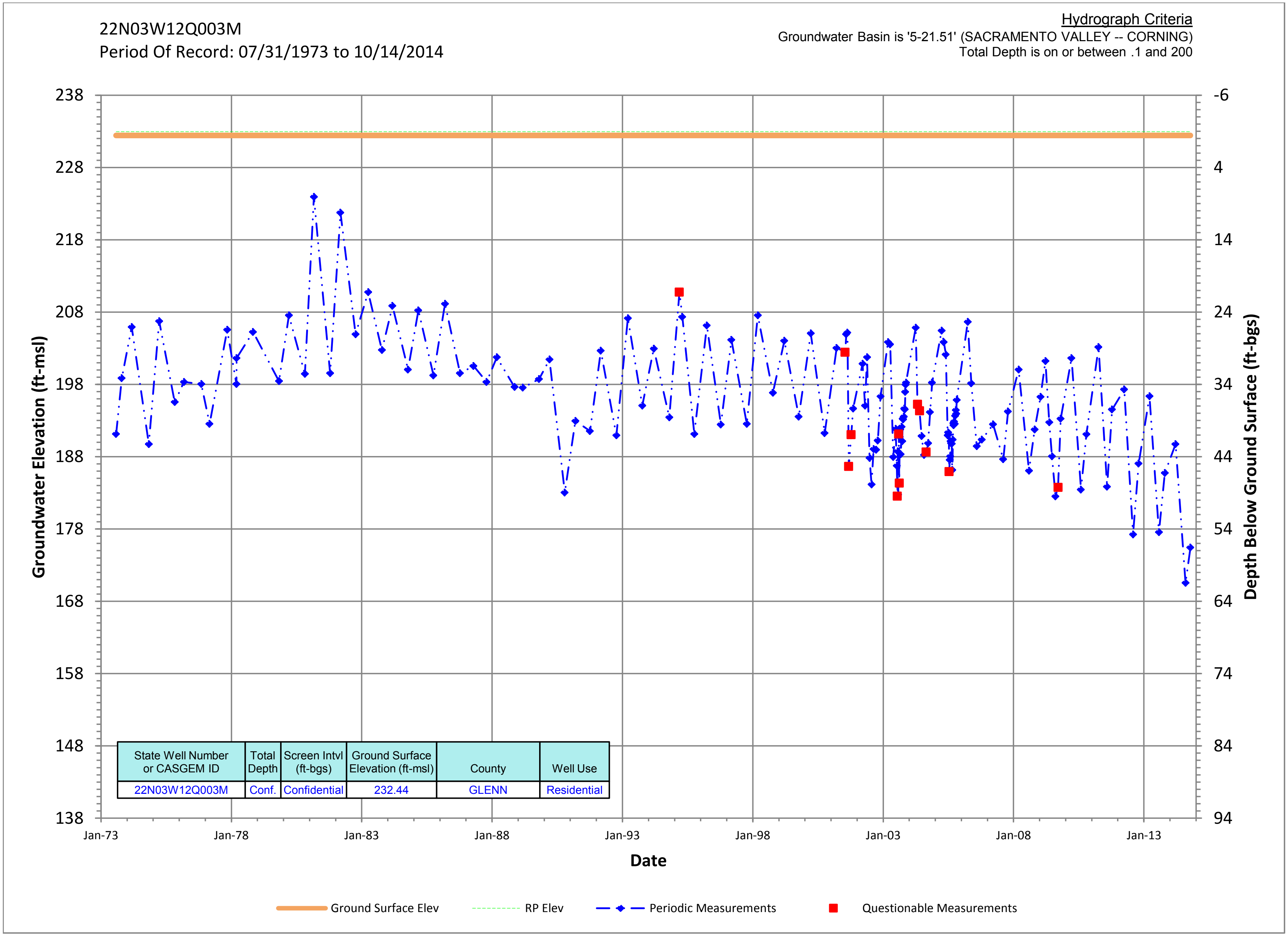
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



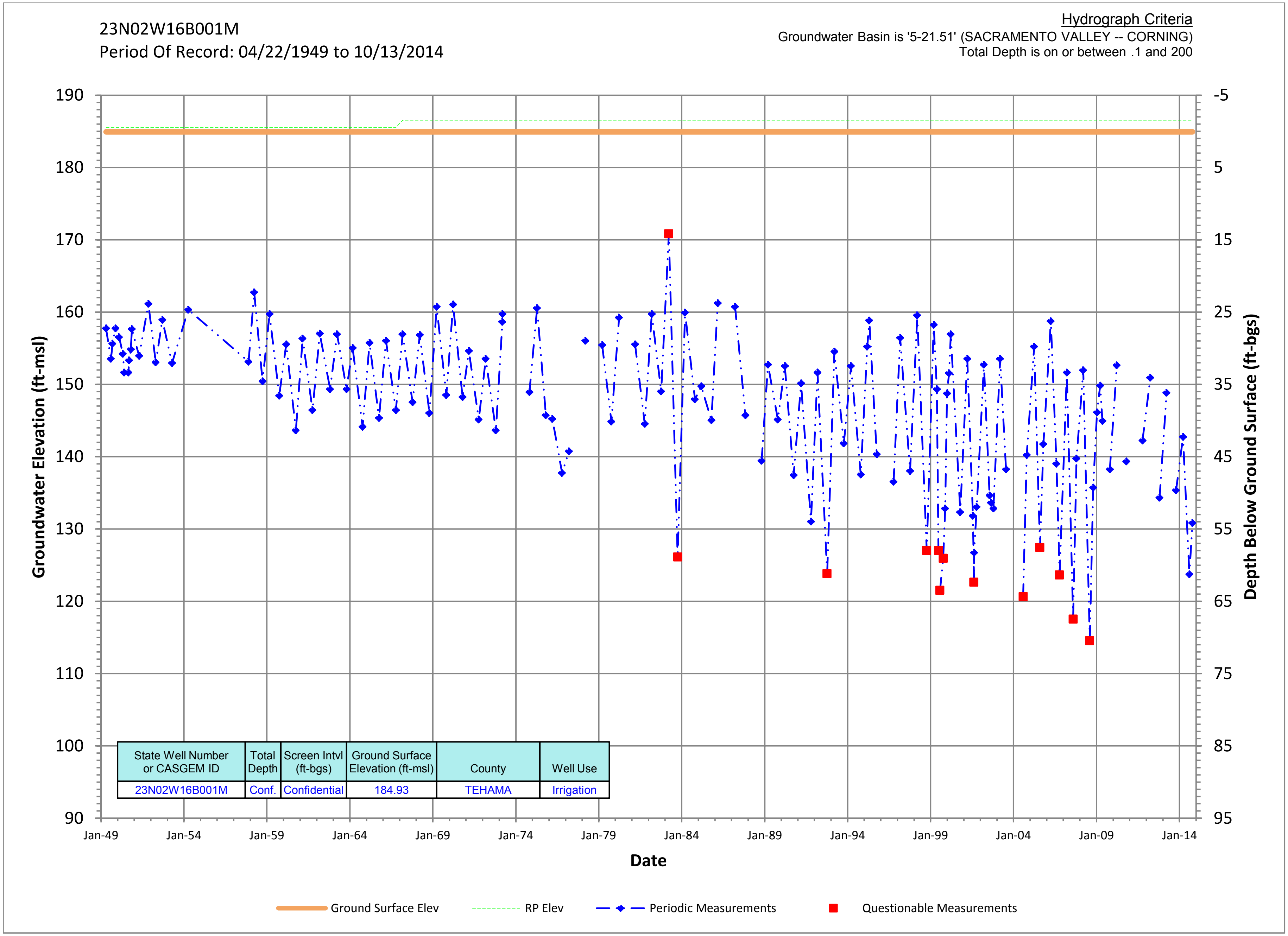
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W04E001M	Conf.	Confidential	285.48	GLENN	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W10R001M	Conf.	Confidential	258.46	GLENN	Irrigation

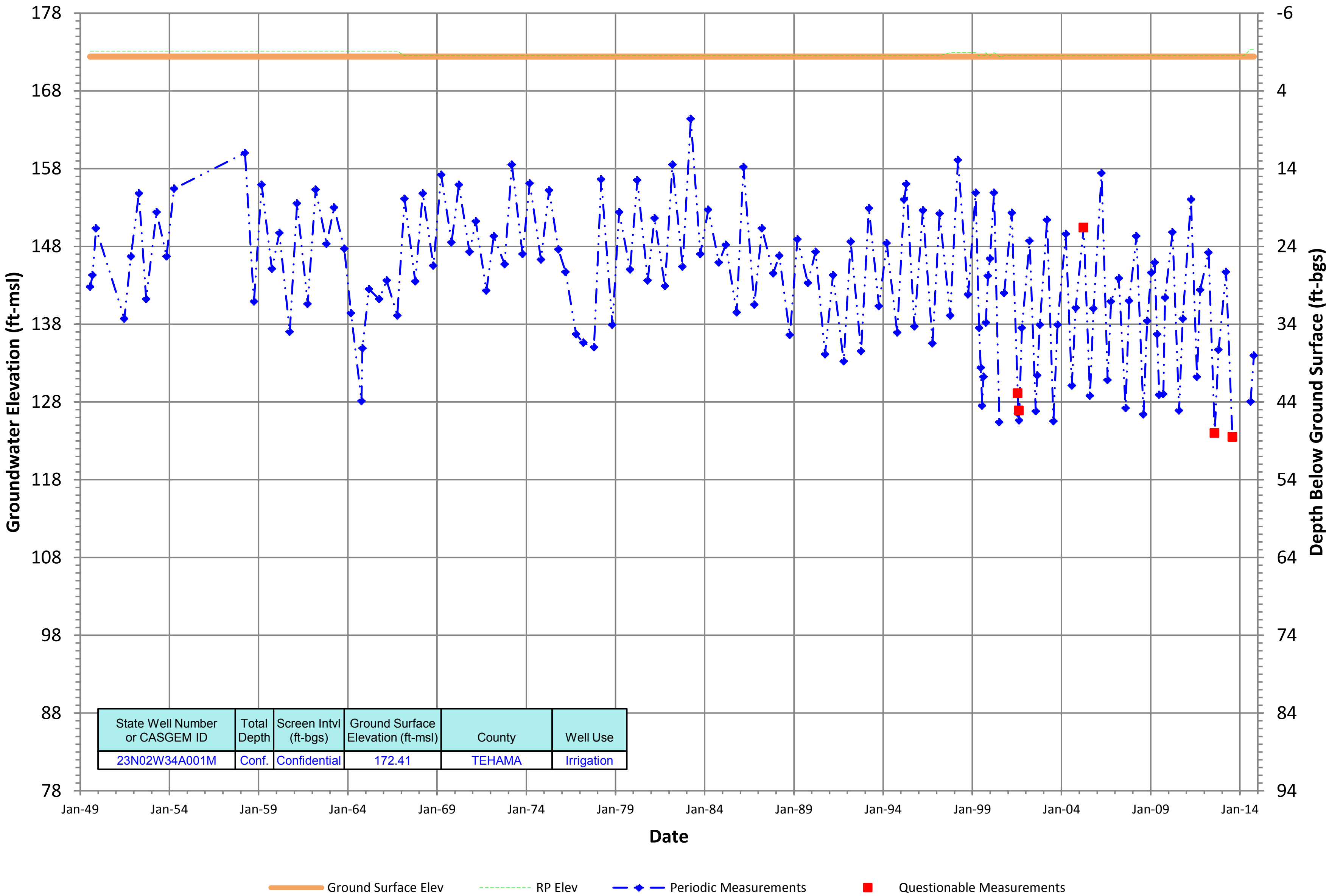


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W12Q003M	Conf.	Confidential	232.44	GLENN	Residential


23N02W16B001M
Period Of Record: 04/22/1949 to 10/13/2014
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
Date
190
180
170
160
150
140
130
120
110
100
90
-5
5
15
25
35
45
55
65
75
85
95
Jan-49
Jan-54
Jan-59
Jan-64
Jan-69
Jan-74
Jan-79
Jan-84
Jan-89
Jan-94
Jan-99
Jan-04
Jan-09
Jan-14
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
23N02W16B001M
Conf.
Confidential
184.93
TEHAMA
Irrigation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

23N02W34A001M
Period Of Record: 07/22/1949 to 10/13/2014

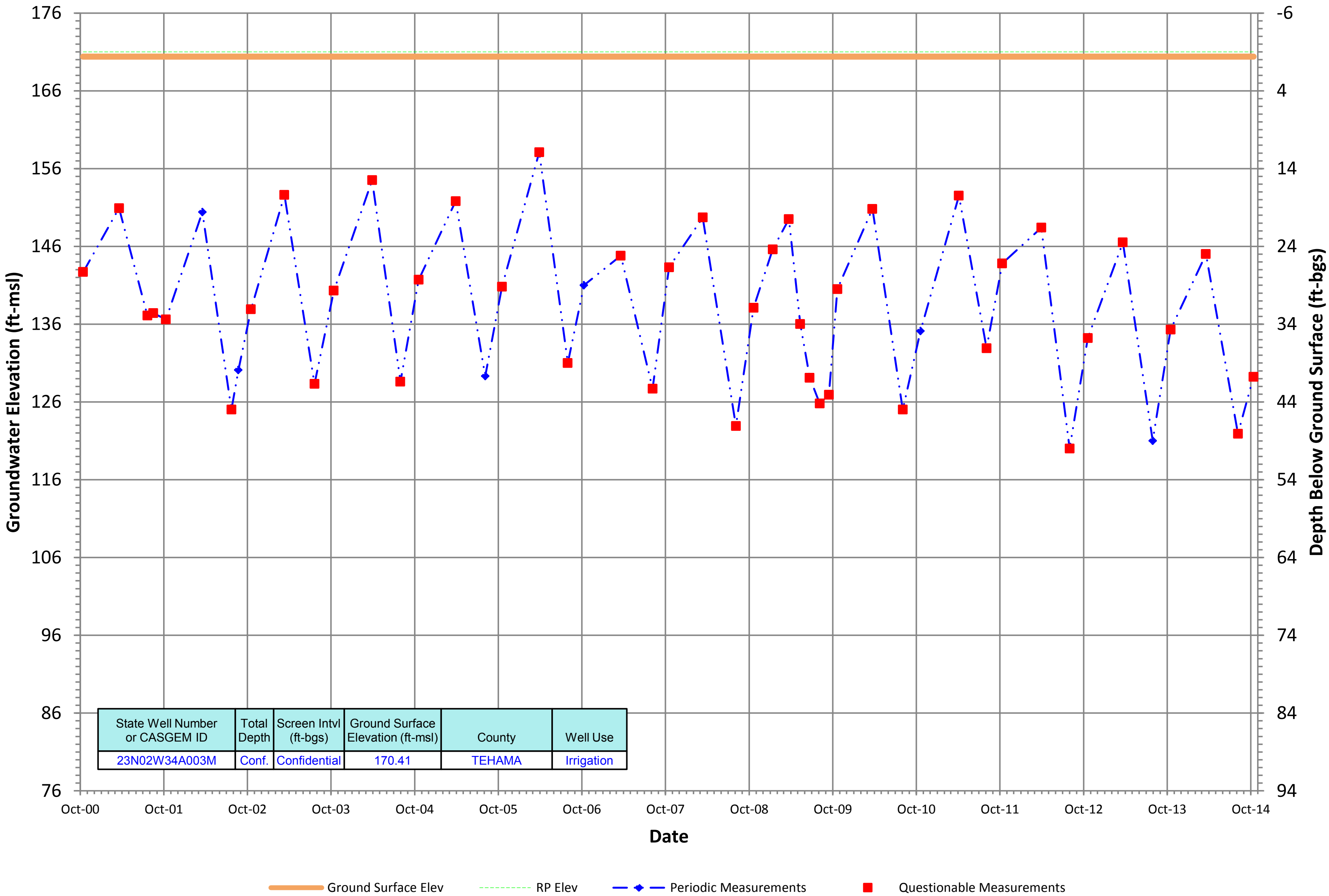
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N02W34A001M	Conf.	Confidential	172.41	TEHAMA	Irrigation

23N02W34A003M
Period Of Record: 10/13/2000 to 10/13/2014

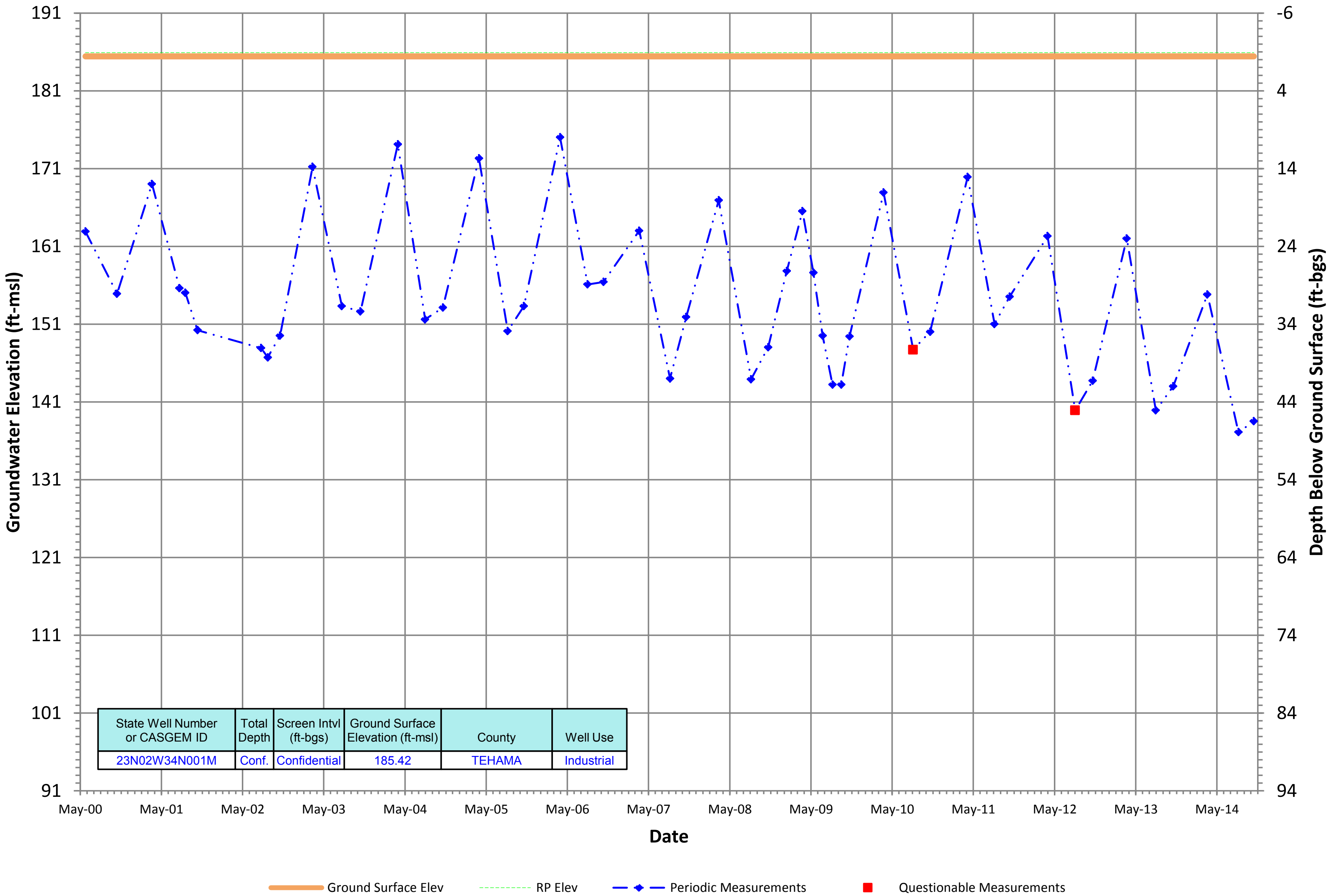
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N02W34A003M	Conf.	Confidential	170.41	TEHAMA	Irrigation

23N02W34N001M
Period Of Record: 05/24/2000 to 10/14/2014

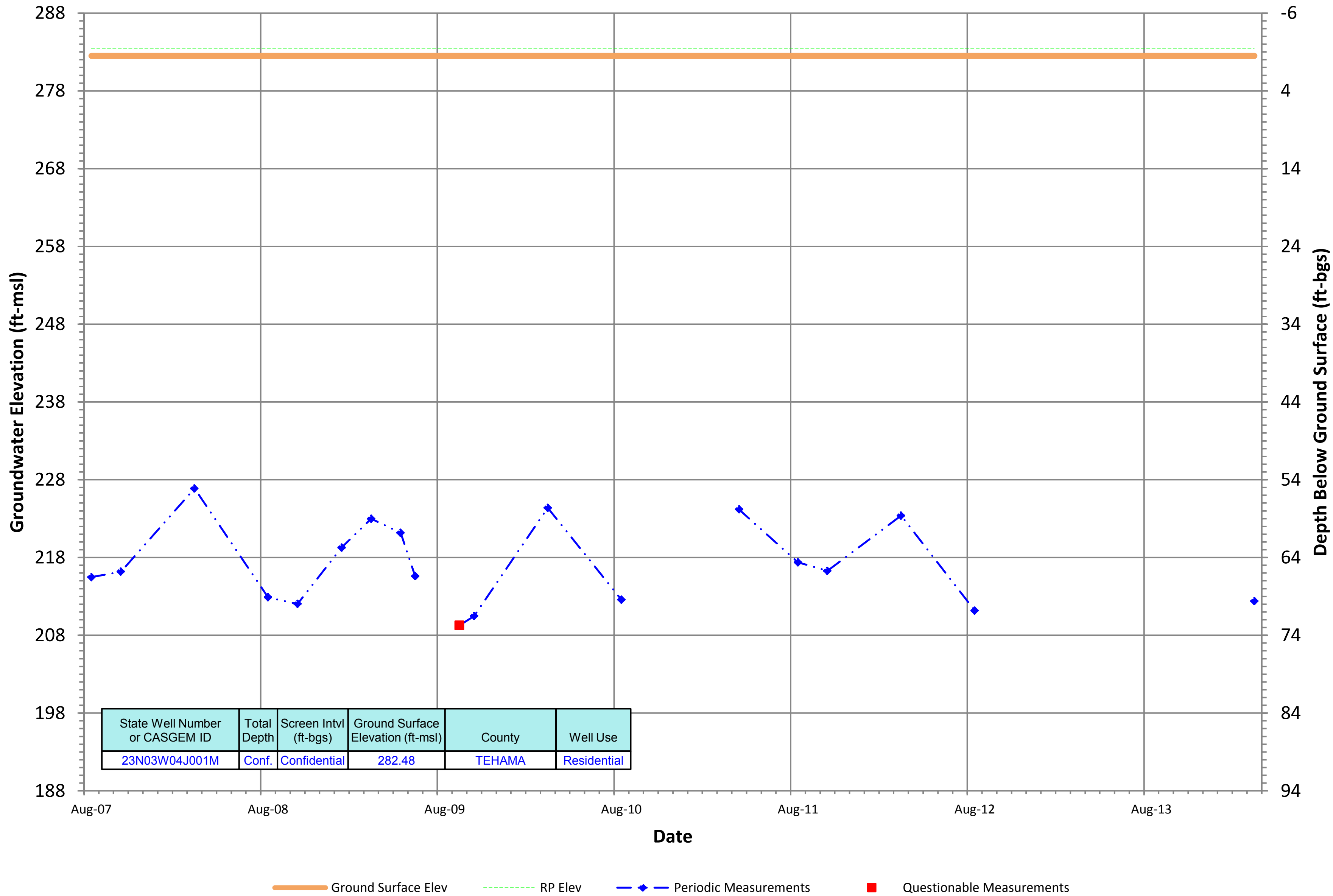
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



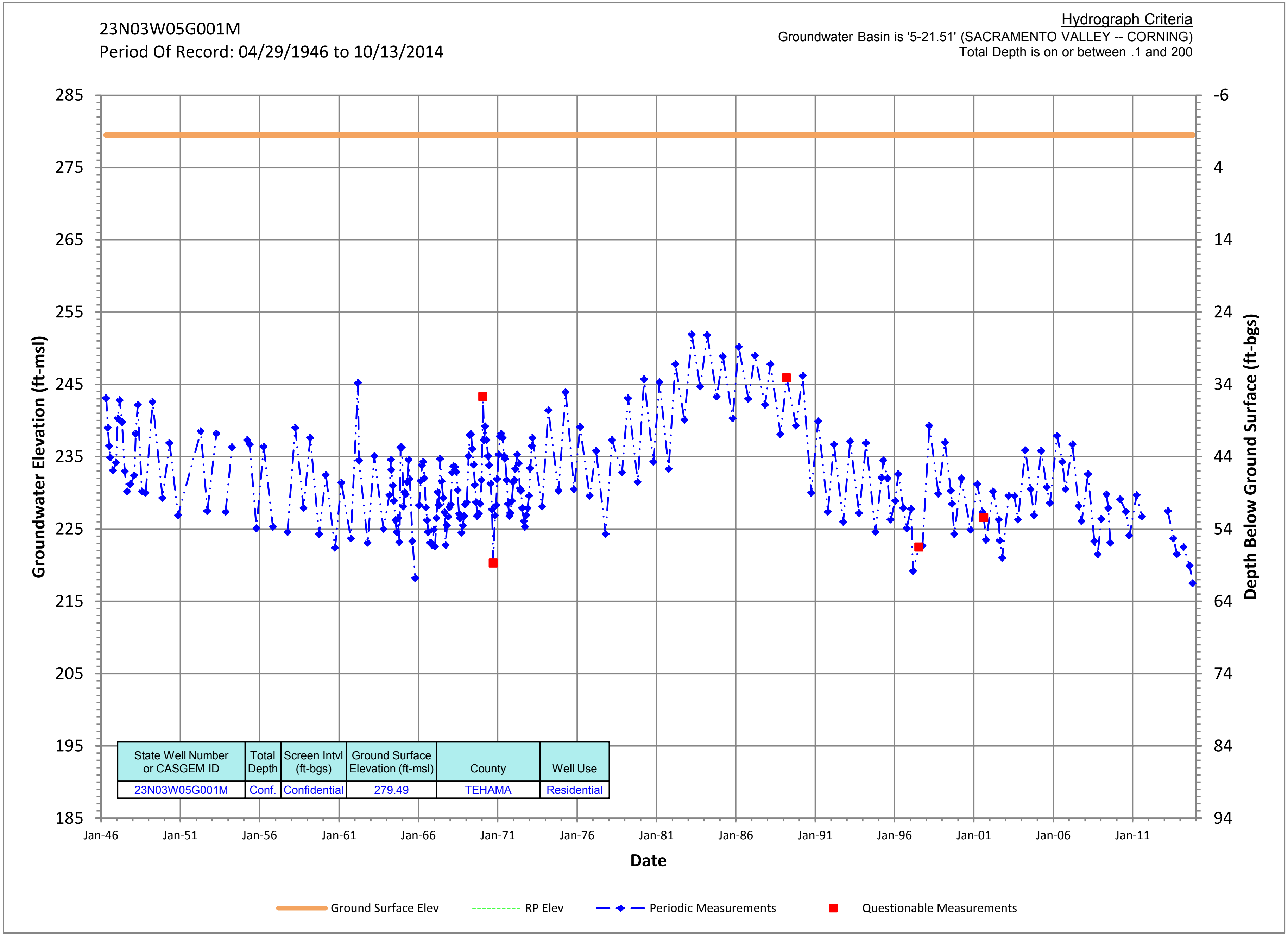
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N02W34N001M	Conf.	Confidential	185.42	TEHAMA	Industrial

23N03W04J001M
Period Of Record: 08/06/2007 to 03/19/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200

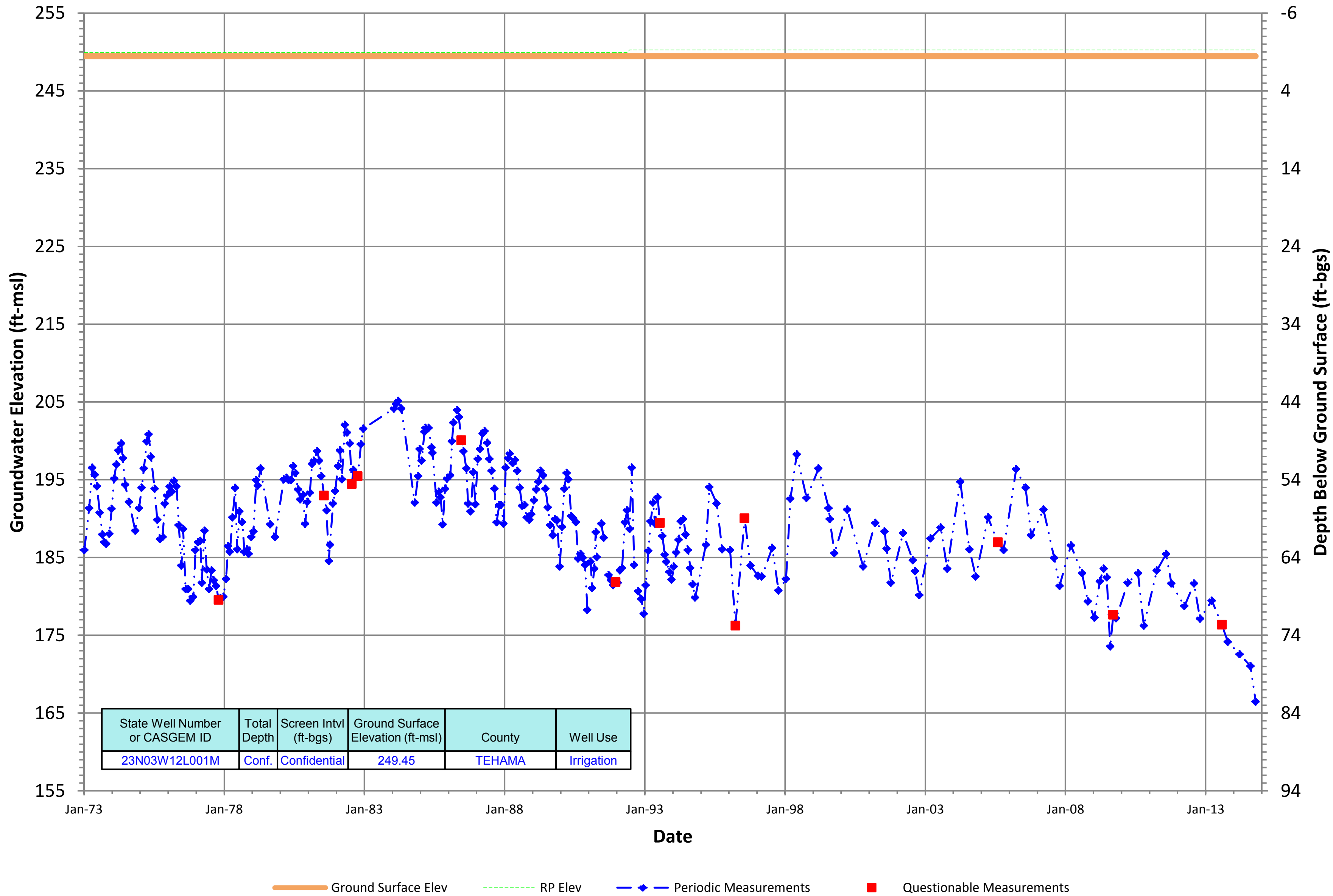


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W04J001M	Conf.	Confidential	282.48	TEHAMA	Residential


23N03W05G001M
Period Of Record: 04/29/1946 to 10/13/2014
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
285
275
265
255
245
235
225
215
205
195
185
-6
4
14
24
34
44
54
64
74
84
94
Jan-46
Jan-51
Jan-56
Jan-61
Jan-66
Jan-71
Jan-76
Jan-81
Jan-86
Jan-91
Jan-96
Jan-01
Jan-06
Jan-11
Date
State Well Number or CASGEM ID | Total Depth | Screen Intvl (ft-bgs) | Ground Surface Elevation (ft-msl) | County | Well Use
23N03W05G001M | Conf. | Confidential | 279.49 | TEHAMA | Residential
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

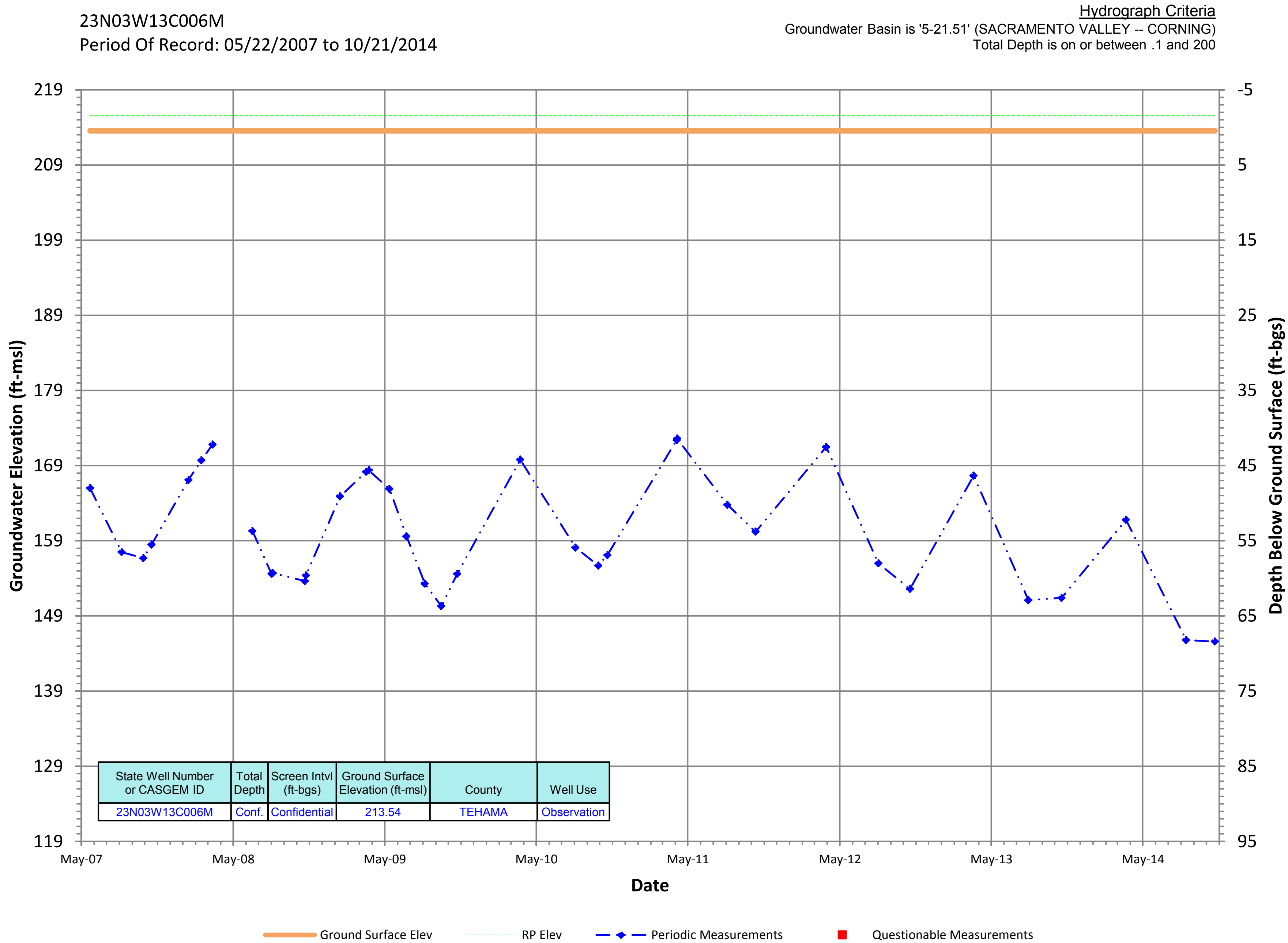
23N03W12L001M
Period Of Record: 01/05/1973 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200

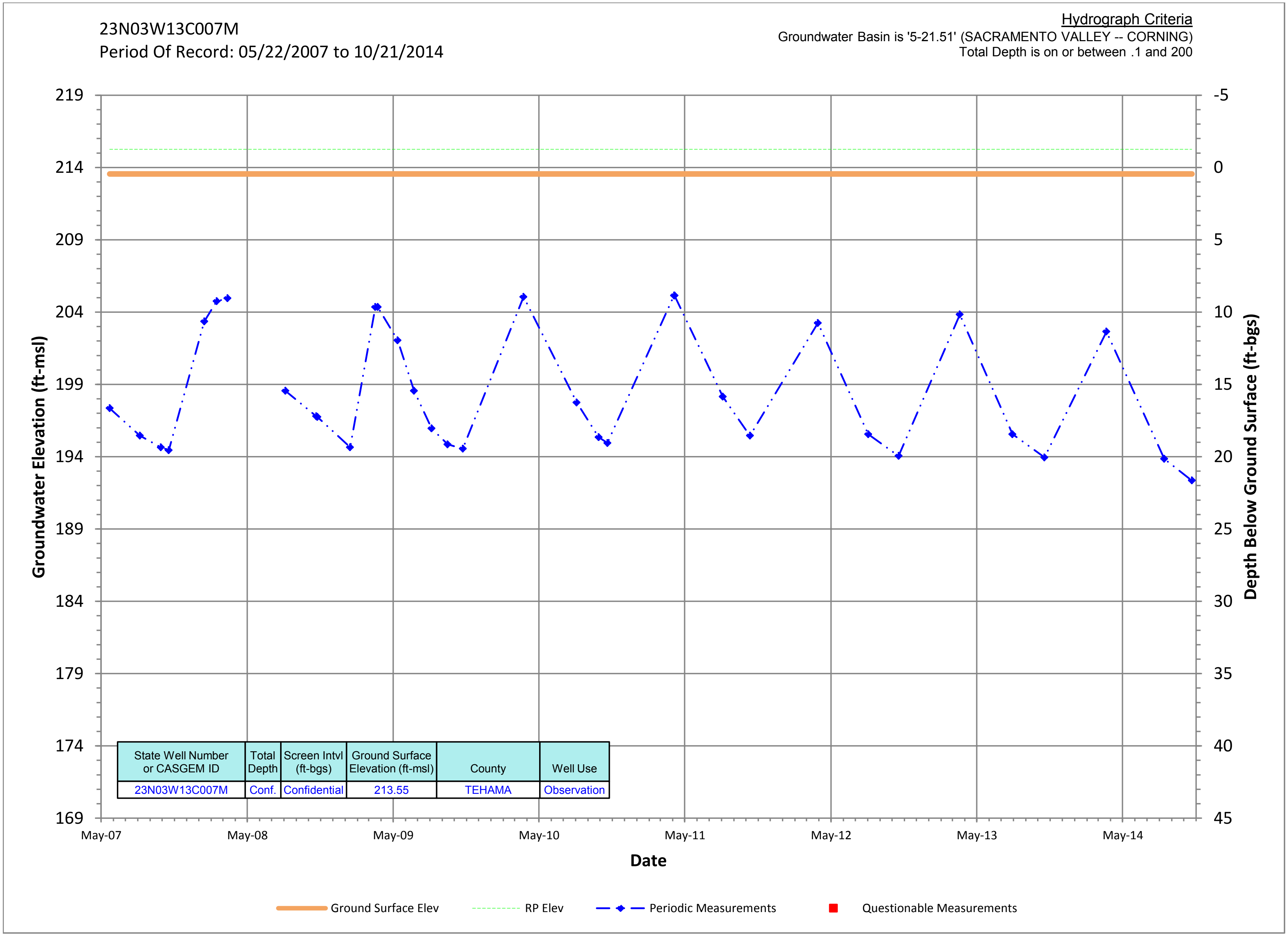


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W12L001M	Conf.	Confidential	249.45	TEHAMA	Irrigation

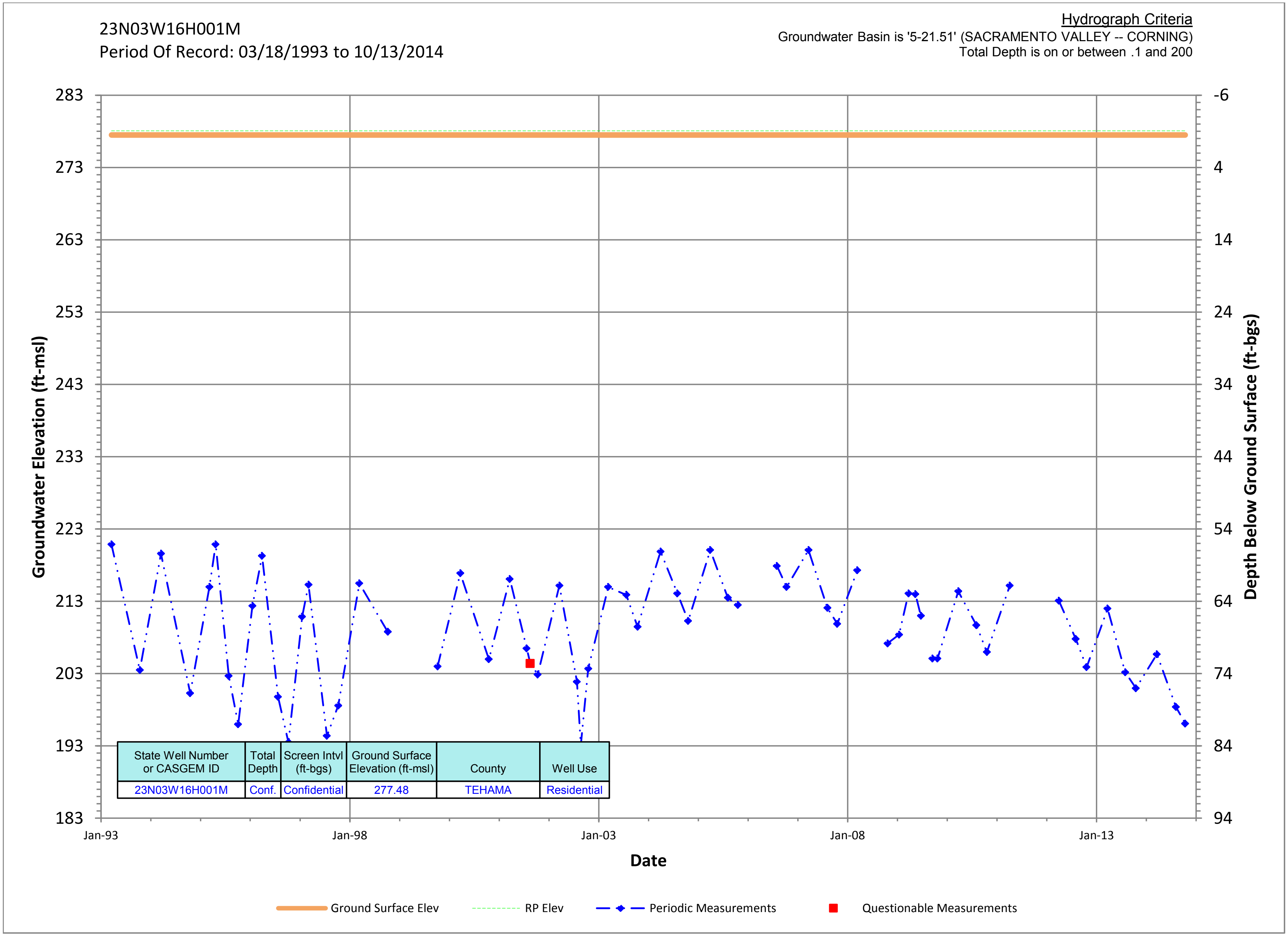
23N03W13C006M
Period Of Record: 05/22/2007 to 10/21/2014



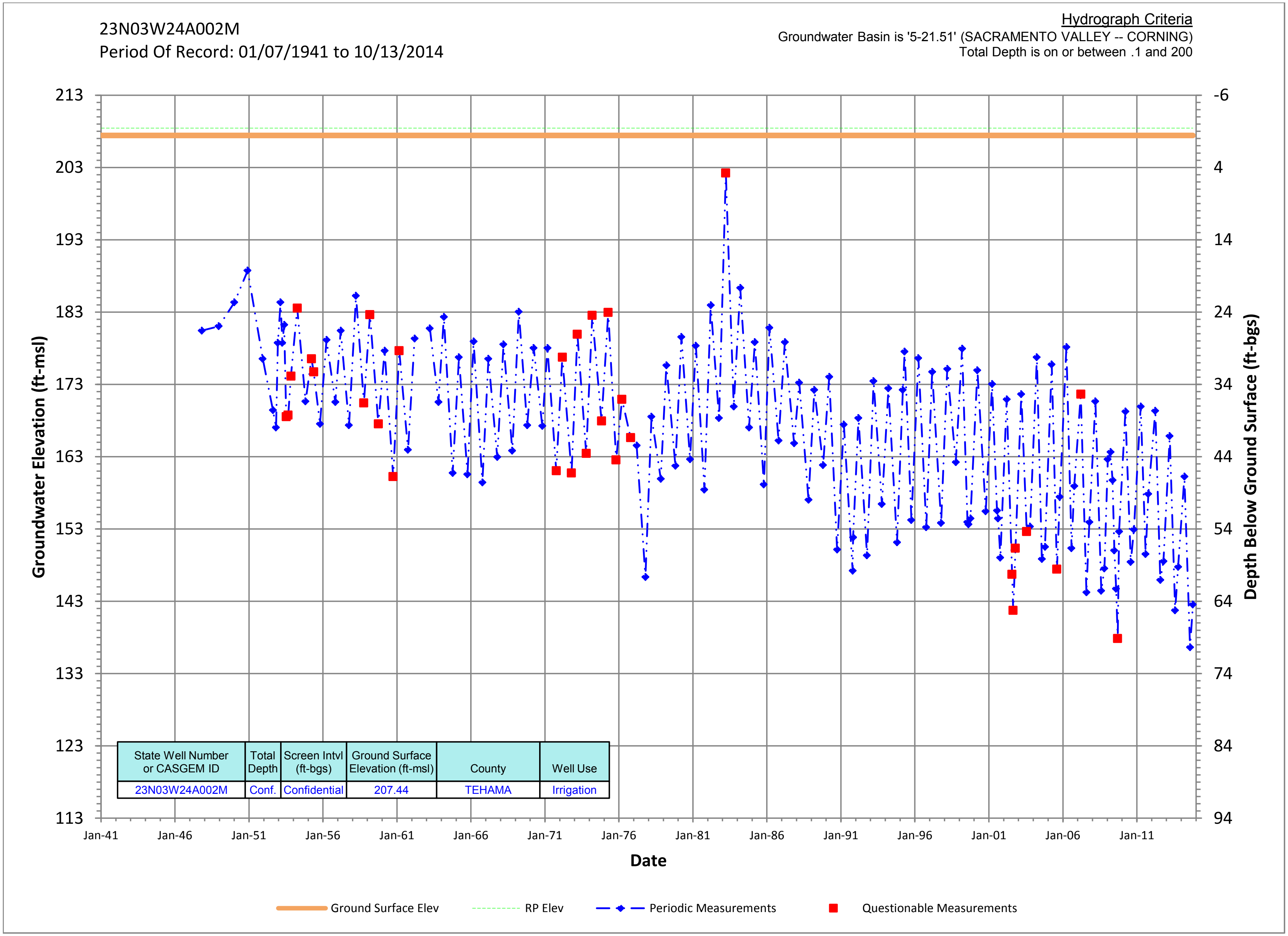
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W13C006M	Conf.	Confidential	213.54	TEHAMA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W13C007M	Conf.	Confidential	213.55	TEHAMA	Observation



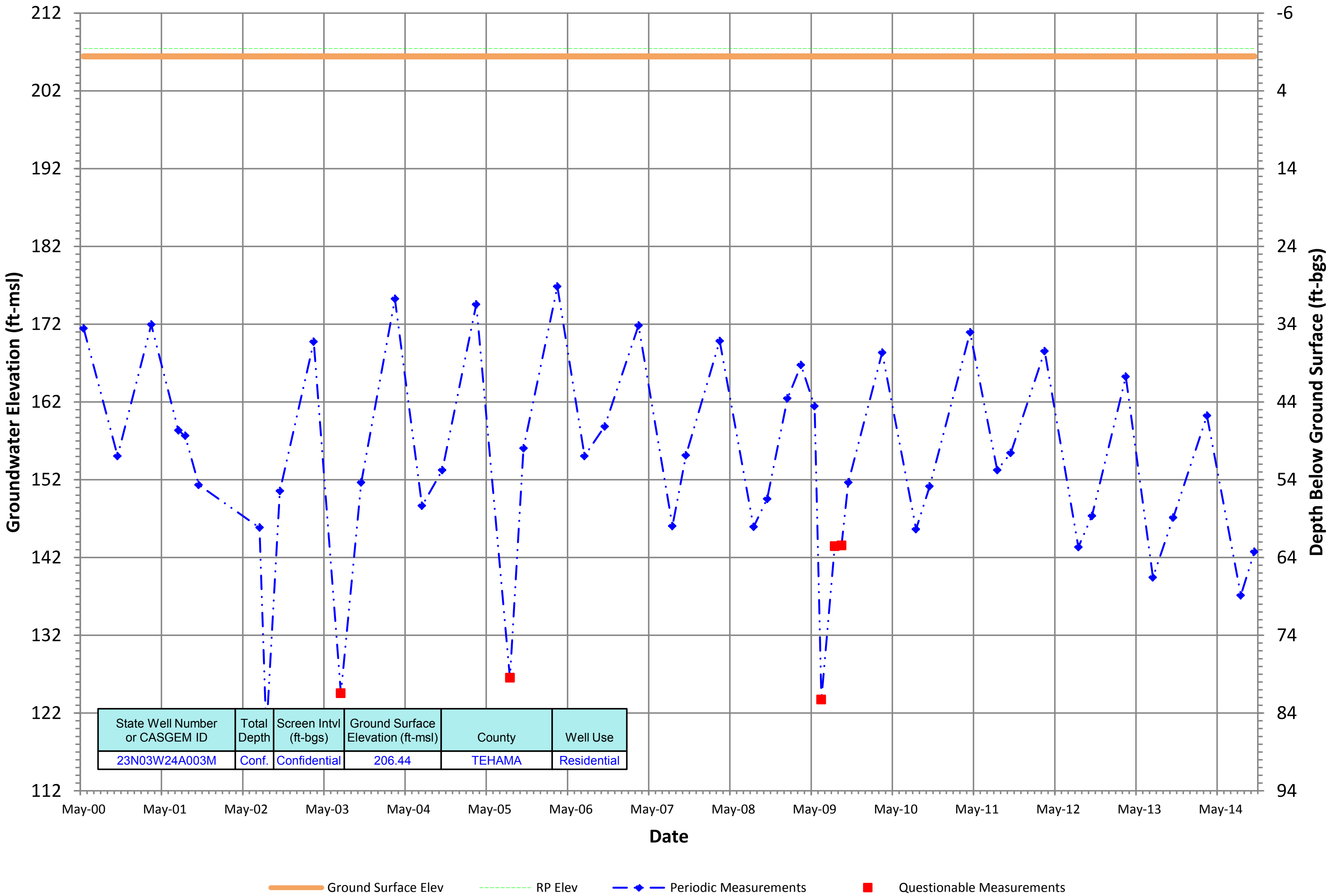
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W16H001M	Conf.	Confidential	277.48	TEHAMA	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W24A002M	Conf.	Confidential	207.44	TEHAMA	Irrigation

23N03W24A003M
Period Of Record: 05/04/2000 to 10/13/2014

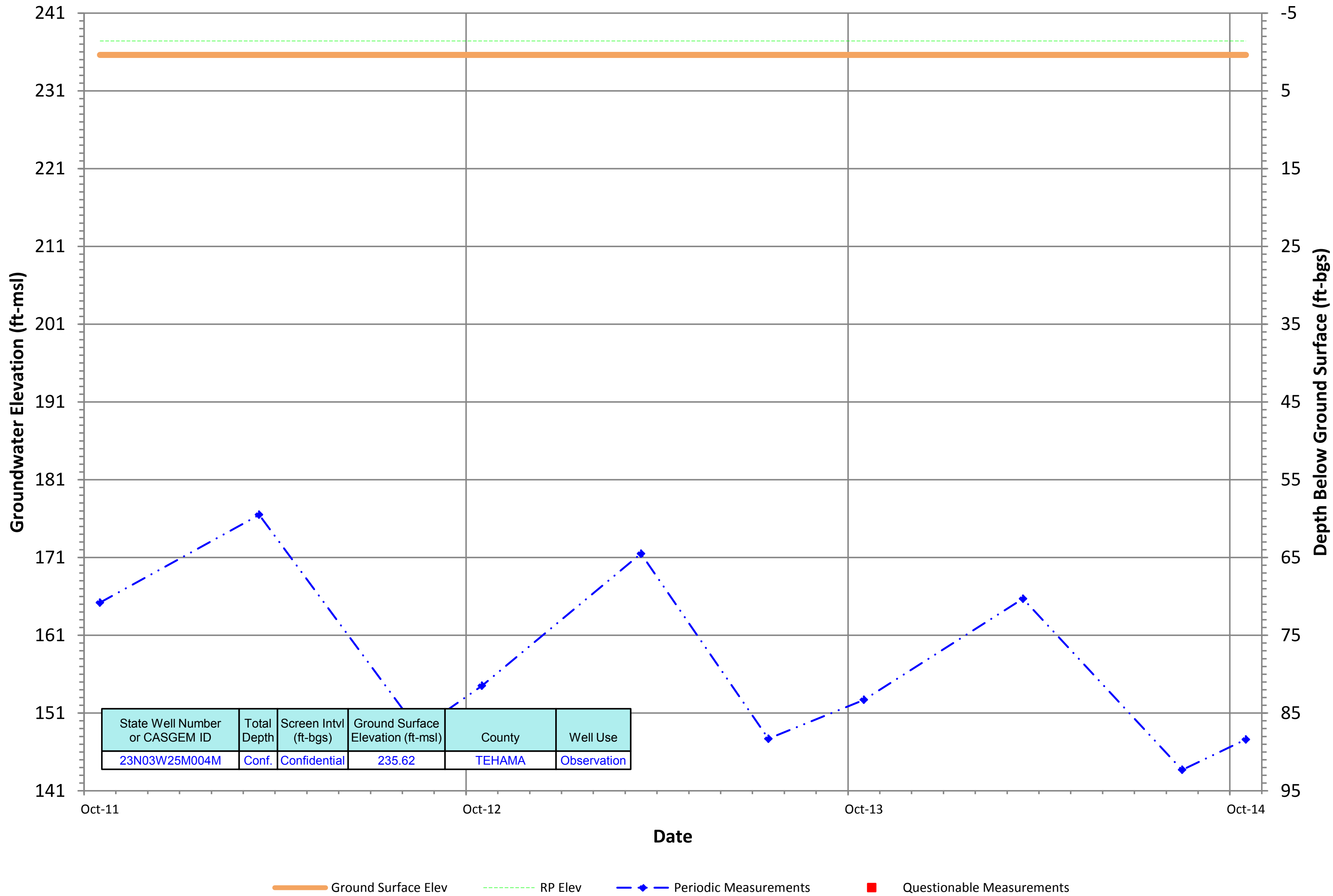
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W24A003M	Conf.	Confidential	206.44	TEHAMA	Residential

23N03W25M004M
Period Of Record: 10/20/2011 to 10/21/2014

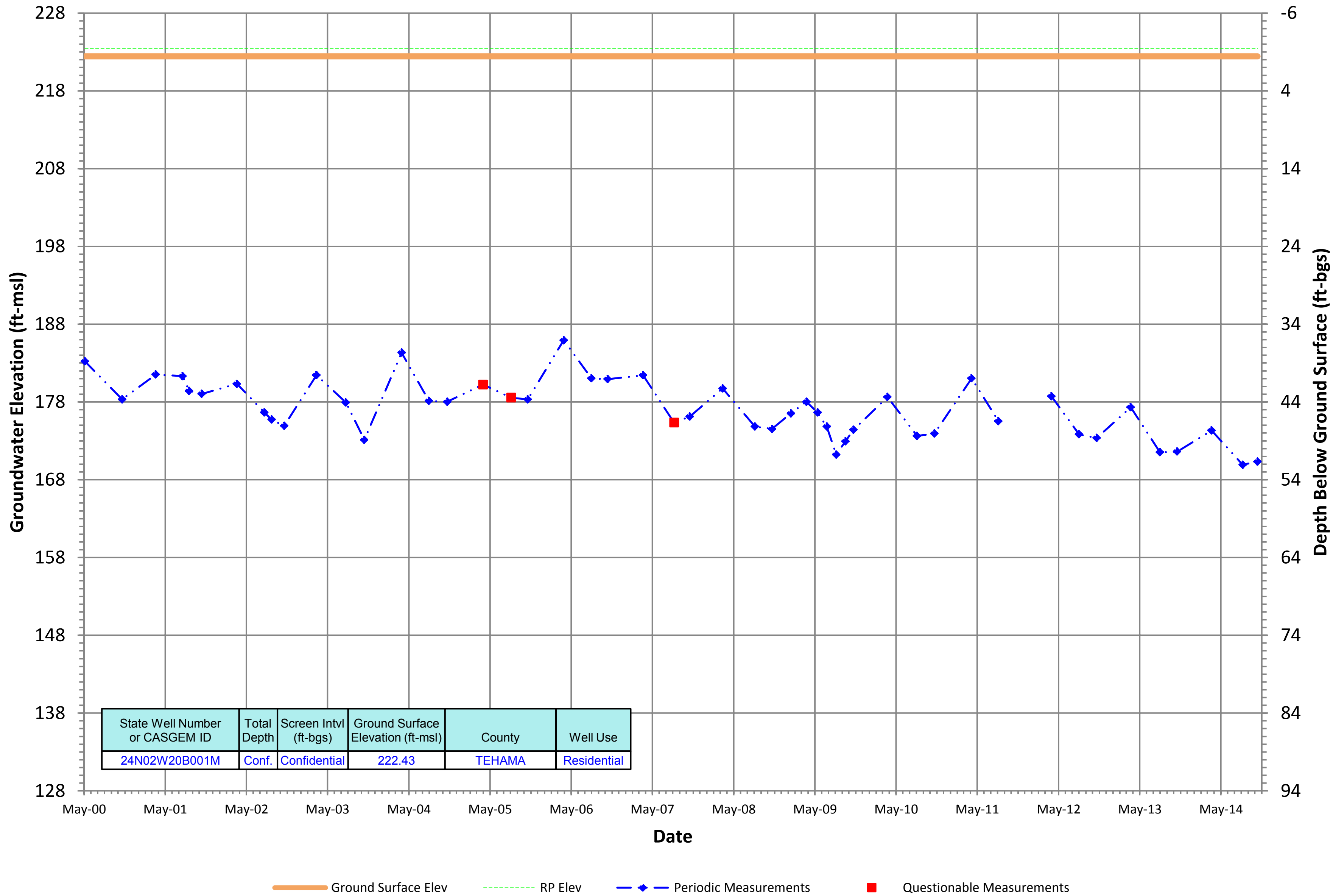
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



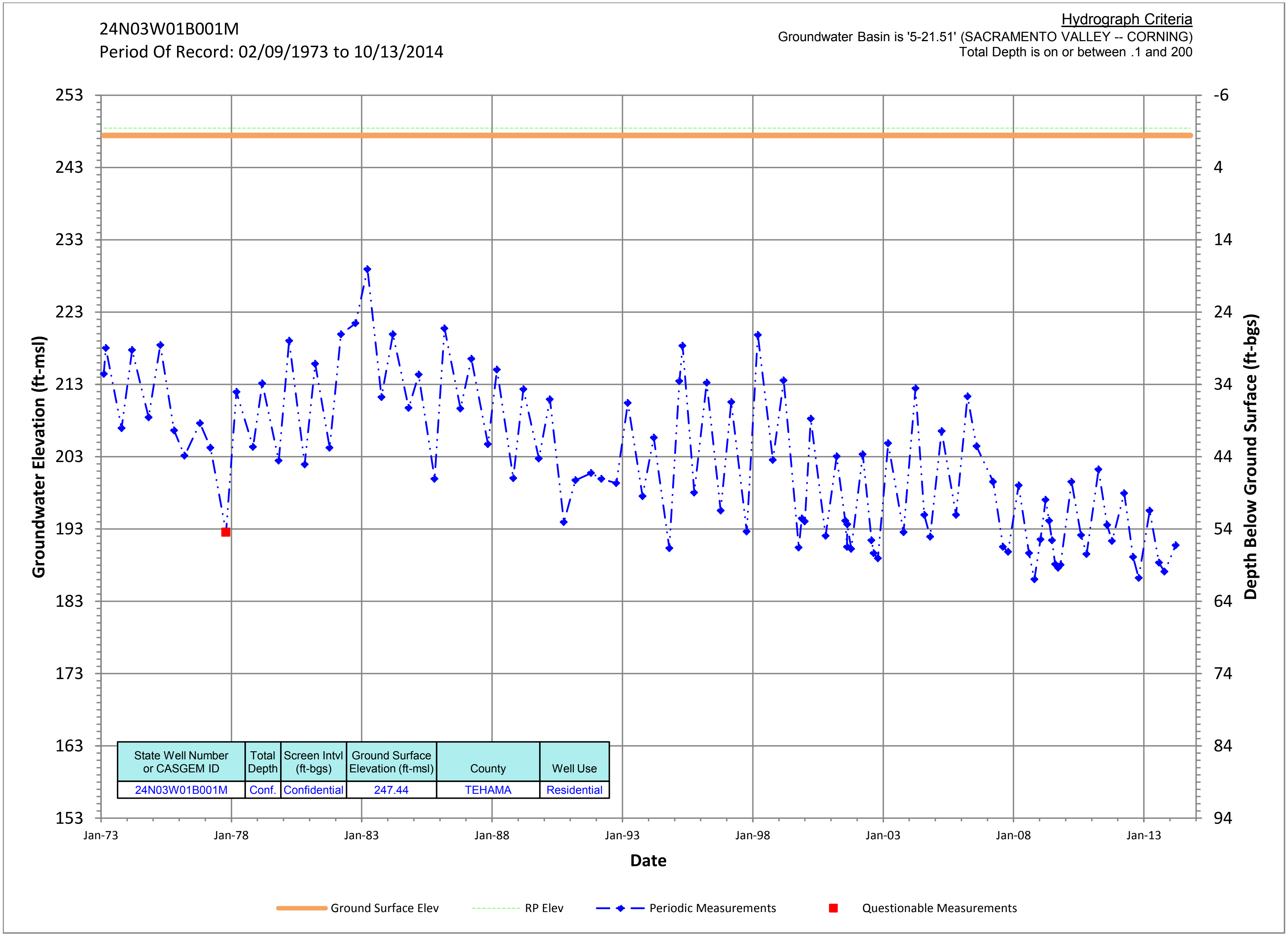
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W25M004M	Conf.	Confidential	235.62	TEHAMA	Observation

24N02W20B001M
Period Of Record: 05/04/2000 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



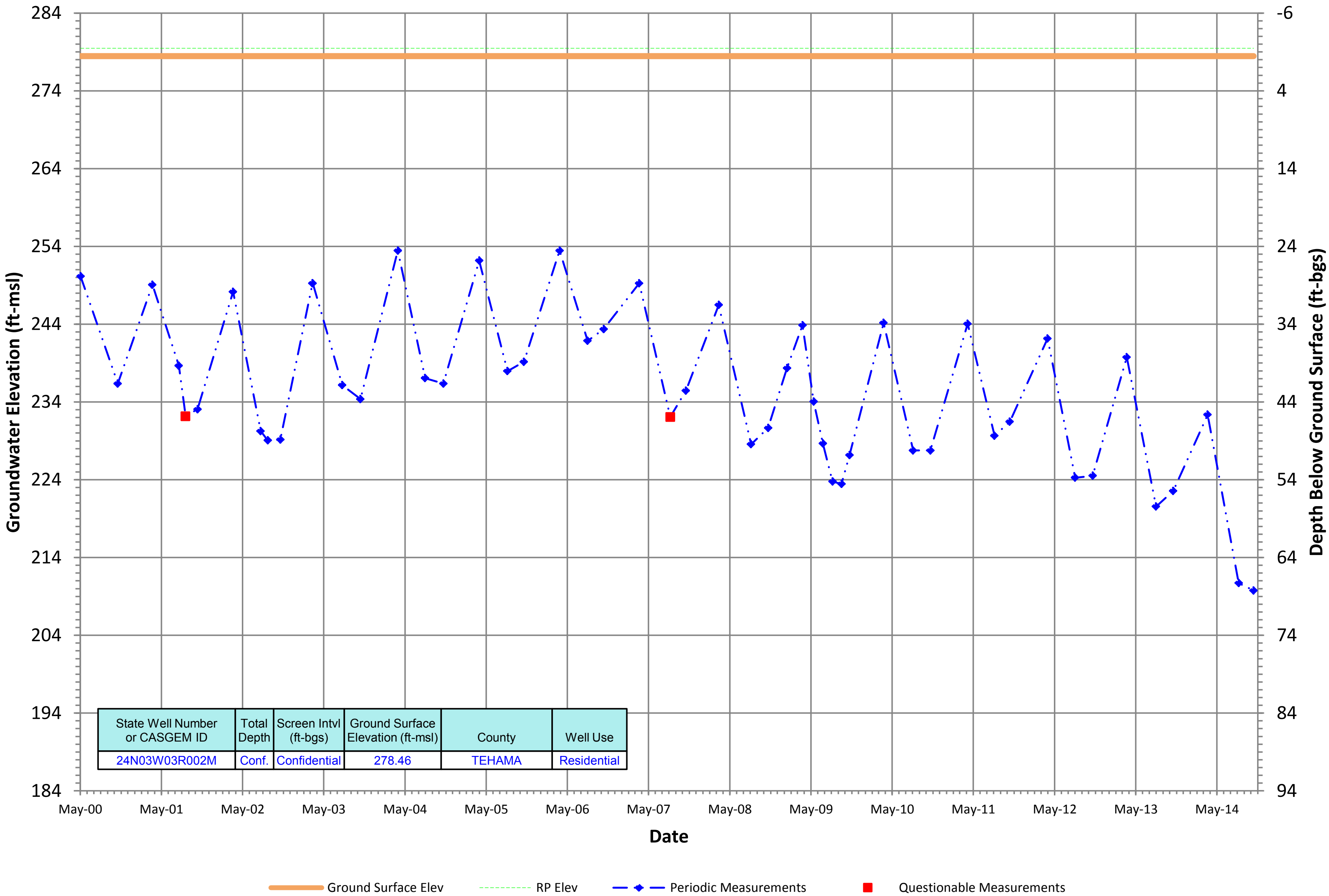
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N02W20B001M	Conf.	Confidential	222.43	TEHAMA	Residential



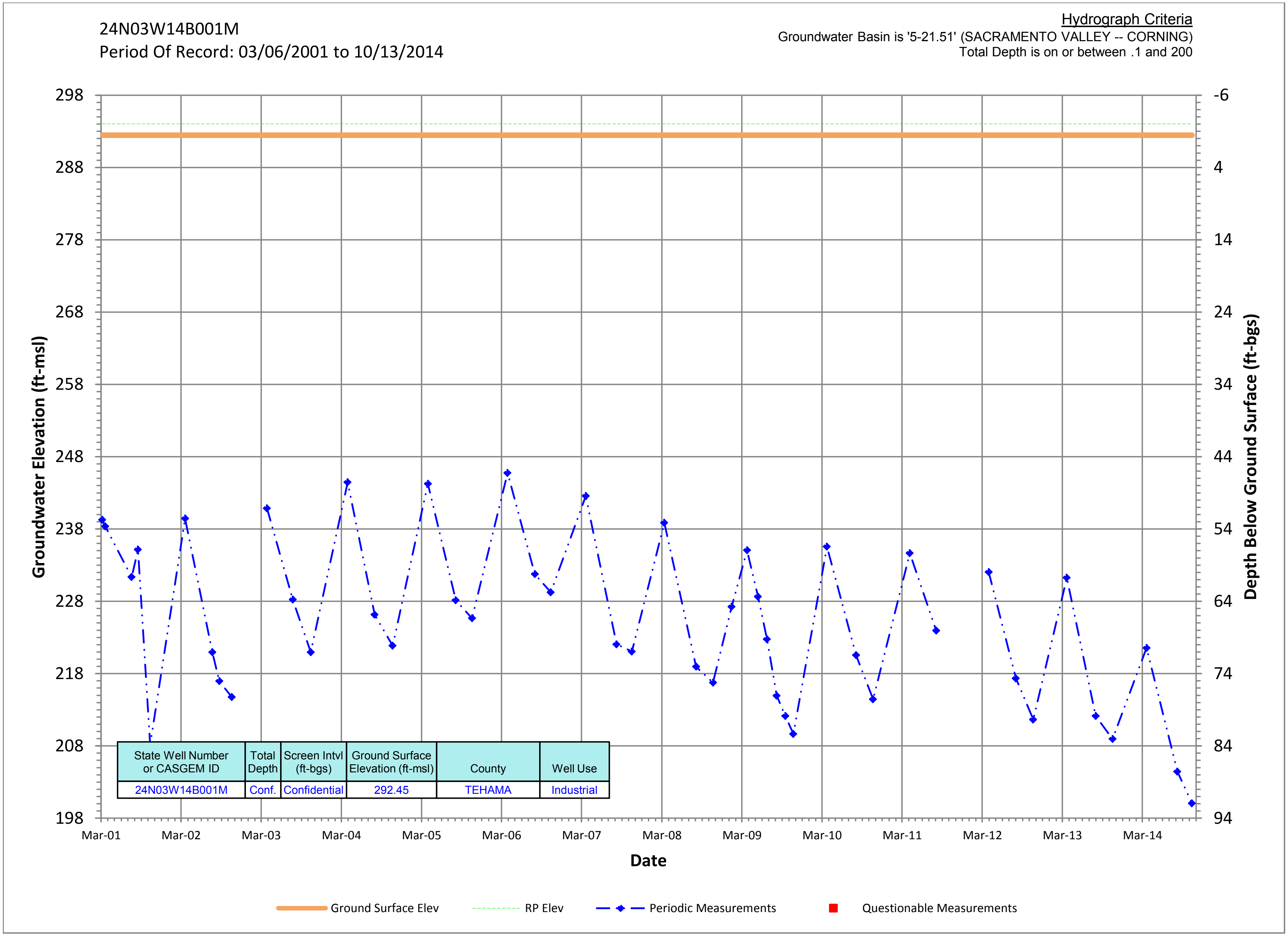
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W01B001M	Conf.	Confidential	247.44	TEHAMA	Residential

24N03W03R002M
Period Of Record: 05/02/2000 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



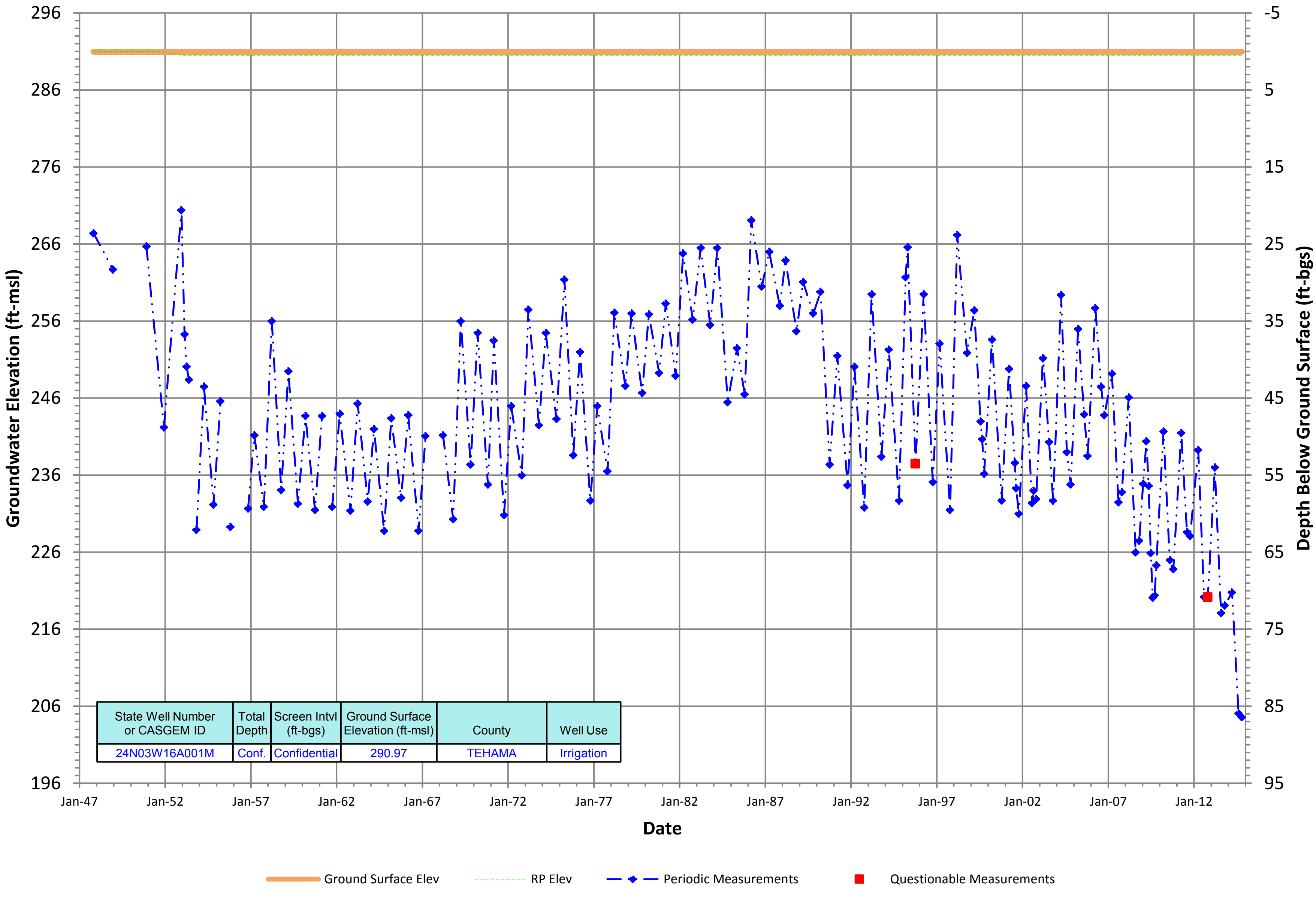
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W03R002M	Conf.	Confidential	278.46	TEHAMA	Residential



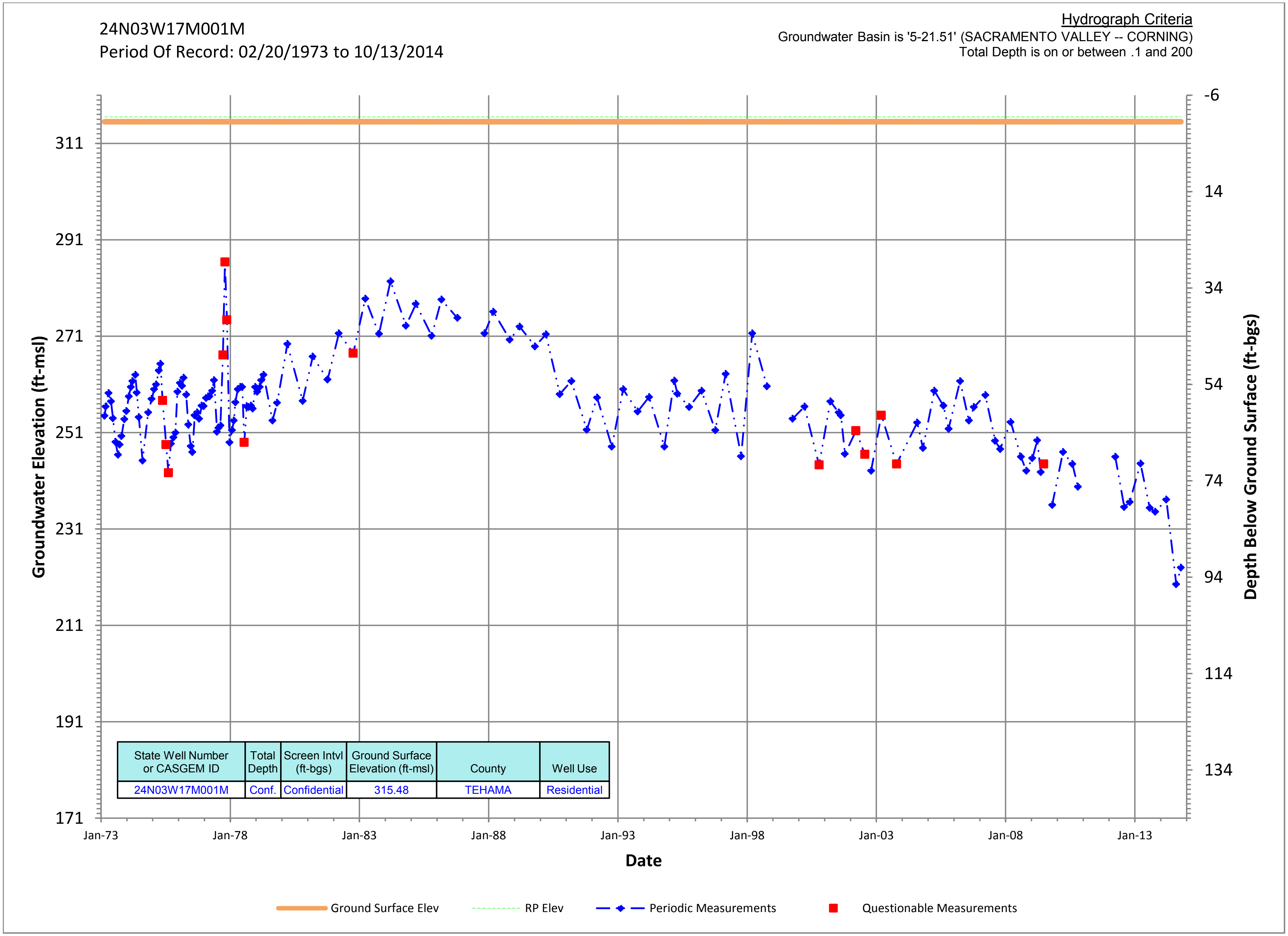
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W14B001M	Conf.	Confidential	292.45	TEHAMA	Industrial

24N03W16A001M
Period Of Record: 10/28/1947 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



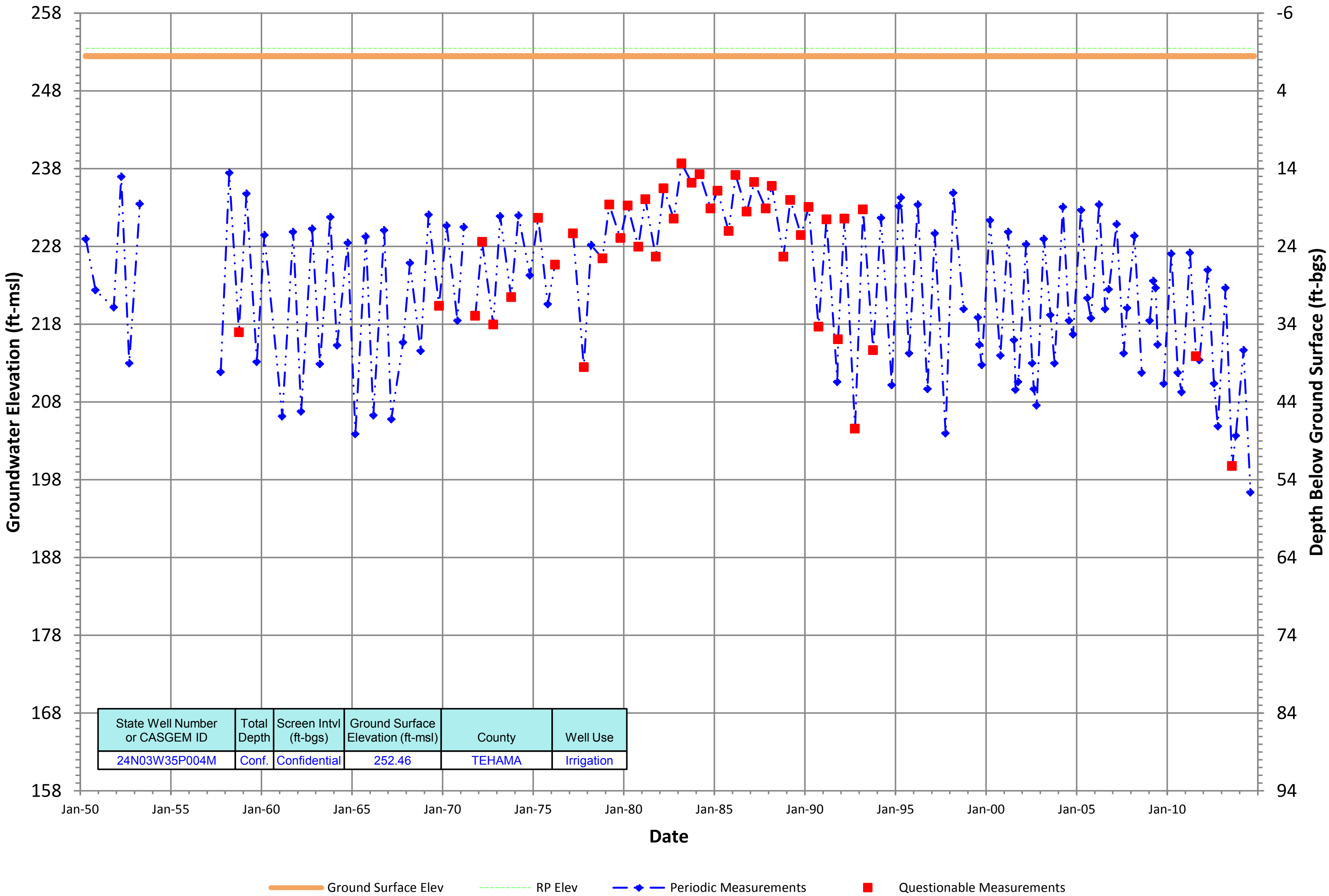
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W16A001M	Conf.	Confidential	290.97	TEHAMA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W17M001M	Conf.	Confidential	315.48	TEHAMA	Residential

24N03W35P004M
Period Of Record: 04/23/1950 to 10/13/2014

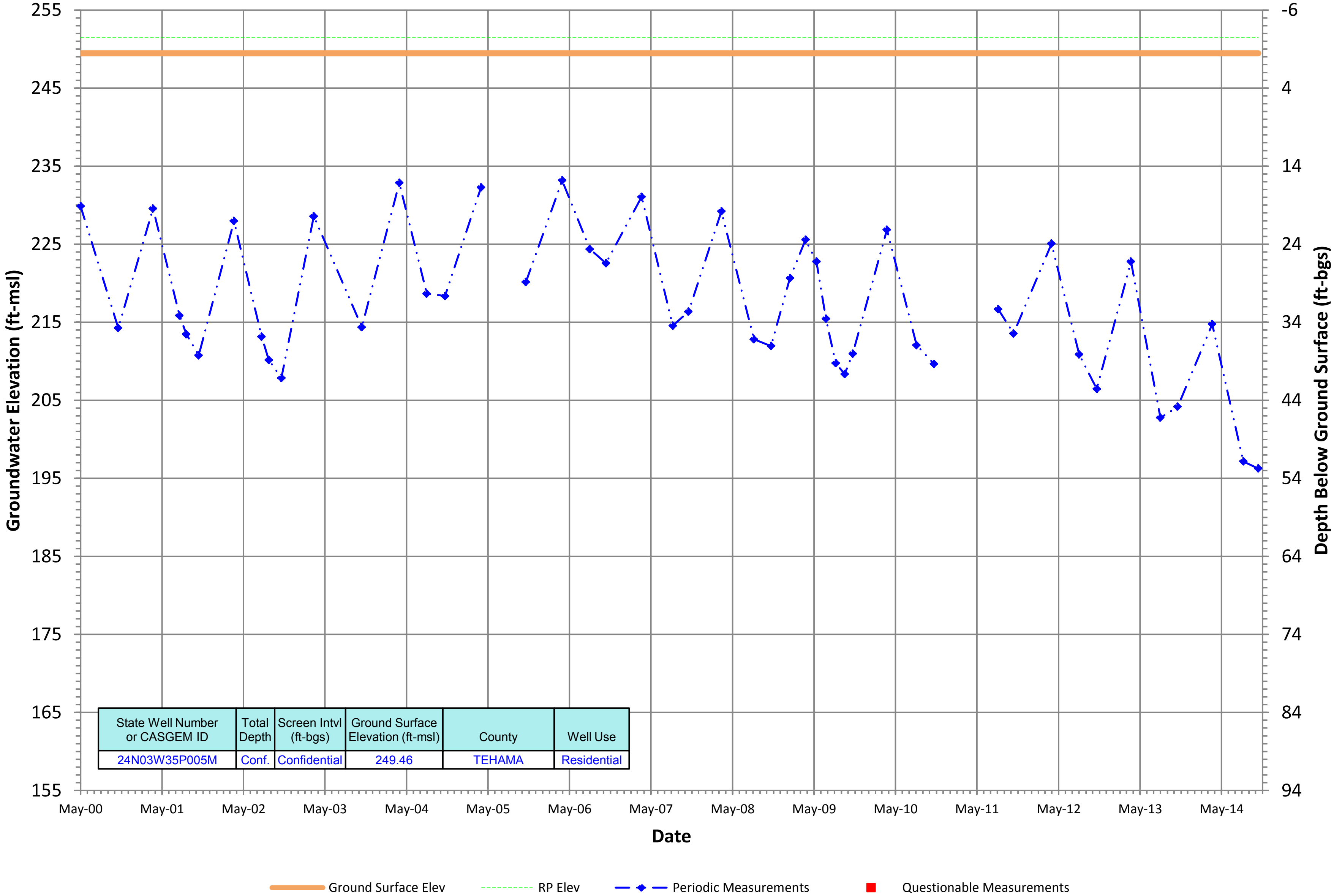
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



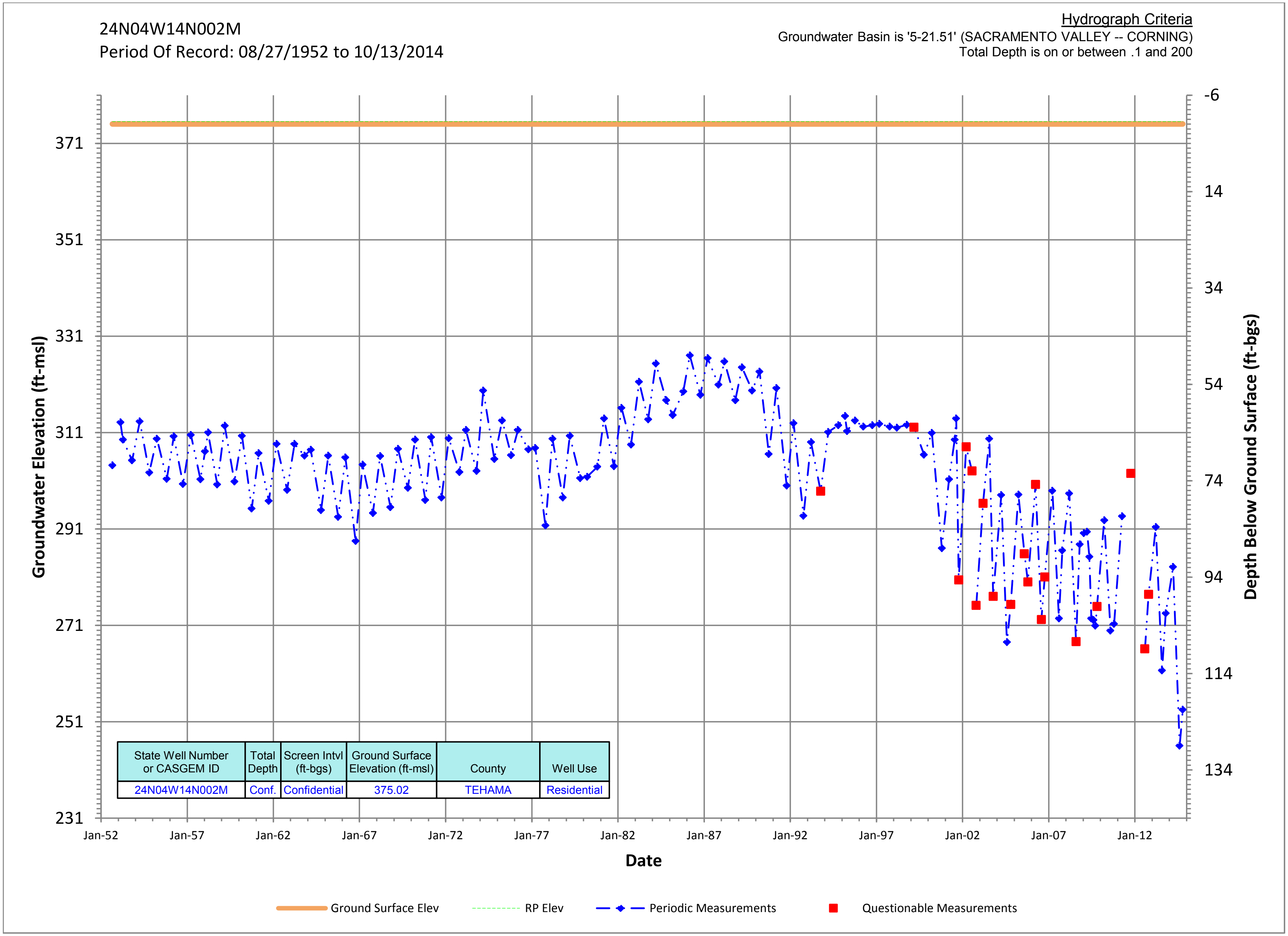
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W35P004M	Conf.	Confidential	252.46	TEHAMA	Irrigation

24N03W35P005M
Period Of Record: 05/01/2000 to 10/13/2014

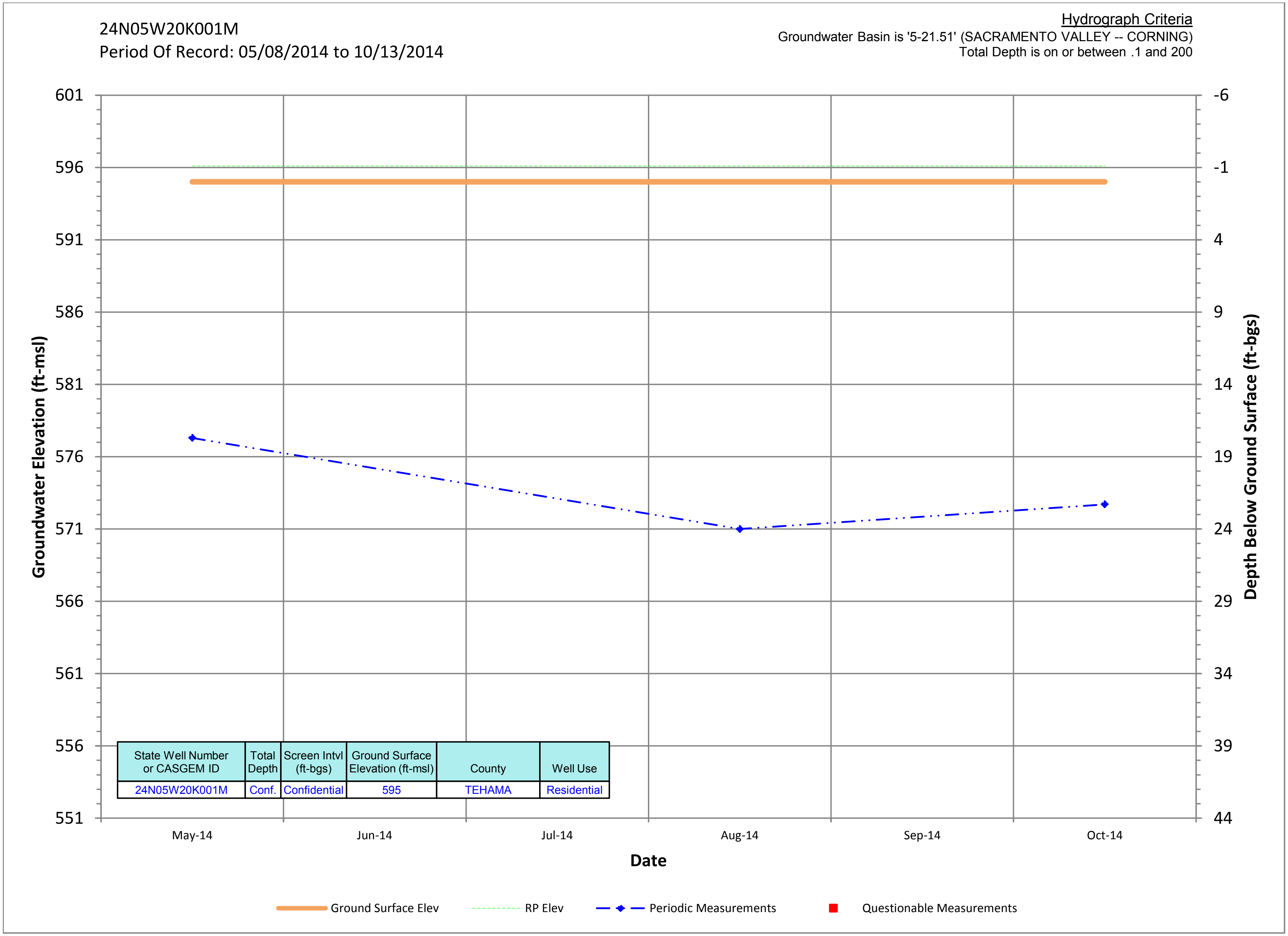
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W35P005M	Conf.	Confidential	249.46	TEHAMA	Residential



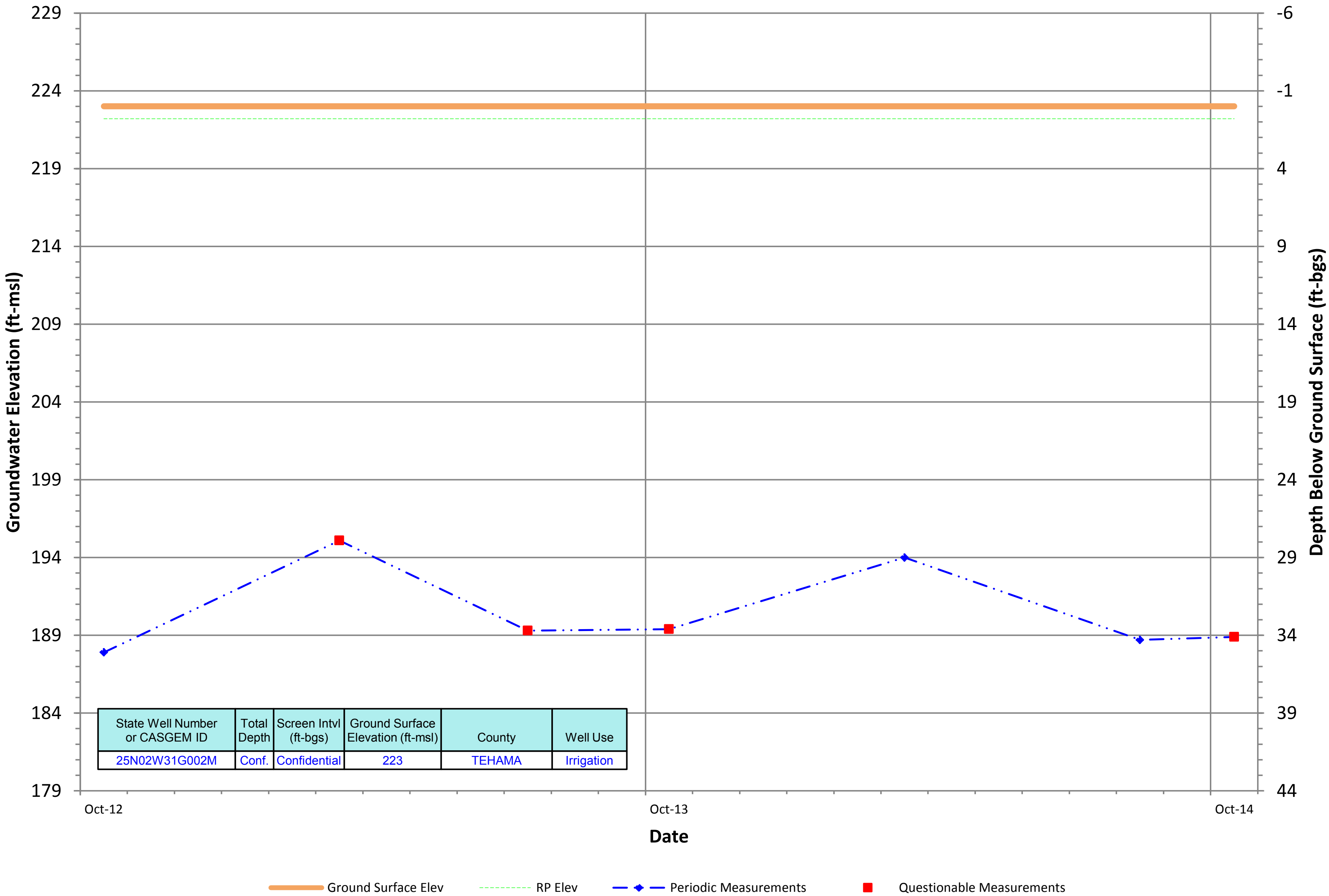
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N04W14N002M	Conf.	Confidential	375.02	TEHAMA	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N05W20K001M	Conf.	Confidential	595	TEHAMA	Residential

25N02W31G002M
Period Of Record: 10/19/2012 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
25N02W31G002M	Conf.	Confidential	223	TEHAMA	Irrigation

Intermediate Depth Groundwater Monitoring Well Hydrographs- Corning Subbasin

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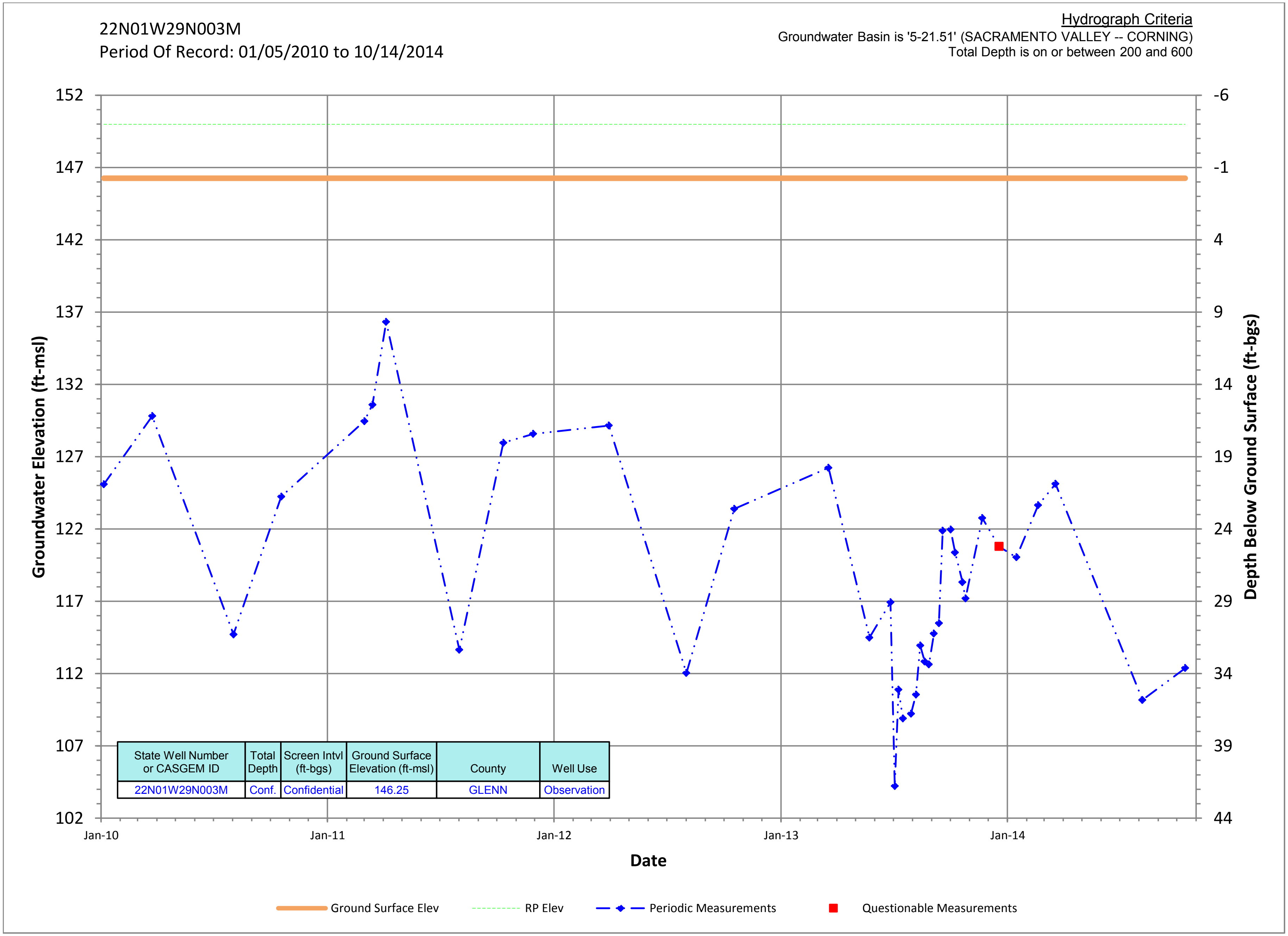
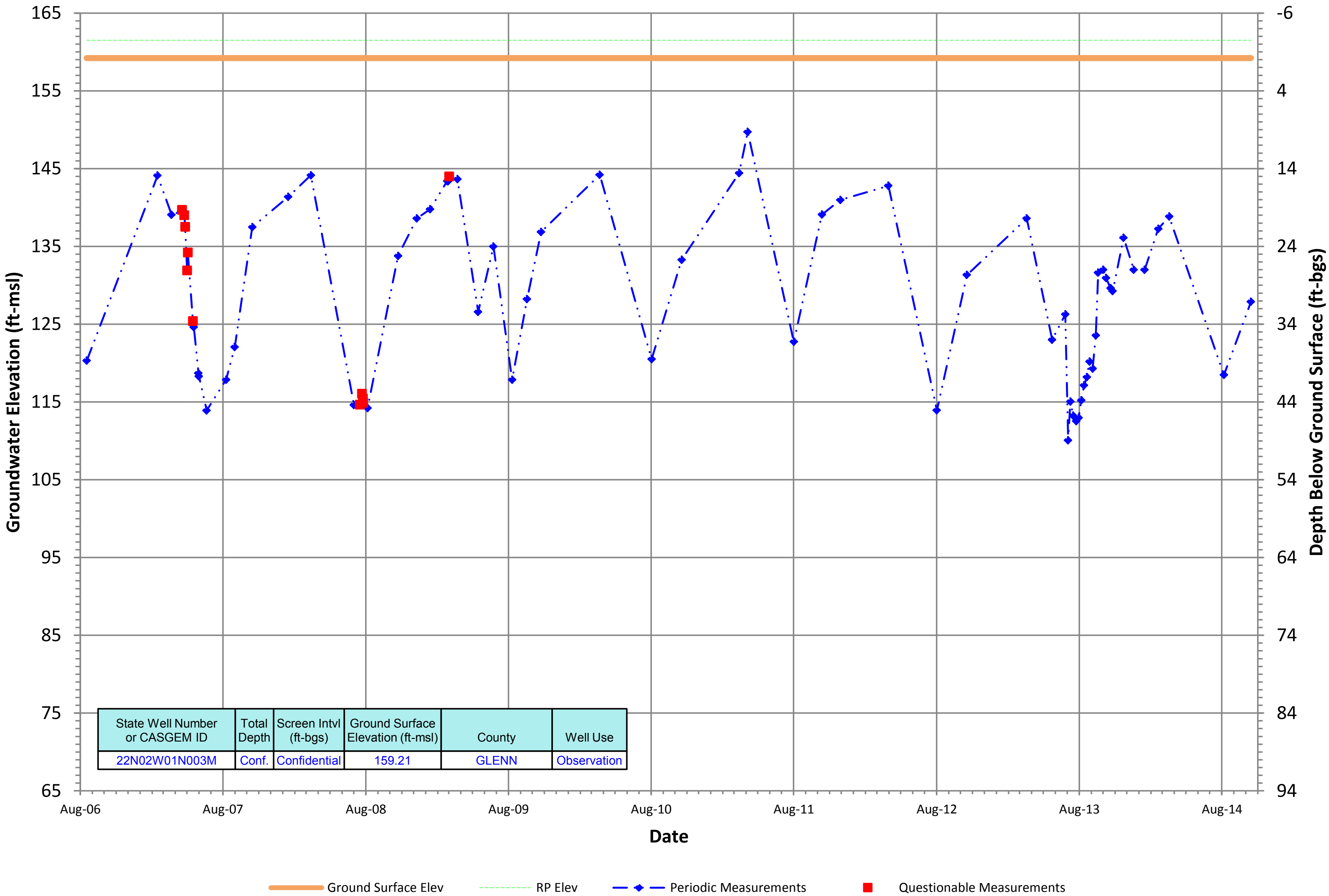


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N01W29N003M	Conf.	Confidential	146.25	GLENN	Observation

22N02W01N003M
Period Of Record: 08/17/2006 to 10/14/2014

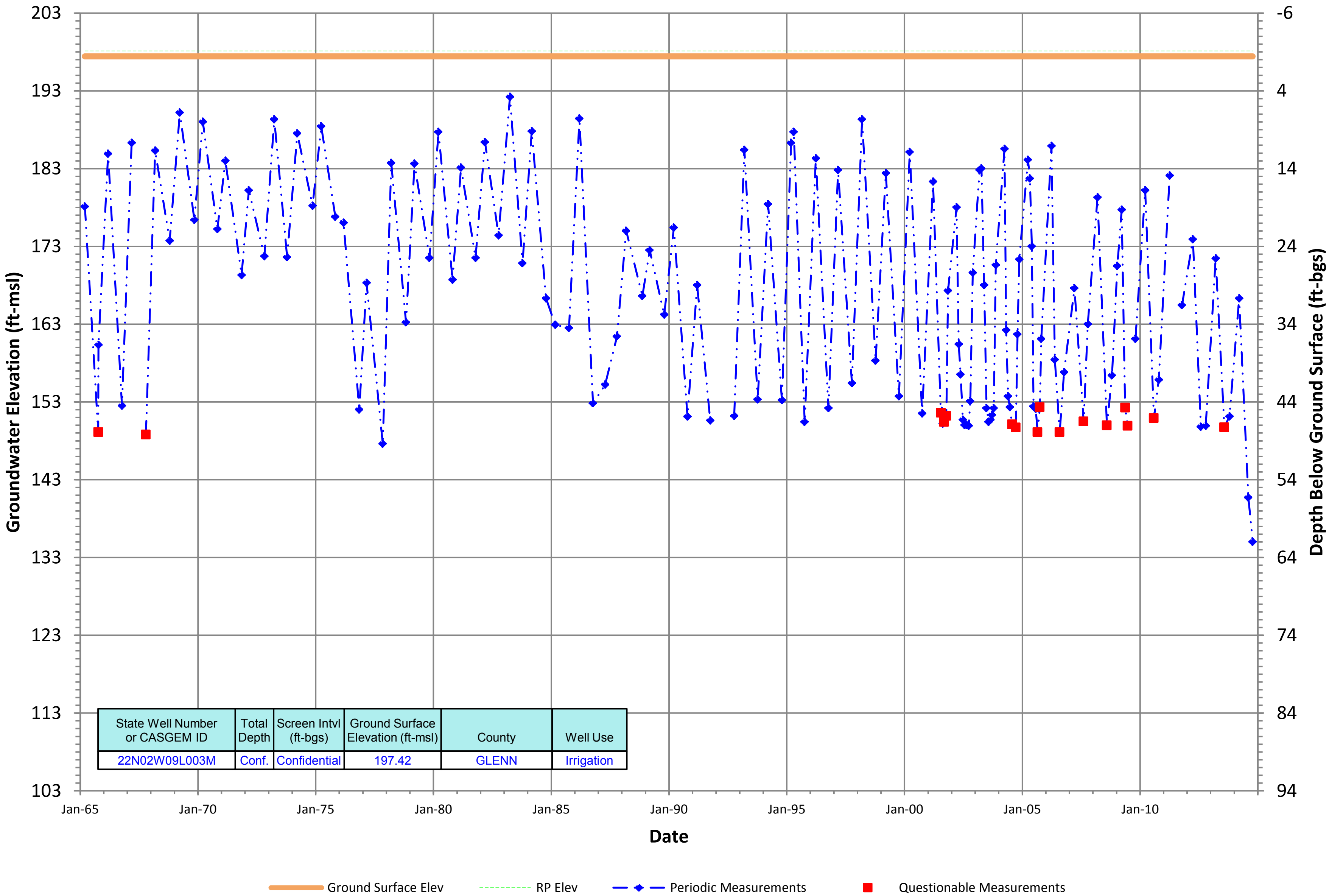
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W01N003M	Conf.	Confidential	159.21	GLENN	Observation

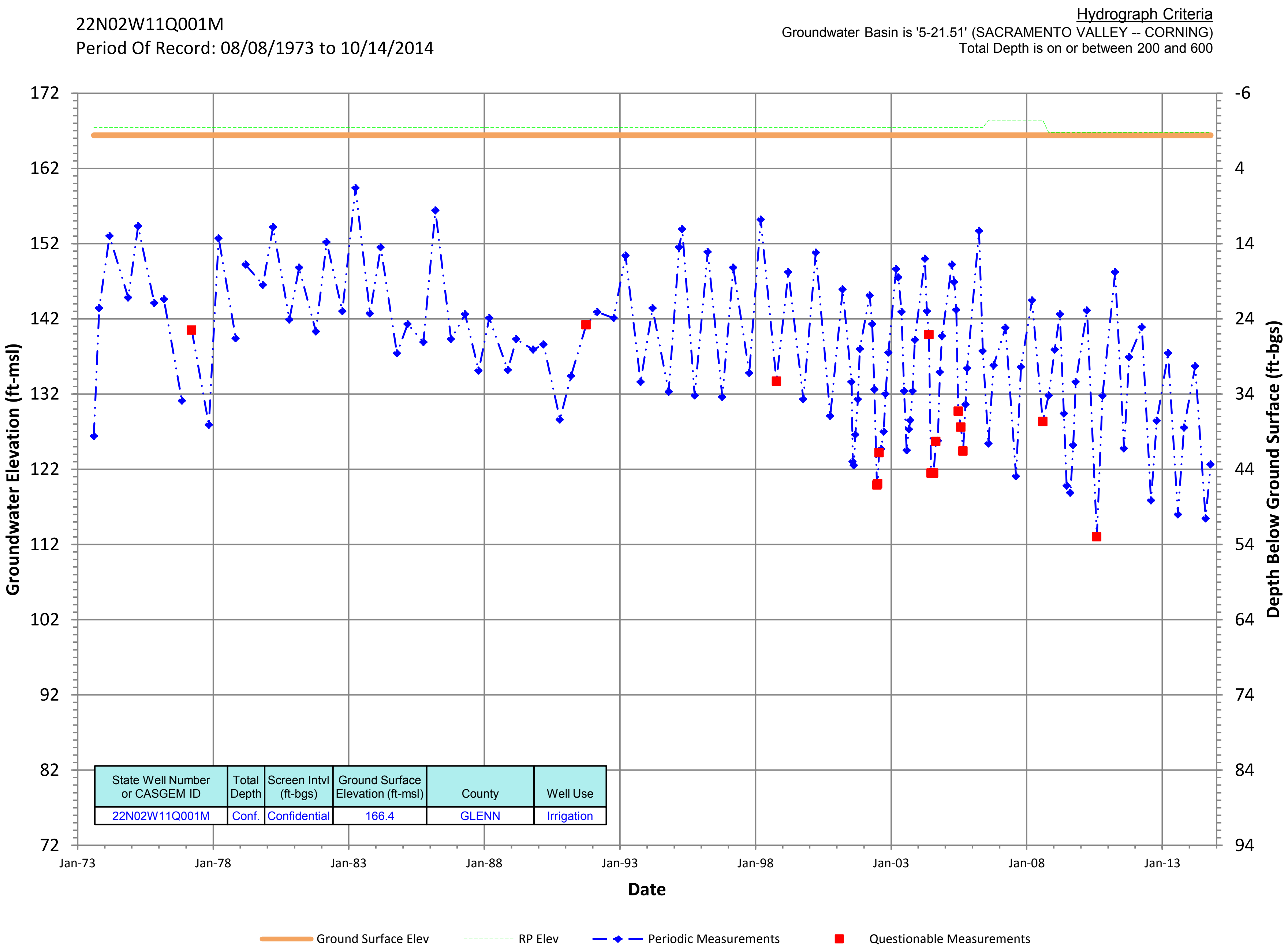
22N02W09L003M
Period Of Record: 03/12/1965 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W09L003M	Conf.	Confidential	197.42	GLENN	Irrigation

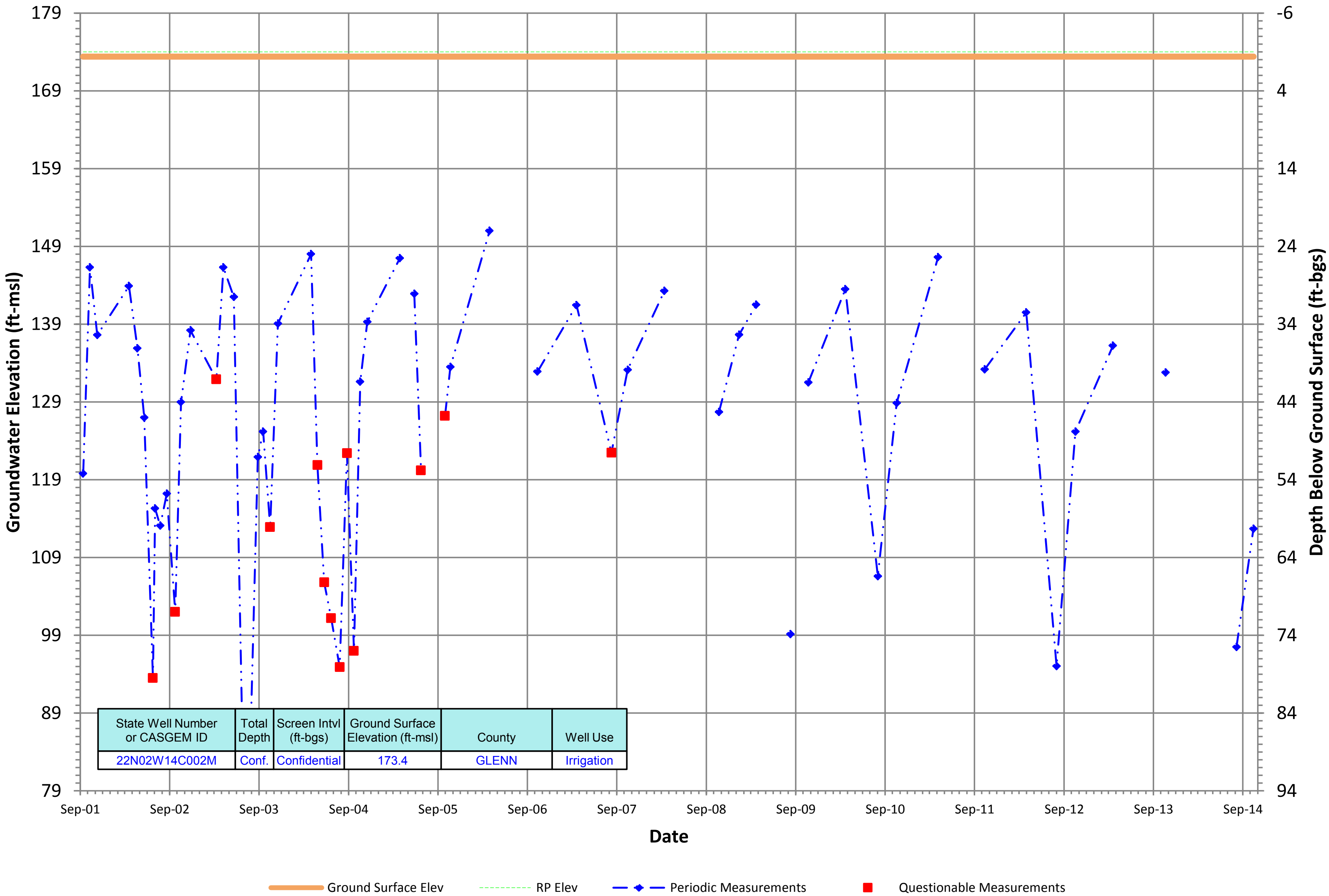
22N02W11Q001M
Period Of Record: 08/08/1973 to 10/14/2014



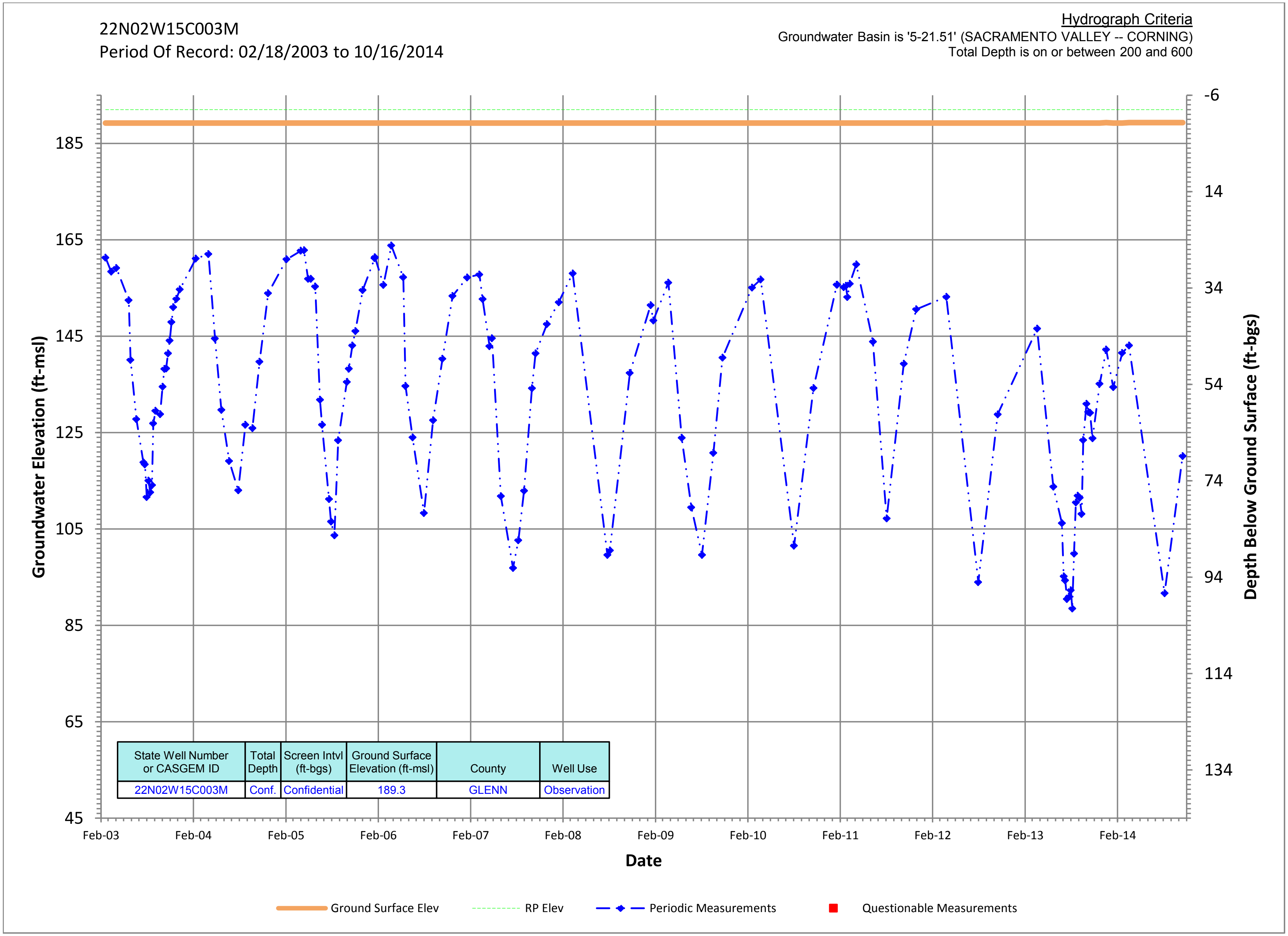
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W11Q001M	Conf.	Confidential	166.4	GLENN	Irrigation

22N02W14C002M
Period Of Record: 09/12/2001 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



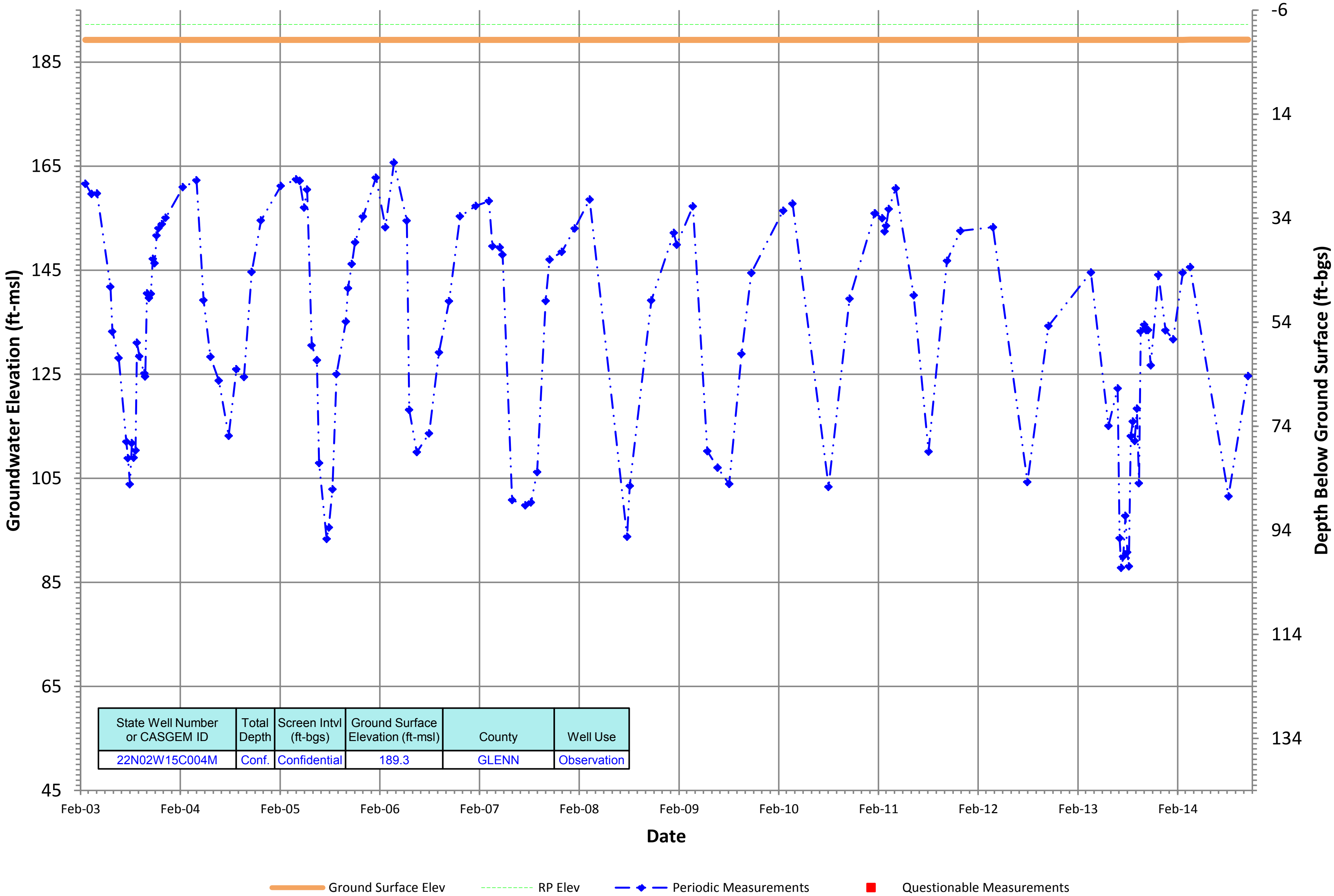
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W14C002M	Conf.	Confidential	173.4	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W15C003M	Conf.	Confidential	189.3	GLENN	Observation

22N02W15C004M
Period Of Record: 02/18/2003 to 10/16/2014

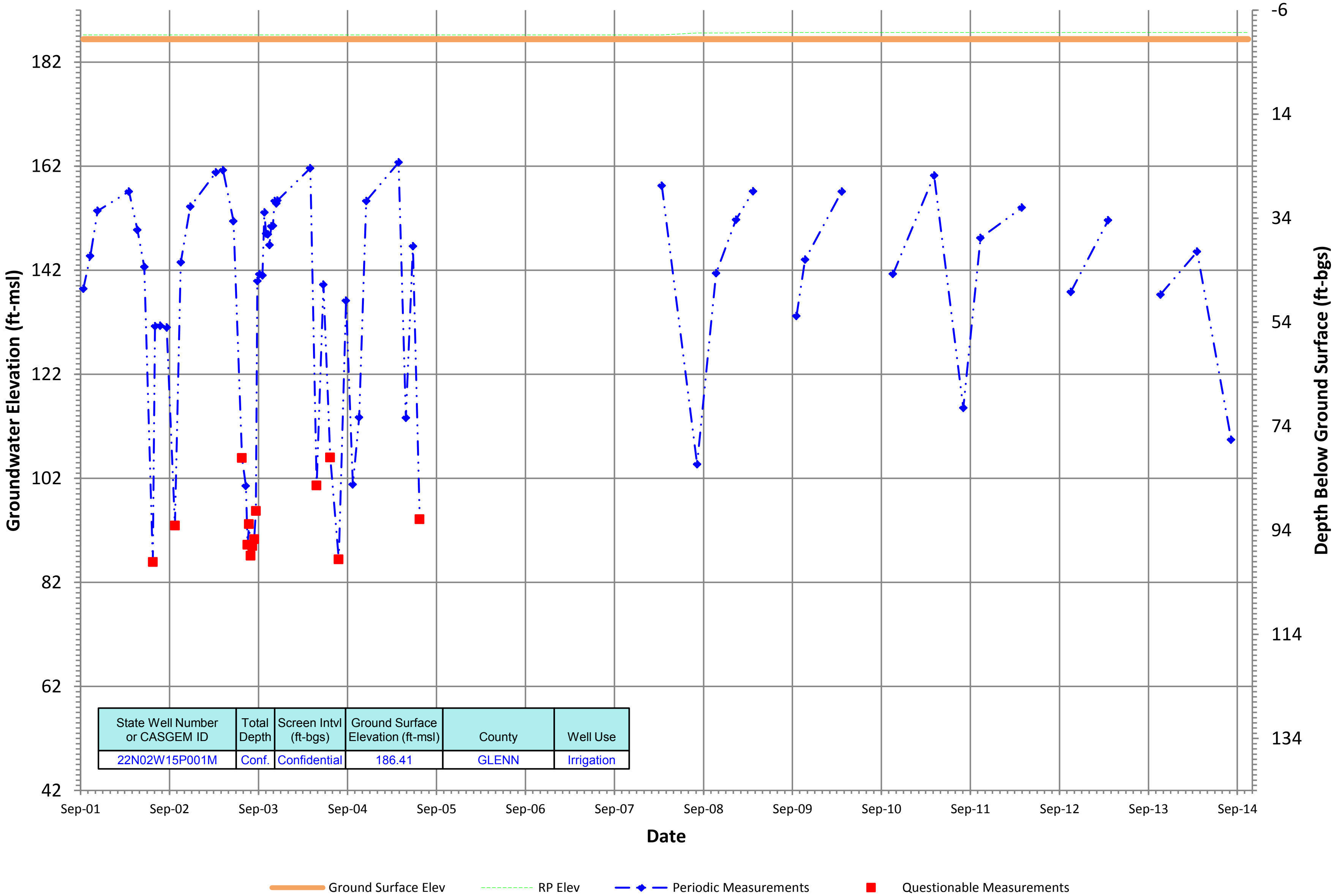
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



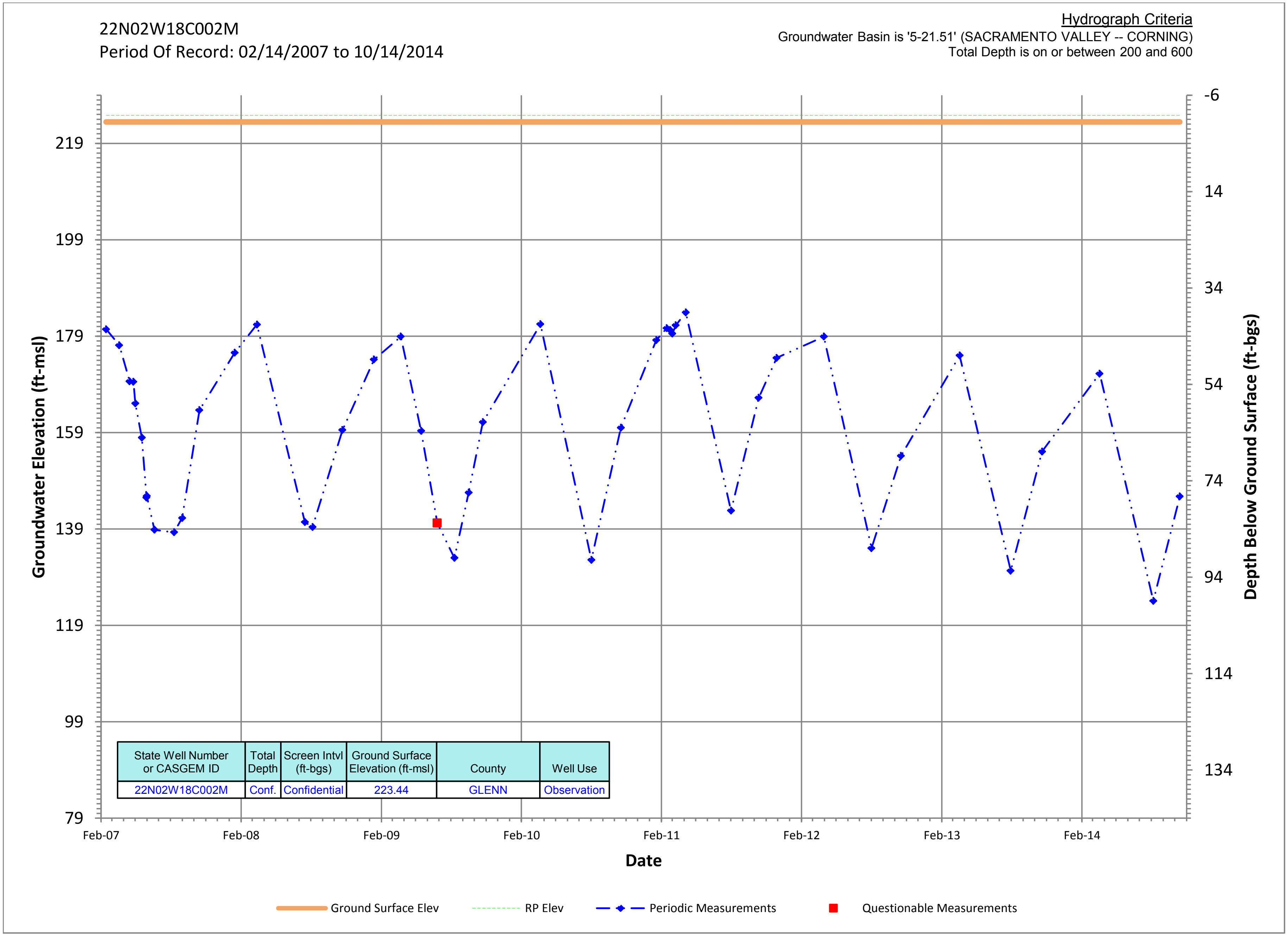
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W15C004M	Conf.	Confidential	189.3	GLENN	Observation

22N02W15P001M
Period Of Record: 09/12/2001 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



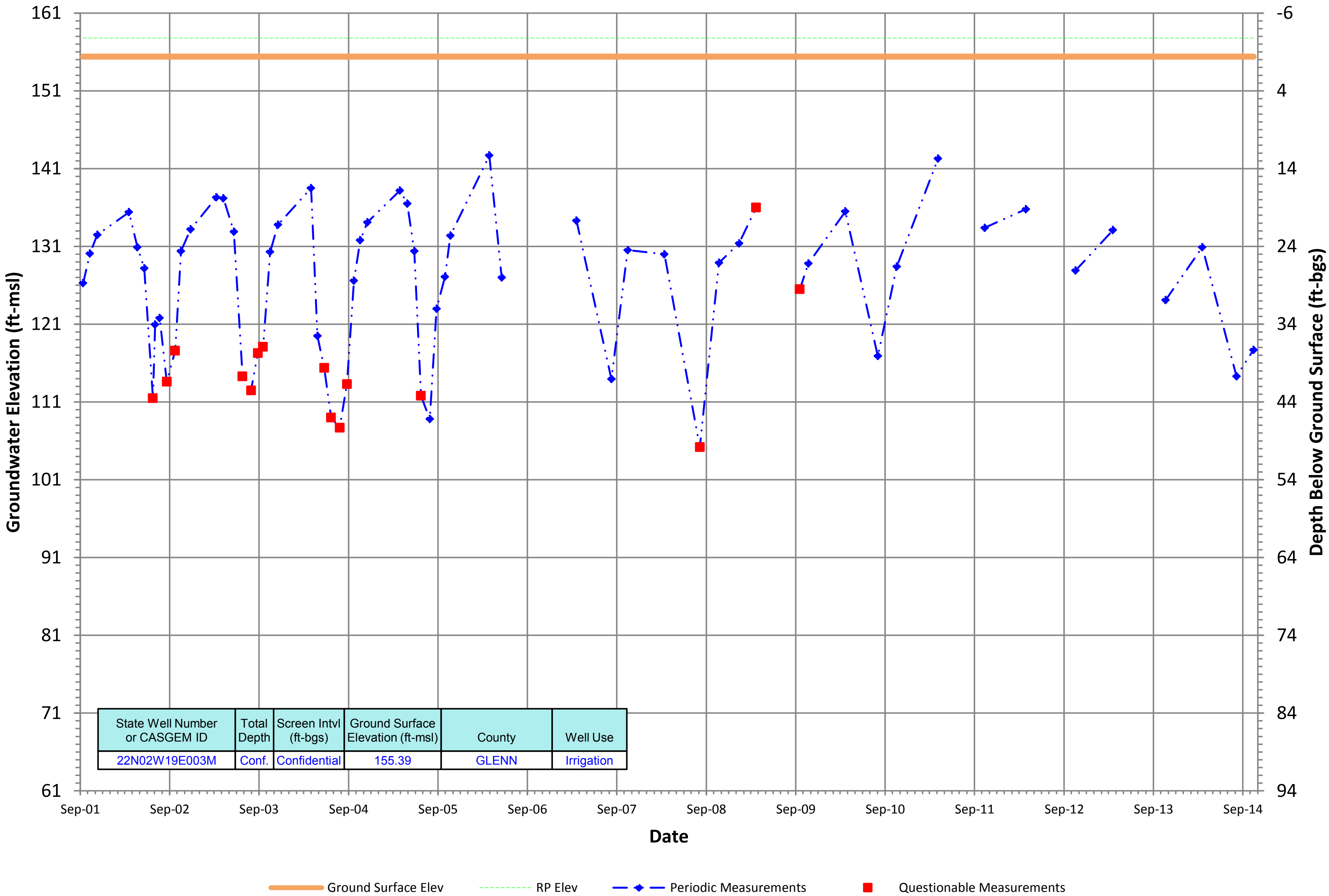
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W15P001M	Conf.	Confidential	186.41	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W18C002M	Conf.	Confidential	223.44	GLENN	Observation

22N02W19E003M
Period Of Record: 09/12/2001 to 10/14/2014

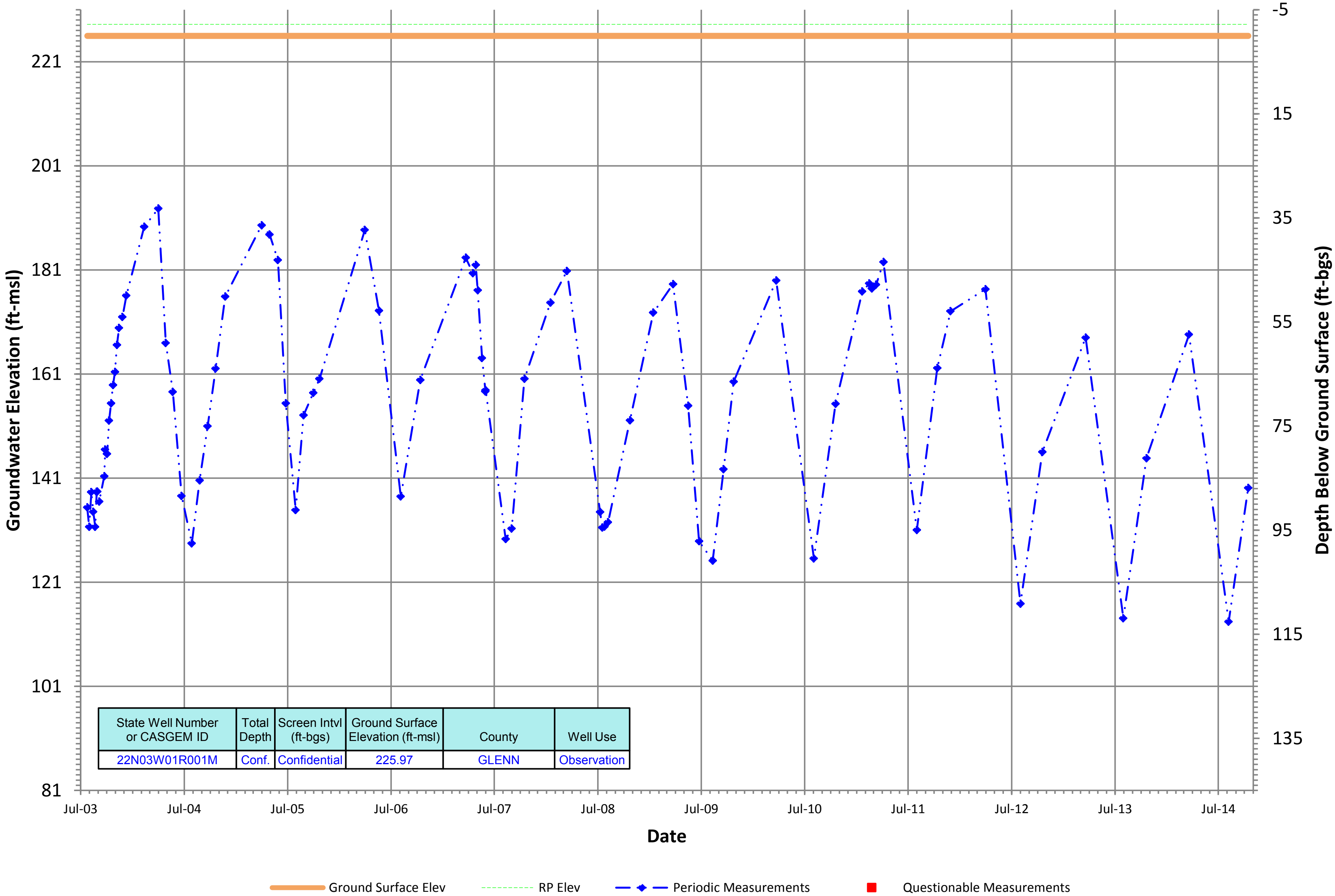
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W19E003M	Conf.	Confidential	155.39	GLENN	Irrigation

22N03W01R001M
Period Of Record: 07/24/2003 to 10/14/2014

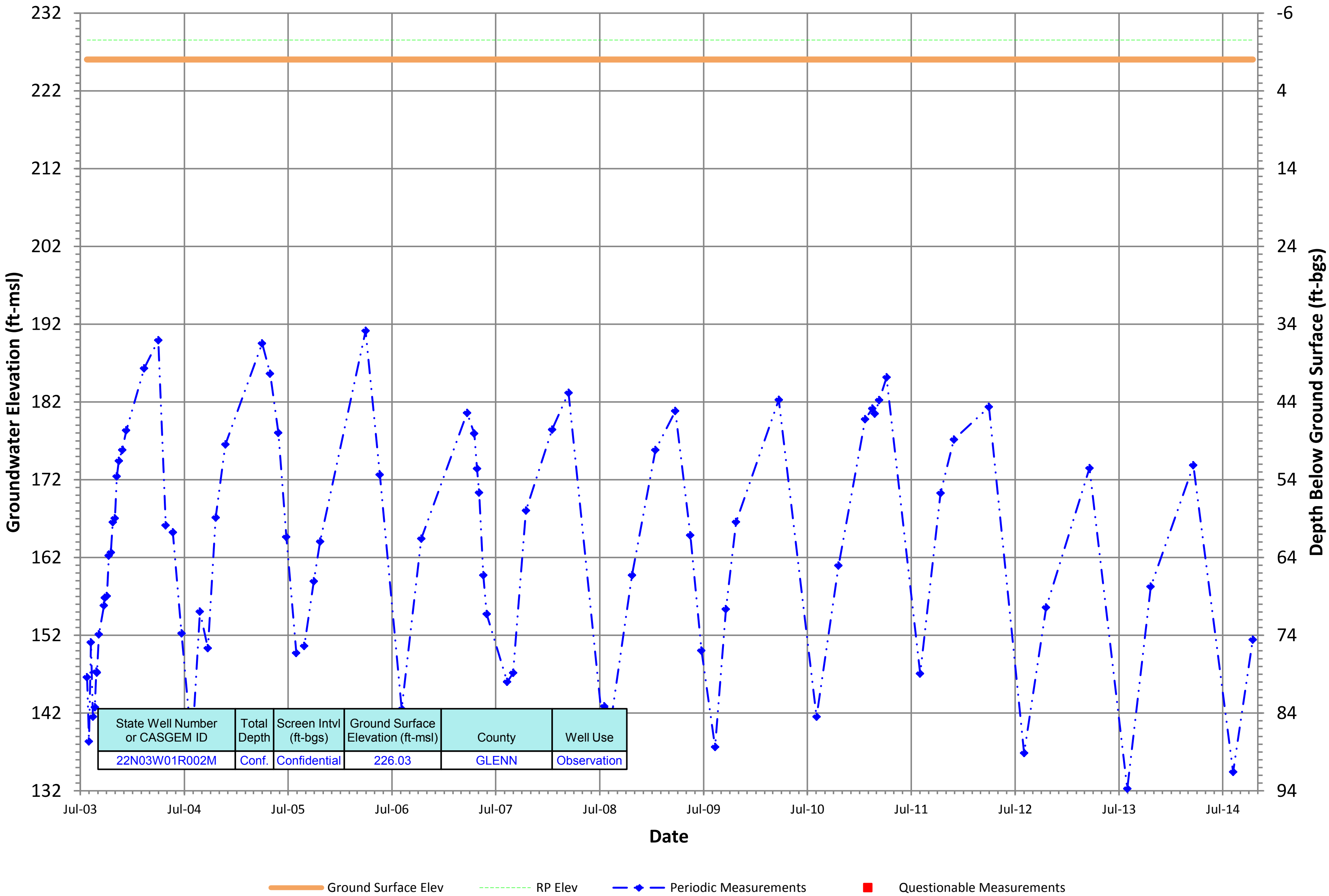
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



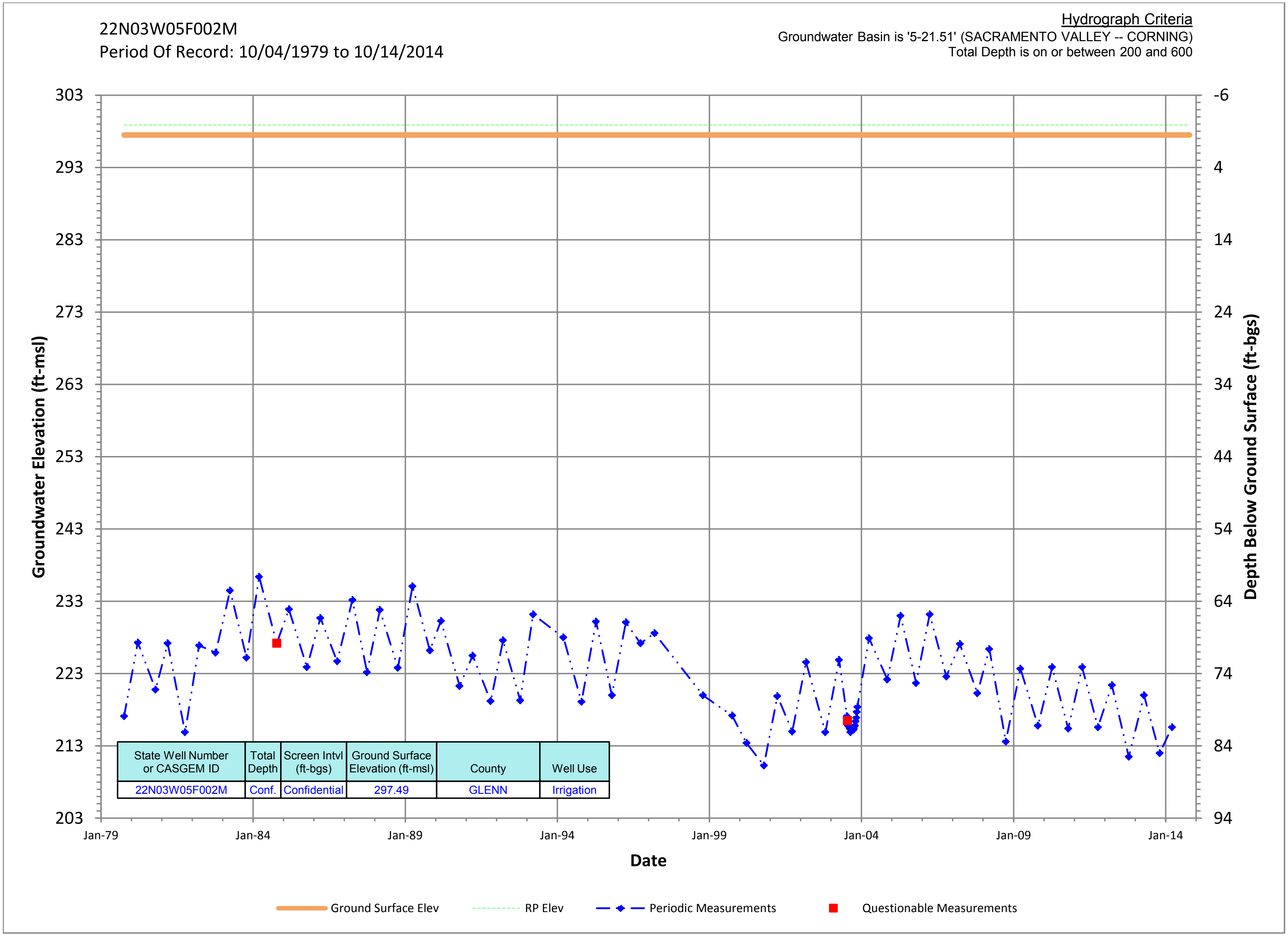
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W01R001M	Conf.	Confidential	225.97	GLENN	Observation

22N03W01R002M
Period Of Record: 07/24/2003 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



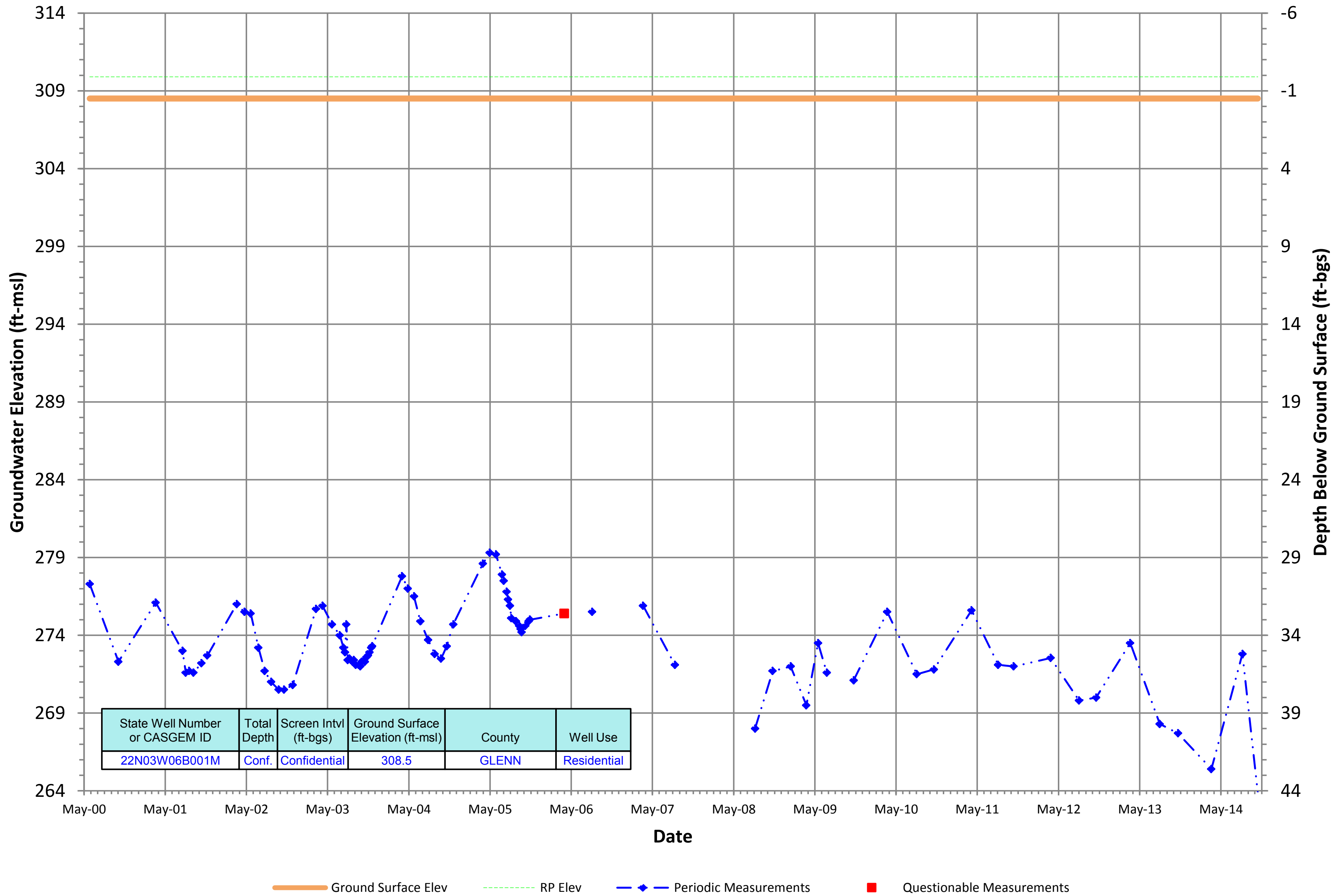
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W01R002M	Conf.	Confidential	226.03	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W05F002M	Conf.	Confidential	297.49	GLENN	Irrigation

22N03W06B001M
Period Of Record: 05/26/2000 to 10/14/2014

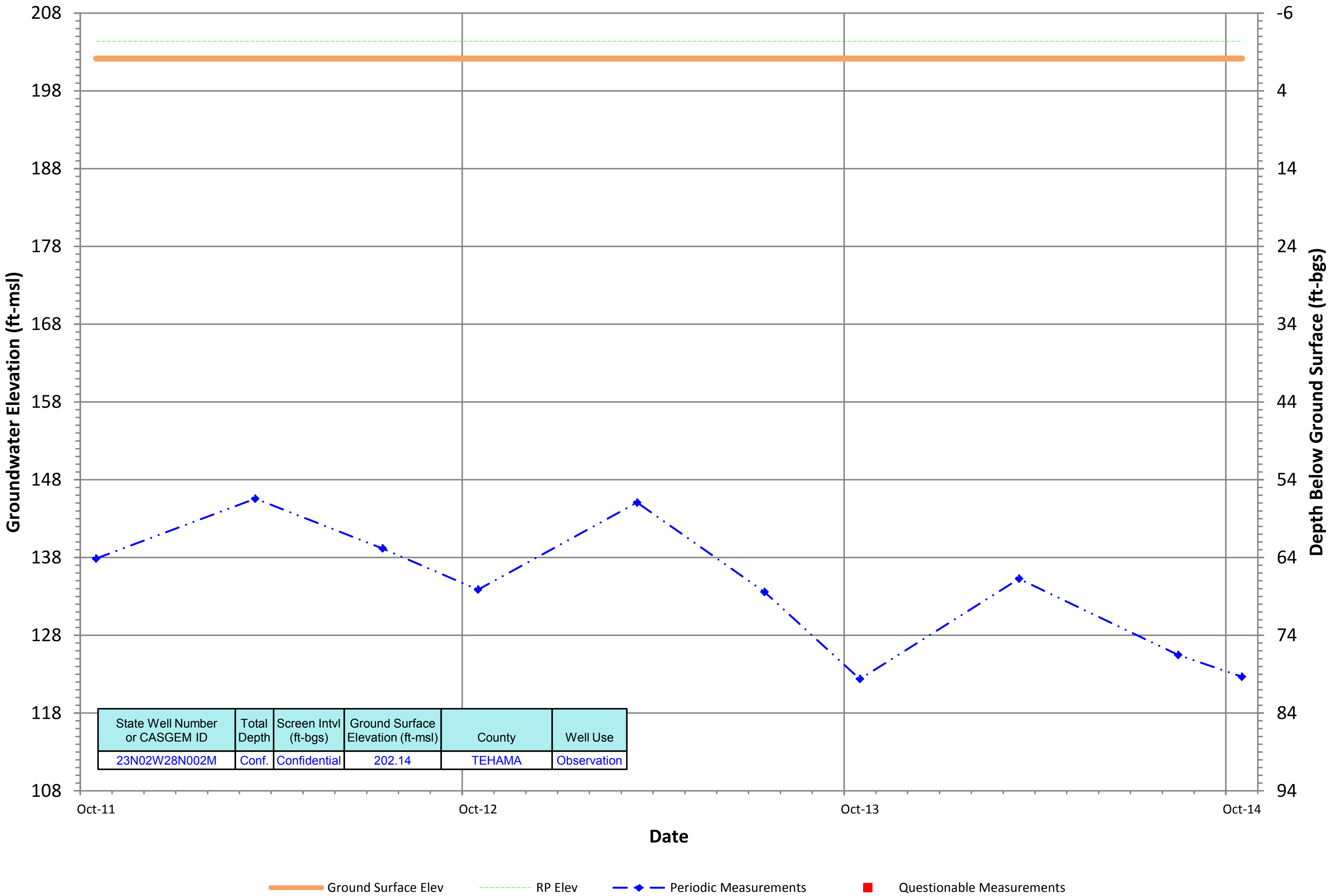
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N03W06B001M	Conf.	Confidential	308.5	GLENN	Residential

23N02W28N002M
Period Of Record: 10/21/2011 to 10/21/2014

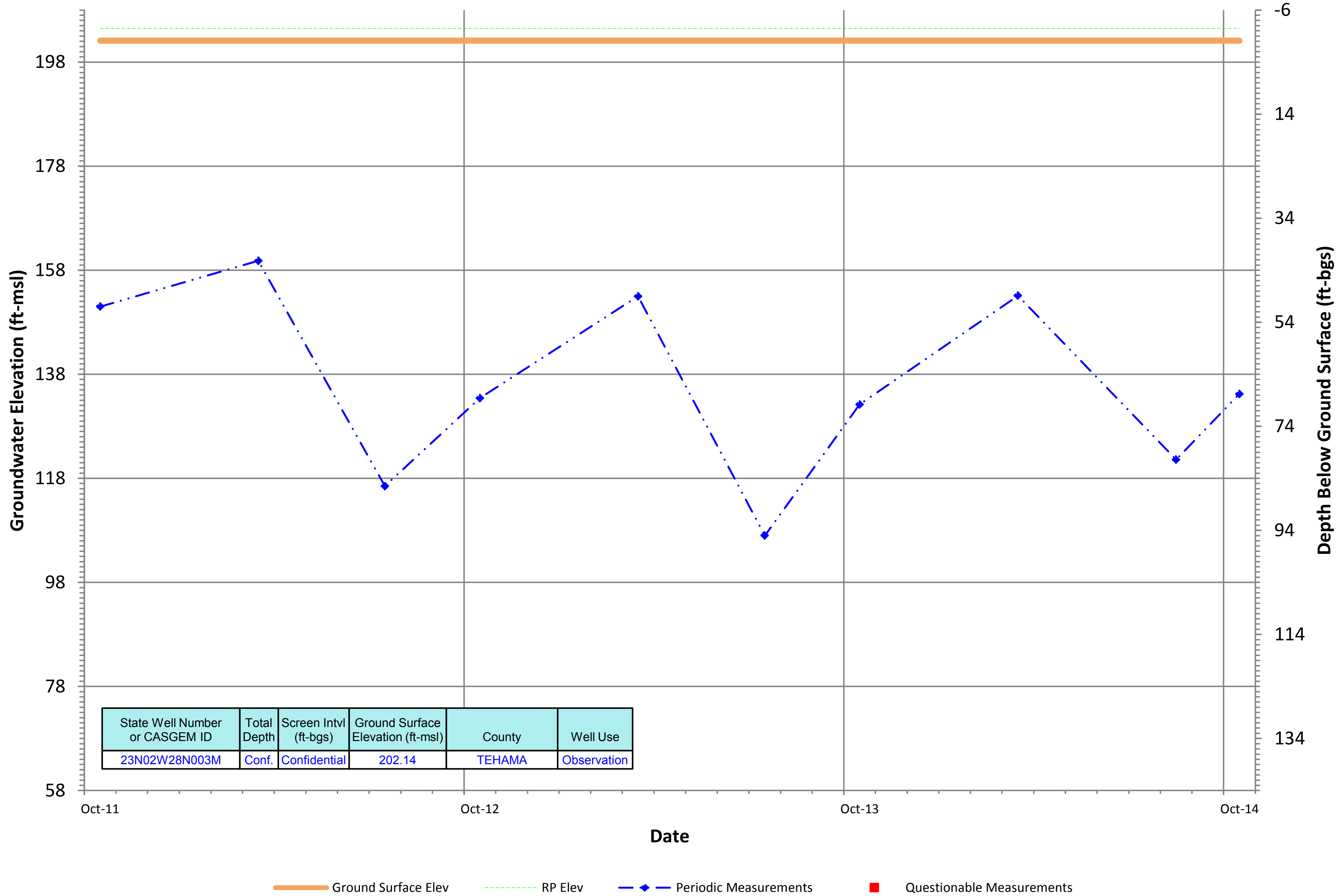
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N02W28N002M	Conf.	Confidential	202.14	TEHAMA	Observation

23N02W28N003M
Period Of Record: 10/21/2011 to 10/21/2014

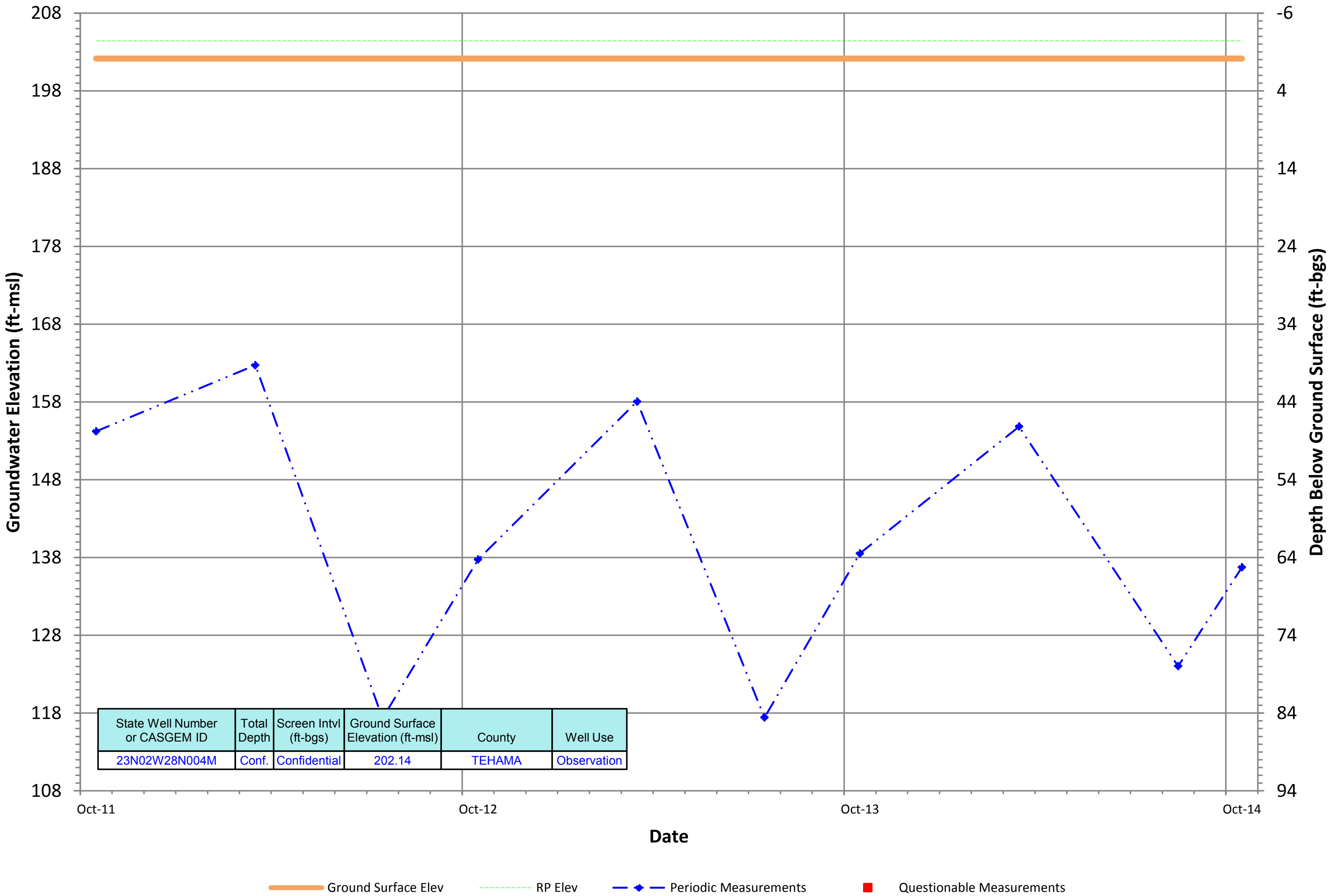
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N02W28N003M	Conf.	Confidential	202.14	TEHAMA	Observation

23N02W28N004M
Period Of Record: 10/21/2011 to 10/21/2014

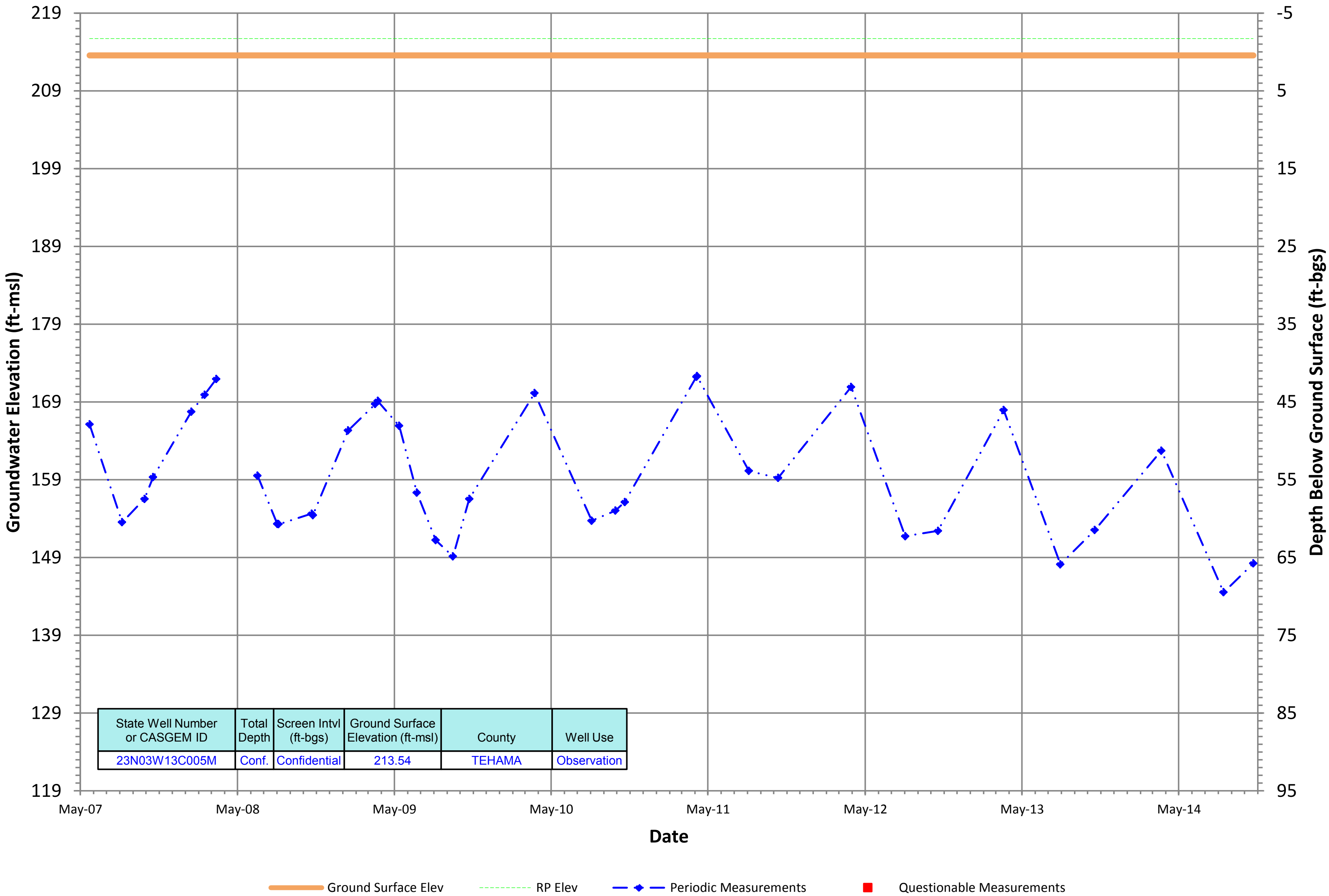
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N02W28N004M	Conf.	Confidential	202.14	TEHAMA	Observation

23N03W13C005M
Period Of Record: 05/22/2007 to 10/21/2014

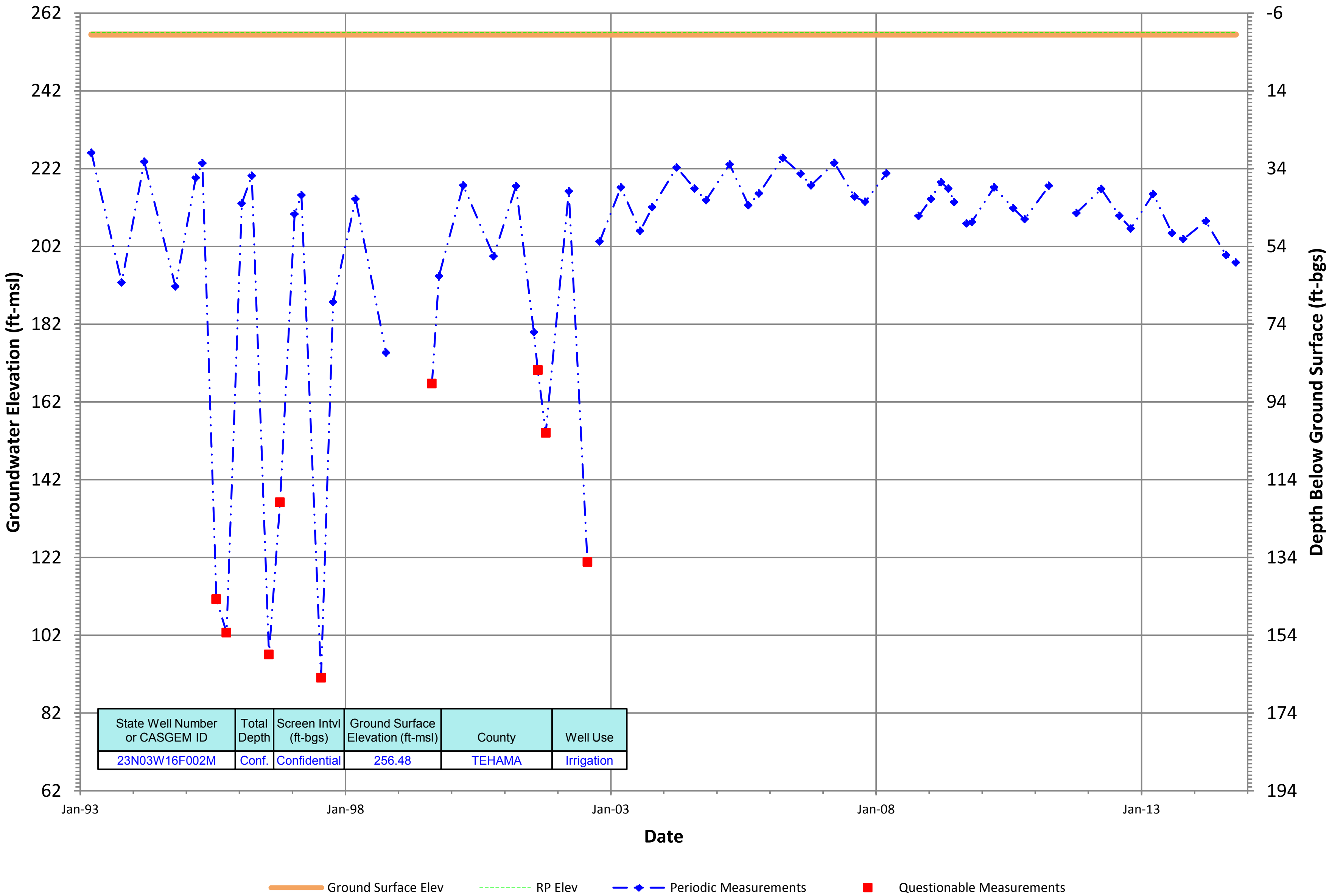
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



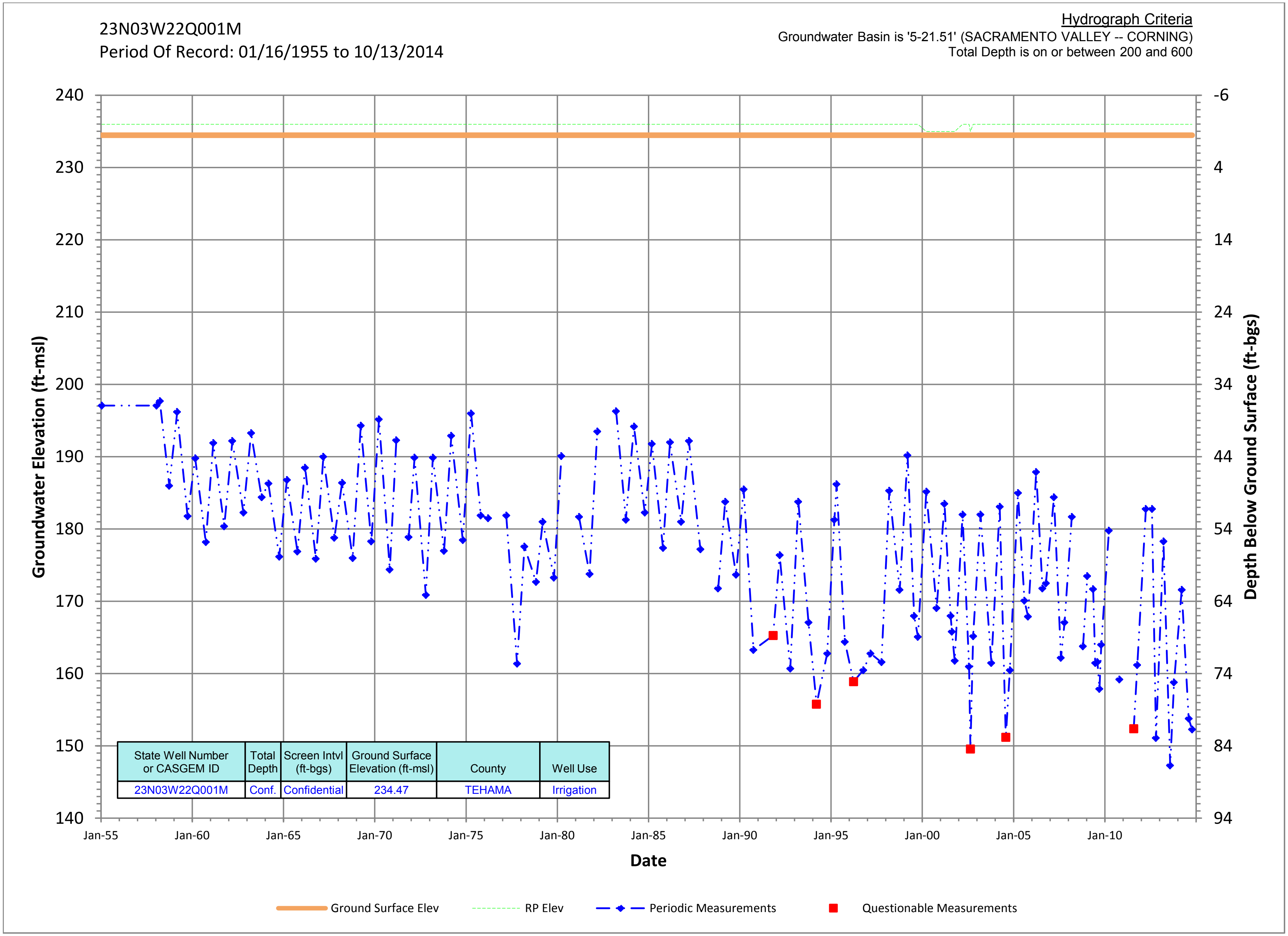
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W13C005M	Conf.	Confidential	213.54	TEHAMA	Observation

23N03W16F002M
Period Of Record: 03/18/1993 to 10/13/2014

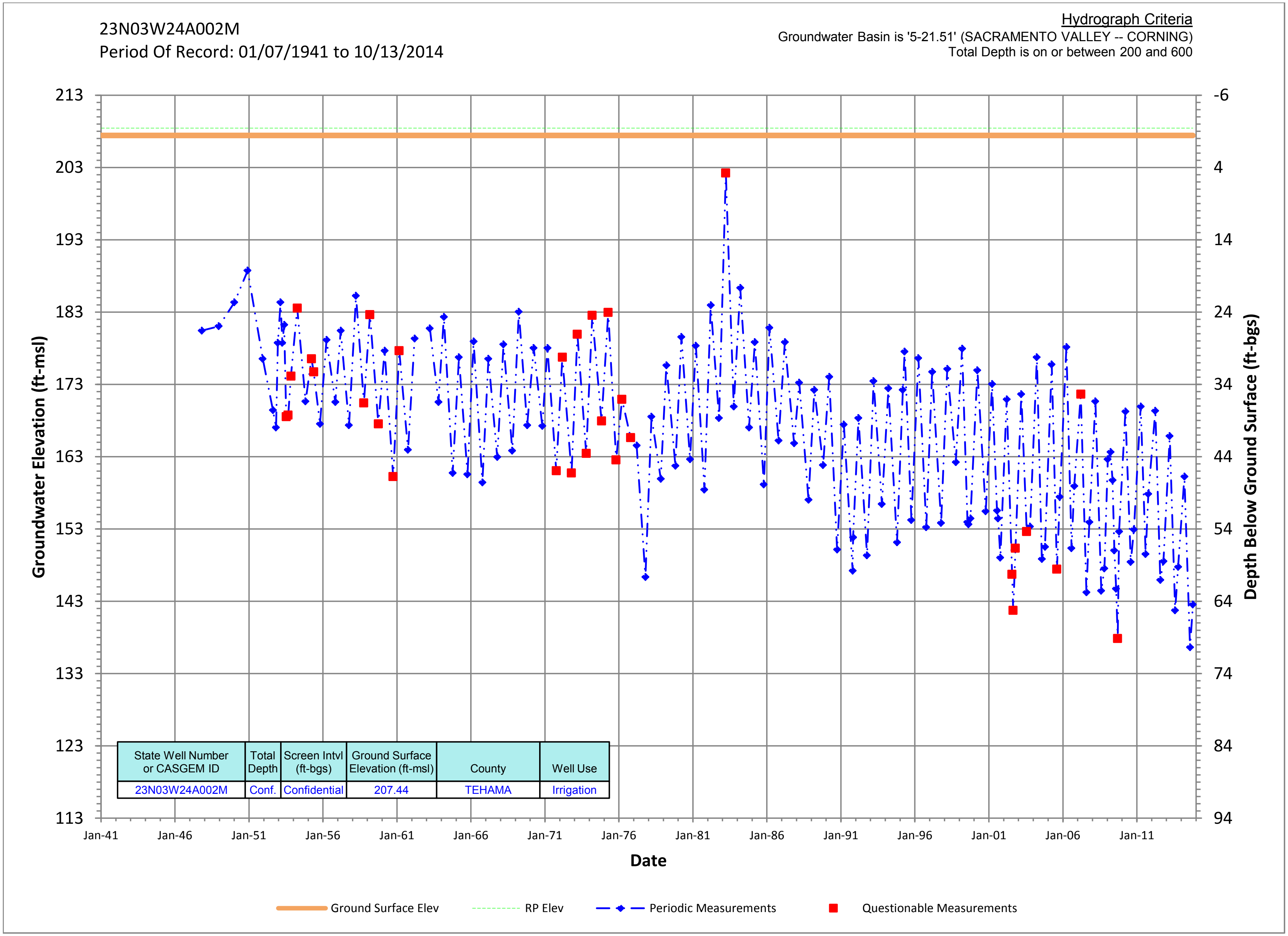
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W16F002M	Conf.	Confidential	256.48	TEHAMA	Irrigation



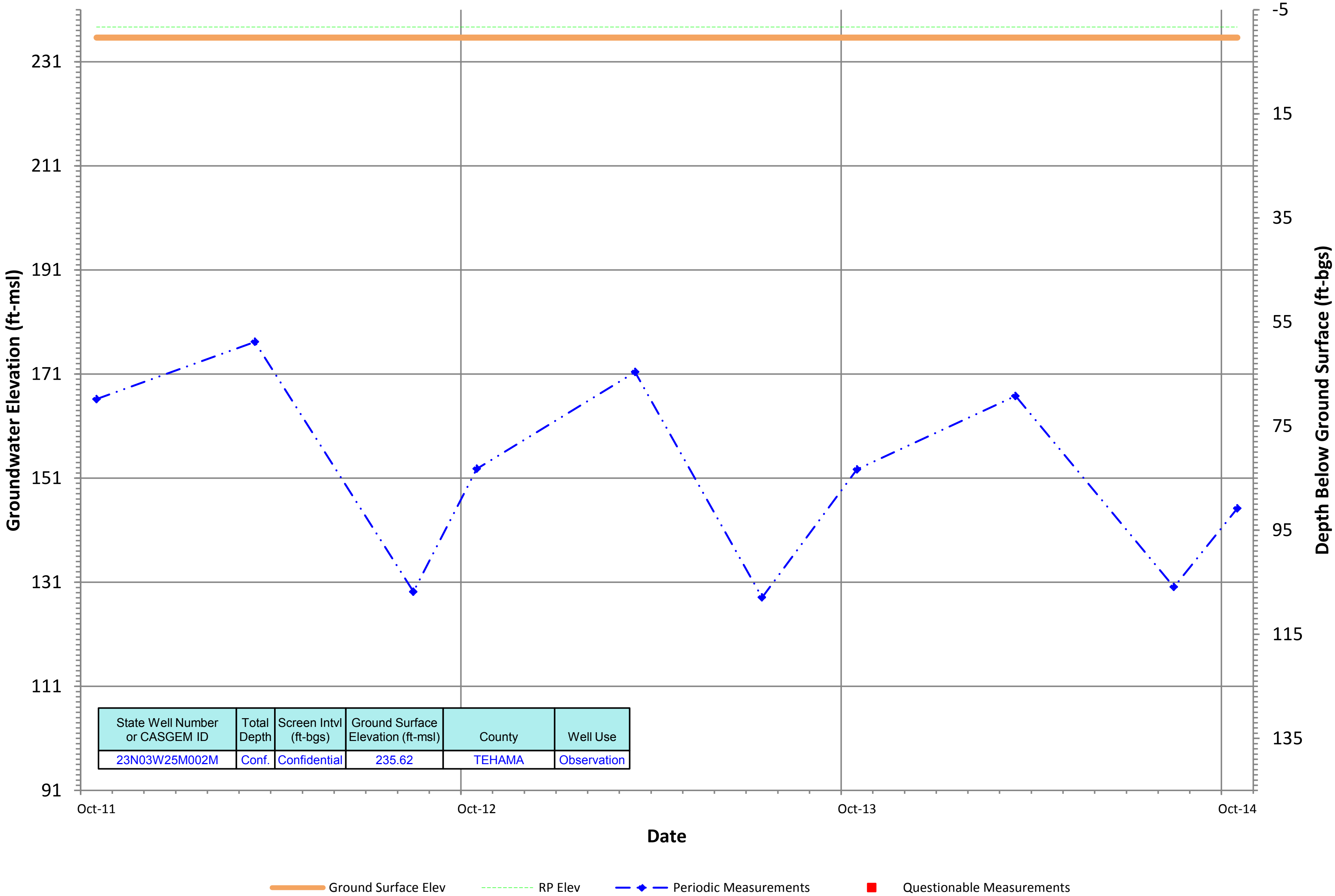
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W22Q001M	Conf.	Confidential	234.47	TEHAMA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W24A002M	Conf.	Confidential	207.44	TEHAMA	Irrigation

23N03W25M002M
Period Of Record: 10/20/2011 to 10/21/2014

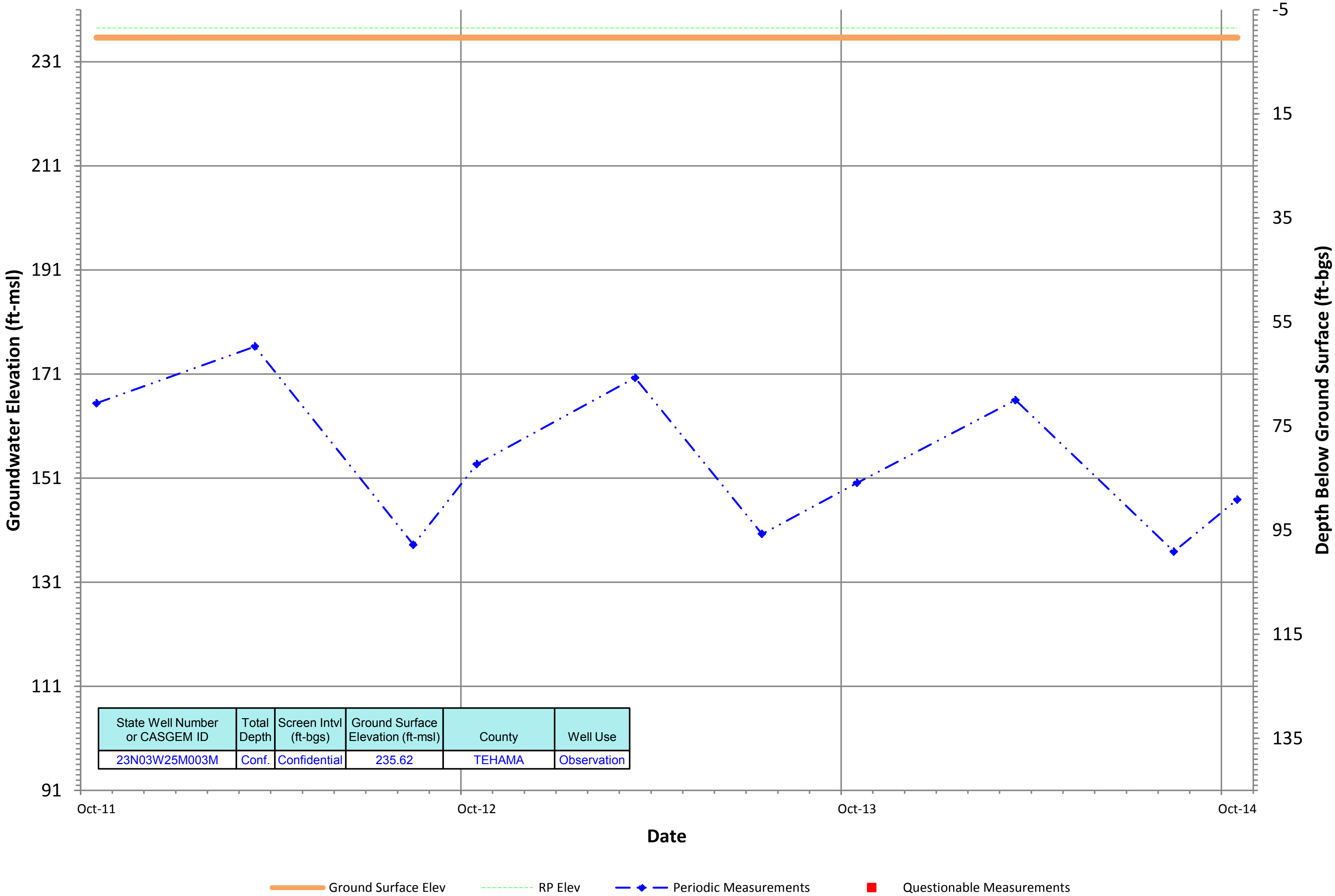
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W25M002M	Conf.	Confidential	235.62	TEHAMA	Observation

23N03W25M003M
Period Of Record: 10/20/2011 to 10/21/2014

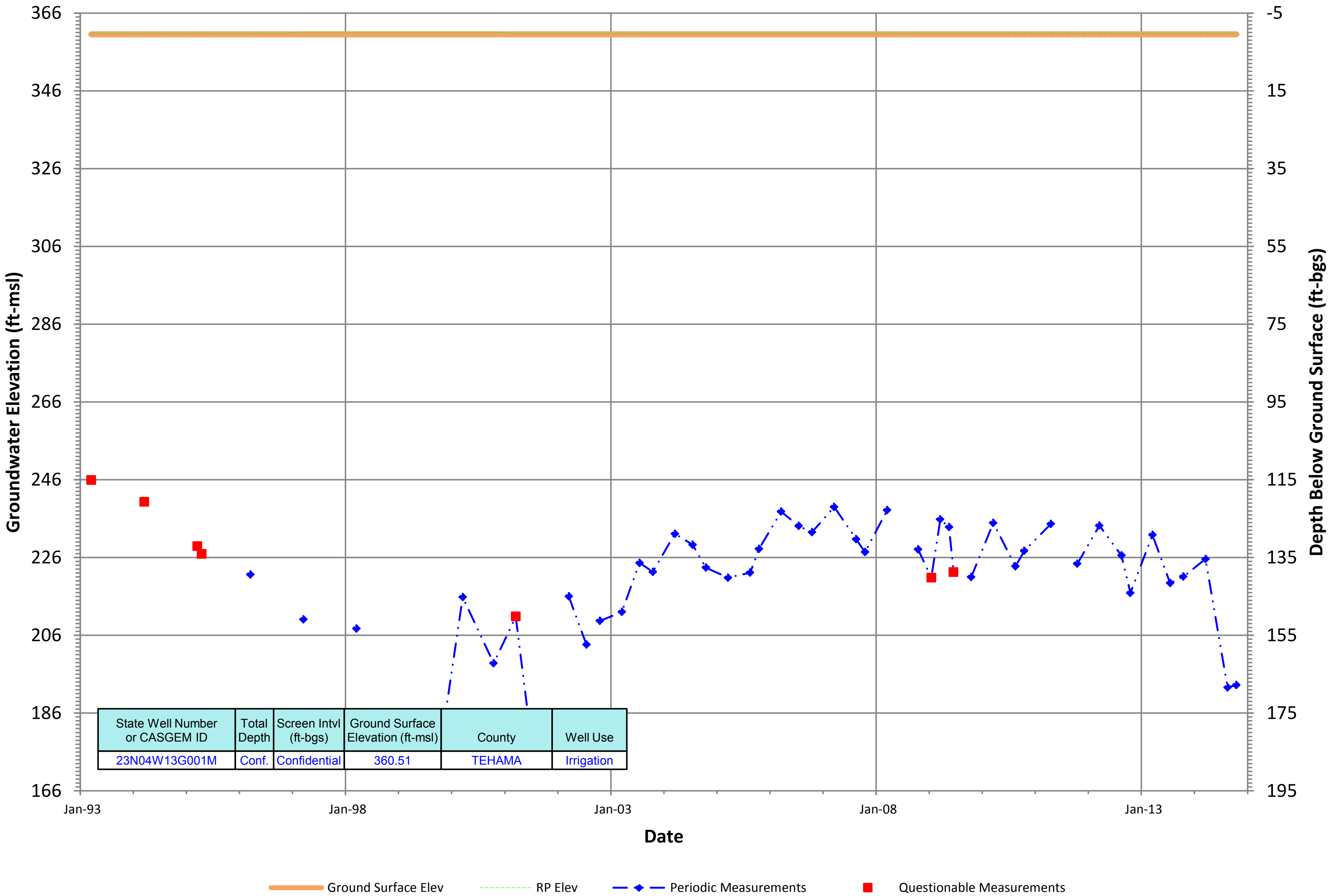
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



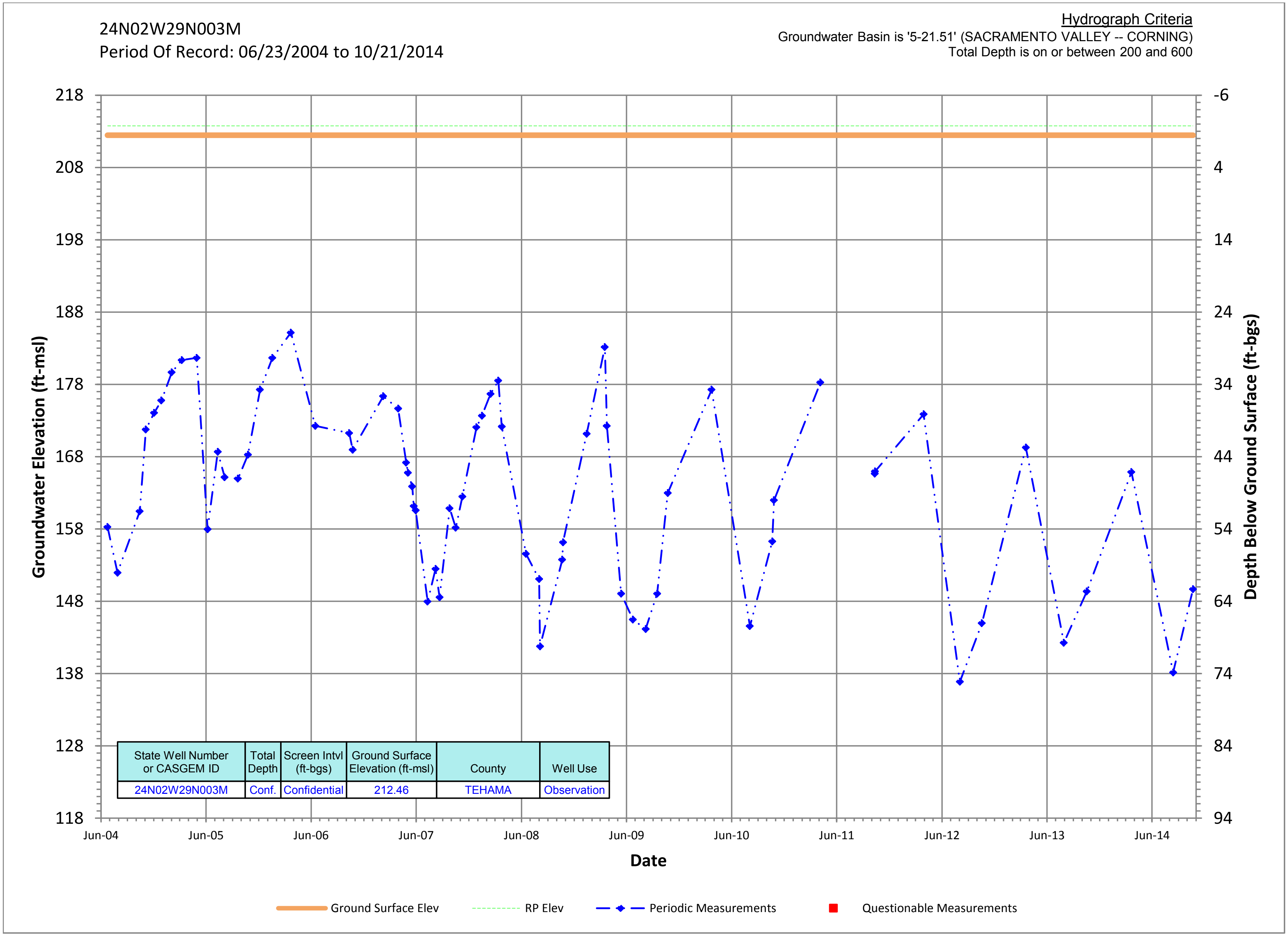
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W25M003M	Conf.	Confidential	235.62	TEHAMA	Observation

23N04W13G001M
Period Of Record: 03/13/1993 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



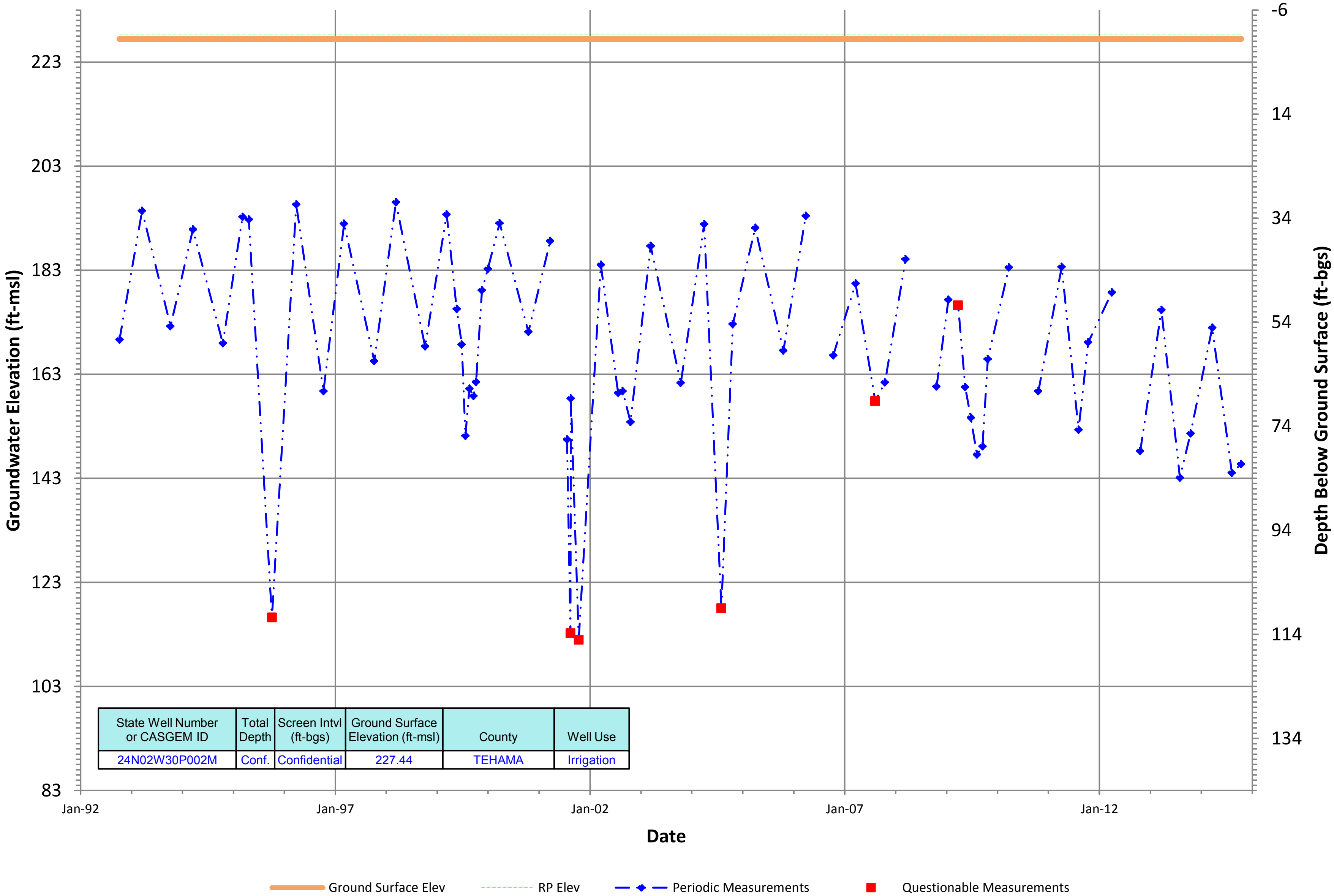
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N04W13G001M	Conf.	Confidential	360.51	TEHAMA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N02W29N003M	Conf.	Confidential	212.46	TEHAMA	Observation

24N02W30P002M
Period Of Record: 10/06/1992 to 10/13/2014

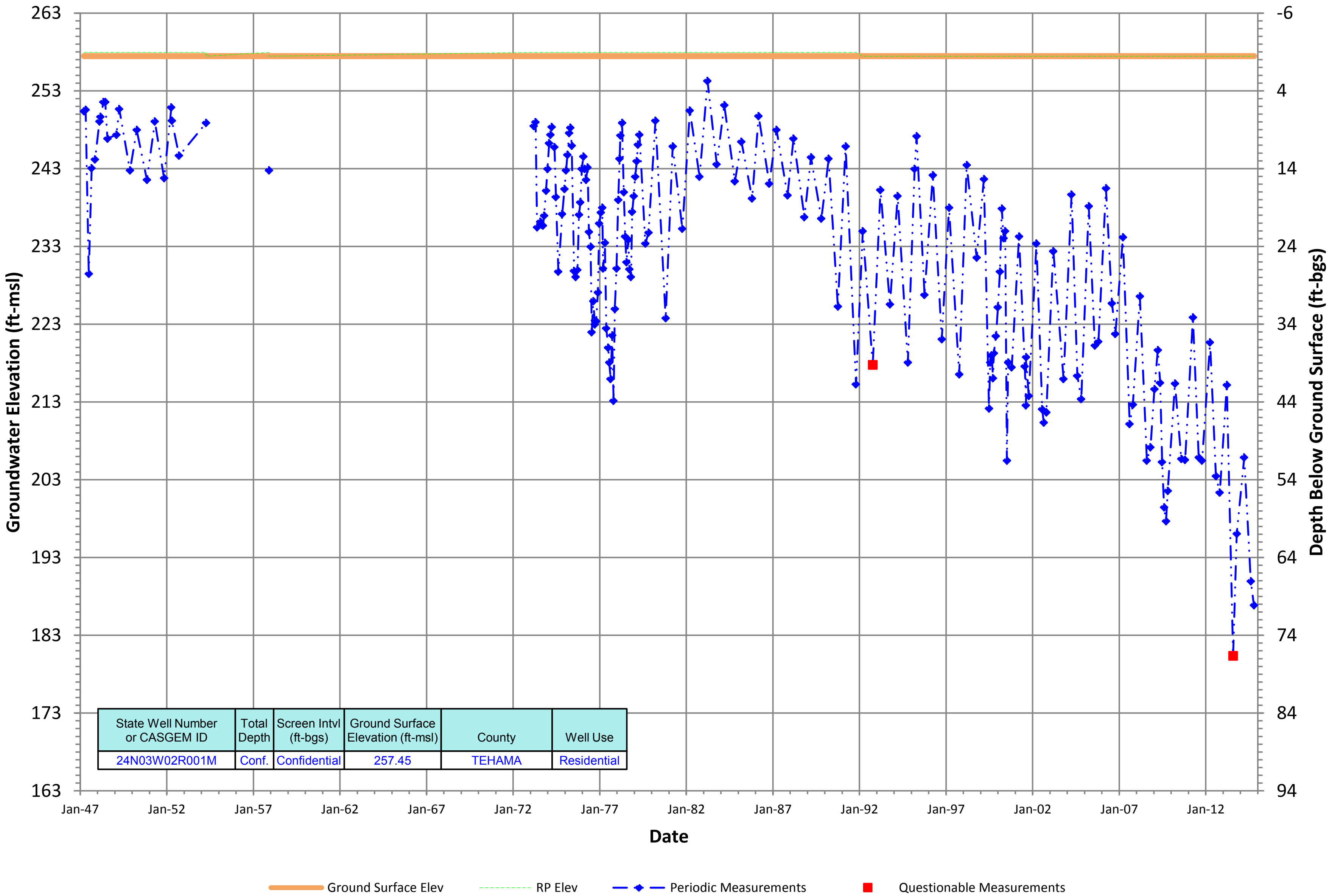
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N02W30P002M	Conf.	Confidential	227.44	TEHAMA	Irrigation

24N03W02R001M
Period Of Record: 03/20/1947 to 10/13/2014

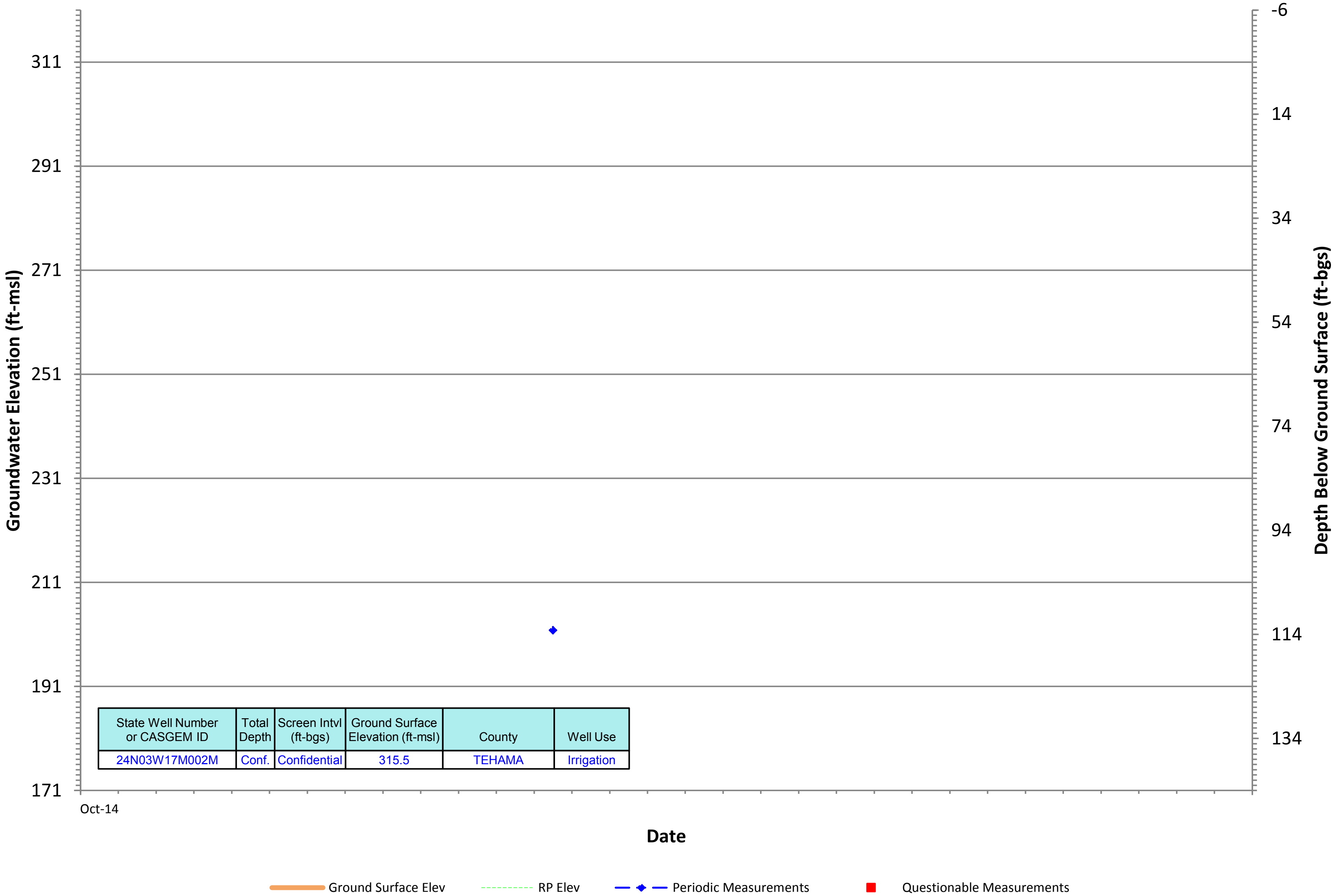
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W02R001M	Conf.	Confidential	257.45	TEHAMA	Residential

24N03W17M002M
Period Of Record: 10/13/2014 to 10/13/2014

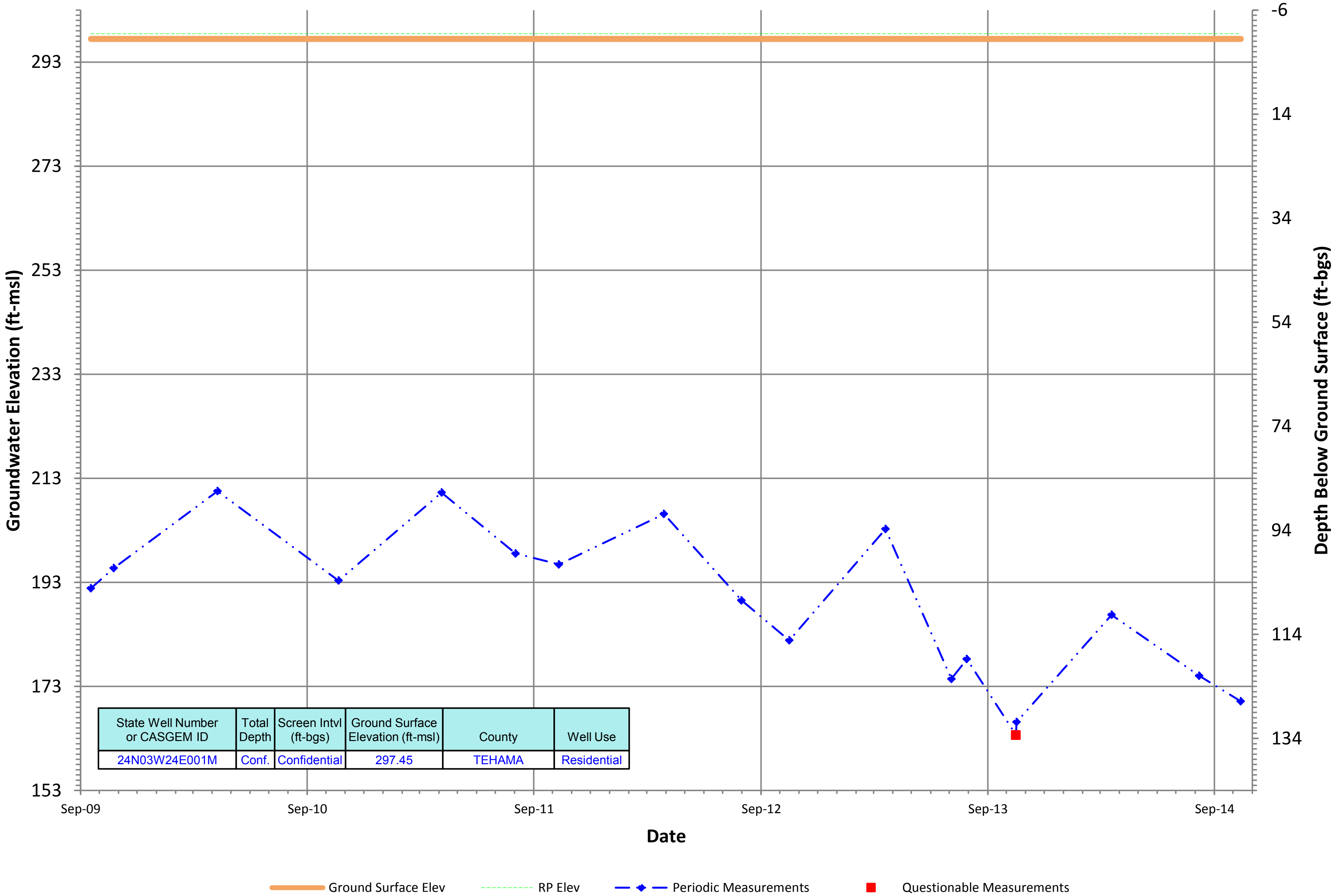
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W17M002M	Conf.	Confidential	315.5	TEHAMA	Irrigation

24N03W24E001M
Period Of Record: 09/17/2009 to 10/13/2014

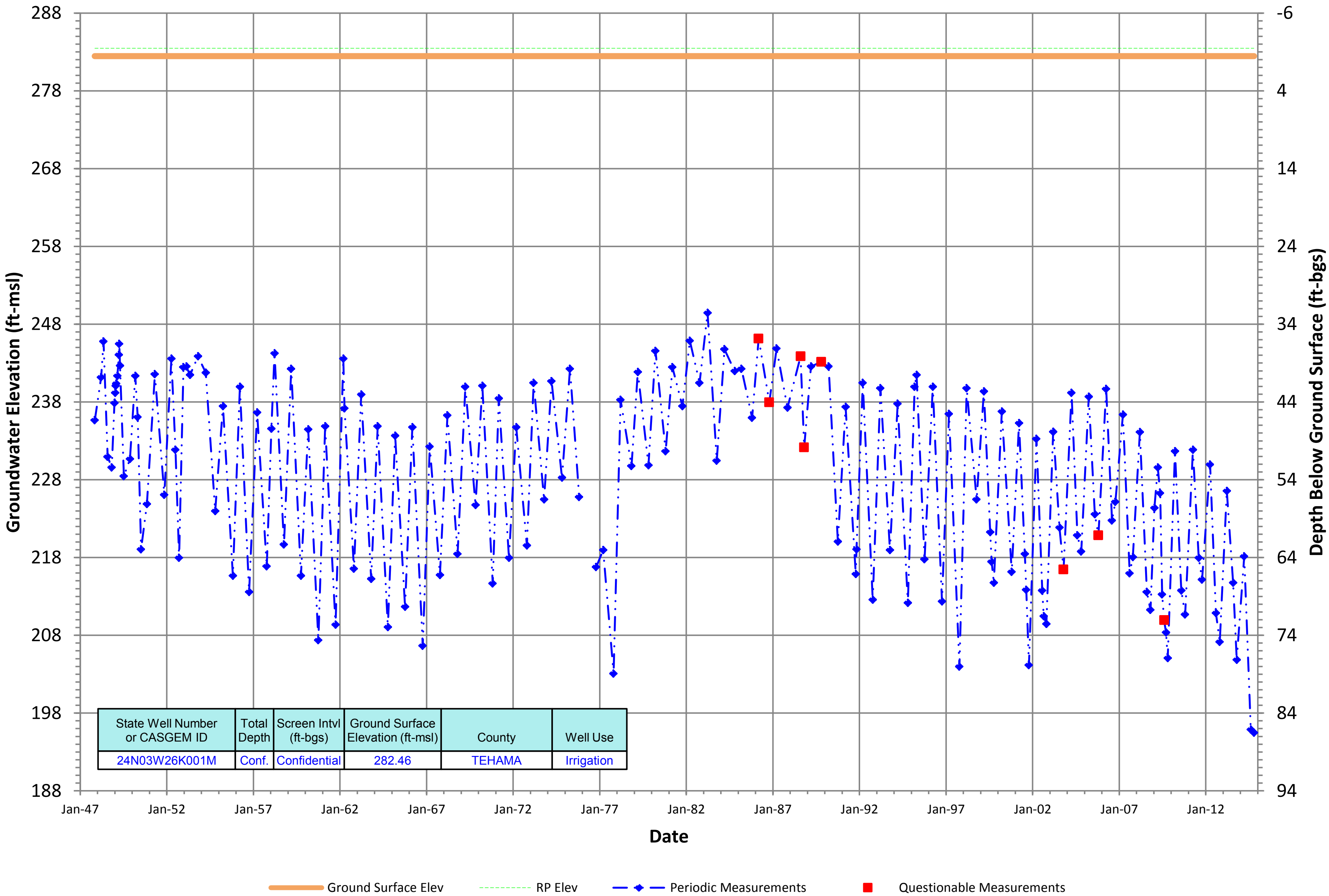
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



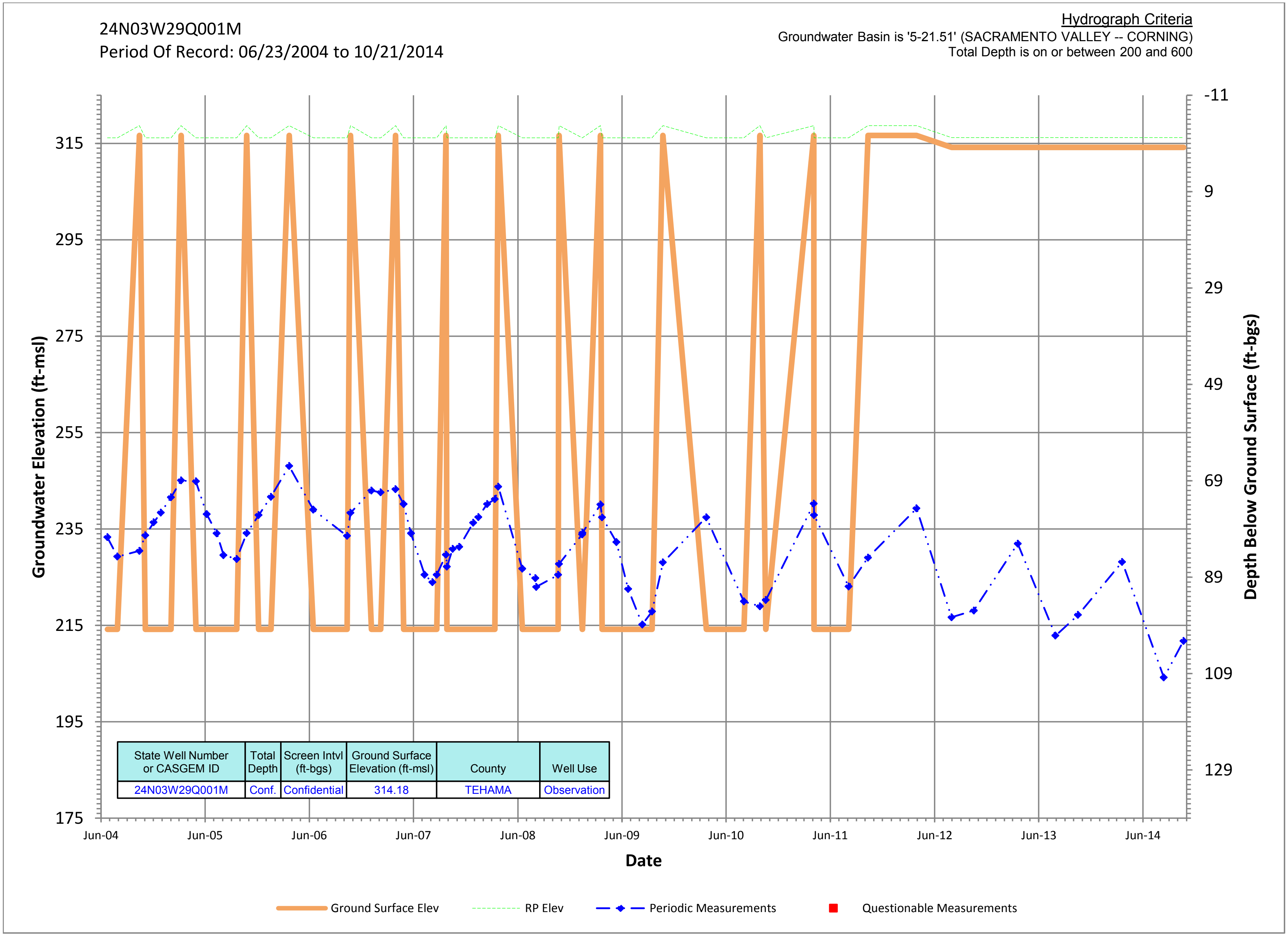
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W24E001M	Conf.	Confidential	297.45	TEHAMA	Residential

24N03W26K001M
Period Of Record: 11/01/1947 to 10/13/2014

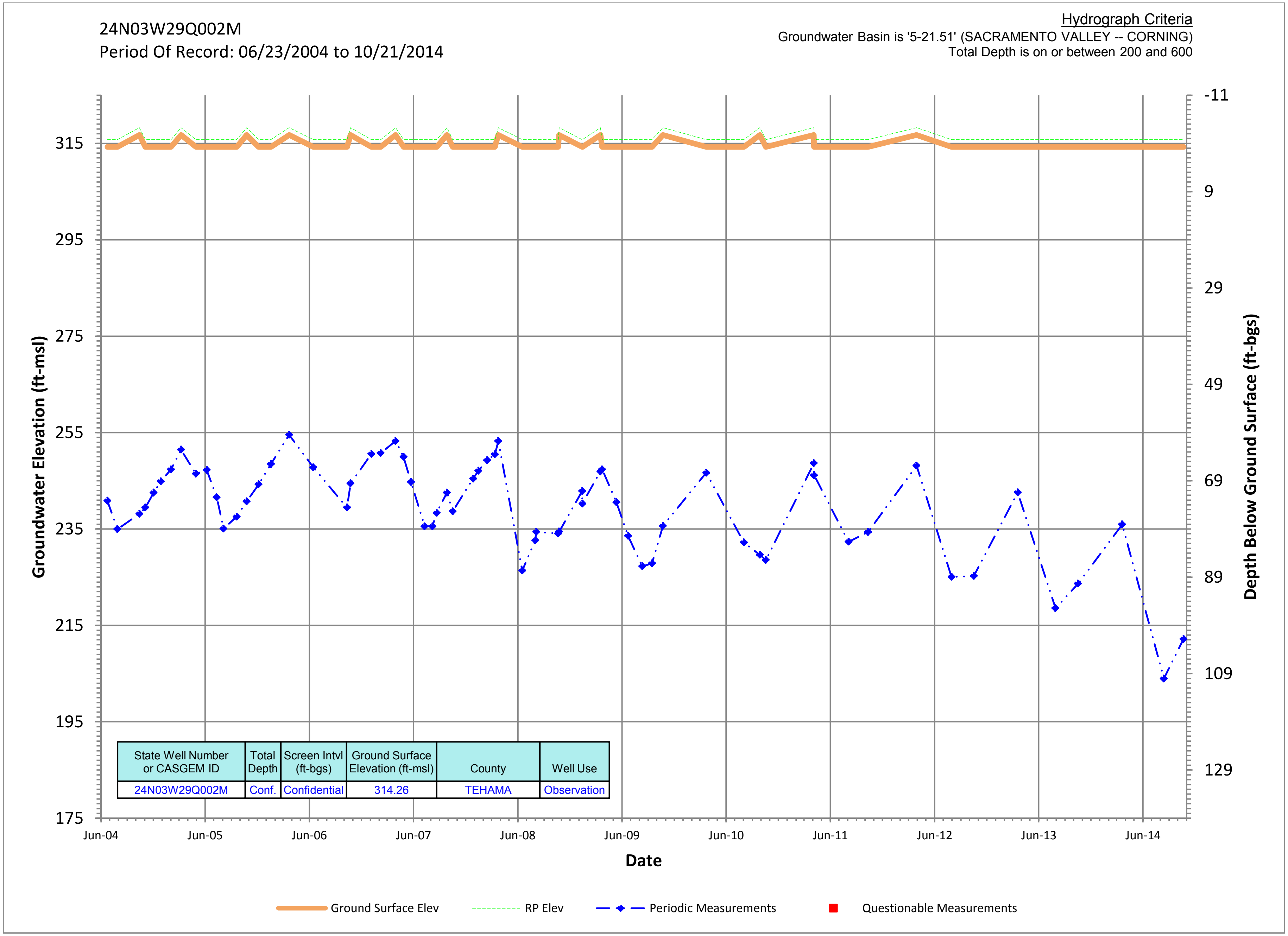
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W26K001M	Conf.	Confidential	282.46	TEHAMA	Irrigation



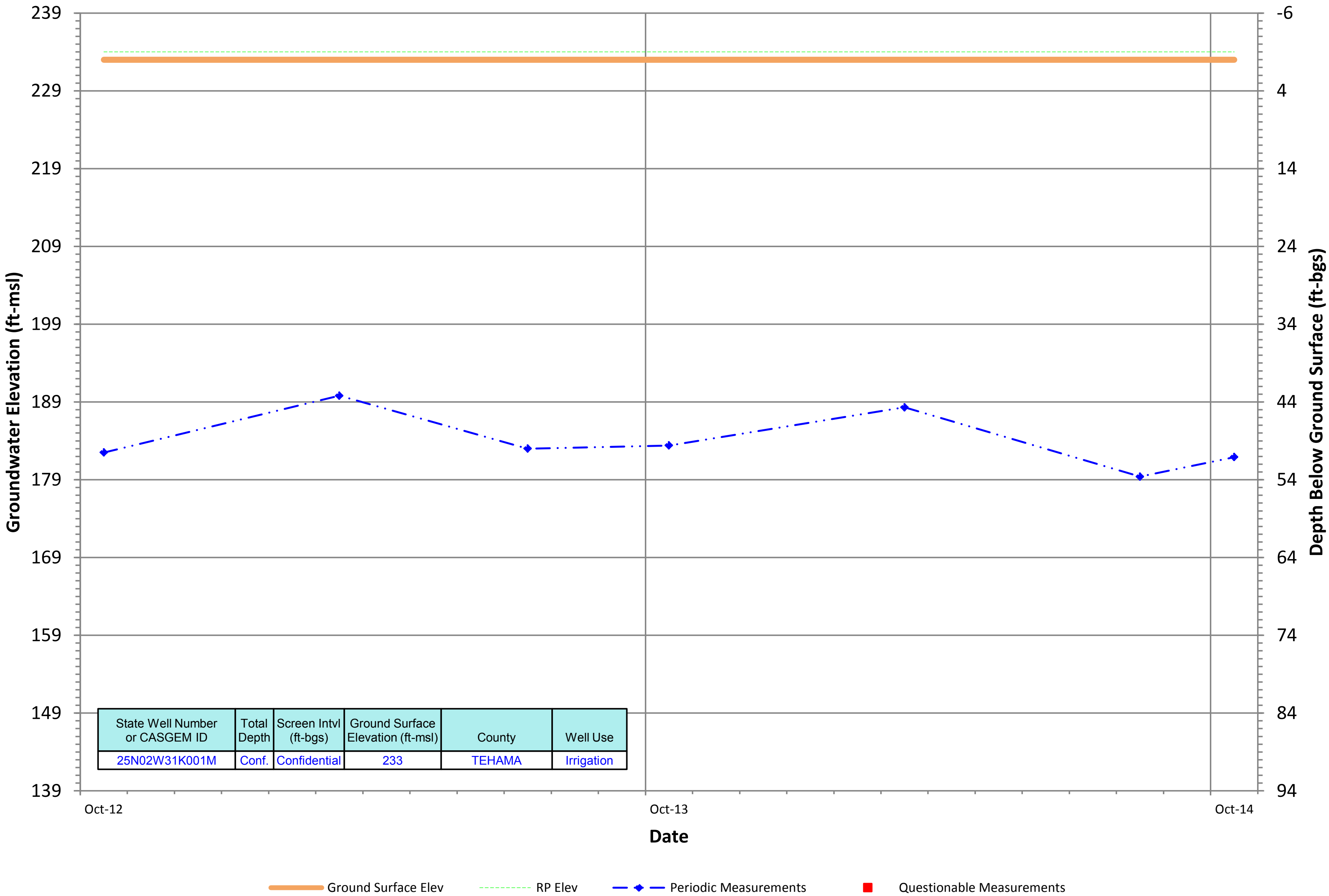
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W29Q001M	Conf.	Confidential	314.18	TEHAMA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W29Q002M	Conf.	Confidential	314.26	TEHAMA	Observation

25N02W31K001M
Period Of Record: 10/19/2012 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
25N02W31K001M	Conf.	Confidential	233	TEHAMA	Irrigation

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Deep Groundwater Monitoring Well Hydrographs- Corning Subbasin

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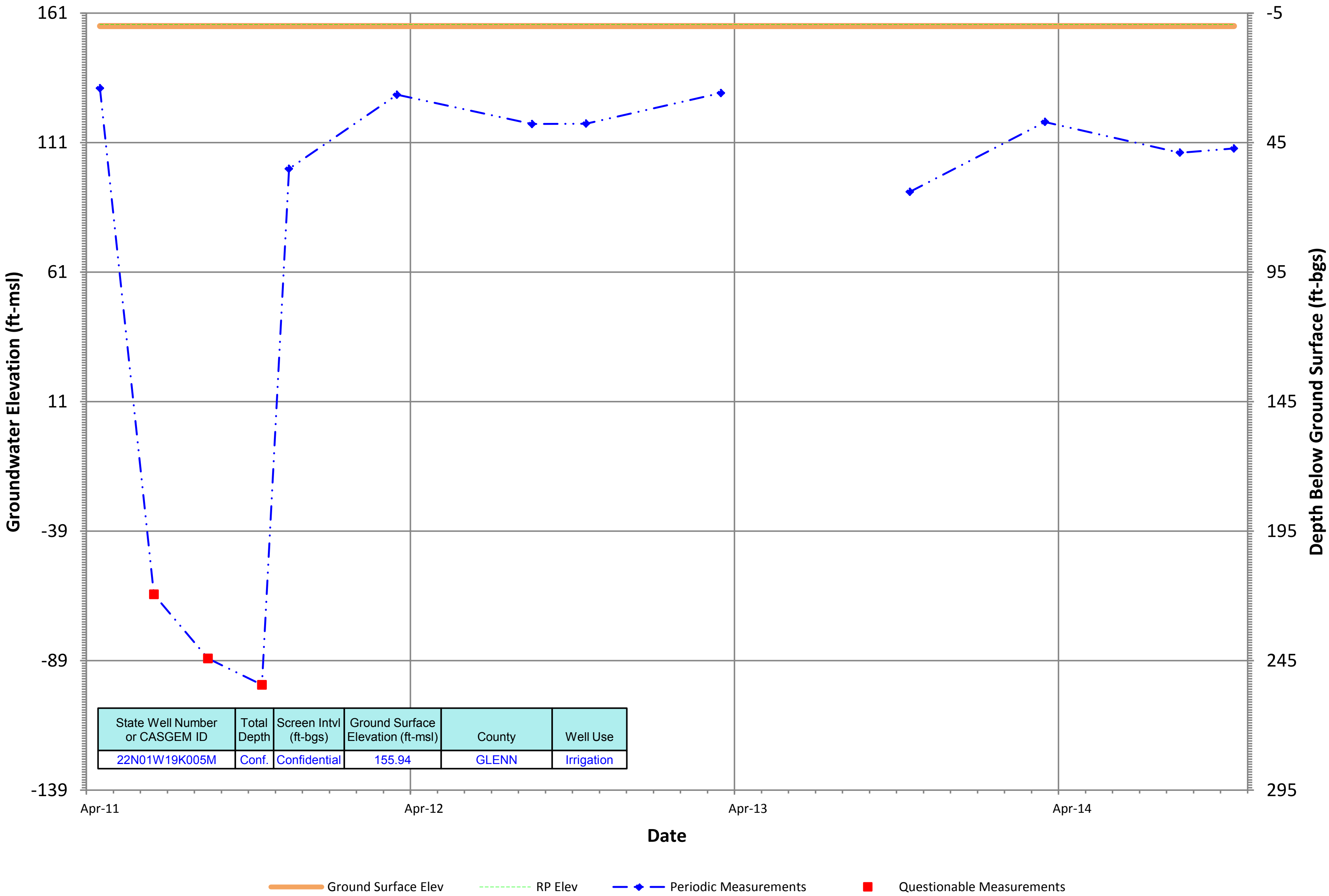
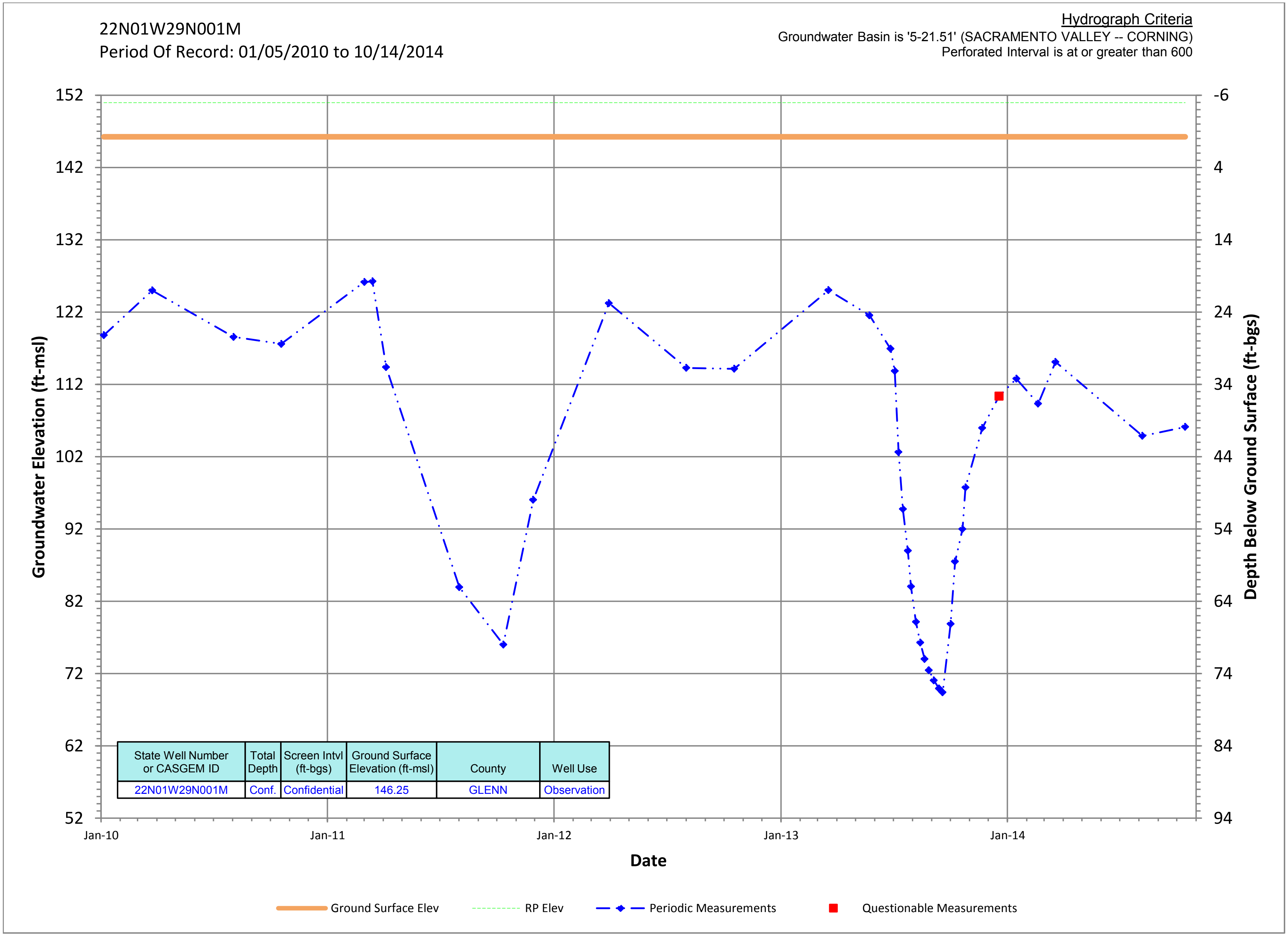
22N01W19K005M
Period Of Record: 04/05/2011 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600

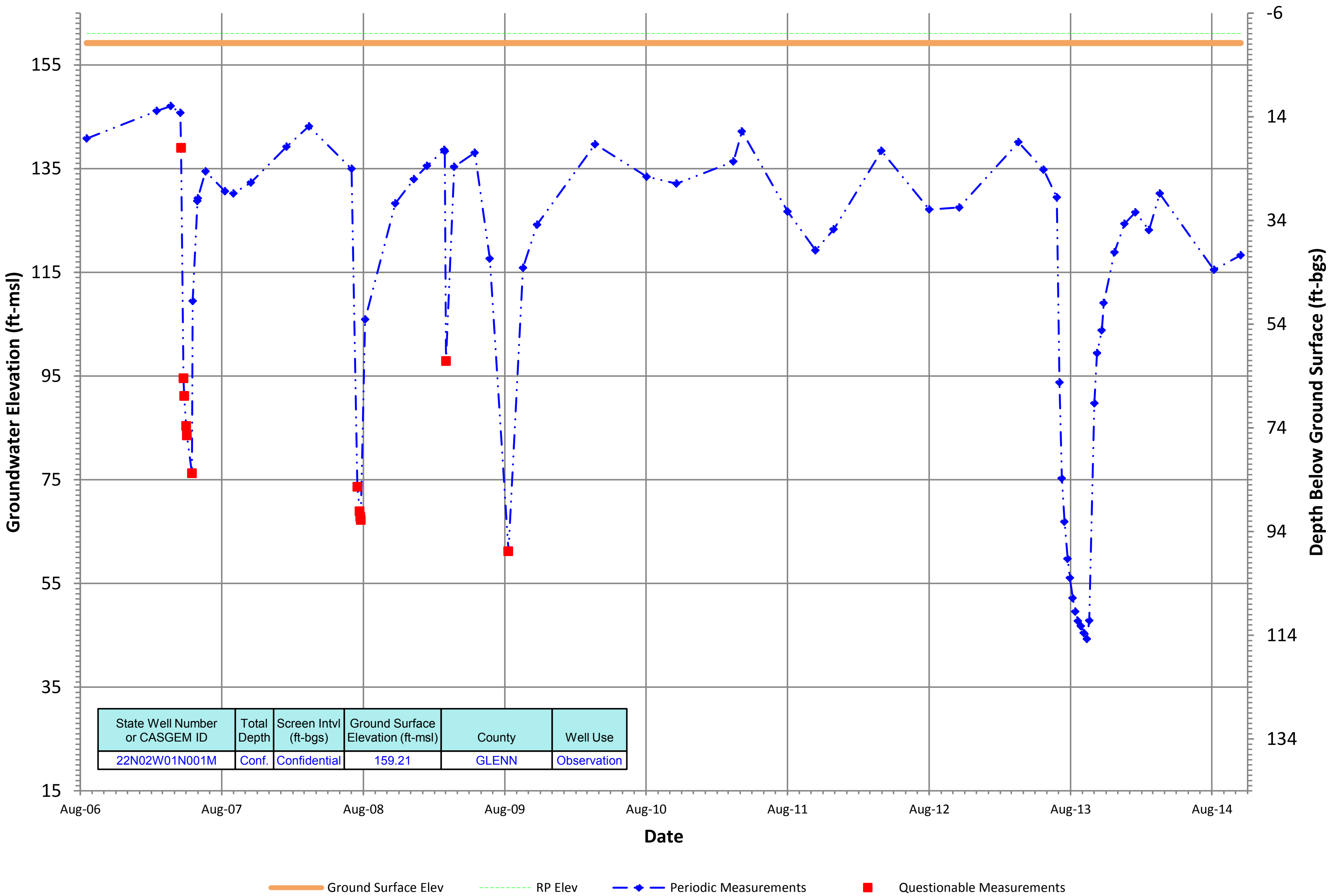


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N01W19K005M	Conf.	Confidential	155.94	GLENN	Irrigation

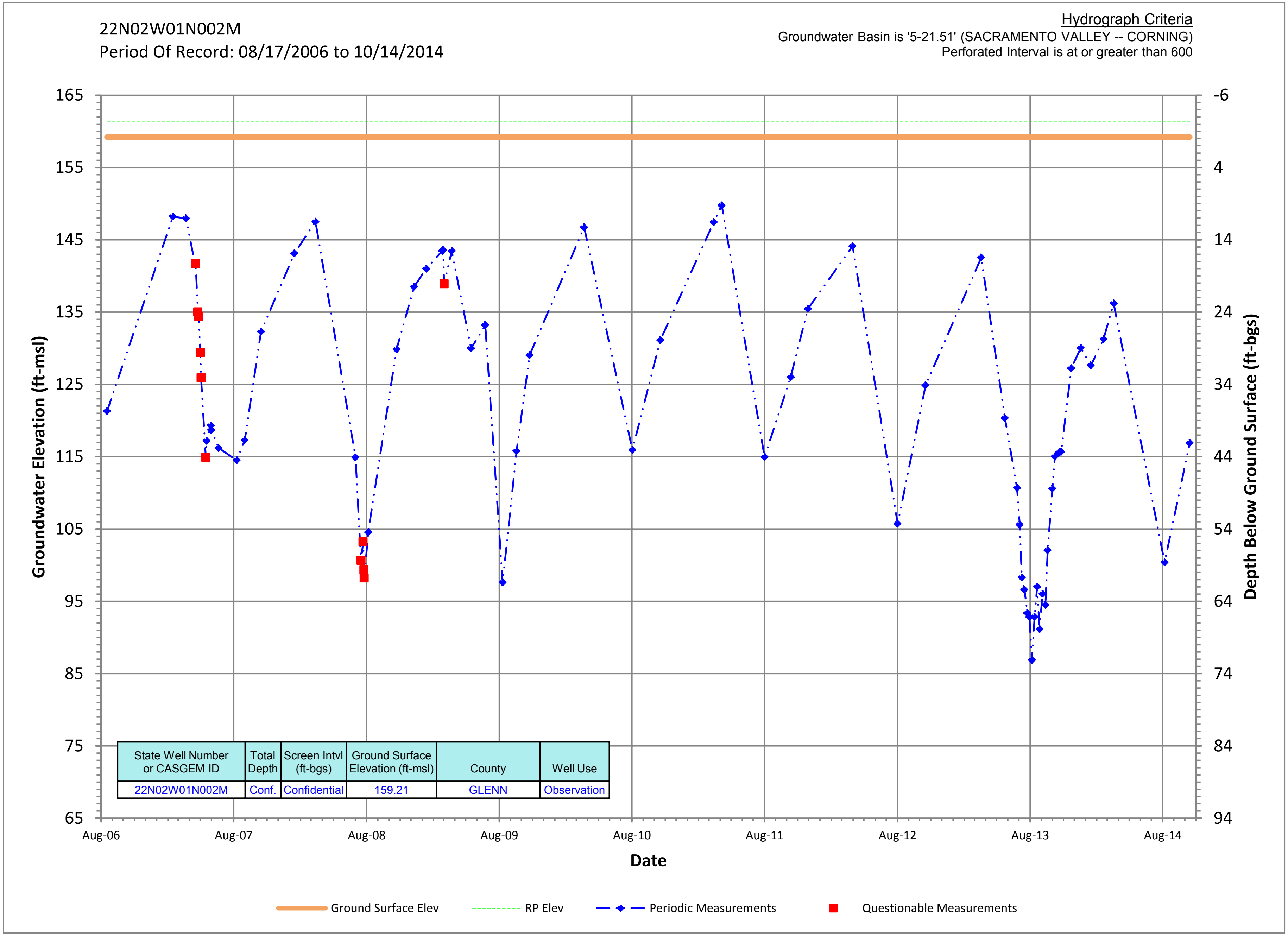

22N01W29N001M
Period Of Record: 01/05/2010 to 10/14/2014
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
152
142
132
122
112
102
92
82
72
62
52
-6
4
14
24
34
44
54
64
74
84
94
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
22N01W29N001M
Conf.
Confidential
146.25
GLENN
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

22N02W01N001M
Period Of Record: 08/17/2006 to 10/14/2014

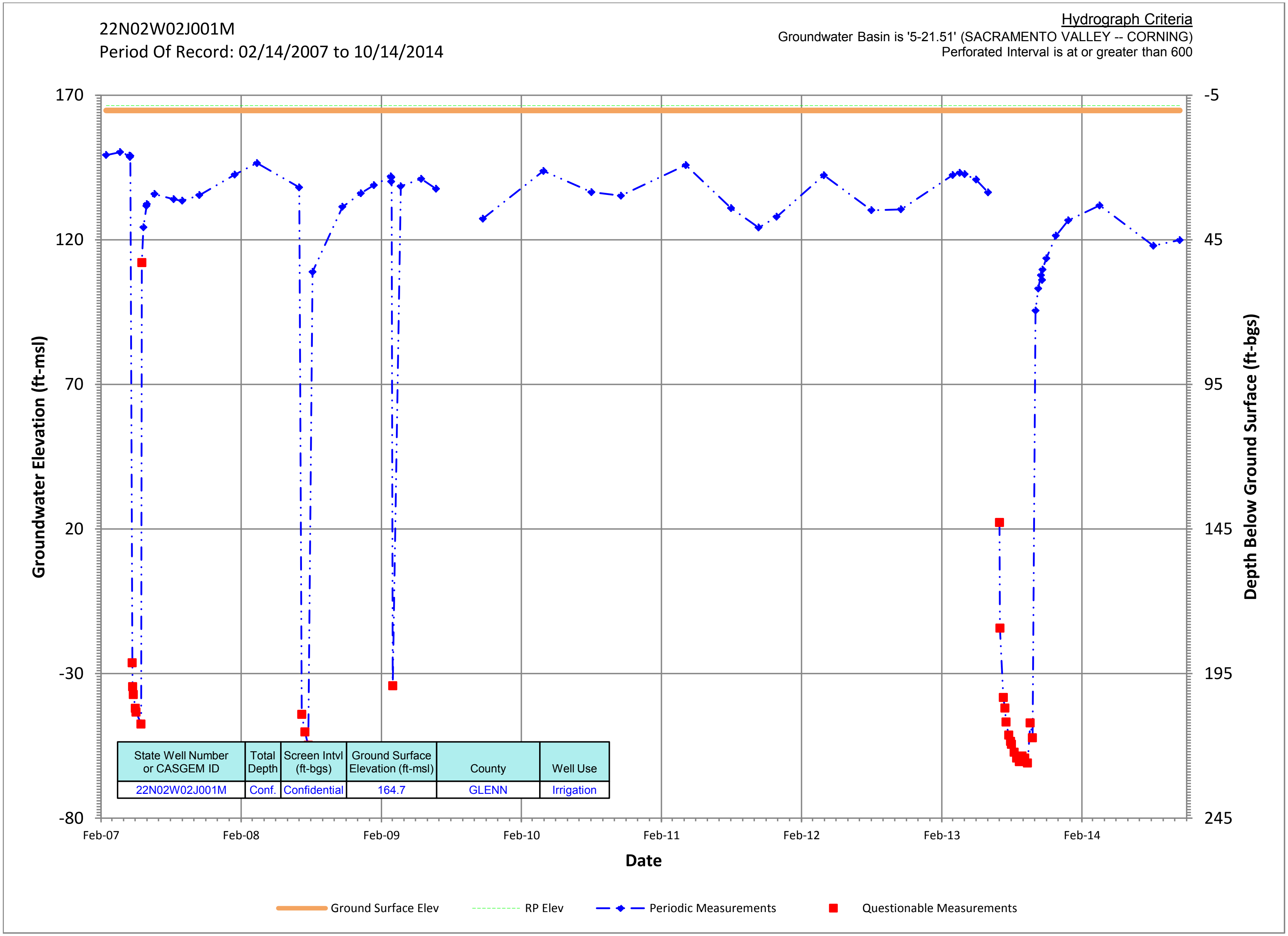
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W01N001M	Conf.	Confidential	159.21	GLENN	Observation



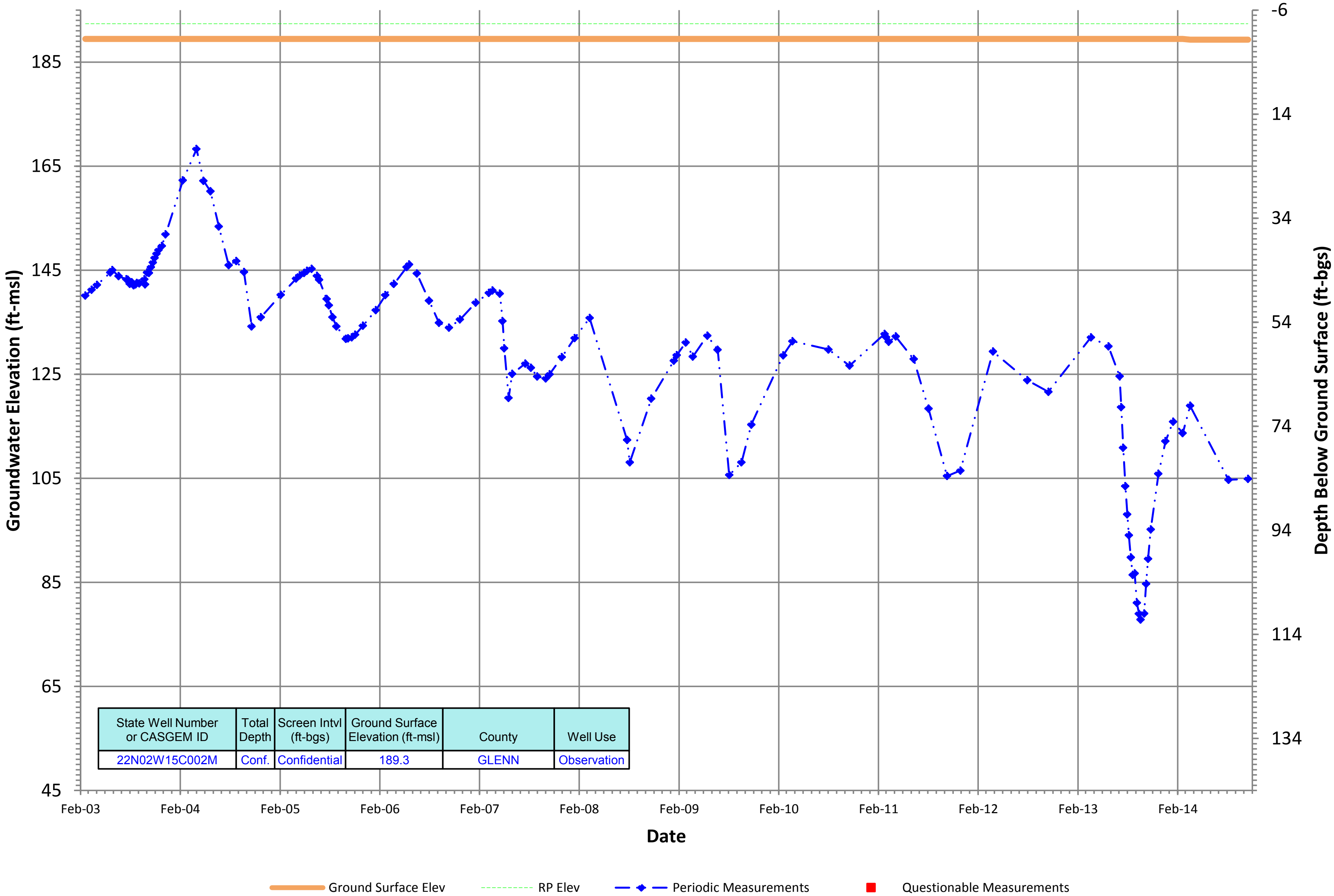
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W01N002M	Conf.	Confidential	159.21	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W02J001M	Conf.	Confidential	164.7	GLENN	Irrigation

22N02W15C002M
Period Of Record: 02/18/2003 to 10/16/2014

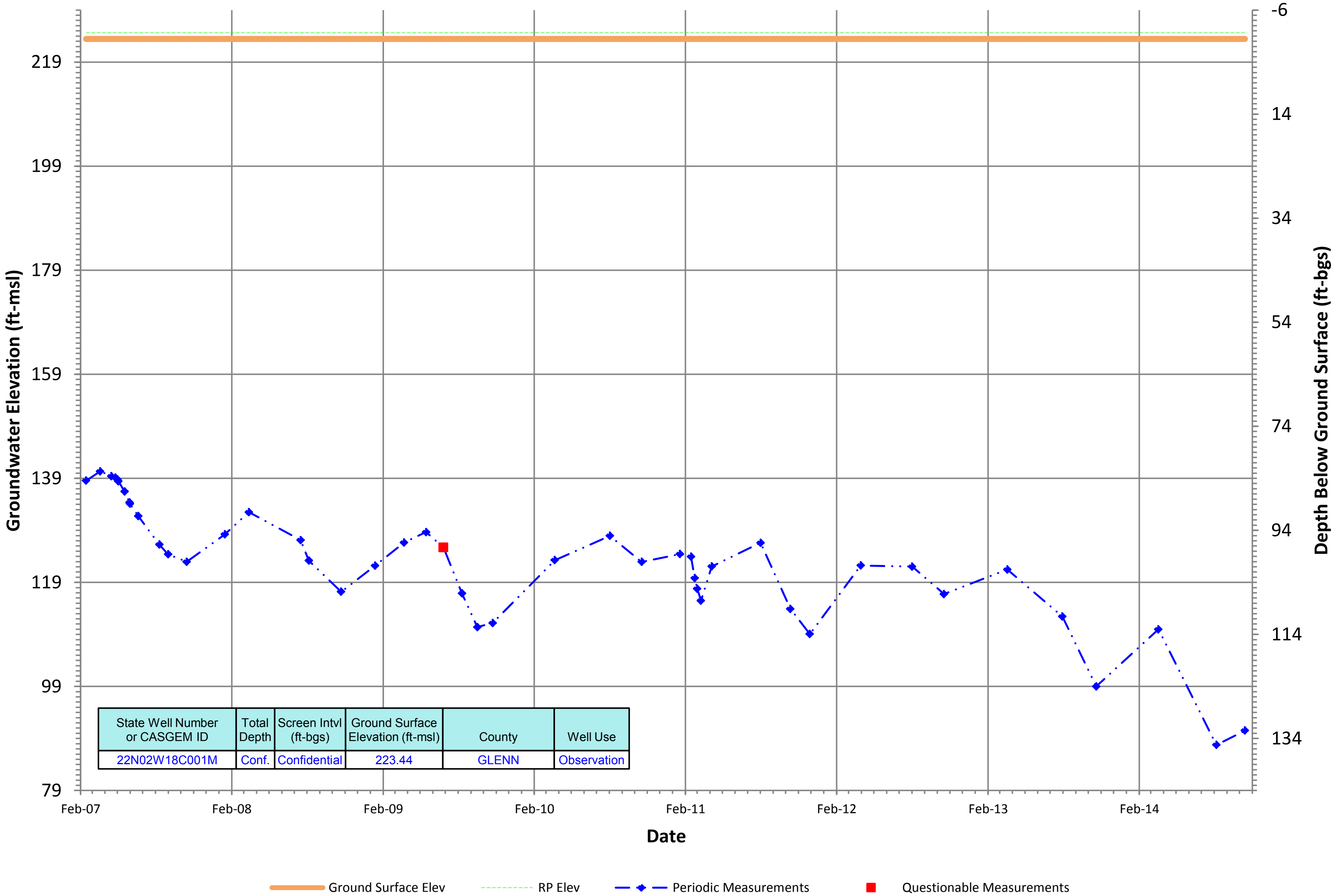
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W15C002M	Conf.	Confidential	189.3	GLENN	Observation

22N02W18C001M
Period Of Record: 02/14/2007 to 10/14/2014

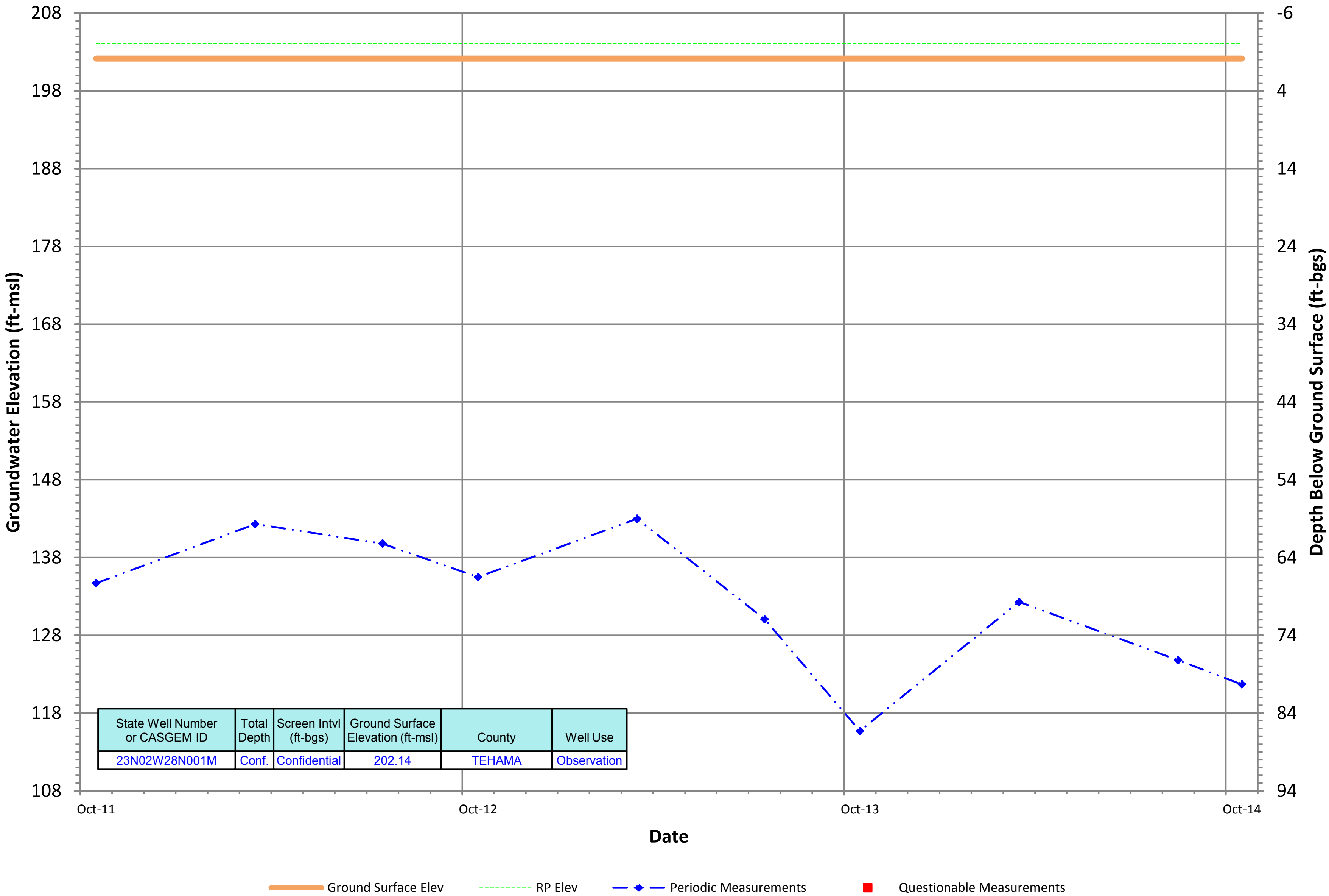
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02W18C001M	Conf.	Confidential	223.44	GLENN	Observation

23N02W28N001M
Period Of Record: 10/21/2011 to 10/21/2014

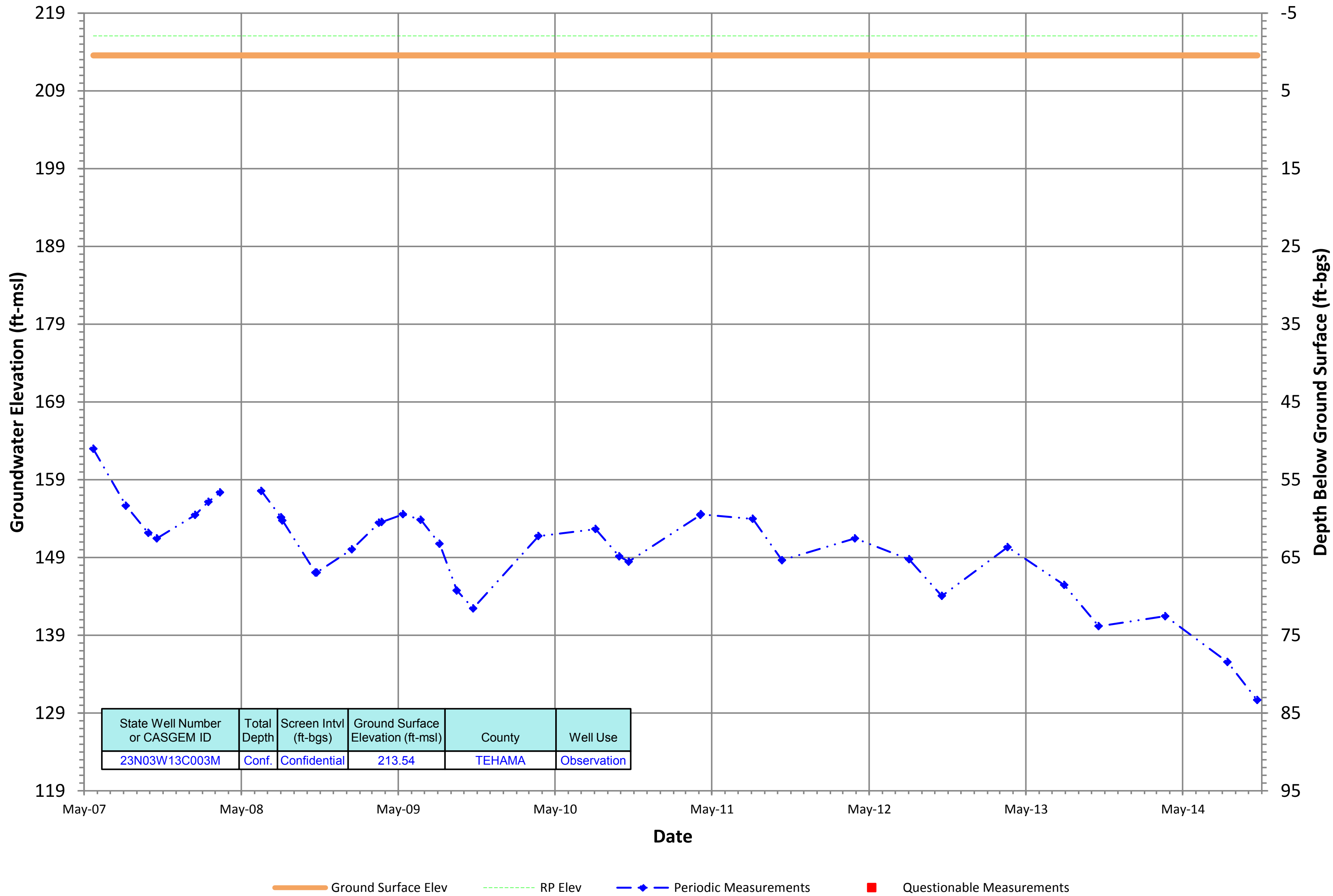
Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600



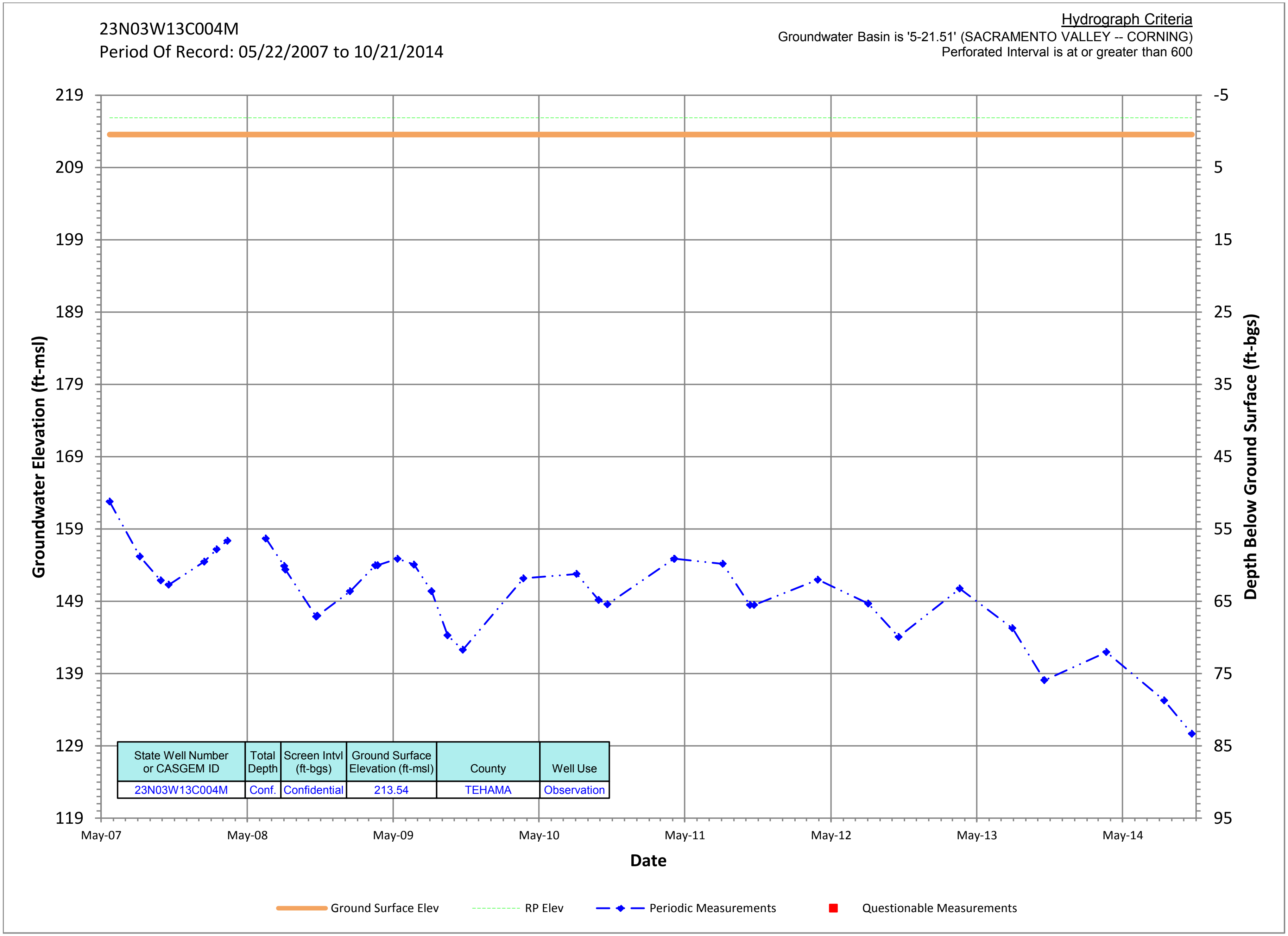
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N02W28N001M	Conf.	Confidential	202.14	TEHAMA	Observation

23N03W13C003M
Period Of Record: 05/22/2007 to 10/21/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600



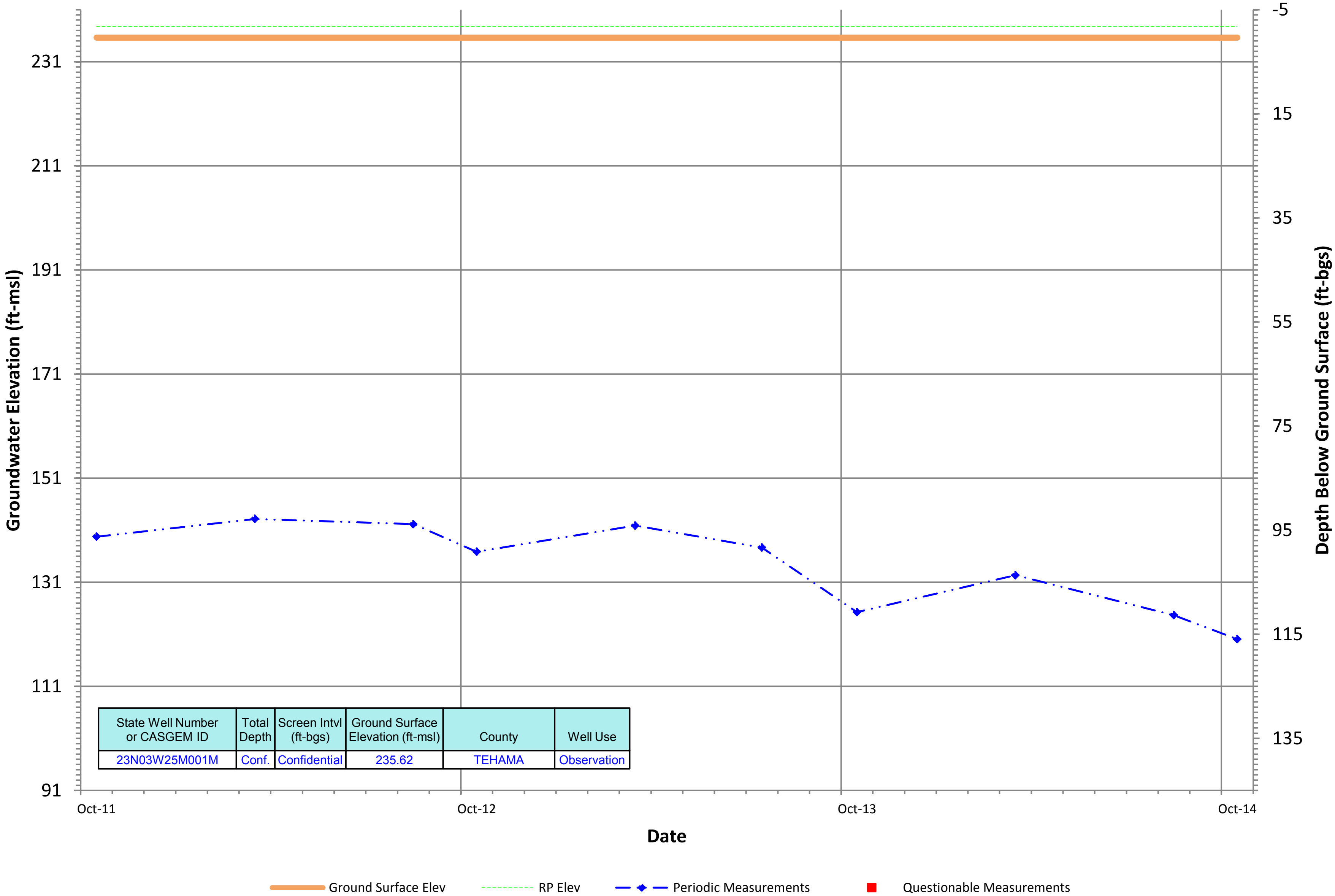
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W13C003M	Conf.	Confidential	213.54	TEHAMA	Observation



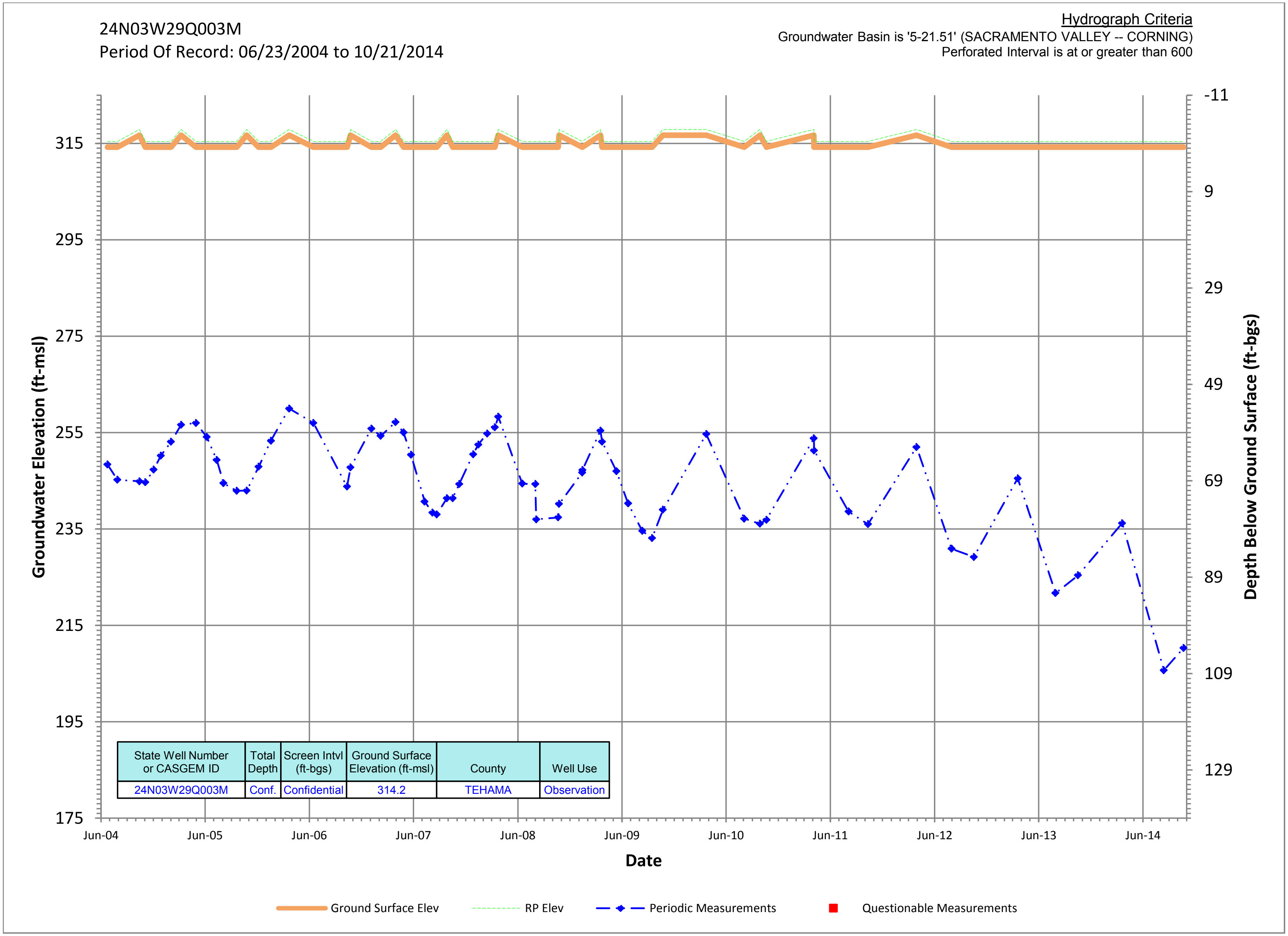
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W13C004M	Conf.	Confidential	213.54	TEHAMA	Observation

23N03W25M001M
Period Of Record: 10/20/2011 to 10/21/2014

Hydrograph Criteria
Groundwater Basin is '5-21.51' (SACRAMENTO VALLEY -- CORNING)
Perforated Interval is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
23N03W25M001M	Conf.	Confidential	235.62	TEHAMA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
24N03W29Q003M	Conf.	Confidential	314.2	TEHAMA	Observation

Shallow Groundwater Monitoring Well Hydrographs- East Butte Subbasin

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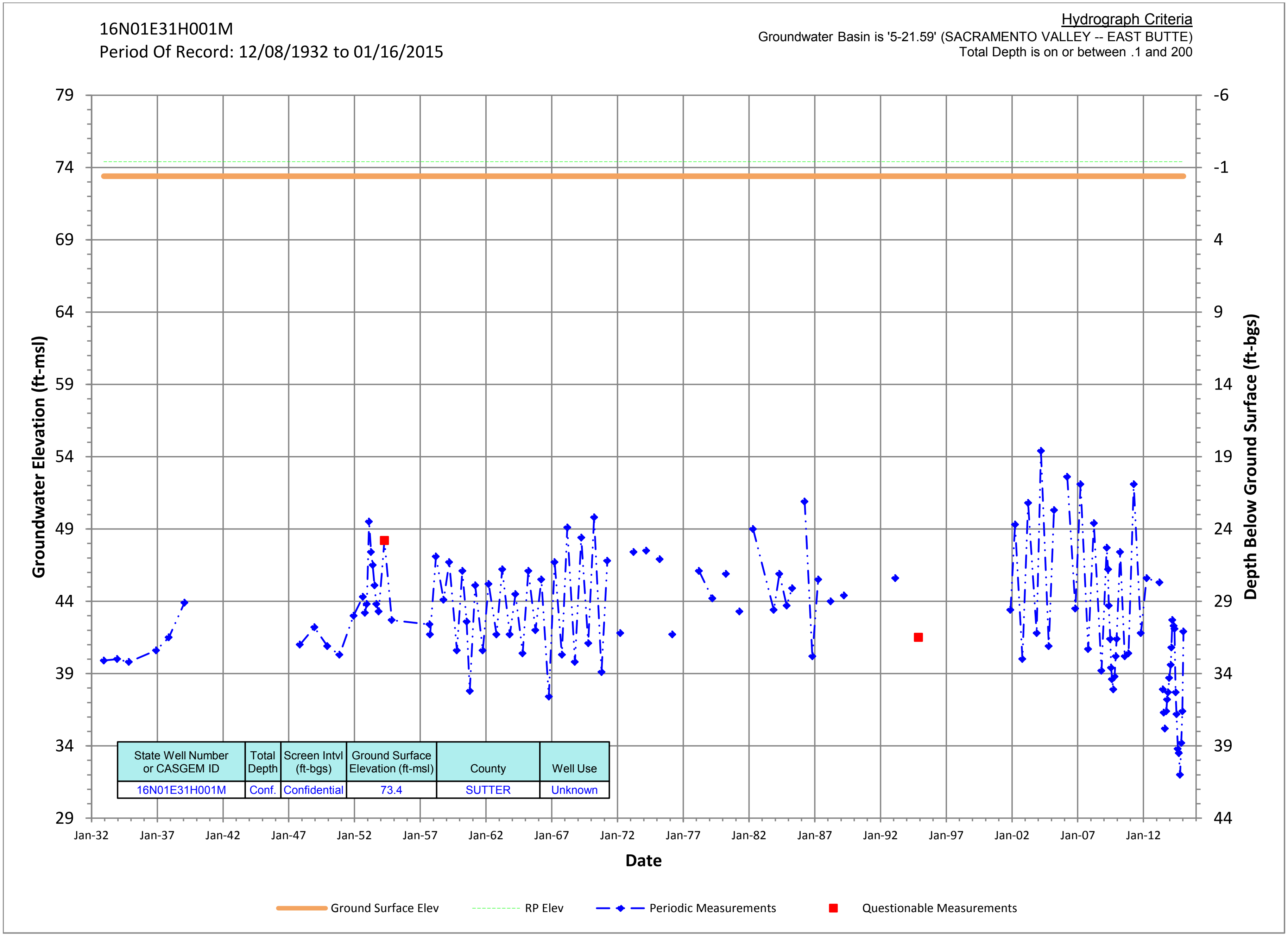
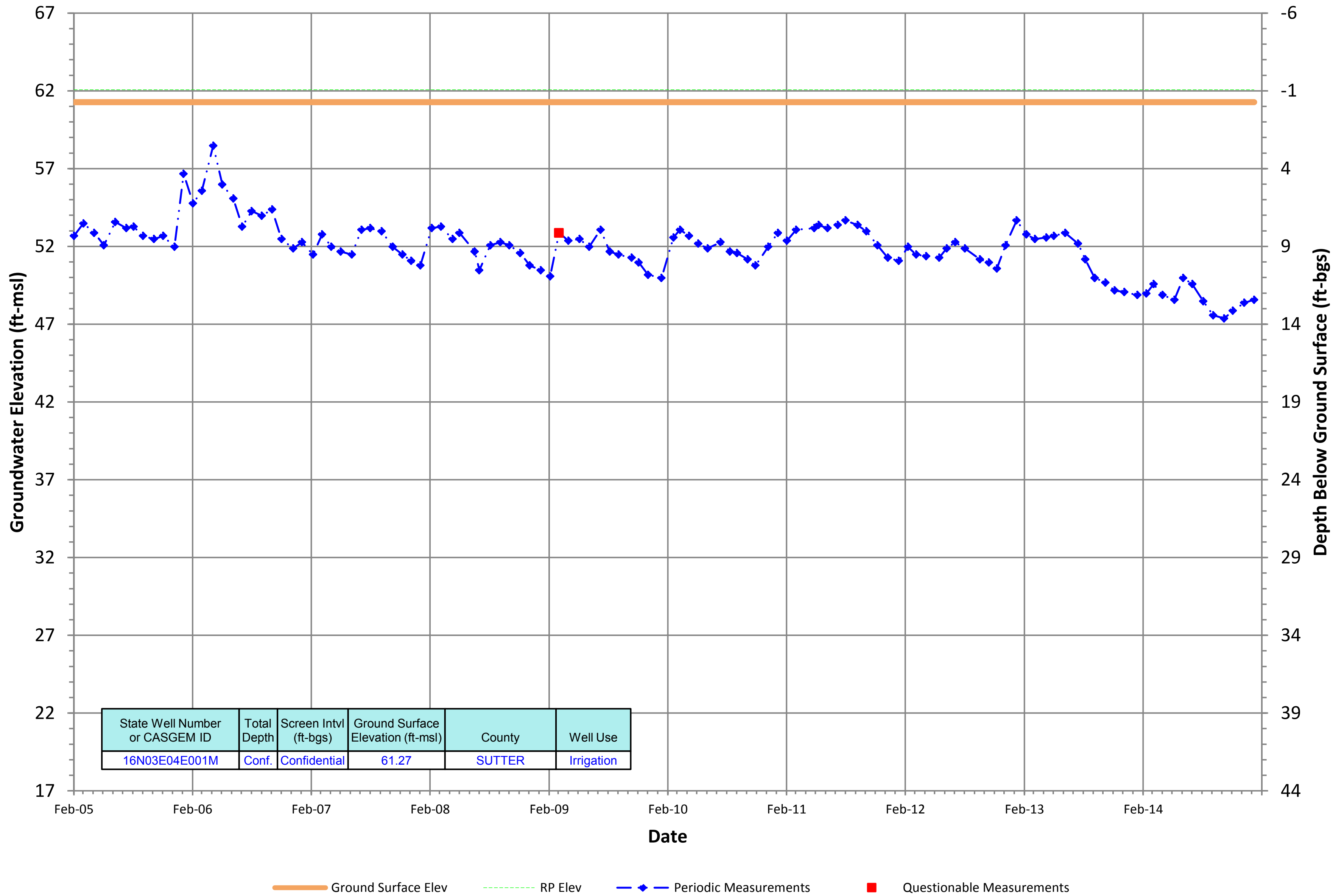


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N01E31H001M	Conf.	Confidential	73.4	SUTTER	Unknown

16N03E04E001M
Period Of Record: 02/01/2005 to 01/08/2015

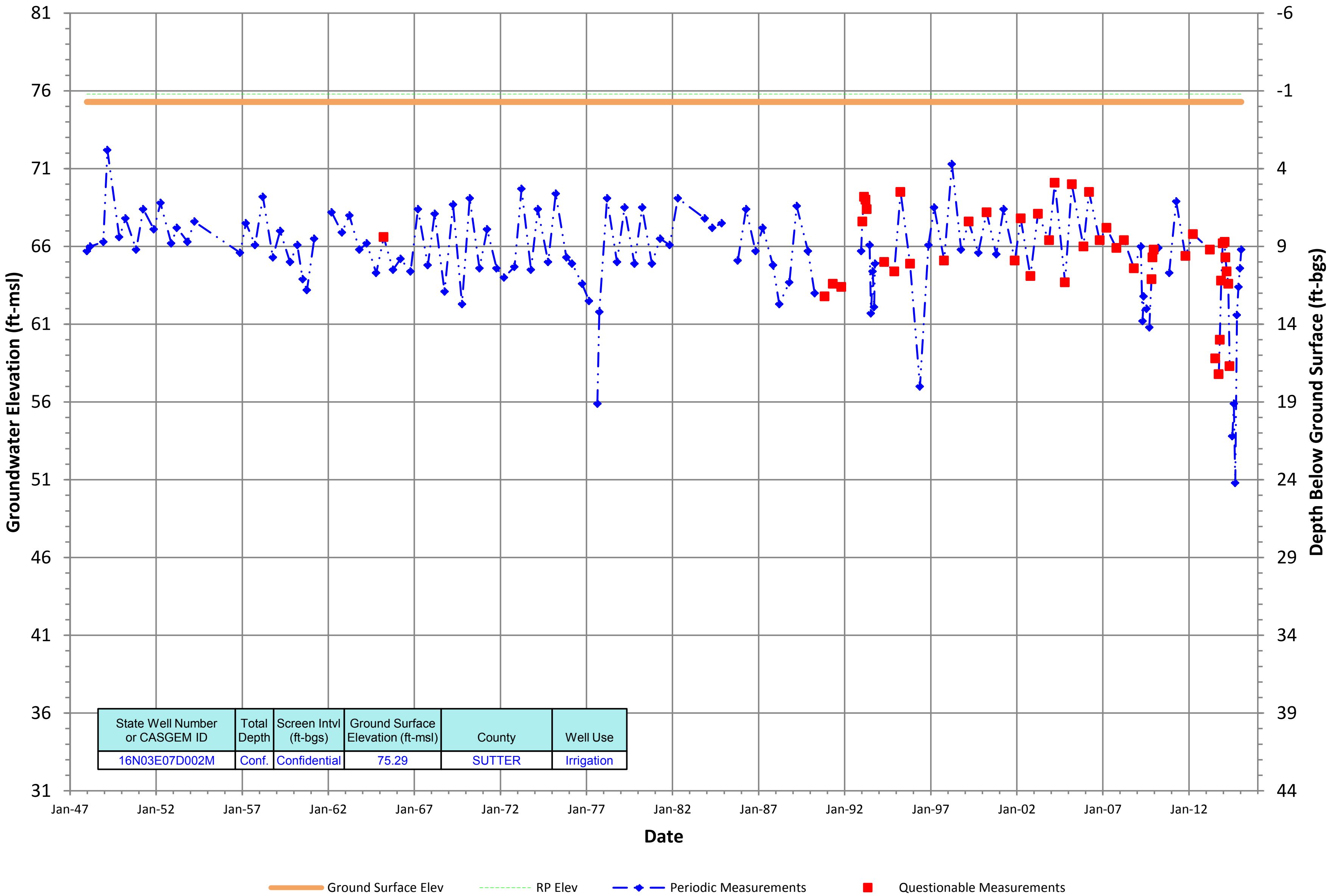
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E04E001M	Conf.	Confidential	61.27	SUTTER	Irrigation

16N03E07D002M
Period Of Record: 12/23/1947 to 01/15/2015

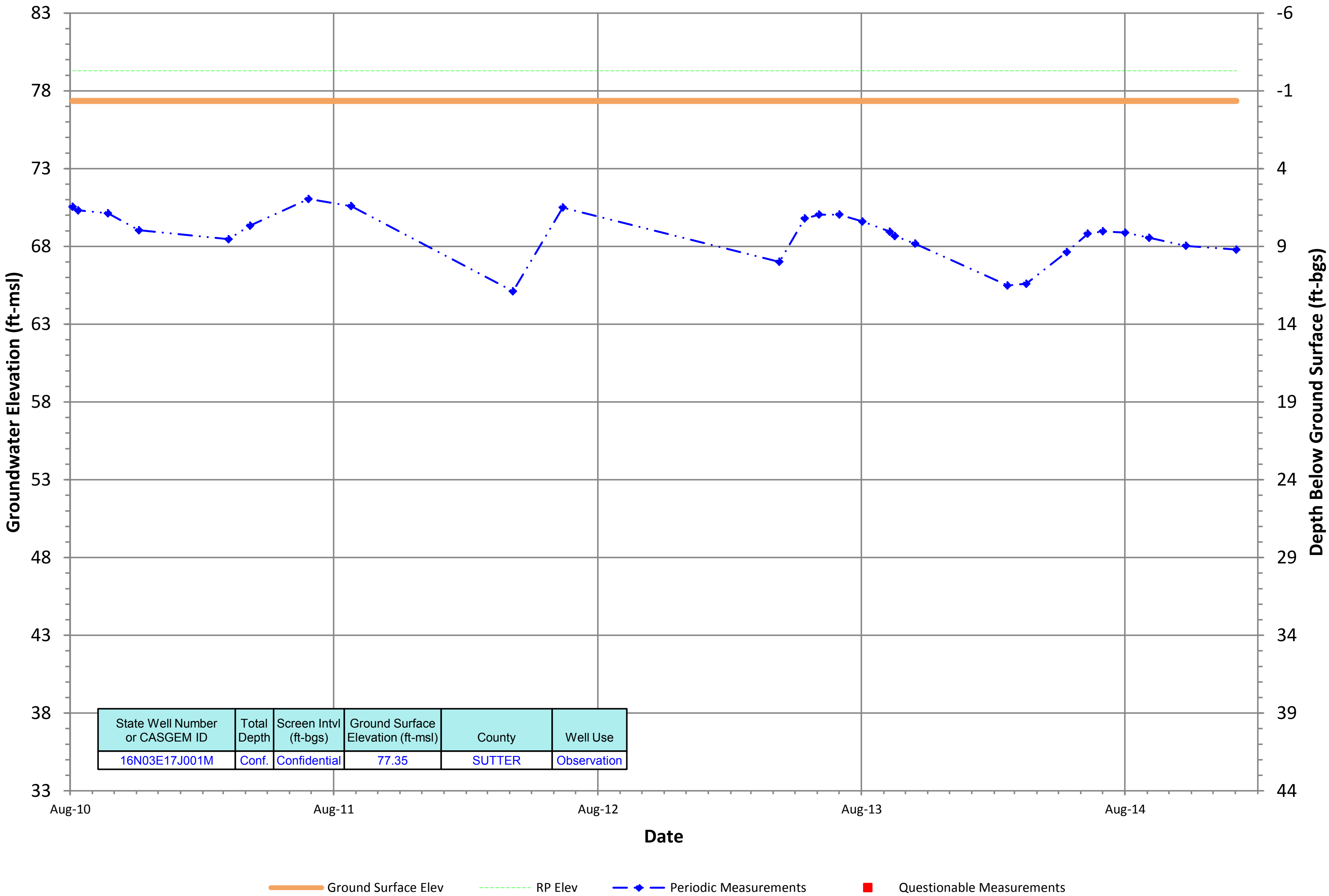
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



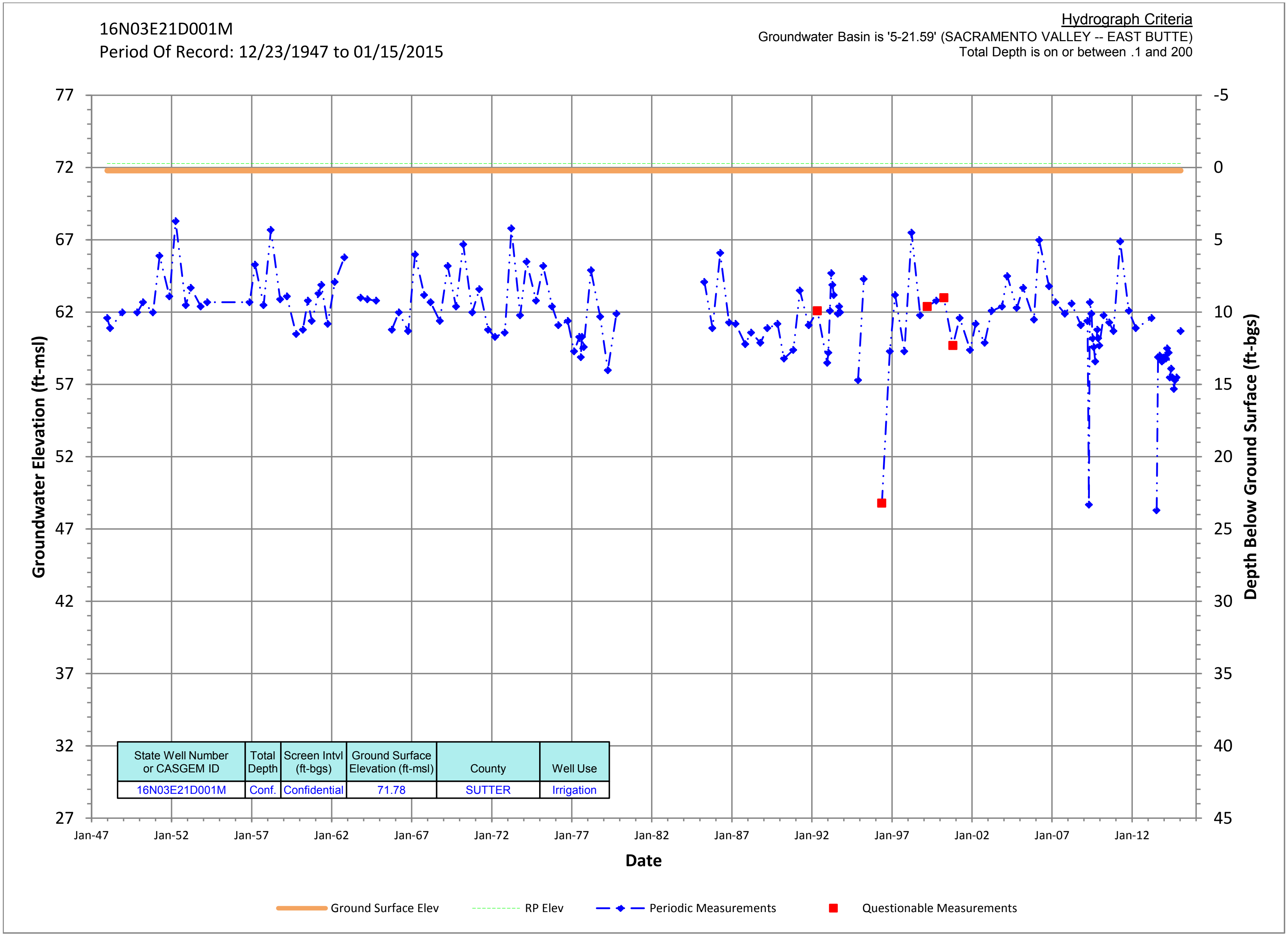
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E07D002M	Conf.	Confidential	75.29	SUTTER	Irrigation

16N03E17J001M
Period Of Record: 08/04/2010 to 01/02/2015

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



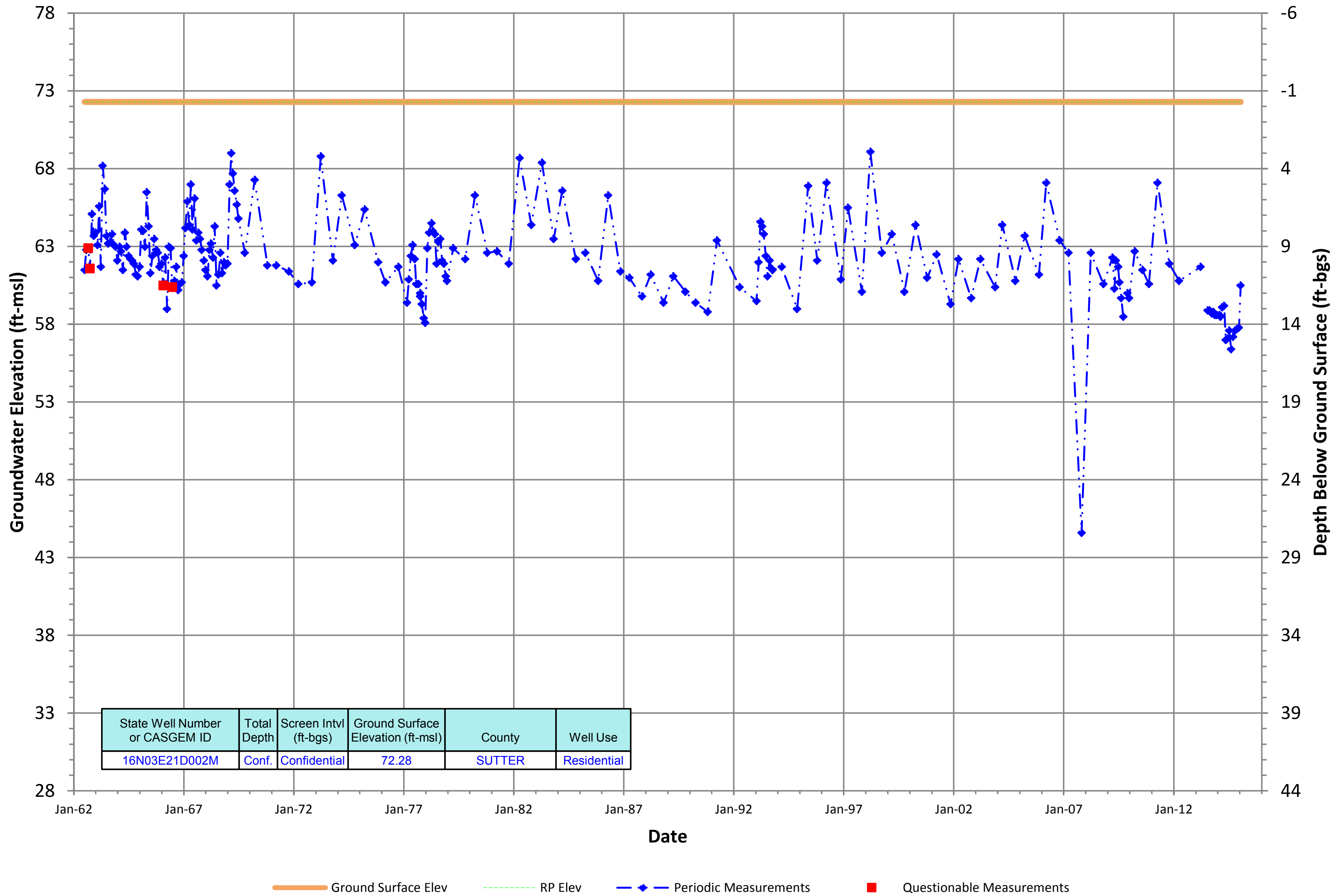
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E17J001M	Conf.	Confidential	77.35	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E21D001M	Conf.	Confidential	71.78	SUTTER	Irrigation

16N03E21D002M
Period Of Record: 06/28/1962 to 01/15/2015

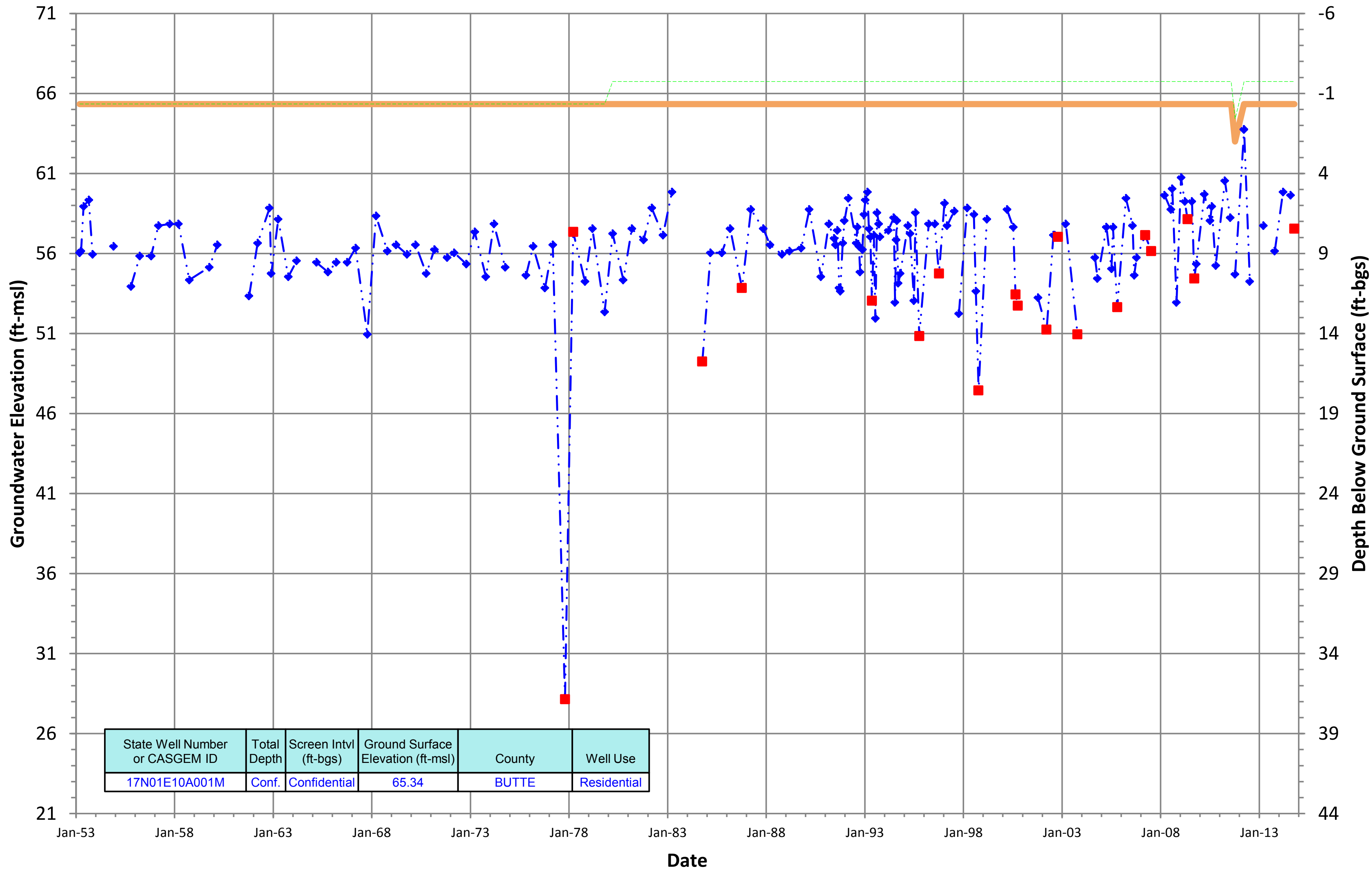
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



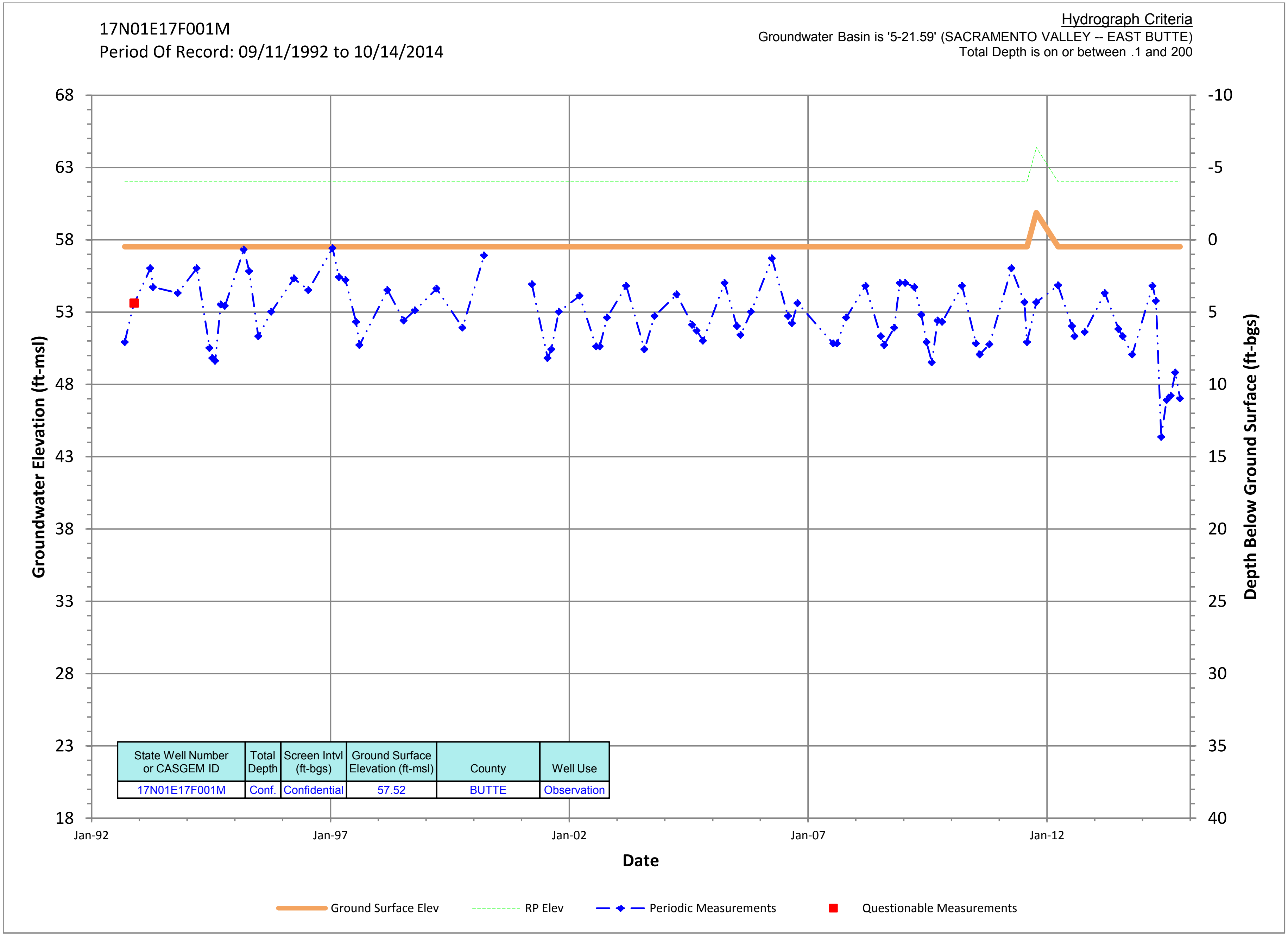
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E21D002M	Conf.	Confidential	72.28	SUTTER	Residential

17N01E10A001M
Period Of Record: 03/10/1953 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



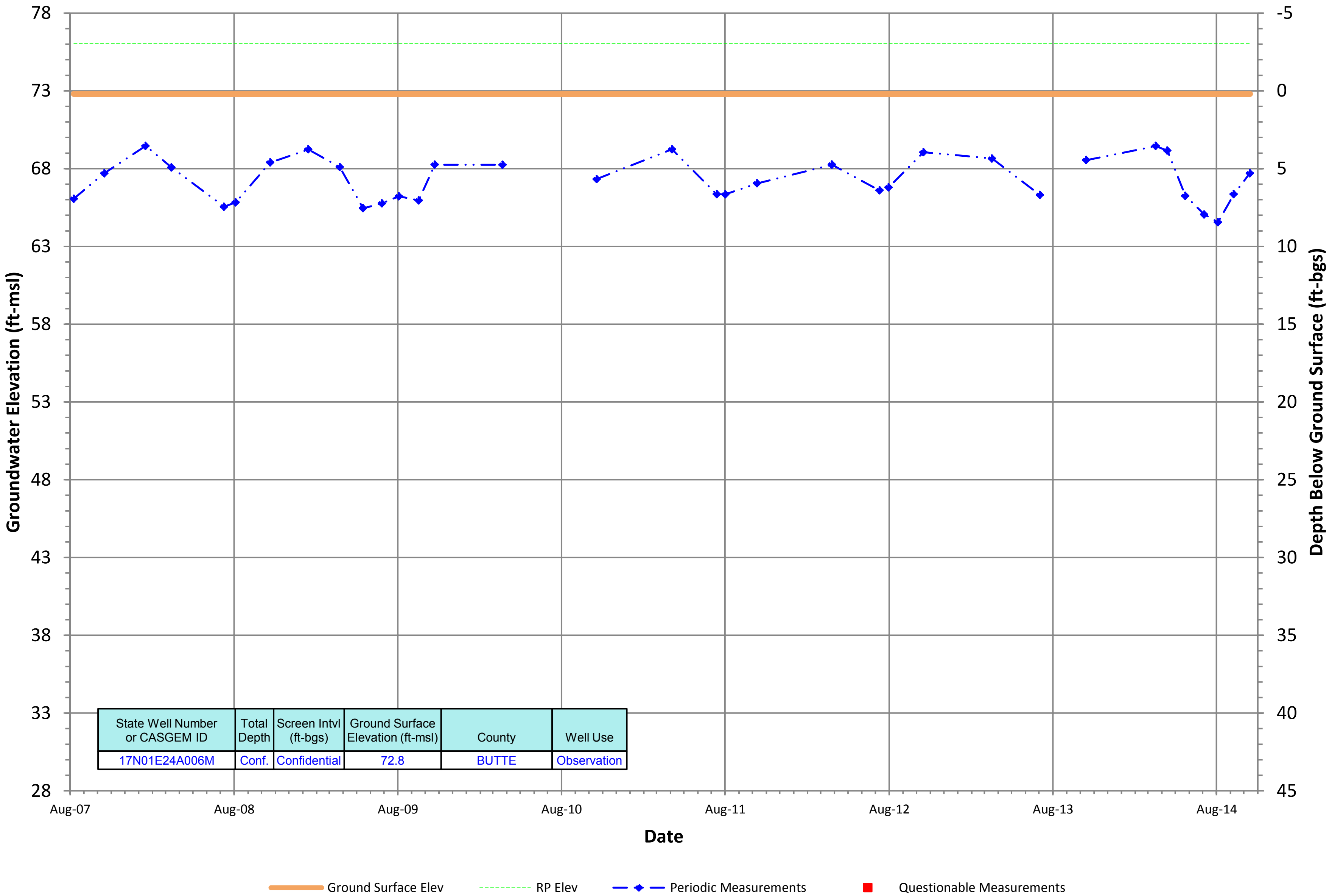
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E10A001M	Conf.	Confidential	65.34	BUTTE	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E17F001M	Conf.	Confidential	57.52	BUTTE	Observation

17N01E24A006M
Period Of Record: 08/09/2007 to 10/14/2014

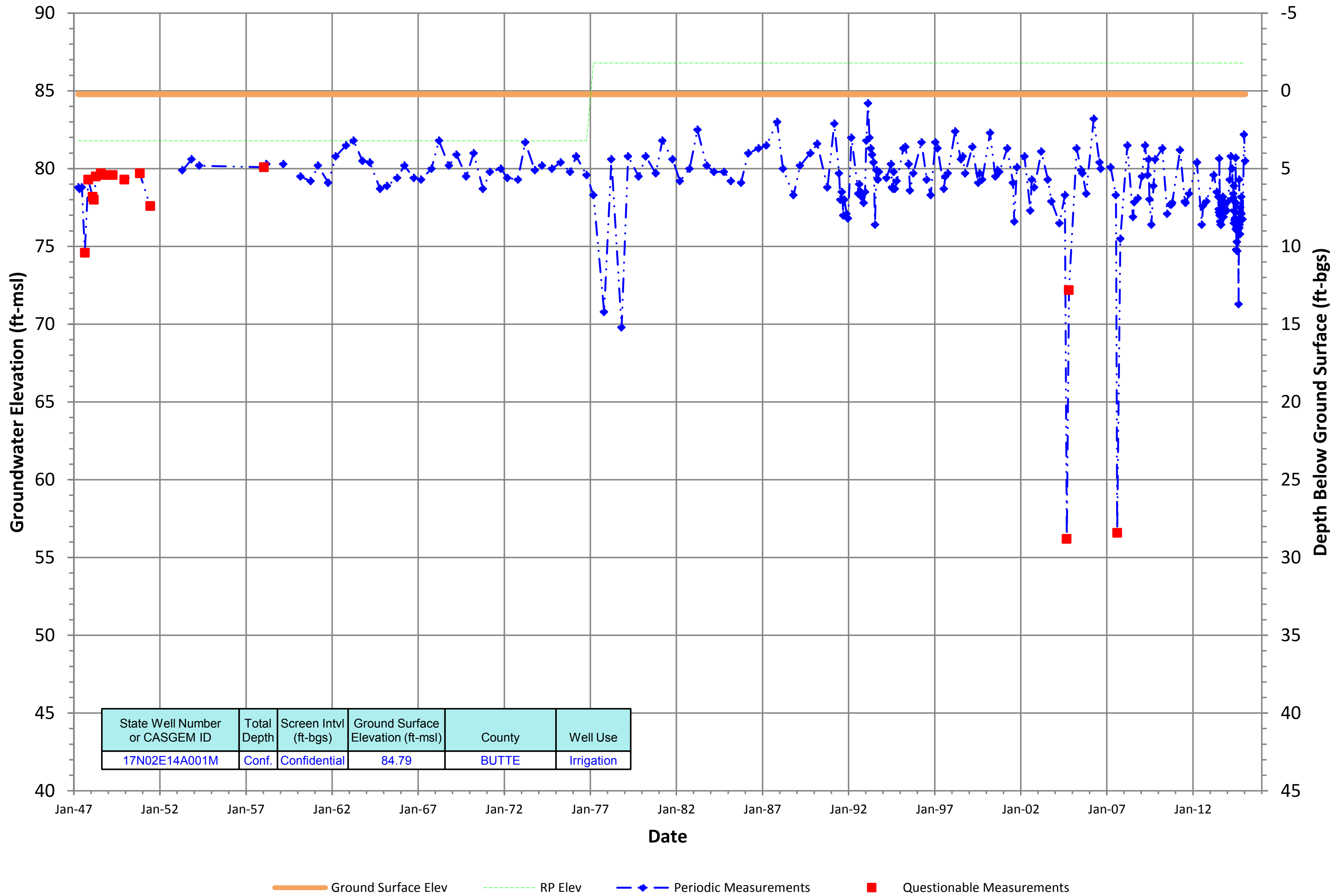
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



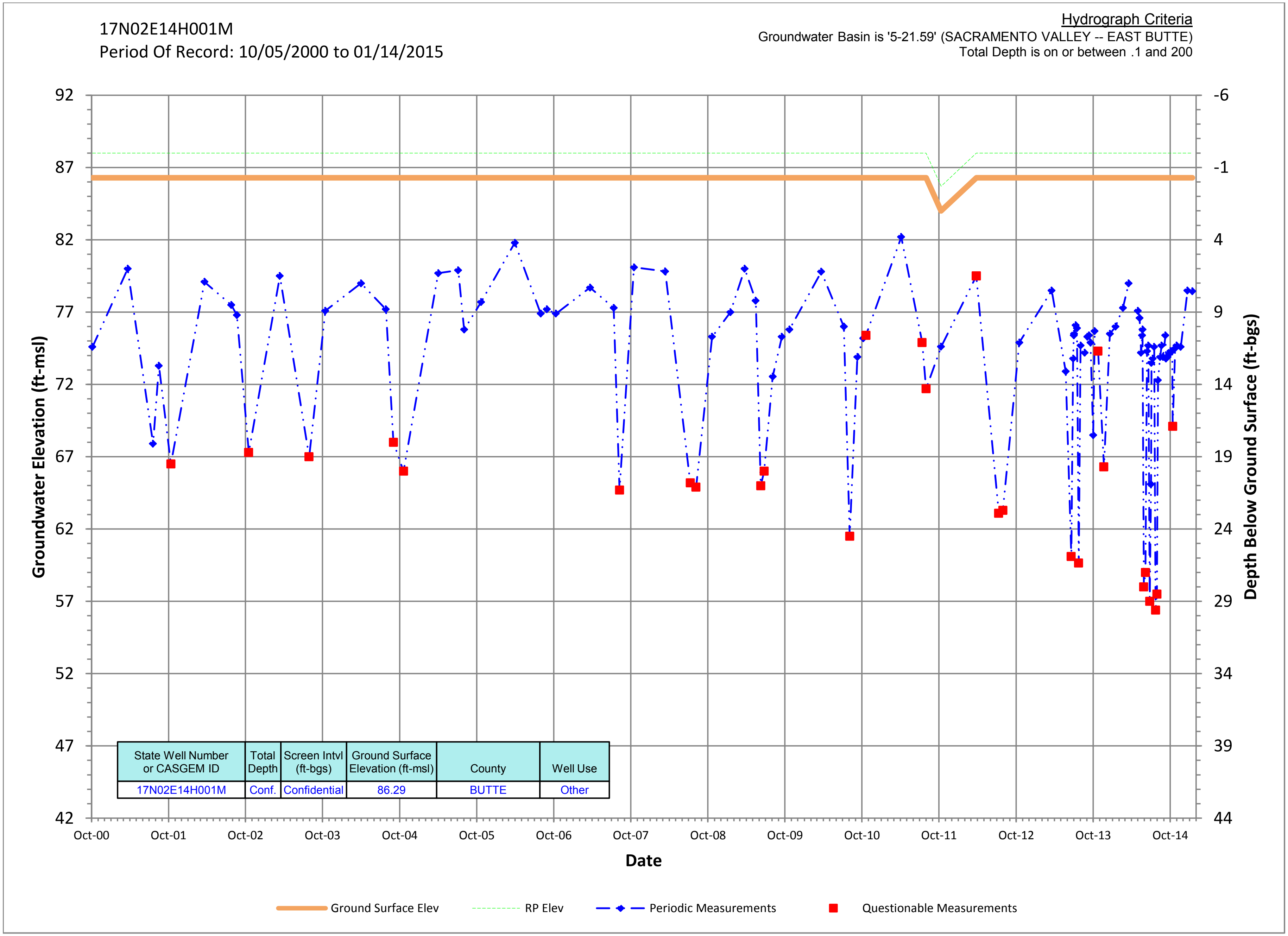
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E24A006M	Conf.	Confidential	72.8	BUTTE	Observation

17N02E14A001M
Period Of Record: 04/07/1947 to 01/14/2015

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



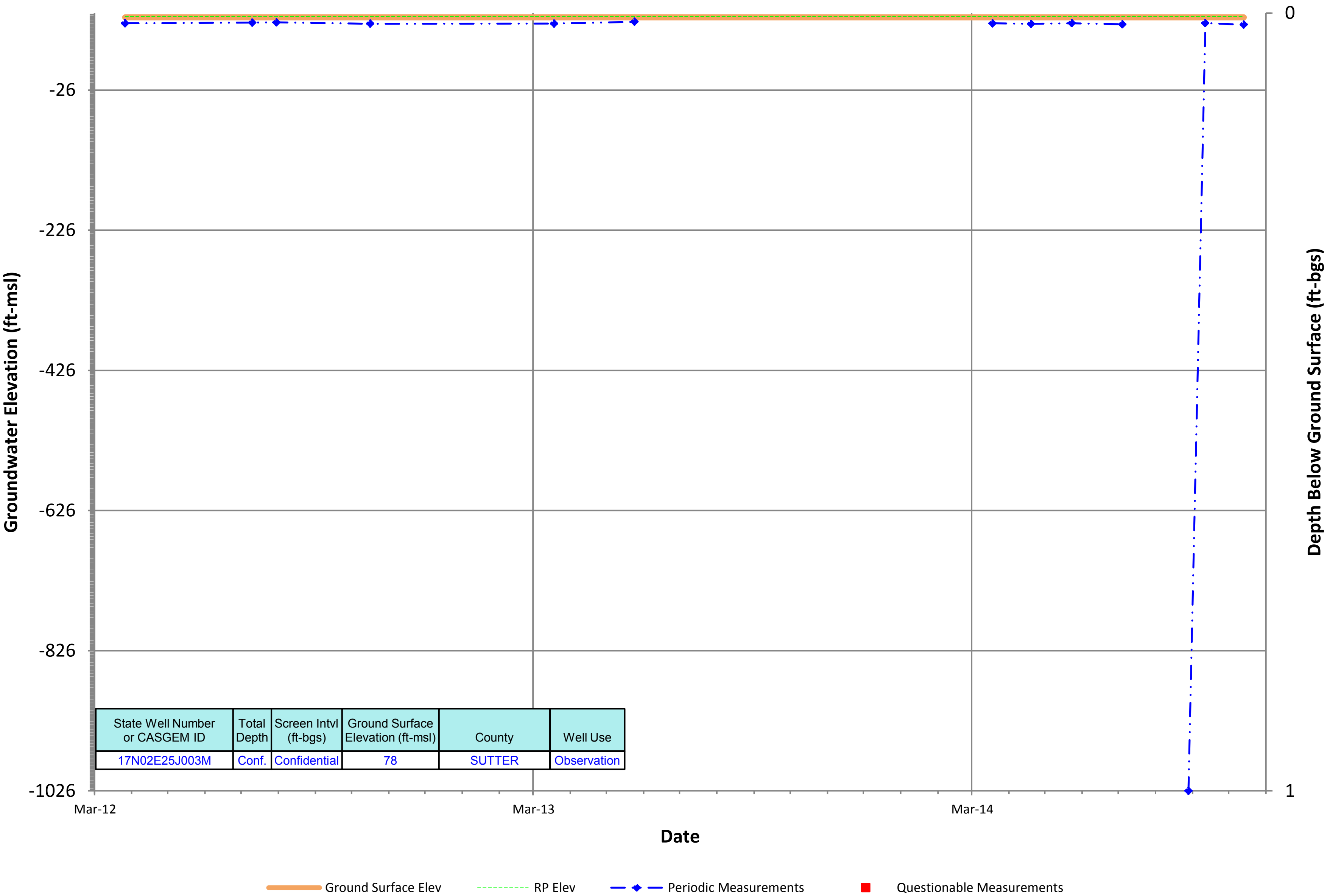
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02E14A001M	Conf.	Confidential	84.79	BUTTE	Irrigation



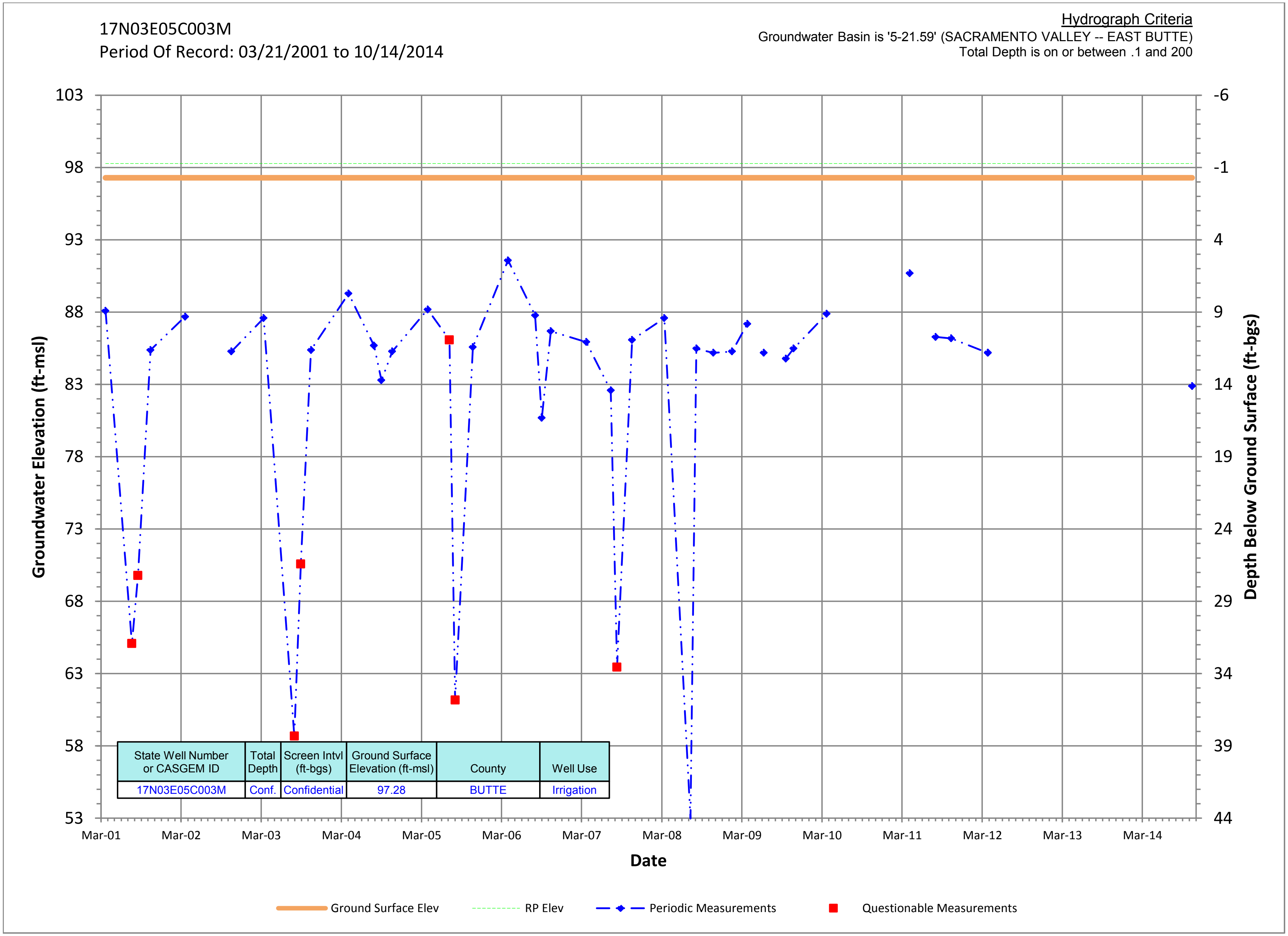
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02E14H001M	Conf.	Confidential	86.29	BUTTE	Other

17N02E25J003M
Period Of Record: 03/26/2012 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



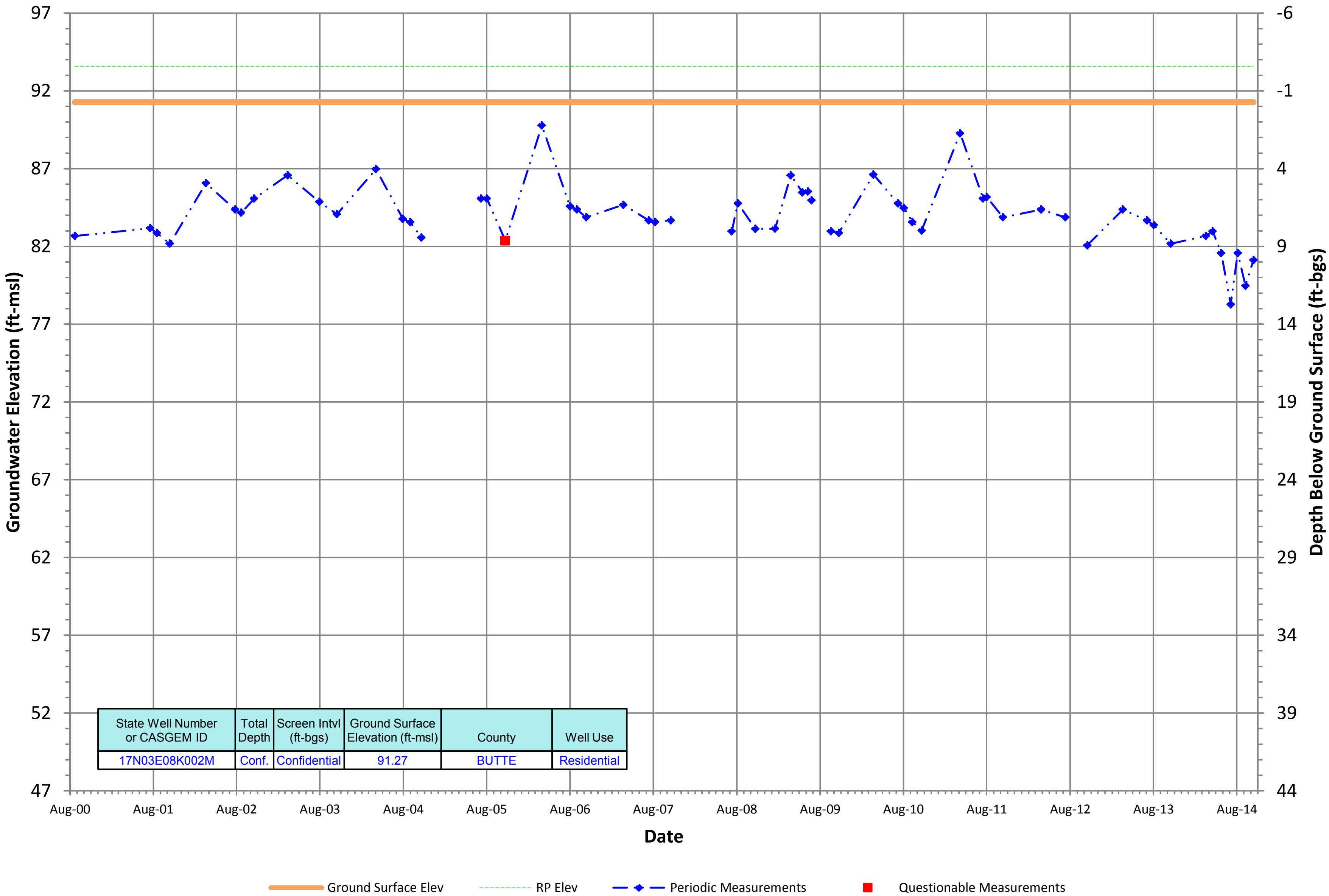
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02E25J003M	Conf.	Confidential	78	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N03E05C003M	Conf.	Confidential	97.28	BUTTE	Irrigation

17N03E08K002M
Period Of Record: 08/22/2000 to 10/13/2014

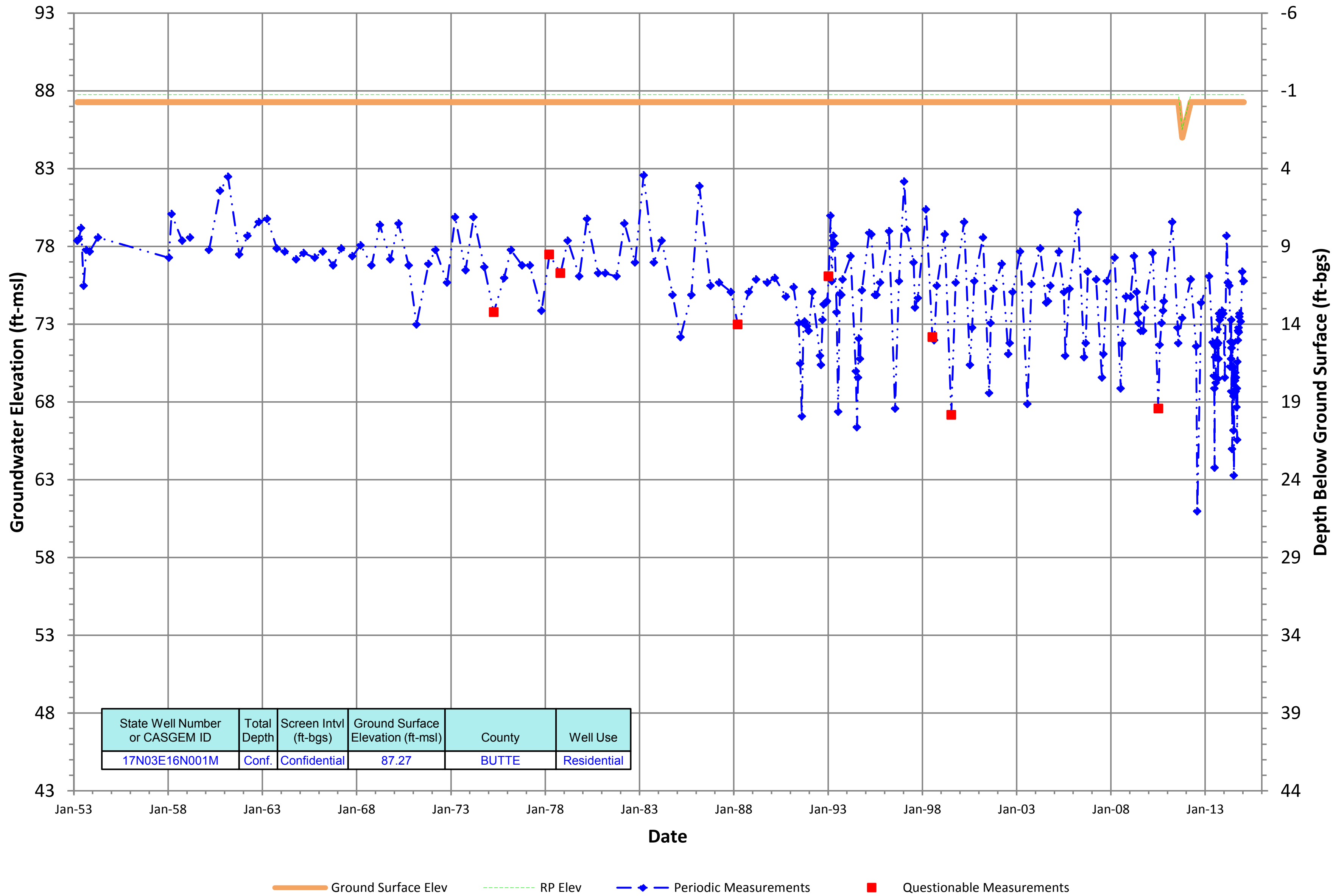
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N03E08K002M	Conf.	Confidential	91.27	BUTTE	Residential

17N03E16N001M
Period Of Record: 03/12/1953 to 01/15/2015

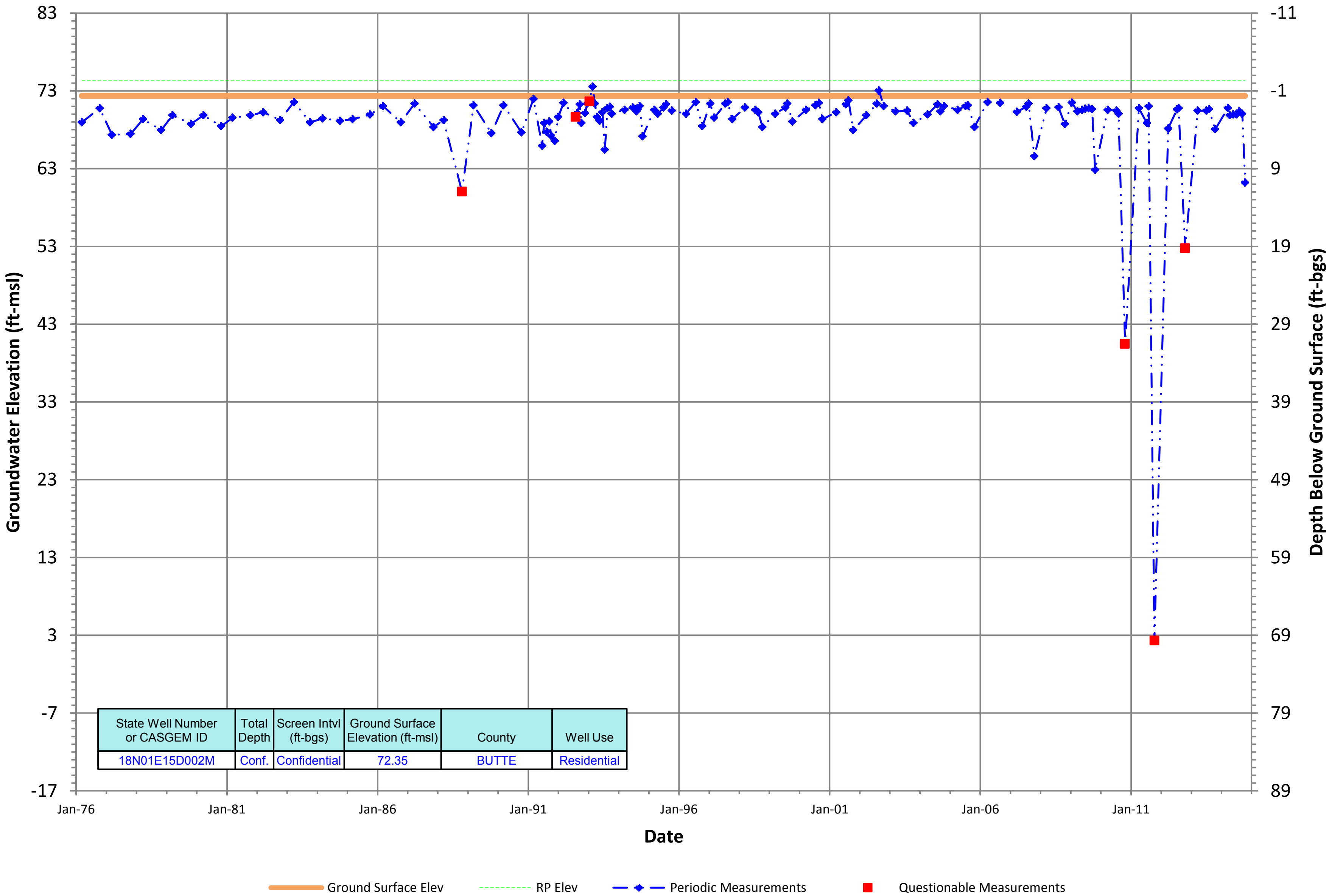
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N03E16N001M	Conf.	Confidential	87.27	BUTTE	Residential

18N01E15D002M
Period Of Record: 03/08/1976 to 10/14/2014

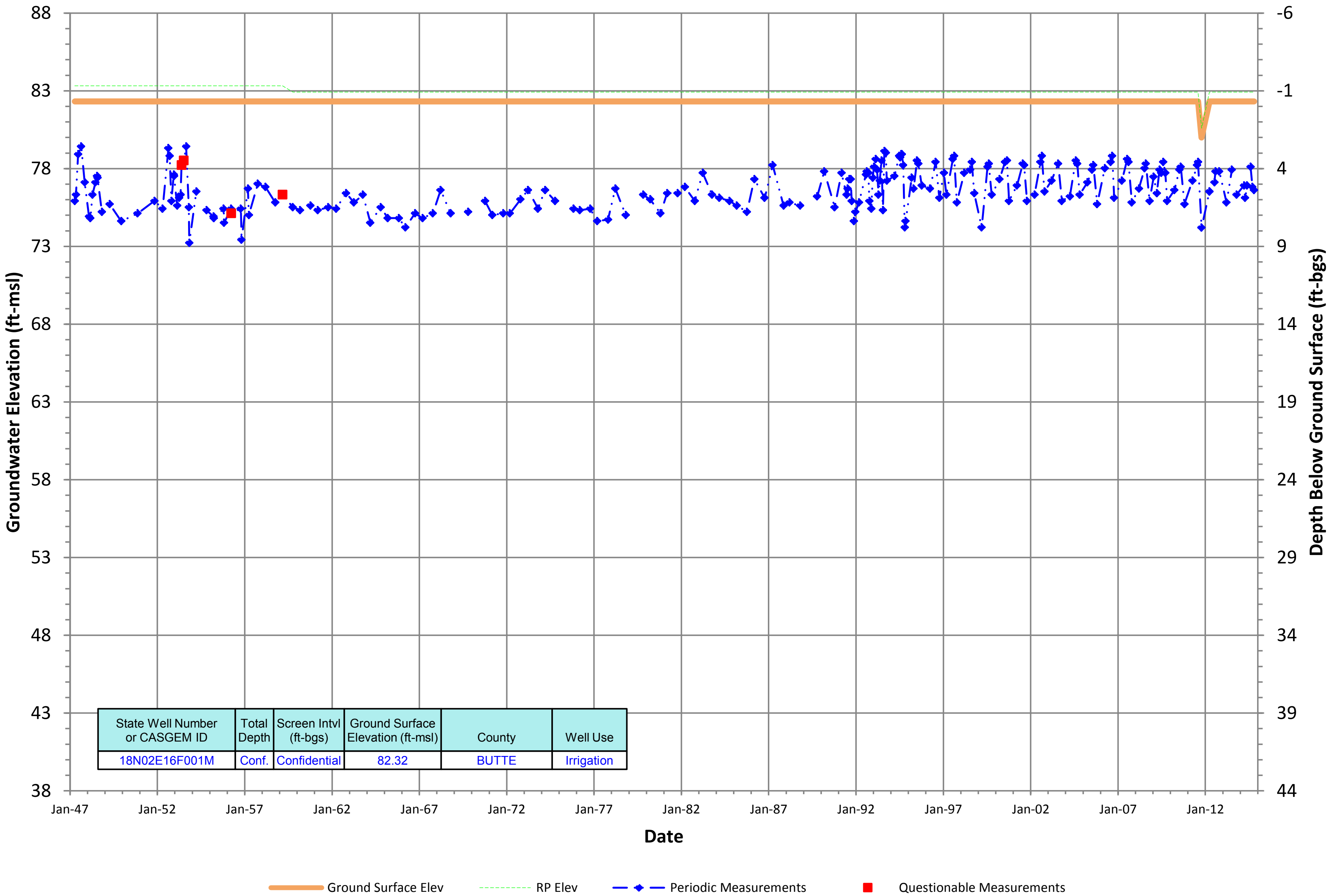
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01E15D002M	Conf.	Confidential	72.35	BUTTE	Residential

18N02E16F001M
Period Of Record: 04/09/1947 to 10/14/2014

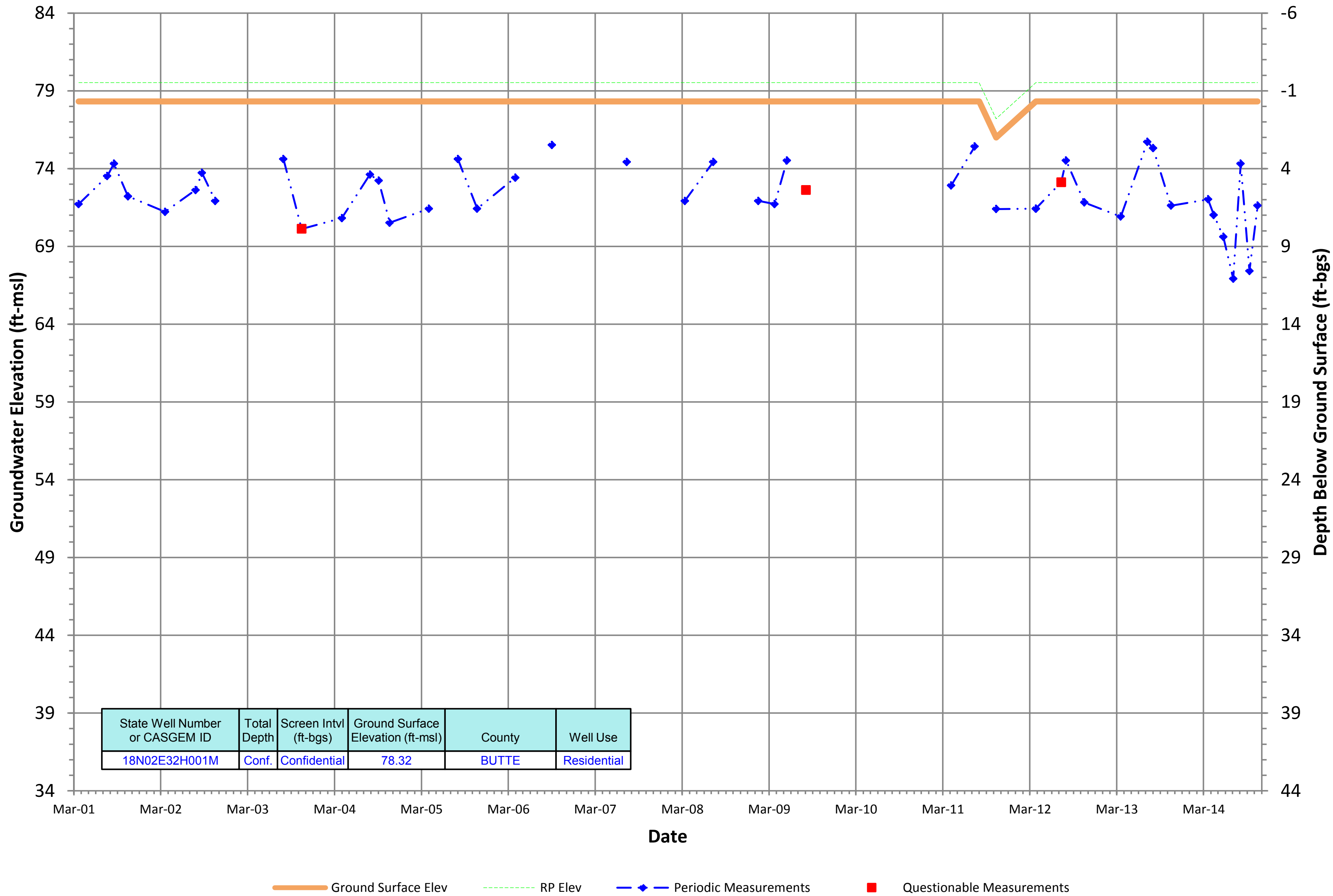
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02E16F001M	Conf.	Confidential	82.32	BUTTE	Irrigation

18N02E32H001M
Period Of Record: 03/21/2001 to 10/14/2014

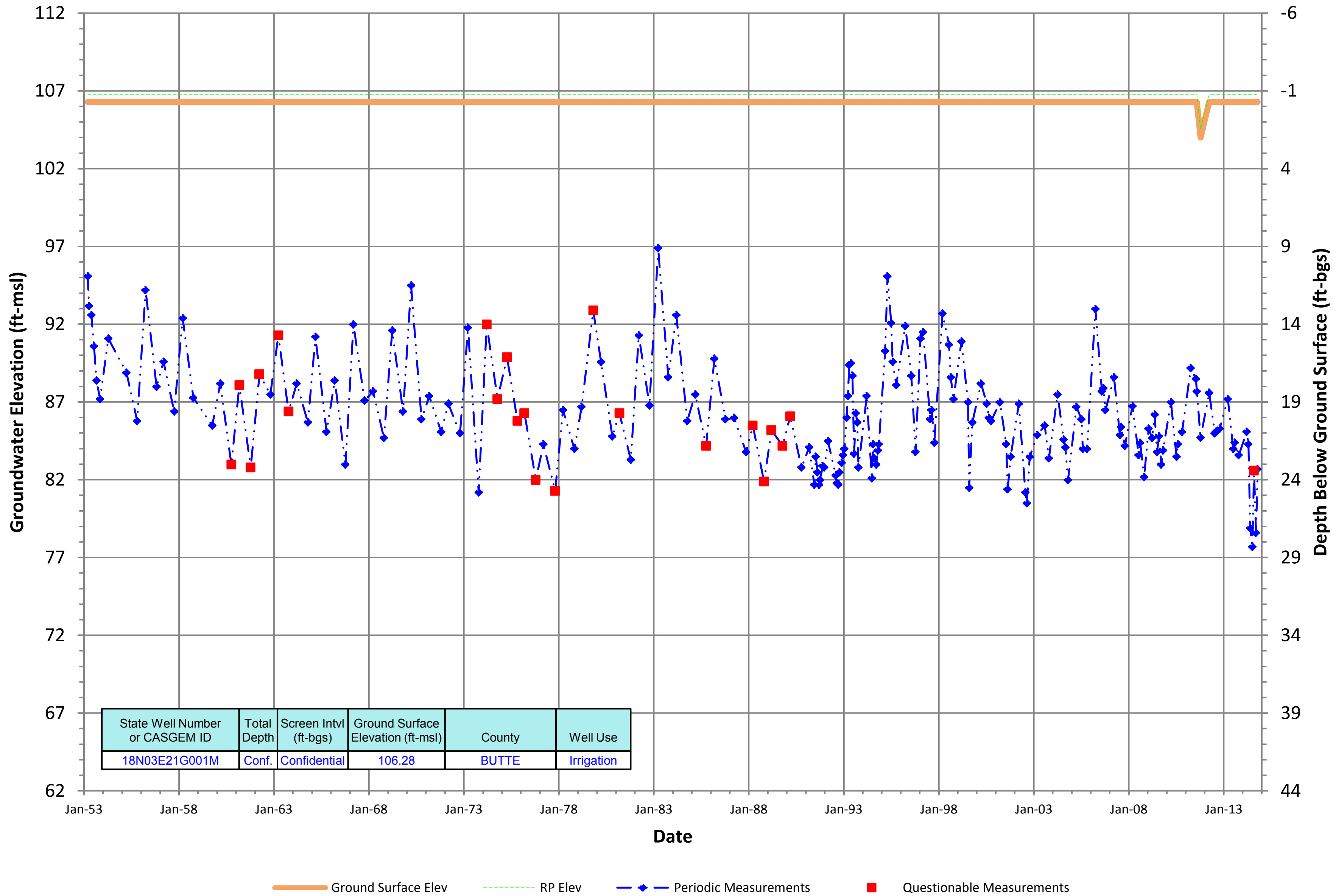
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



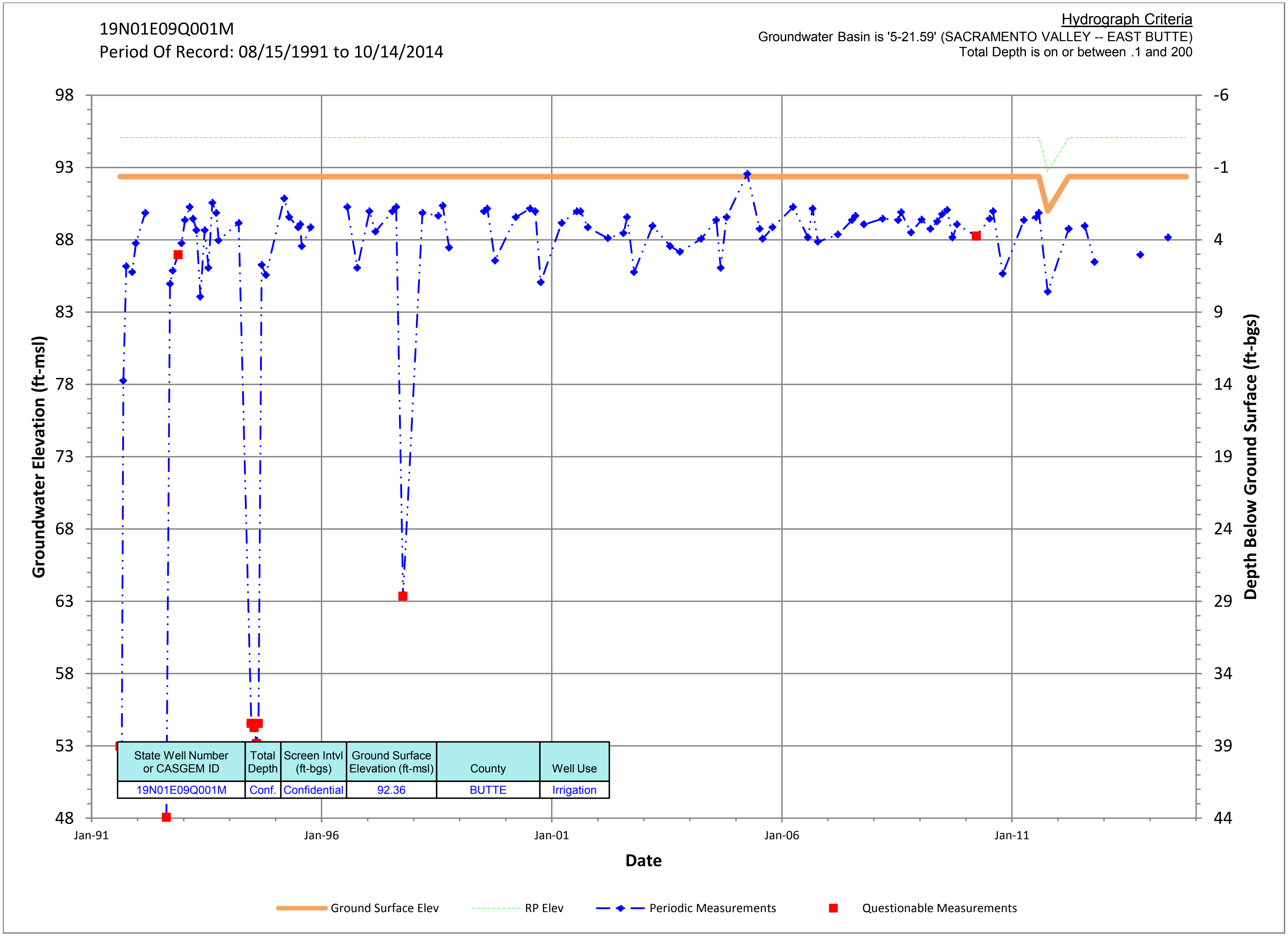
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N02E32H001M	Conf.	Confidential	78.32	BUTTE	Residential

18N03E21G001M
Period Of Record: 03/12/1953 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



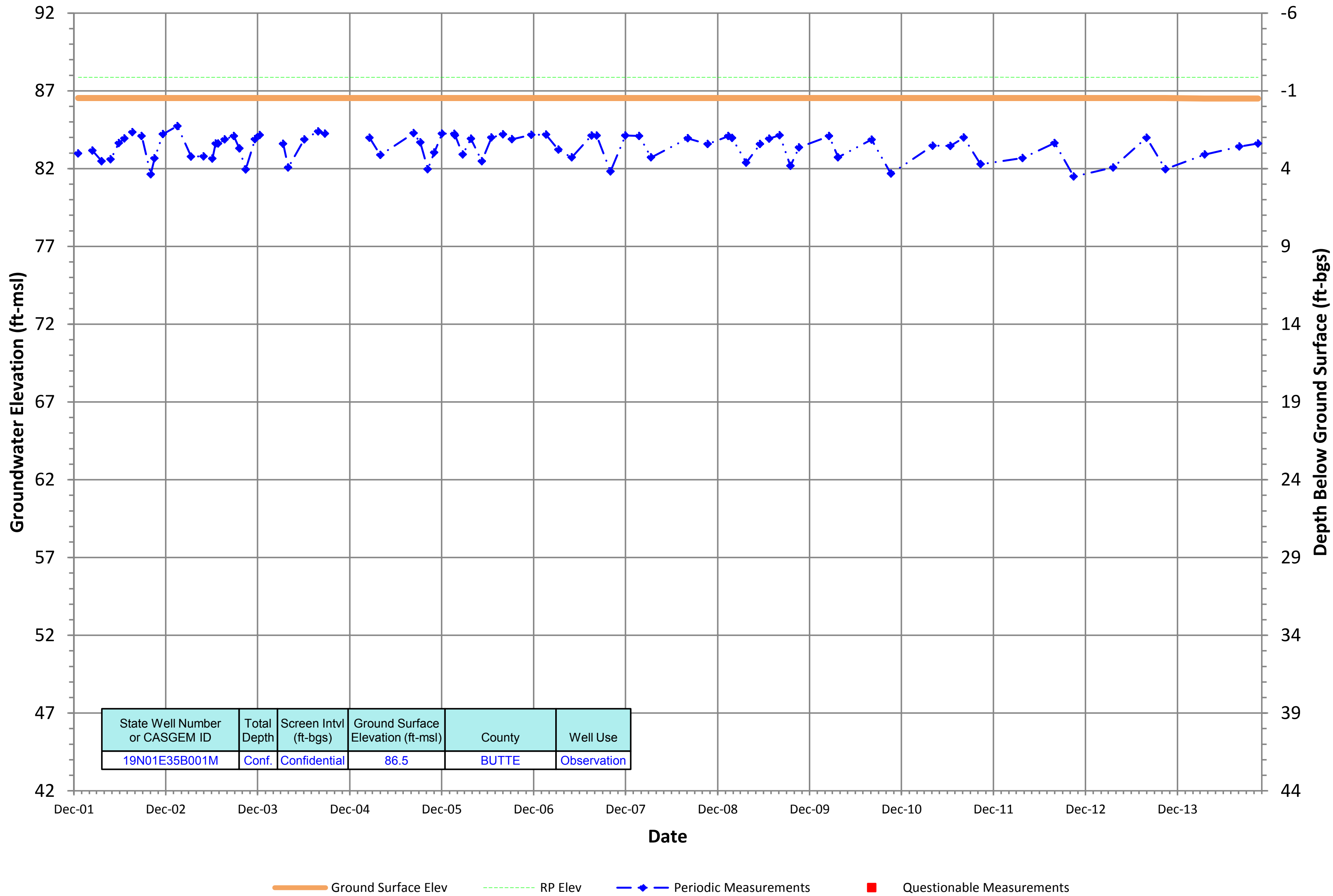
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N03E21G001M	Conf.	Confidential	106.28	BUTTE	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01E09Q001M	Conf.	Confidential	92.36	BUTTE	Irrigation

19N01E35B001M
Period Of Record: 12/18/2001 to 10/17/2014

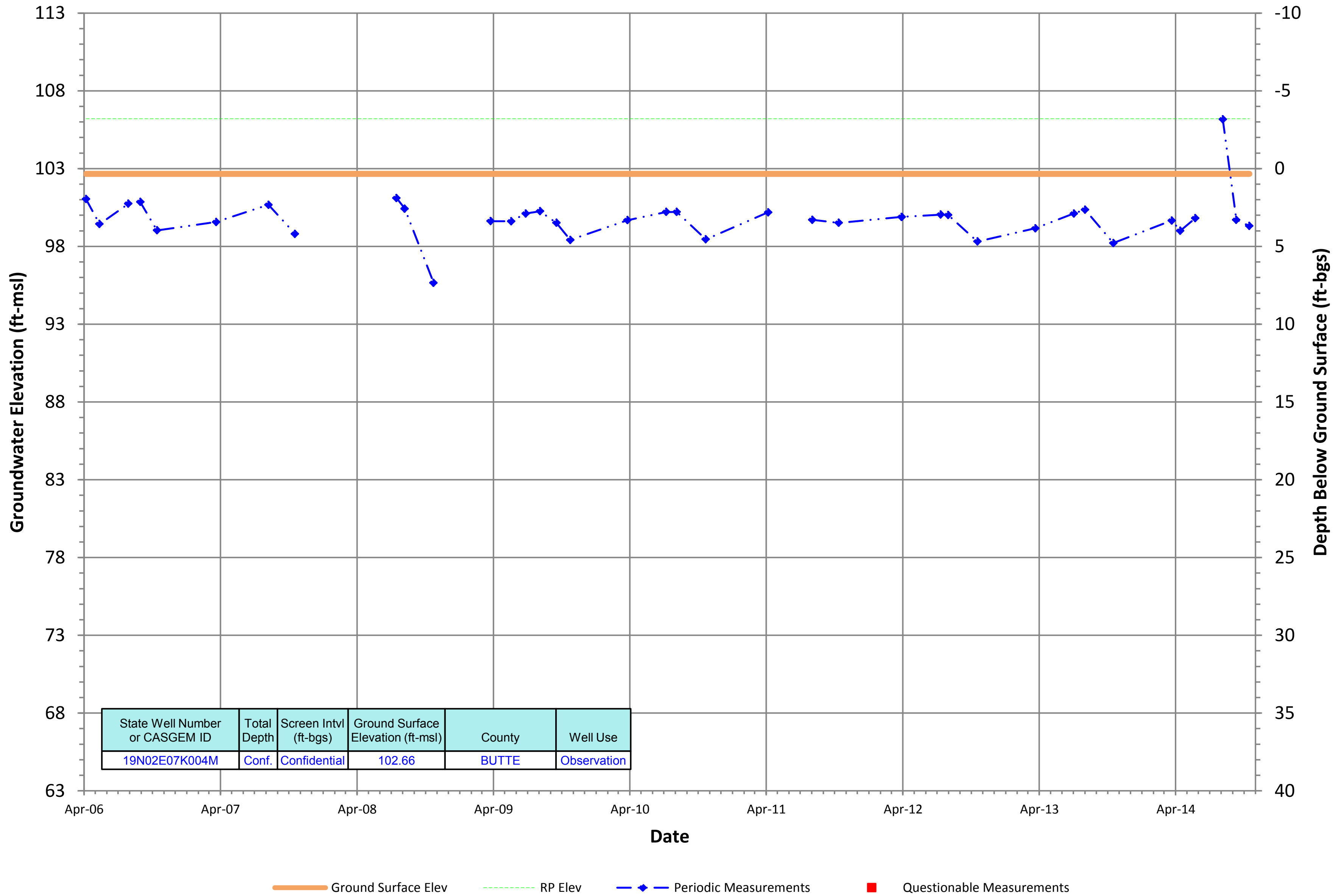
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



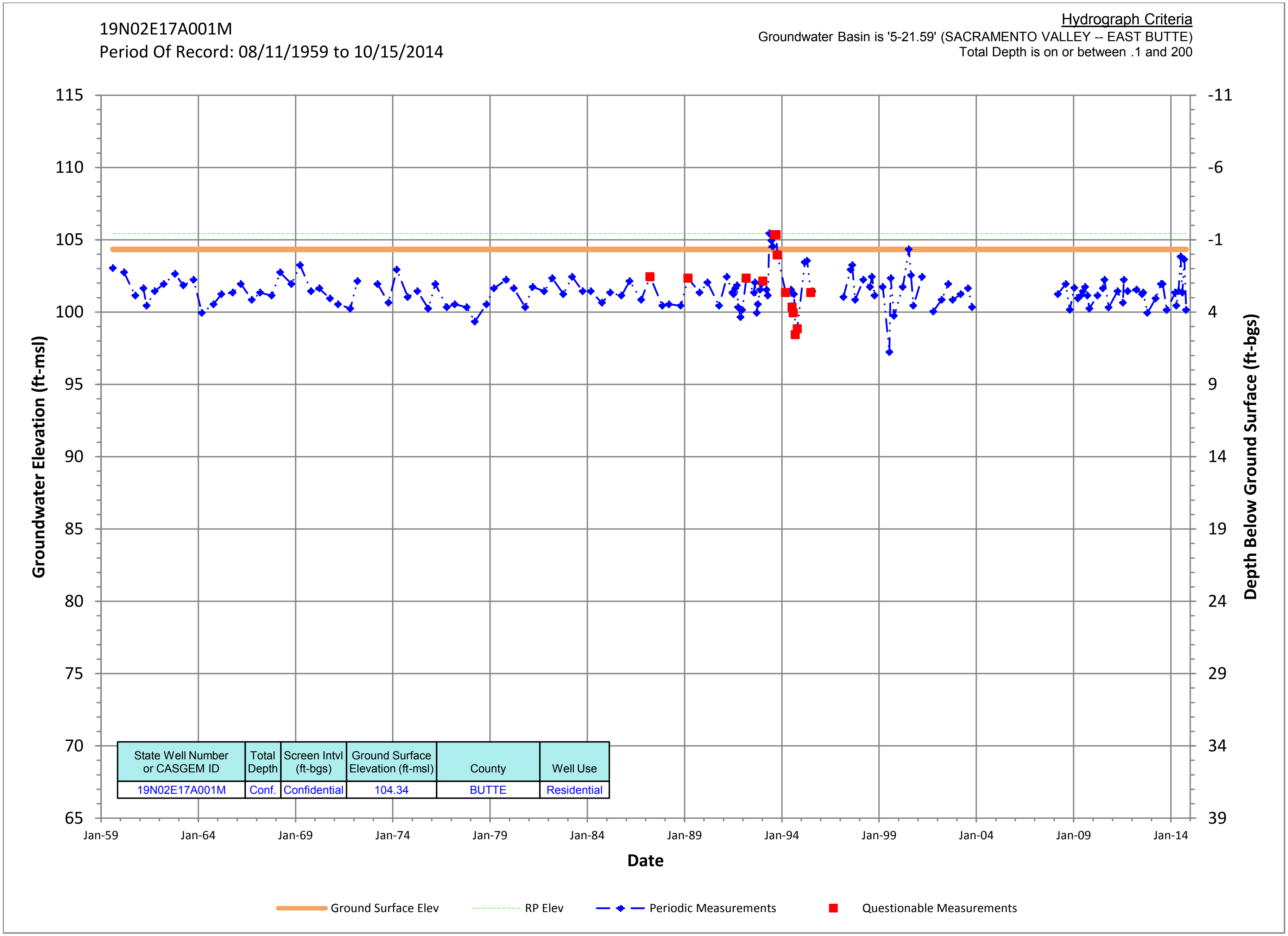
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01E35B001M	Conf.	Confidential	86.5	BUTTE	Observation

19N02E07K004M
Period Of Record: 04/06/2006 to 10/15/2014

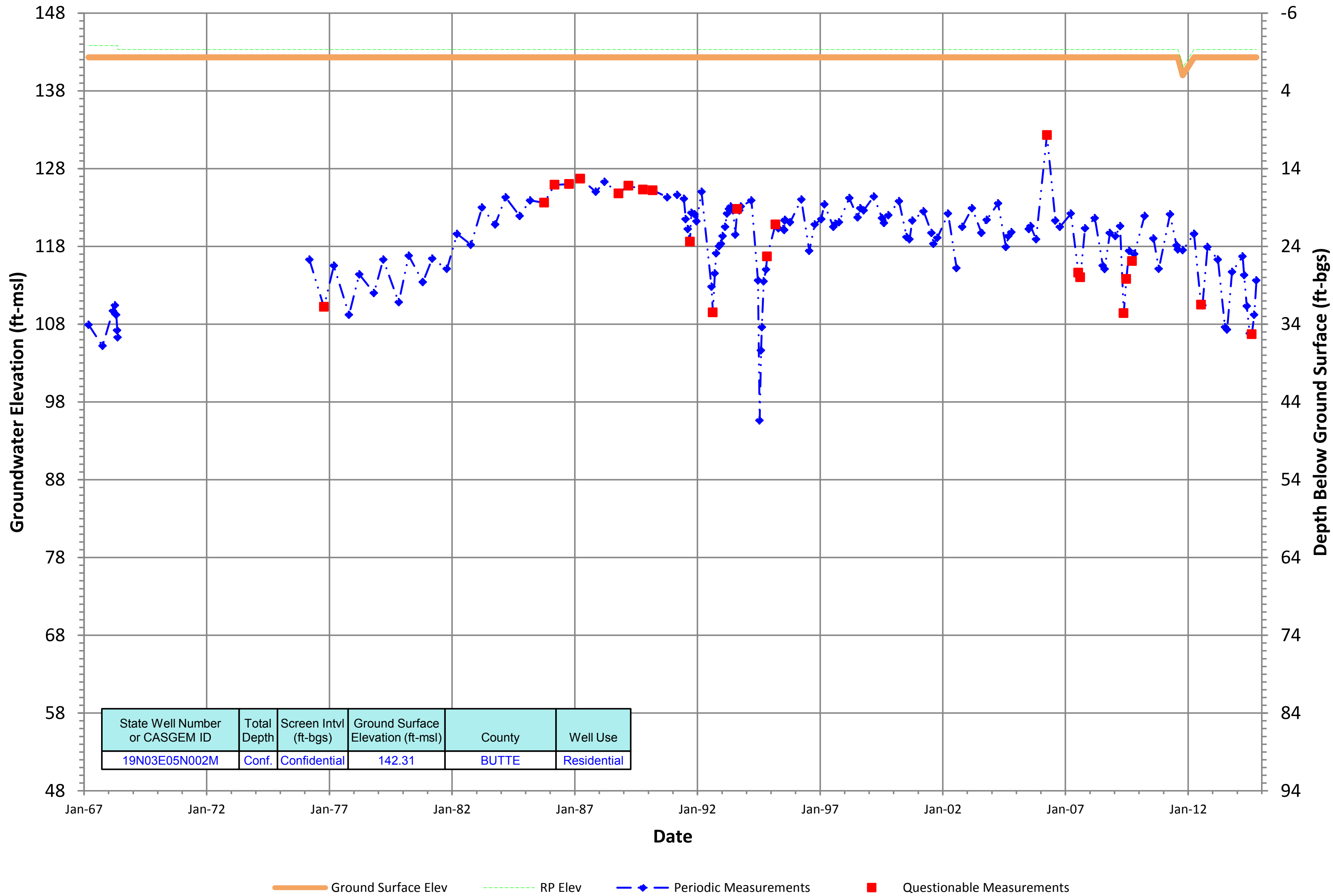
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



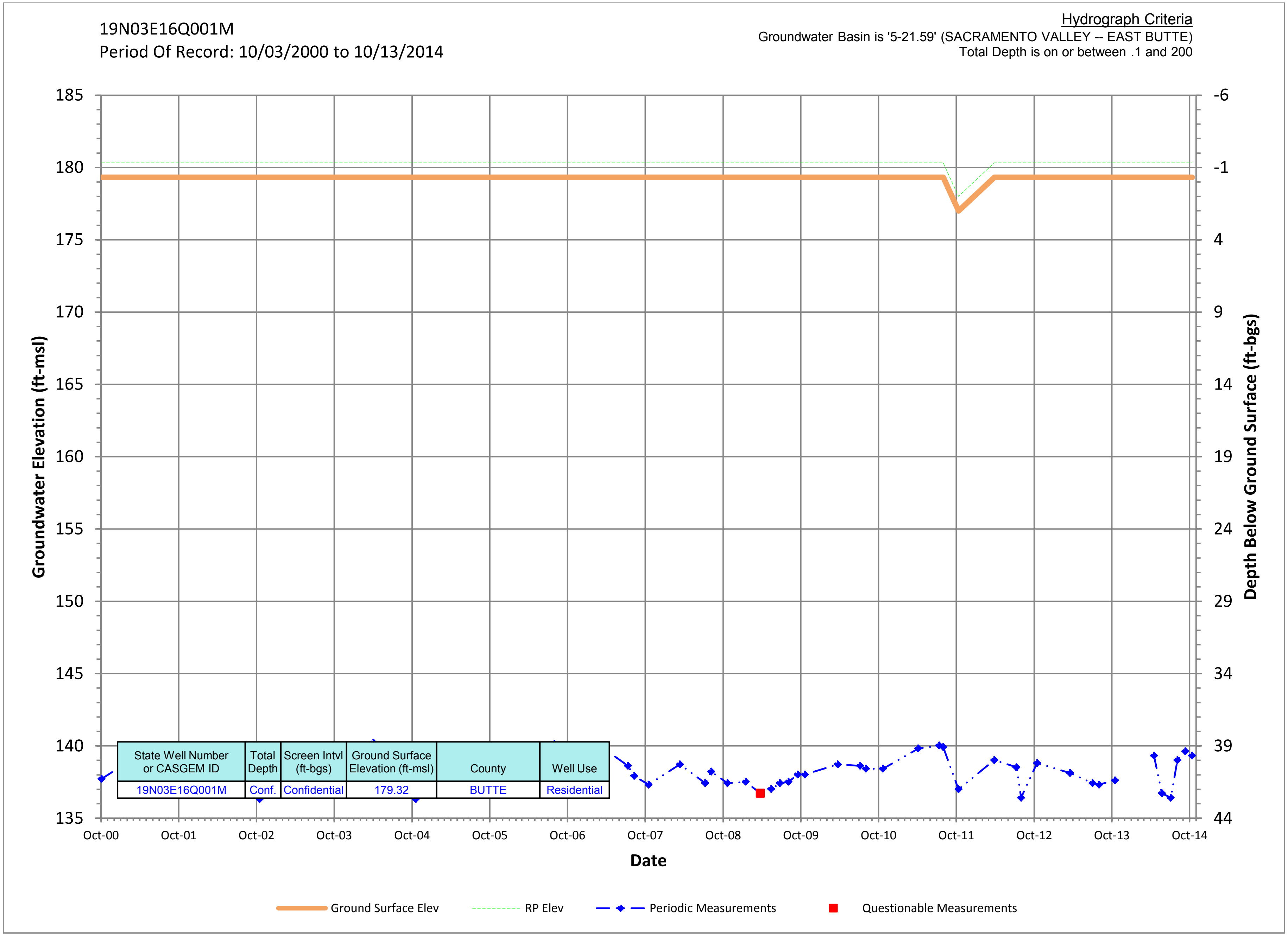
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02E07K004M	Conf.	Confidential	102.66	BUTTE	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02E17A001M	Conf.	Confidential	104.34	BUTTE	Residential



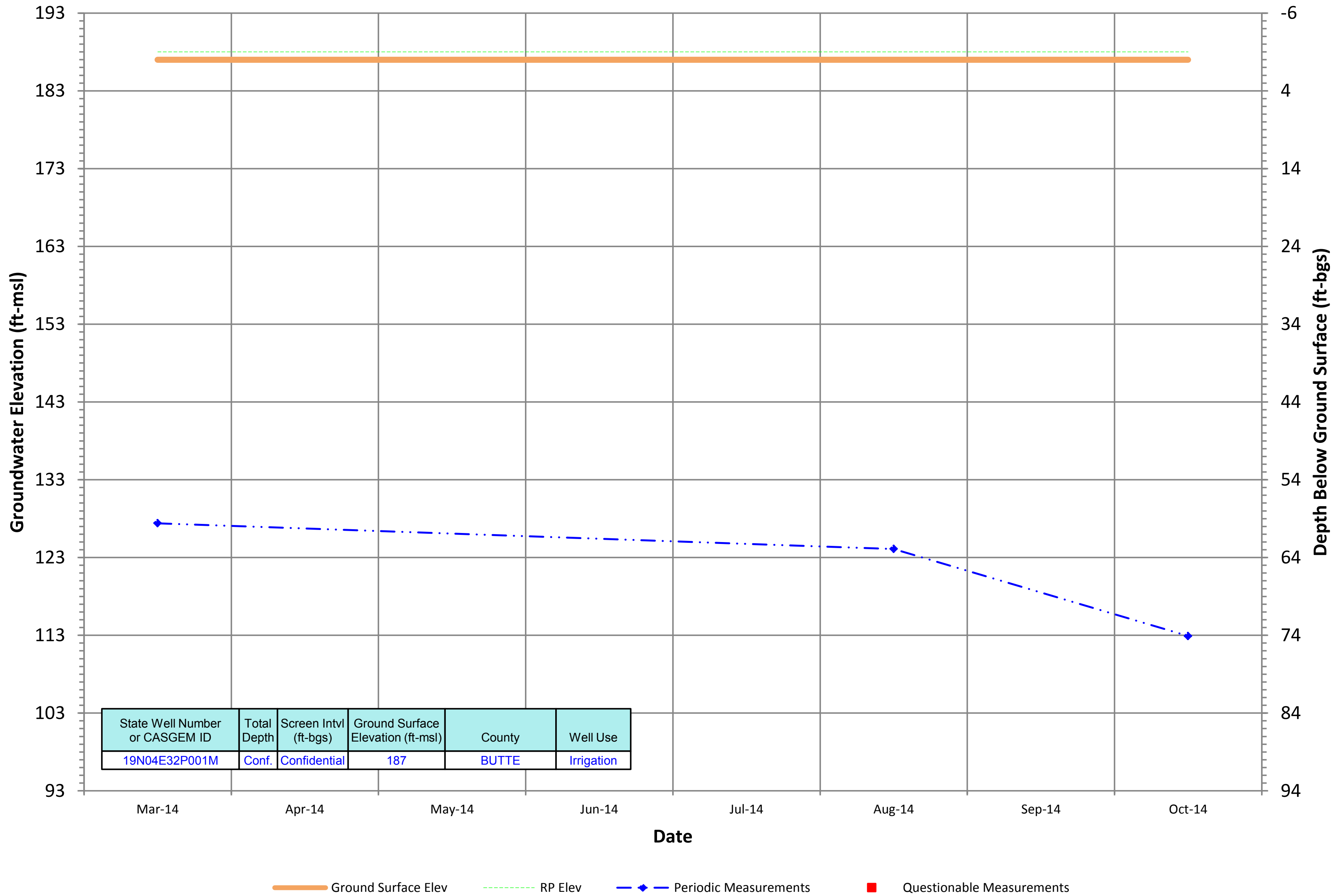
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N03E05N002M	Conf.	Confidential	142.31	BUTTE	Residential



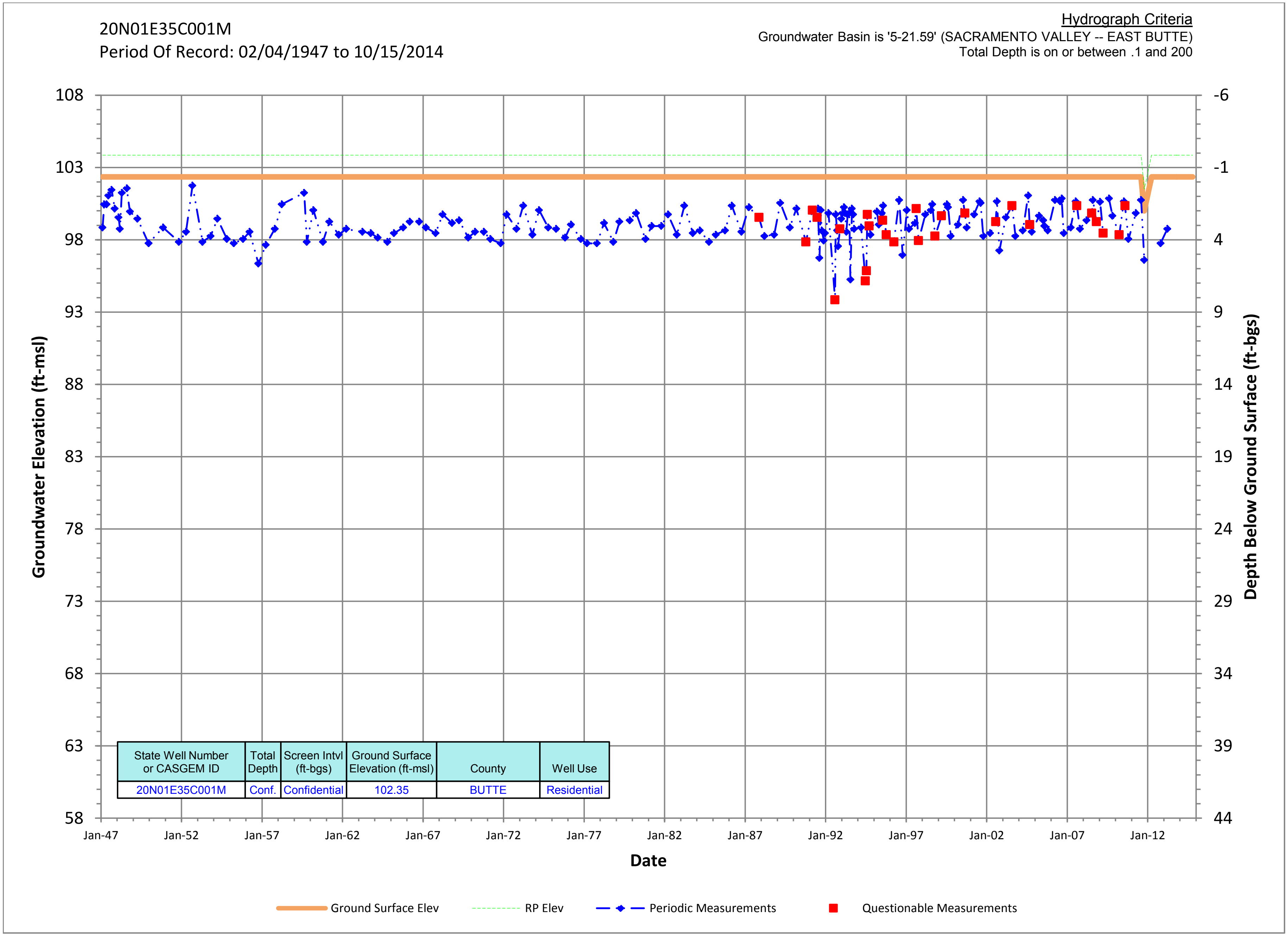
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N03E16Q001M	Conf.	Confidential	179.32	BUTTE	Residential

19N04E32P001M
Period Of Record: 03/20/2014 to 10/14/2014

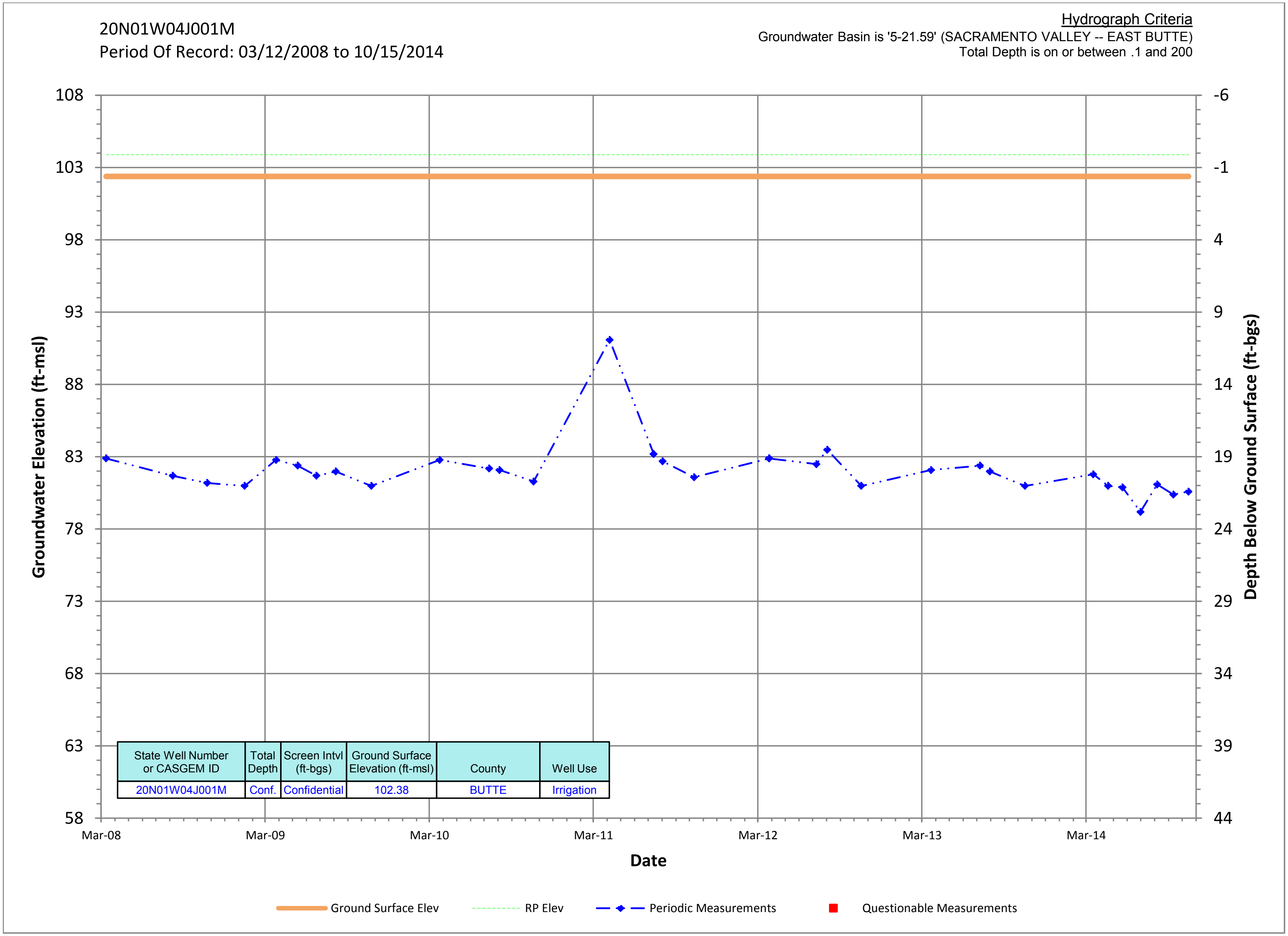
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N04E32P001M	Conf.	Confidential	187	BUTTE	Irrigation



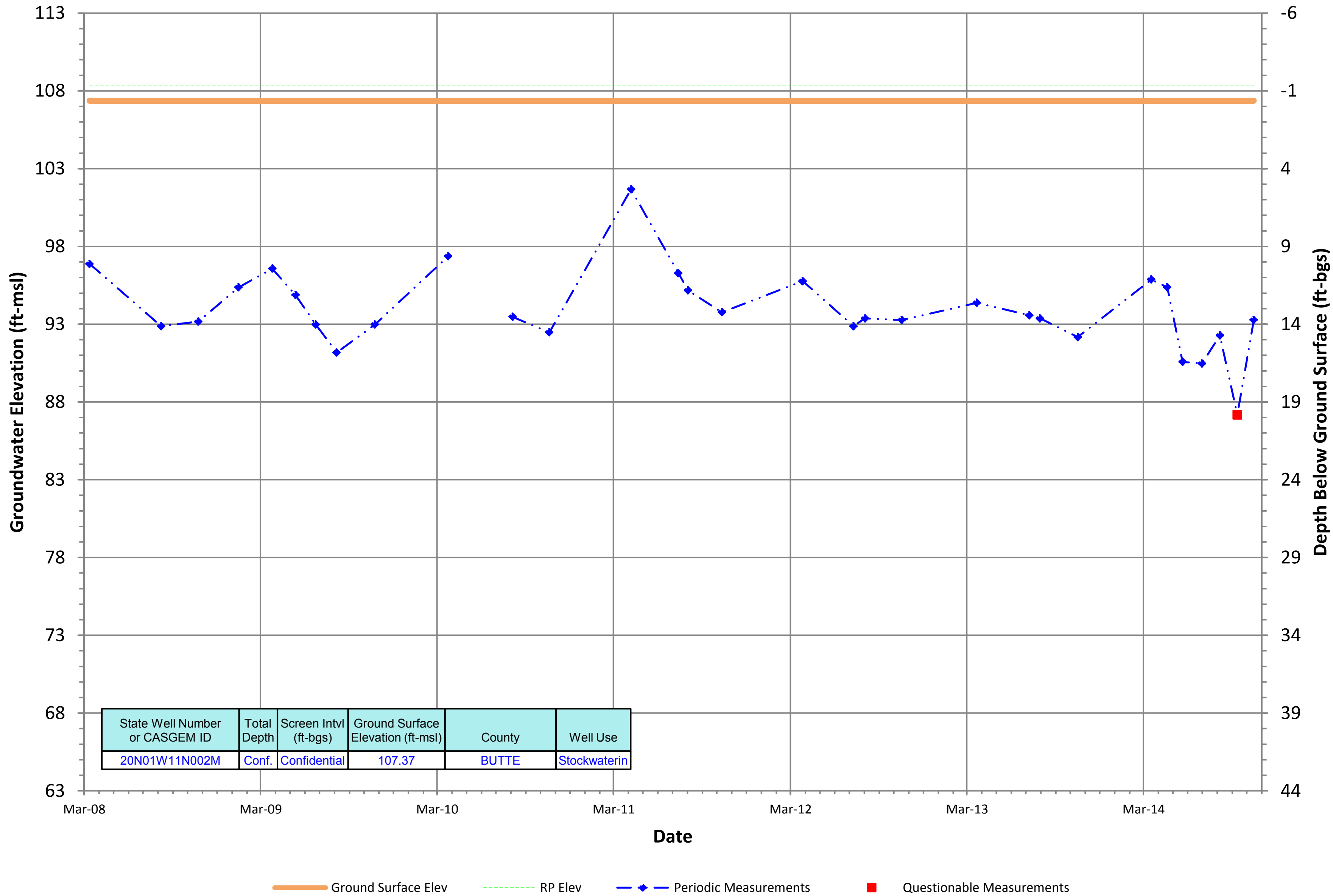
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01E35C001M	Conf.	Confidential	102.35	BUTTE	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01W04J001M	Conf.	Confidential	102.38	BUTTE	Irrigation

20N01W11N002M
Period Of Record: 03/12/2008 to 10/15/2014

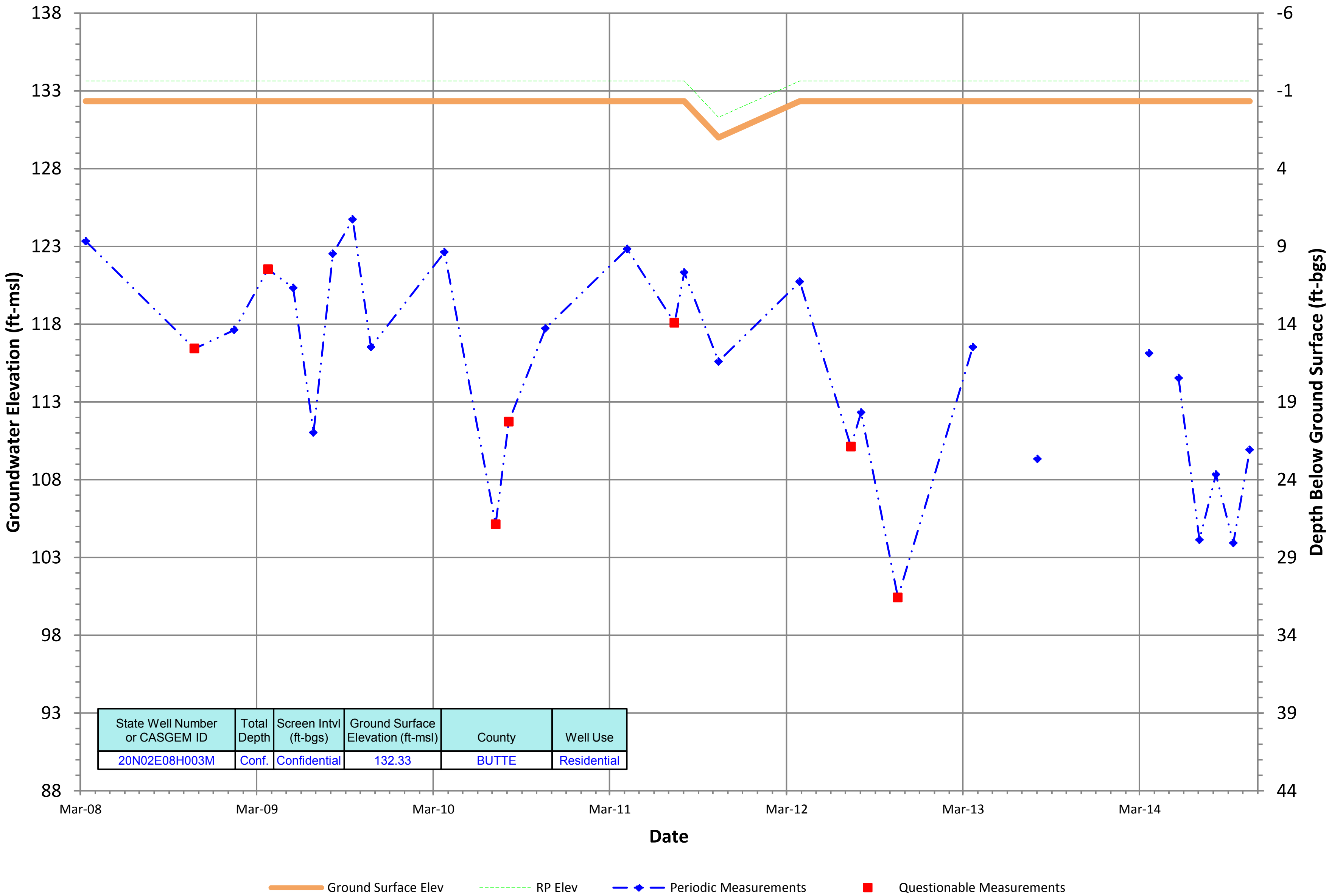
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01W11N002M	Conf.	Confidential	107.37	BUTTE	Stockwaterin

20N02E08H003M
Period Of Record: 03/12/2008 to 10/15/2014

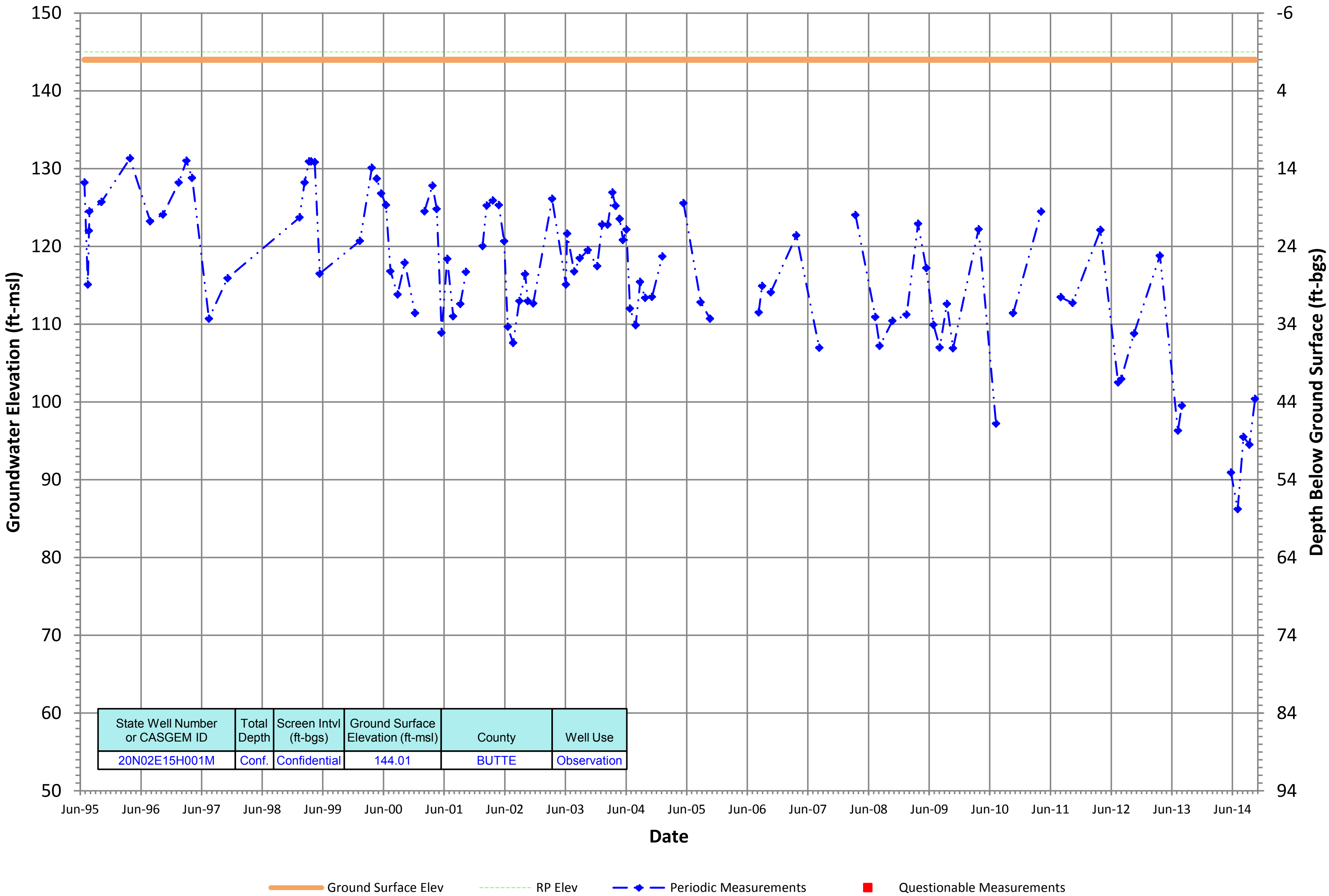
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



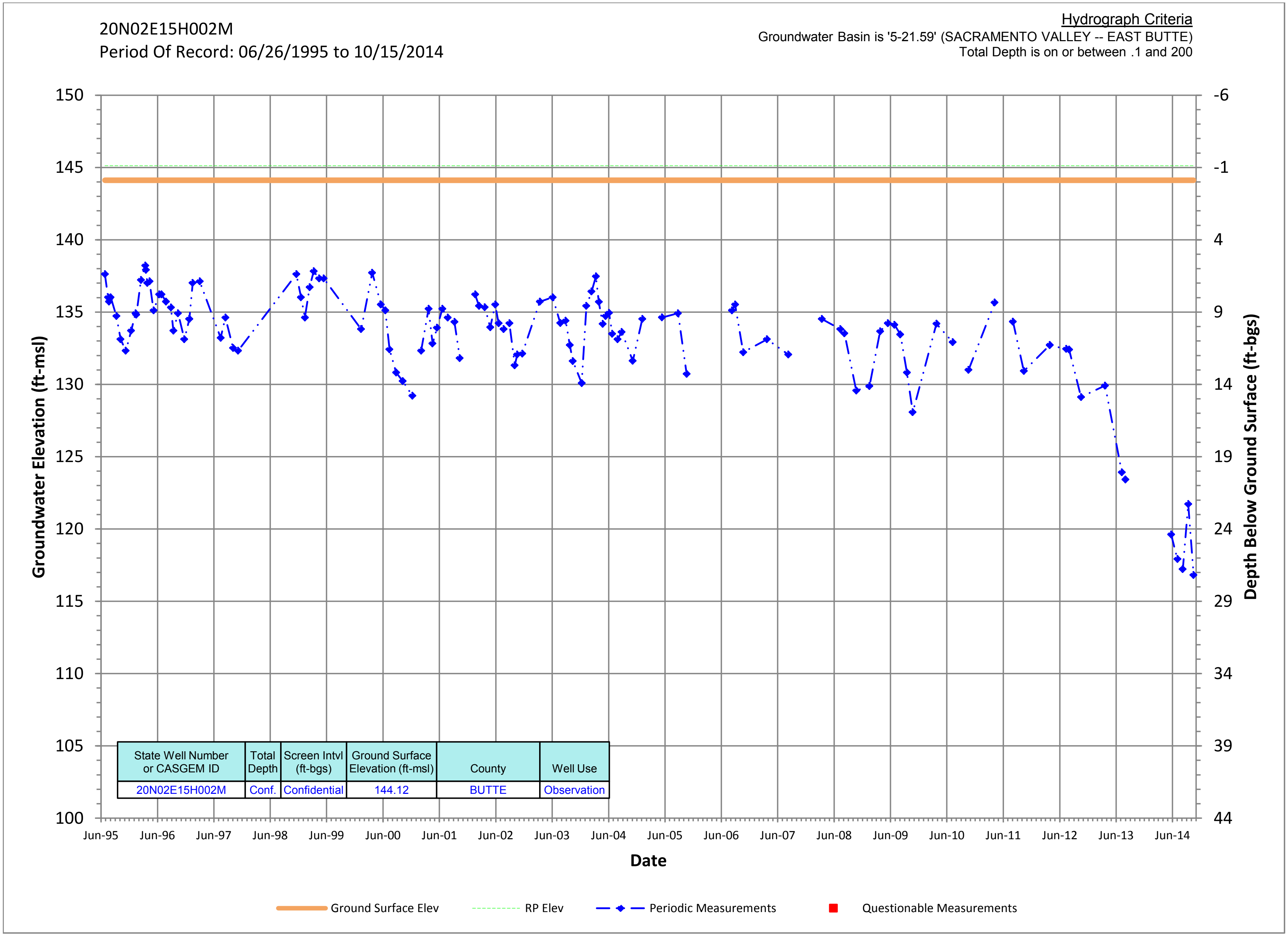
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02E08H003M	Conf.	Confidential	132.33	BUTTE	Residential

20N02E15H001M
Period Of Record: 06/26/1995 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



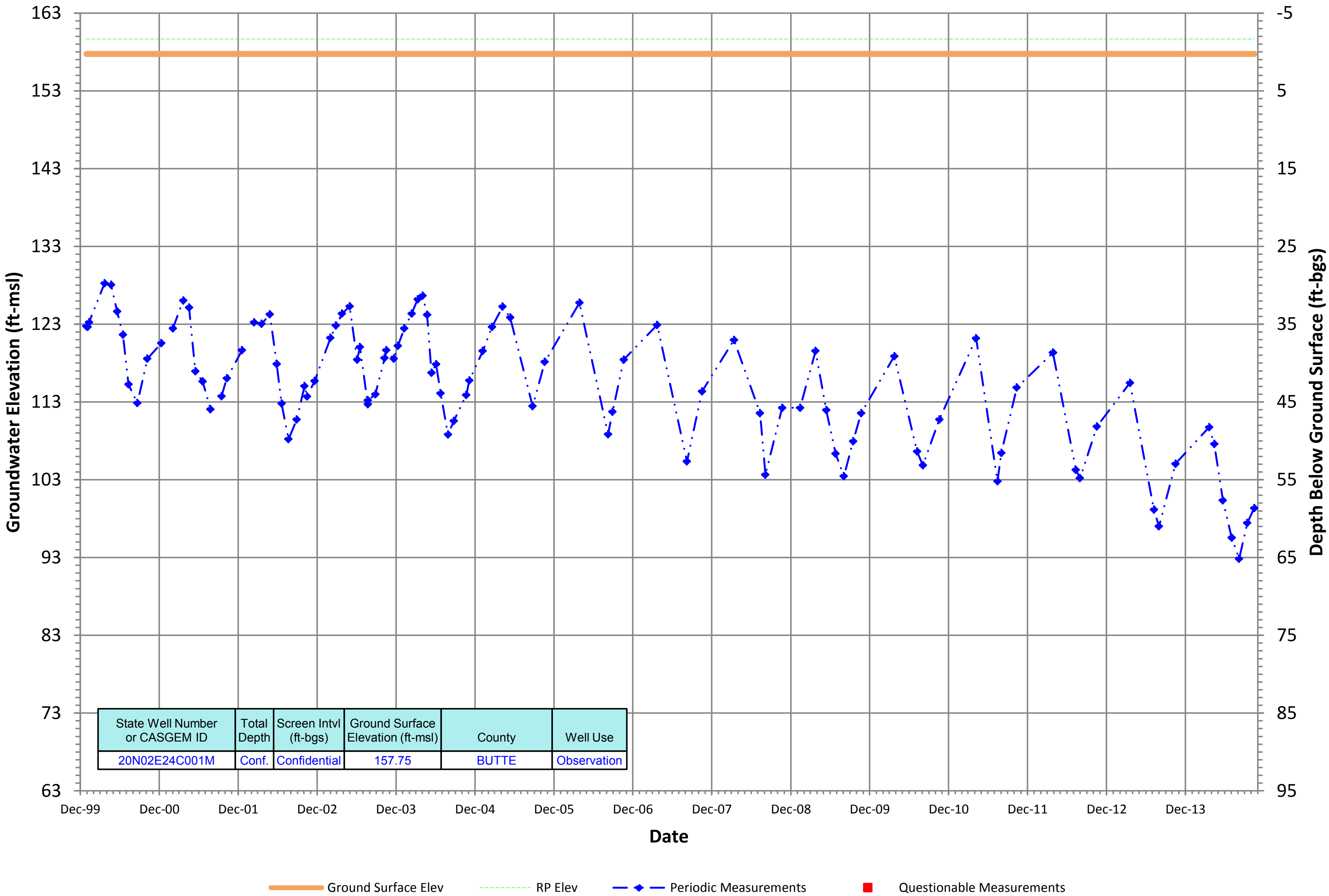
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02E15H001M	Conf.	Confidential	144.01	BUTTE	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02E15H002M	Conf.	Confidential	144.12	BUTTE	Observation

20N02E24C001M
Period Of Record: 12/29/1999 to 10/15/2014

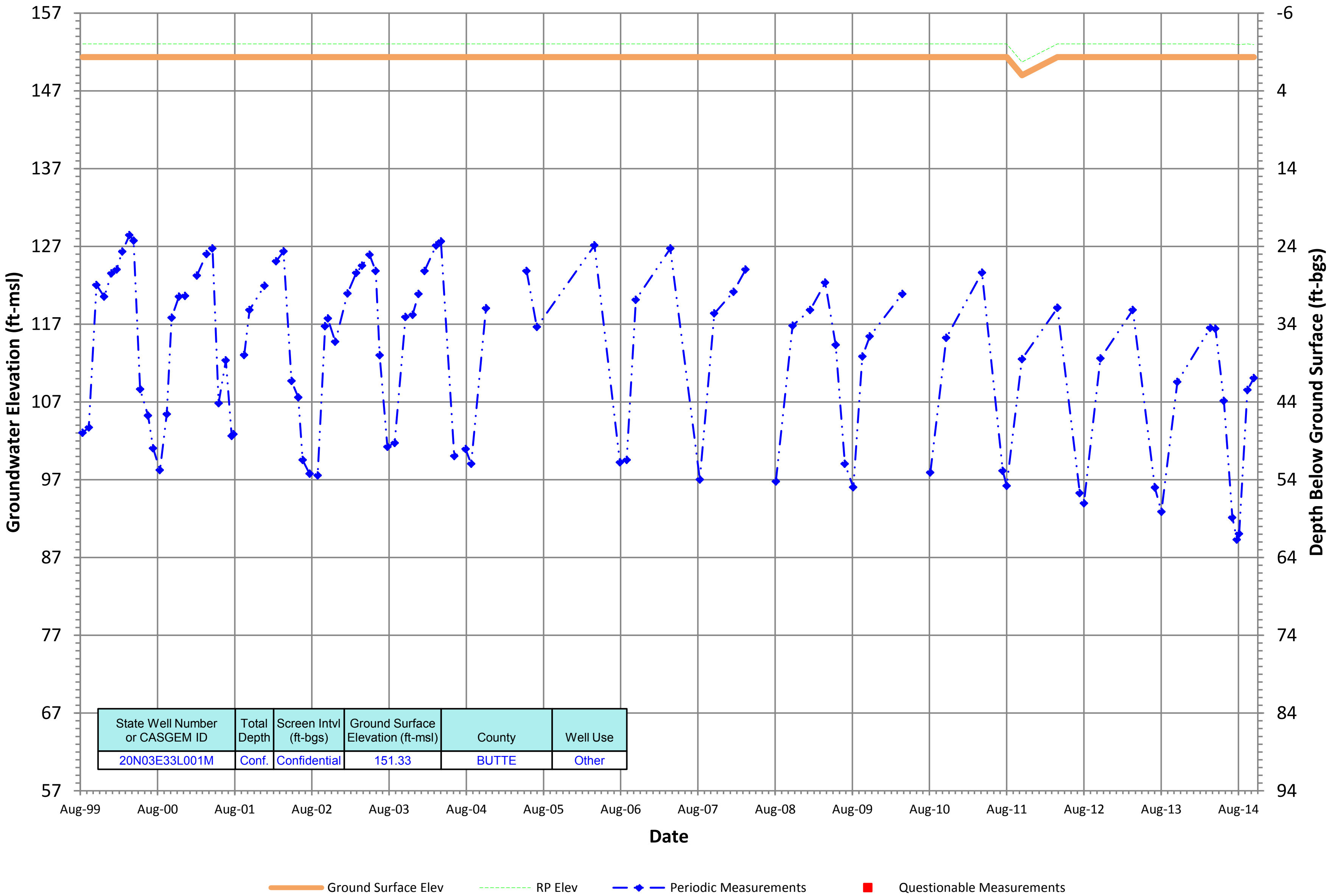
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02E24C001M	Conf.	Confidential	157.75	BUTTE	Observation

20N03E33L001M
Period Of Record: 08/12/1999 to 10/13/2014

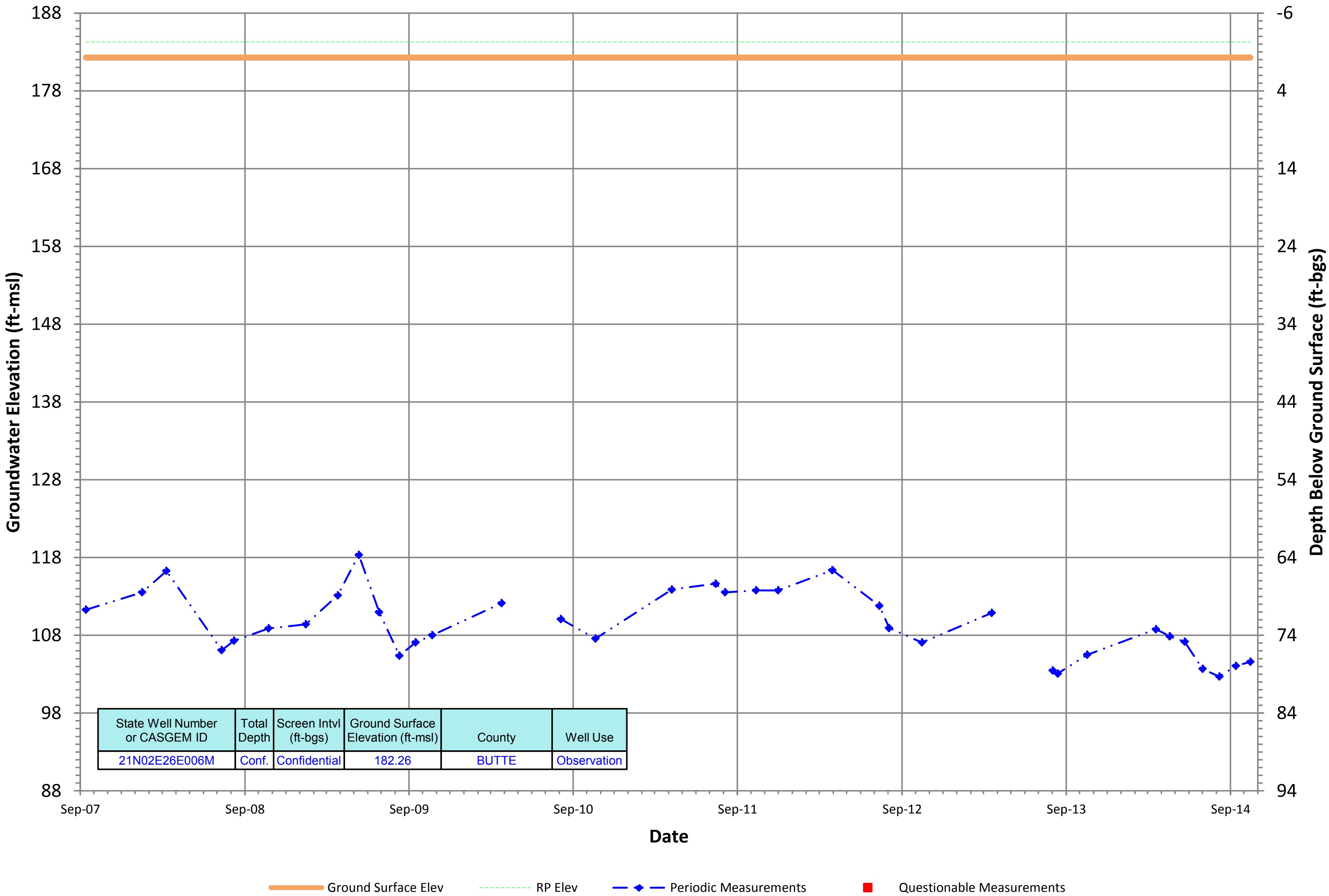
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



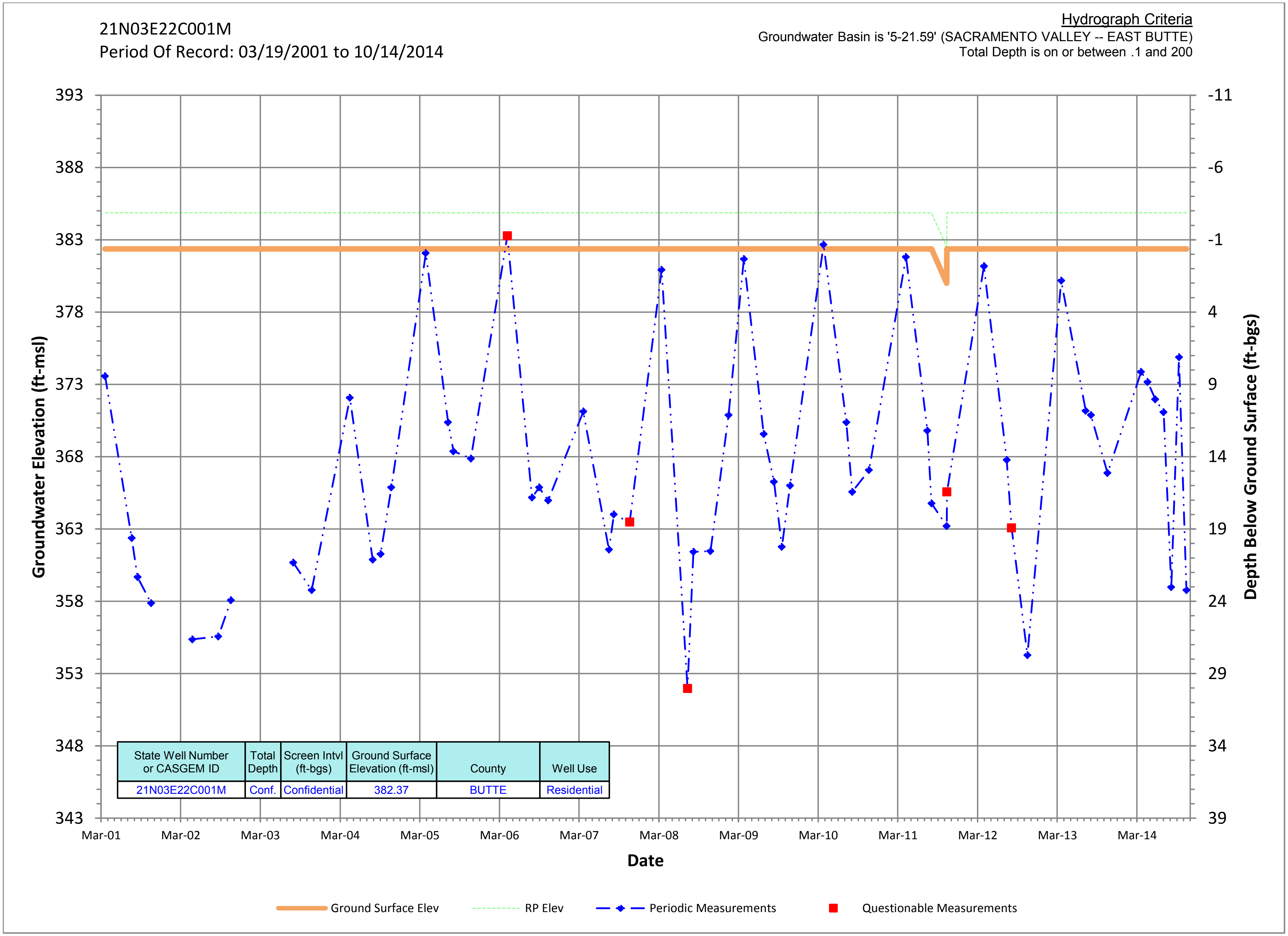
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N03E33L001M	Conf.	Confidential	151.33	BUTTE	Other

21N02E26E006M
Period Of Record: 09/13/2007 to 10/15/2014

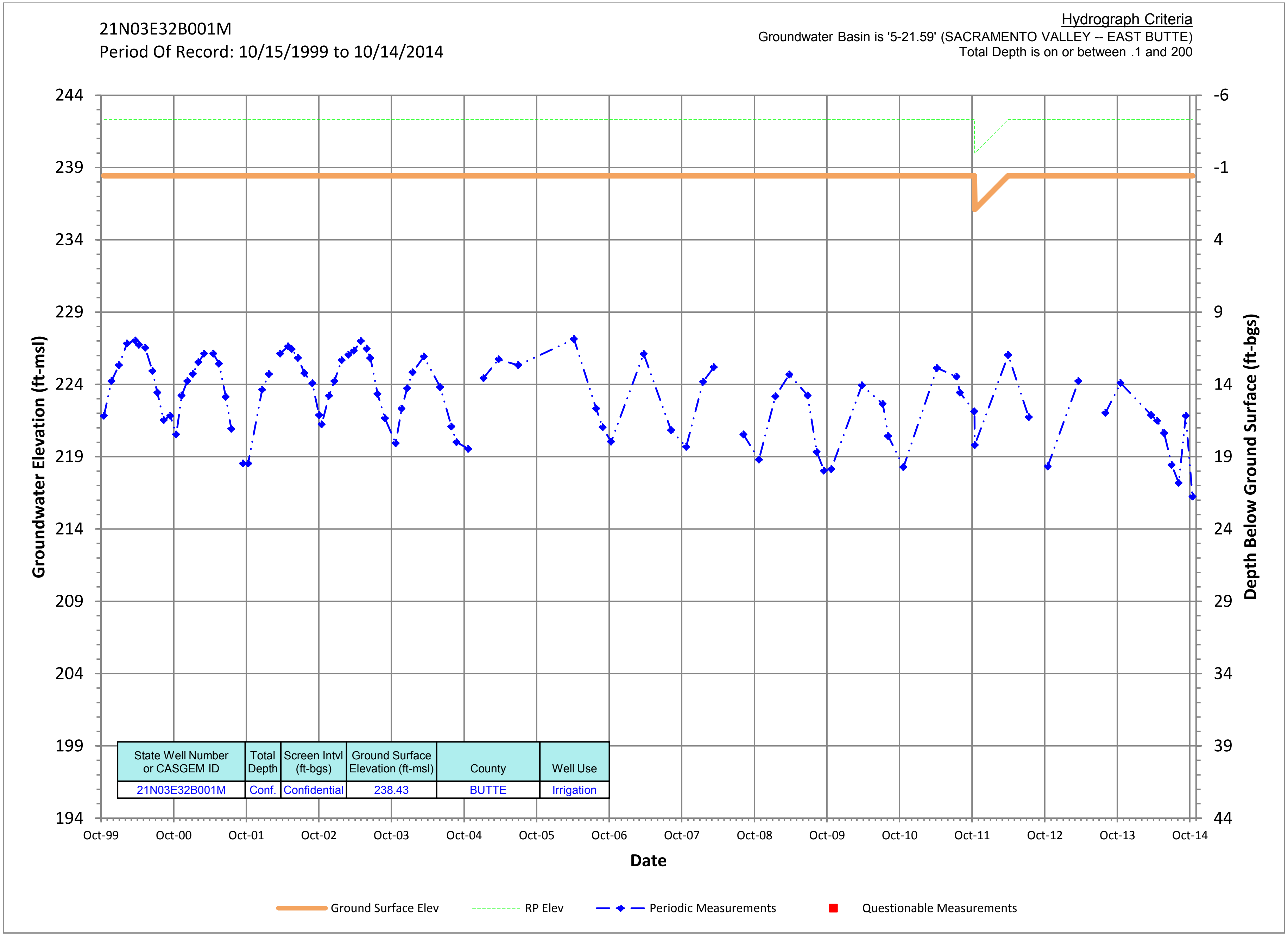
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E26E006M	Conf.	Confidential	182.26	BUTTE	Observation



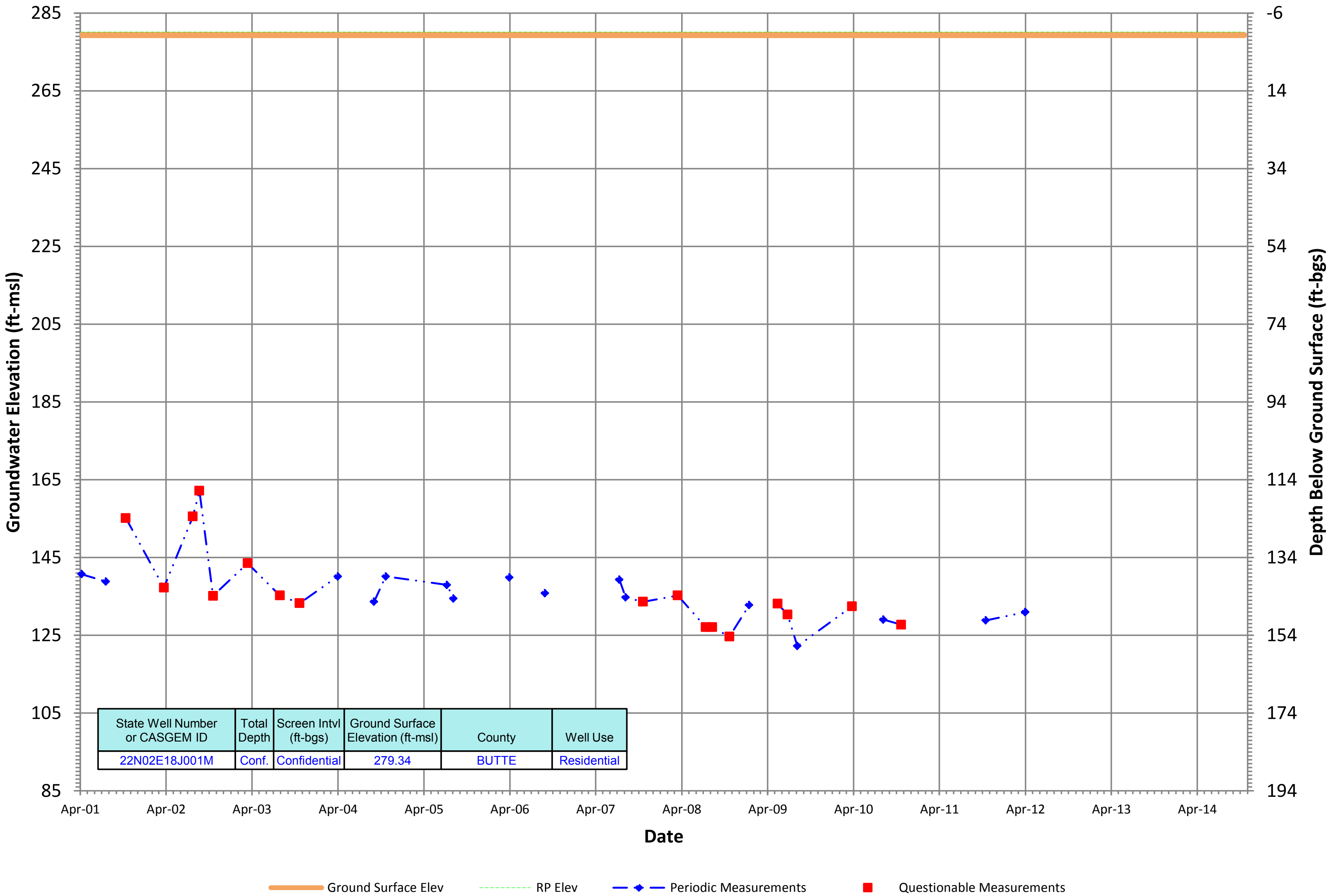
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03E22C001M	Conf.	Confidential	382.37	BUTTE	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N03E32B001M	Conf.	Confidential	238.43	BUTTE	Irrigation

22N02E18J001M
Period Of Record: 04/06/2001 to 10/17/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02E18J001M	Conf.	Confidential	279.34	BUTTE	Residential

Intermediate Depth Groundwater Monitoring Well Hydrographs- East Butte Subbasin

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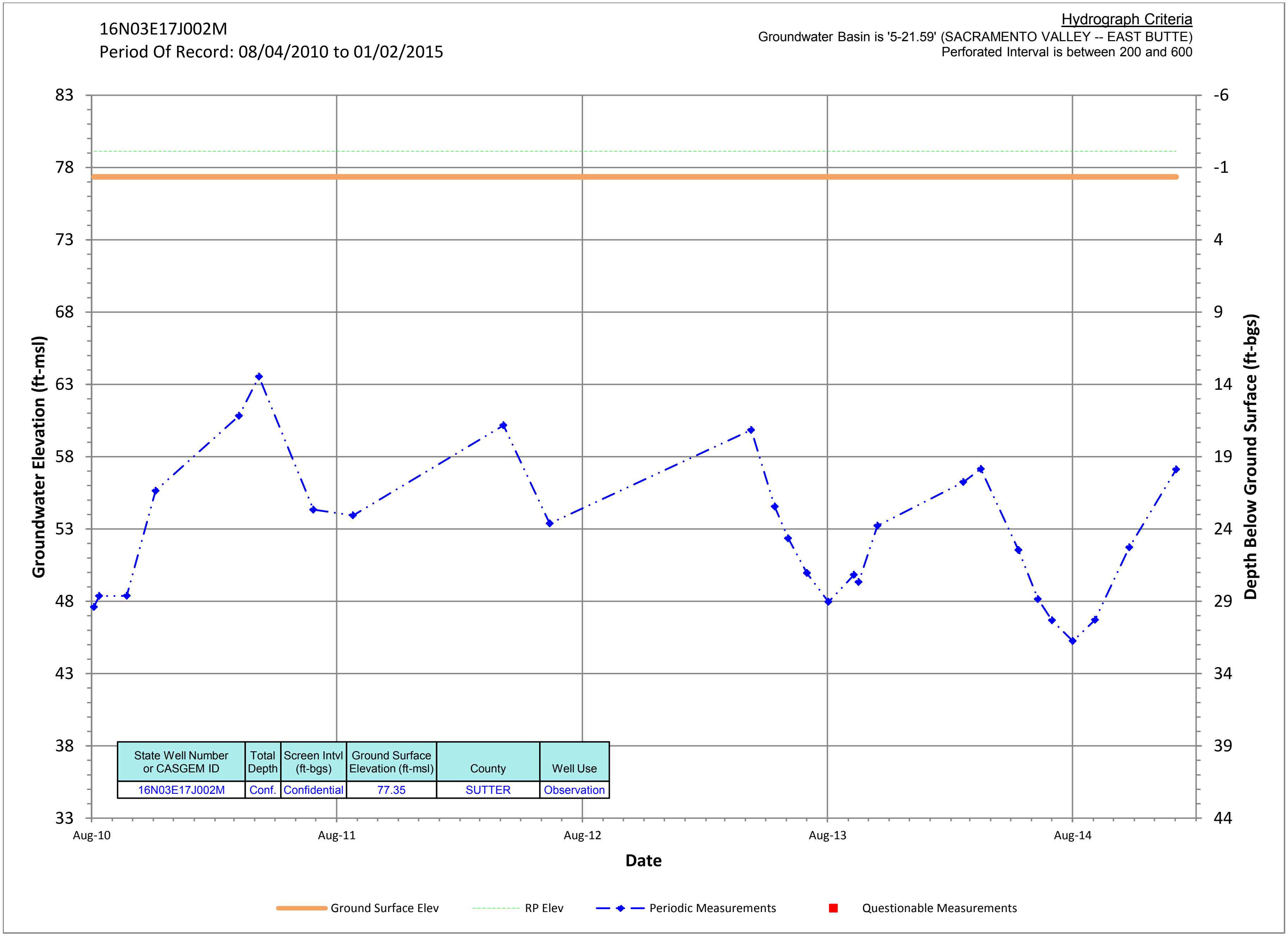
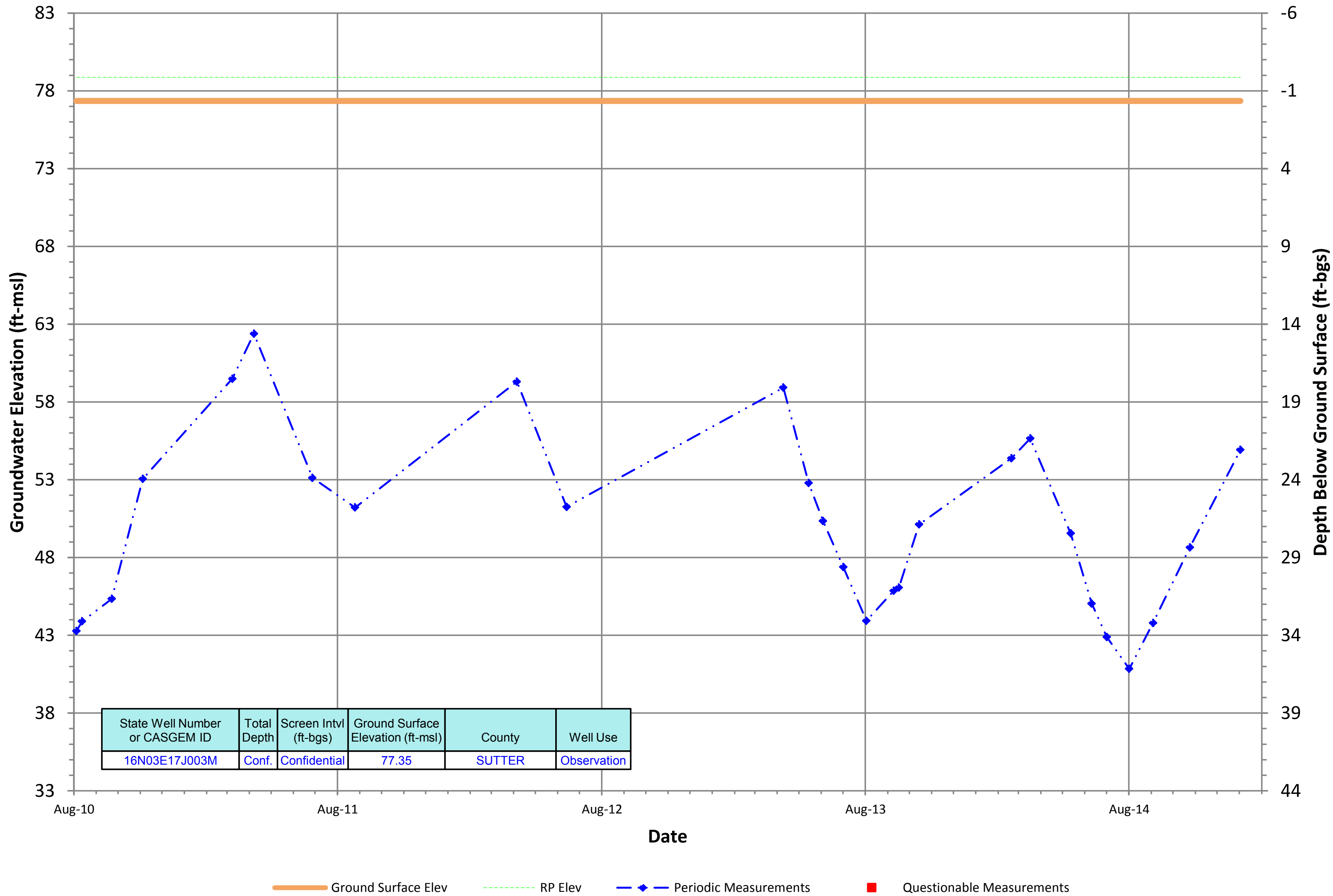


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E17J002M	Conf.	Confidential	77.35	SUTTER	Observation

16N03E17J003M
Period Of Record: 08/04/2010 to 01/02/2015

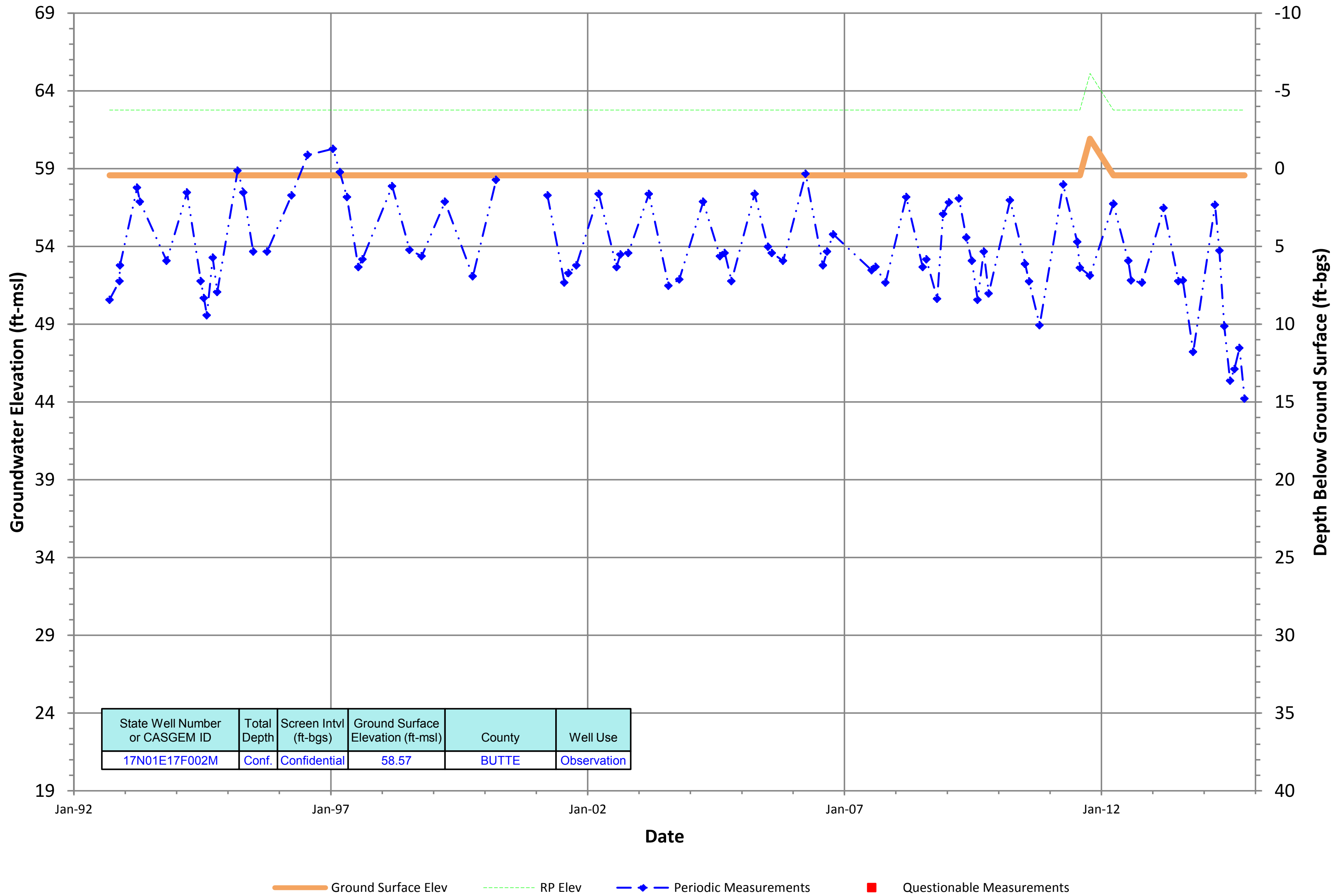
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E17J003M	Conf.	Confidential	77.35	SUTTER	Observation

17N01E17F002M
Period Of Record: 09/11/1992 to 10/14/2014

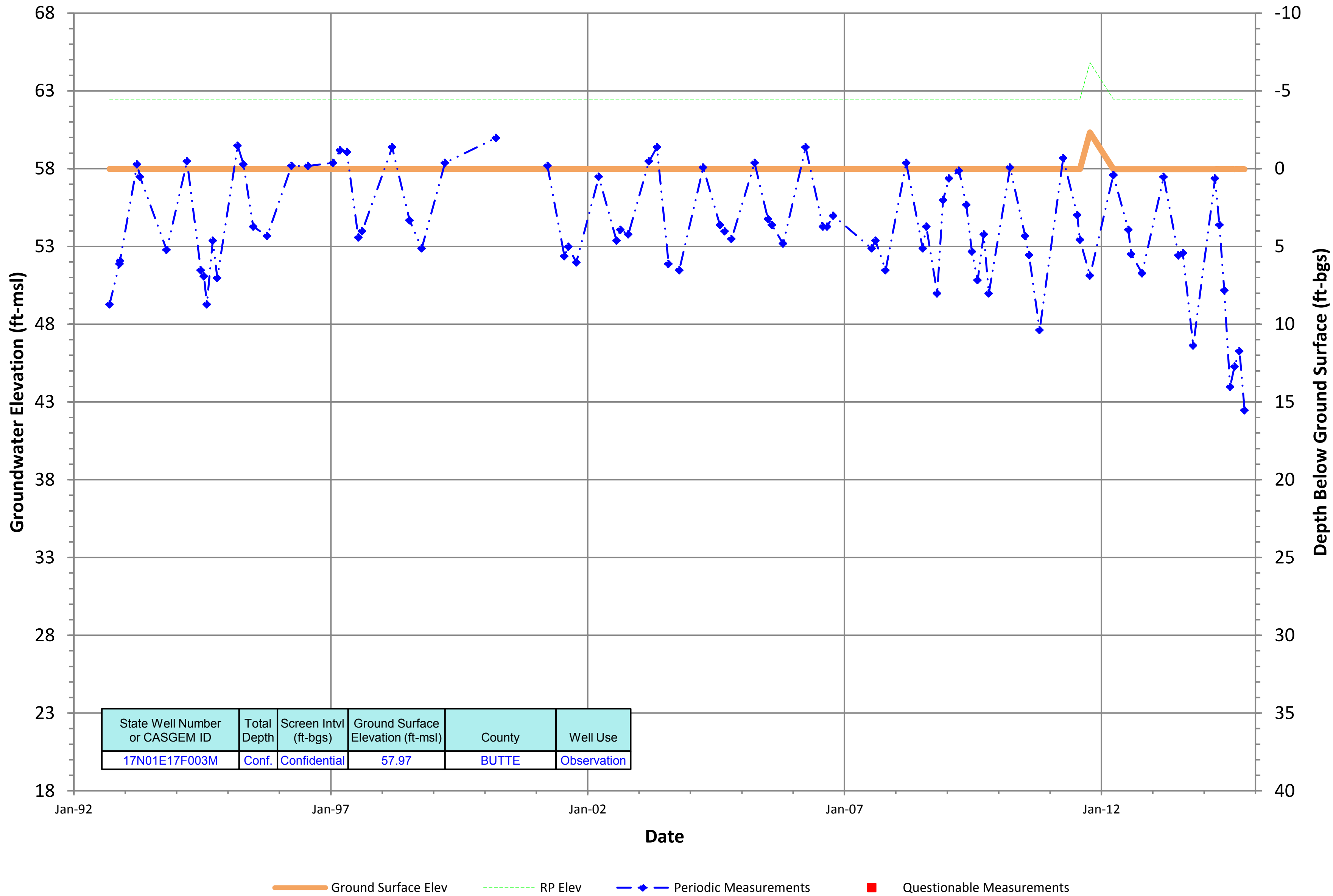
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E17F002M	Conf.	Confidential	58.57	BUTTE	Observation

17N01E17F003M
Period Of Record: 09/11/1992 to 10/14/2014

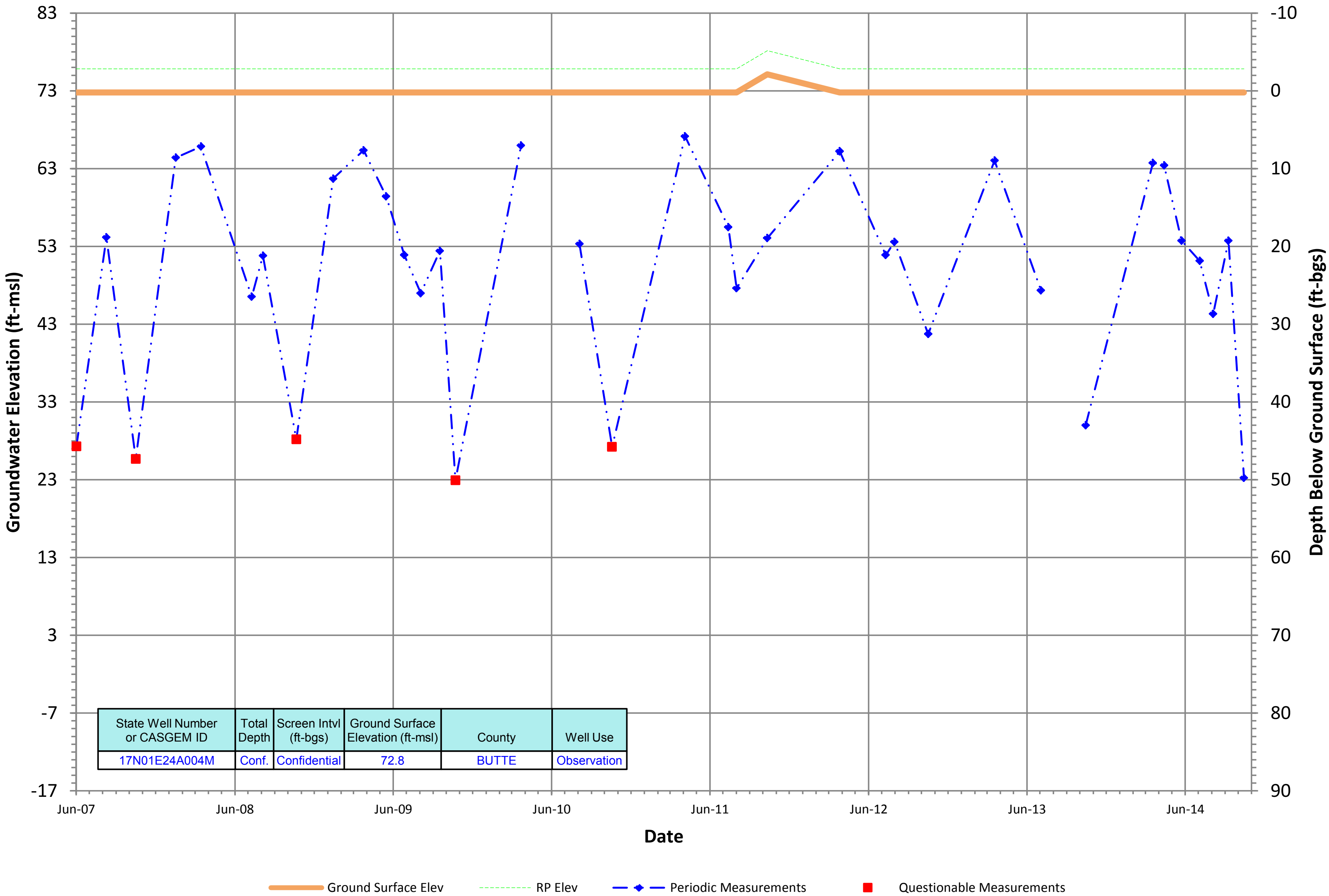
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E17F003M	Conf.	Confidential	57.97	BUTTE	Observation

17N01E24A004M
Period Of Record: 06/01/2007 to 10/14/2014

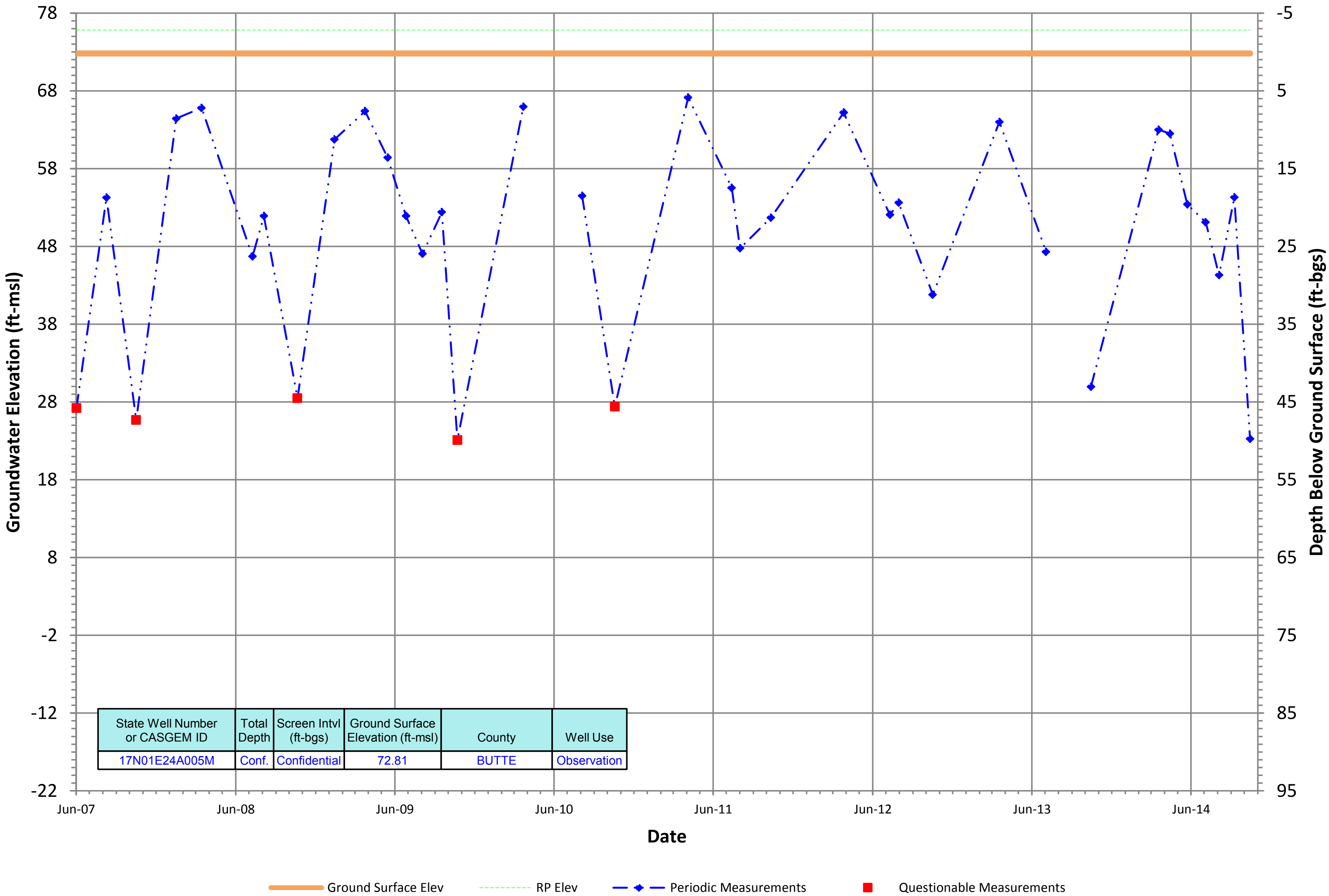
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E24A004M	Conf.	Confidential	72.8	BUTTE	Observation

17N01E24A005M
Period Of Record: 06/01/2007 to 10/14/2014

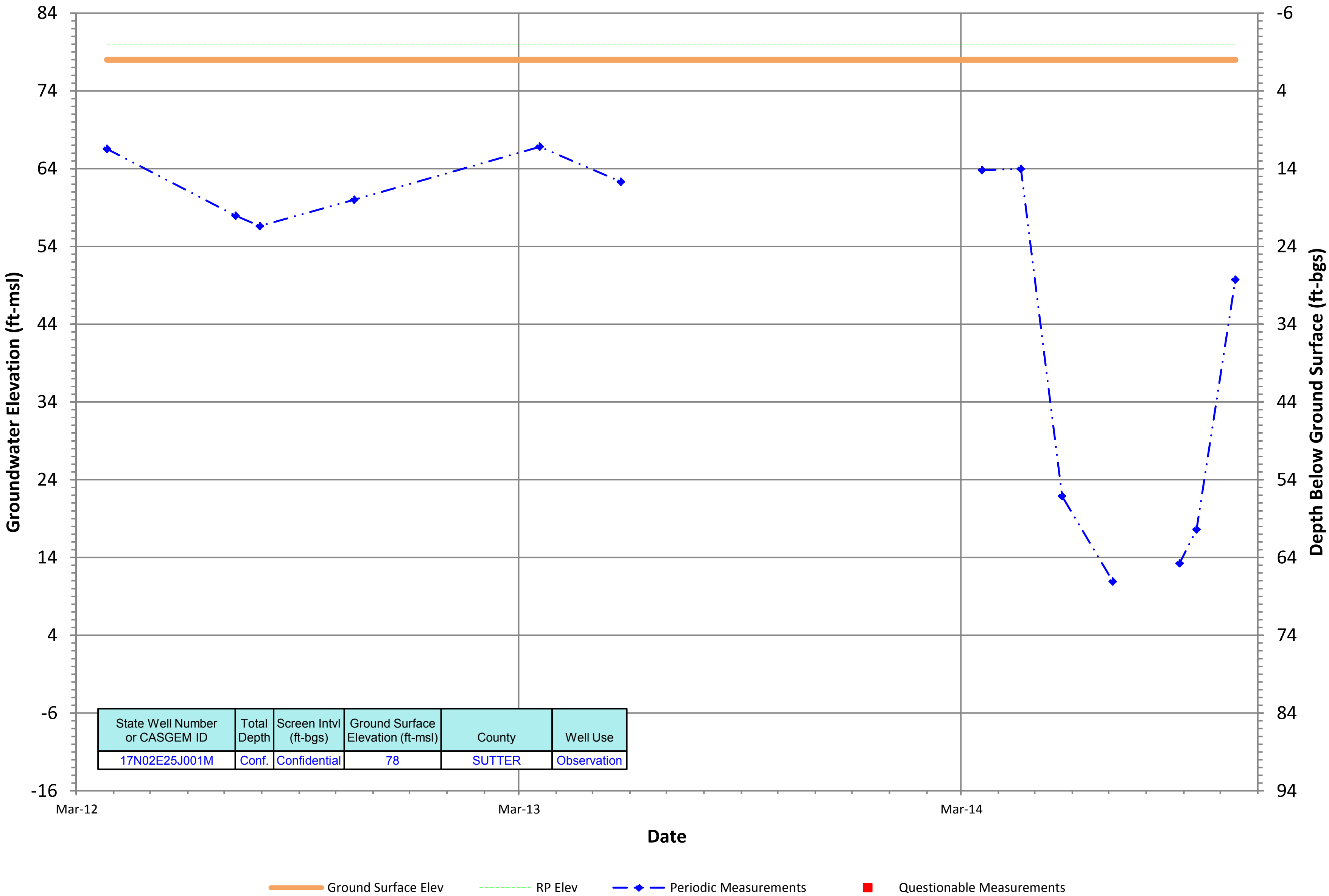
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E24A005M	Conf.	Confidential	72.81	BUTTE	Observation

17N02E25J001M
Period Of Record: 03/26/2012 to 10/13/2014

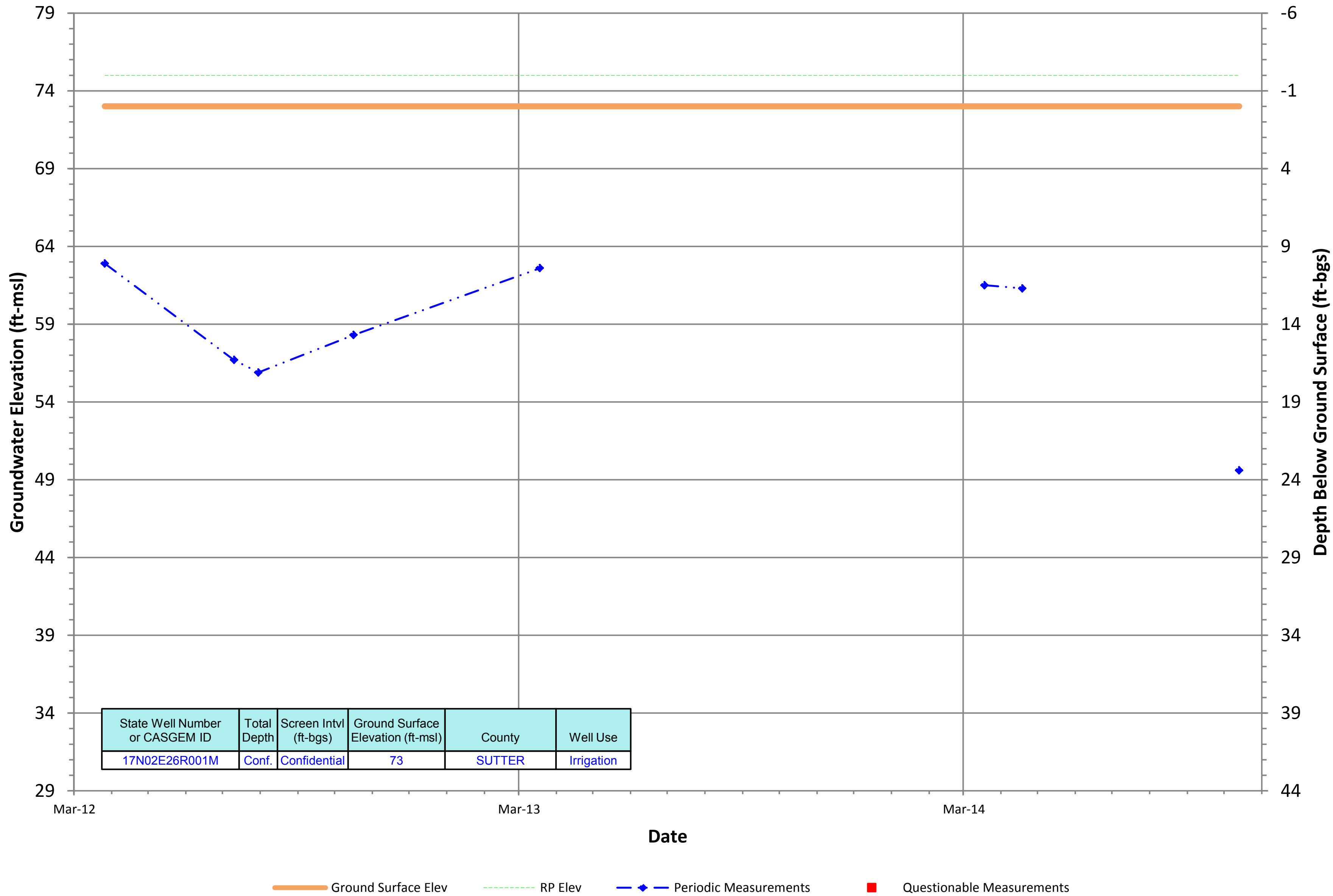
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02E25J001M	Conf.	Confidential	78	SUTTER	Observation

17N02E26R001M
Period Of Record: 03/26/2012 to 10/13/2014

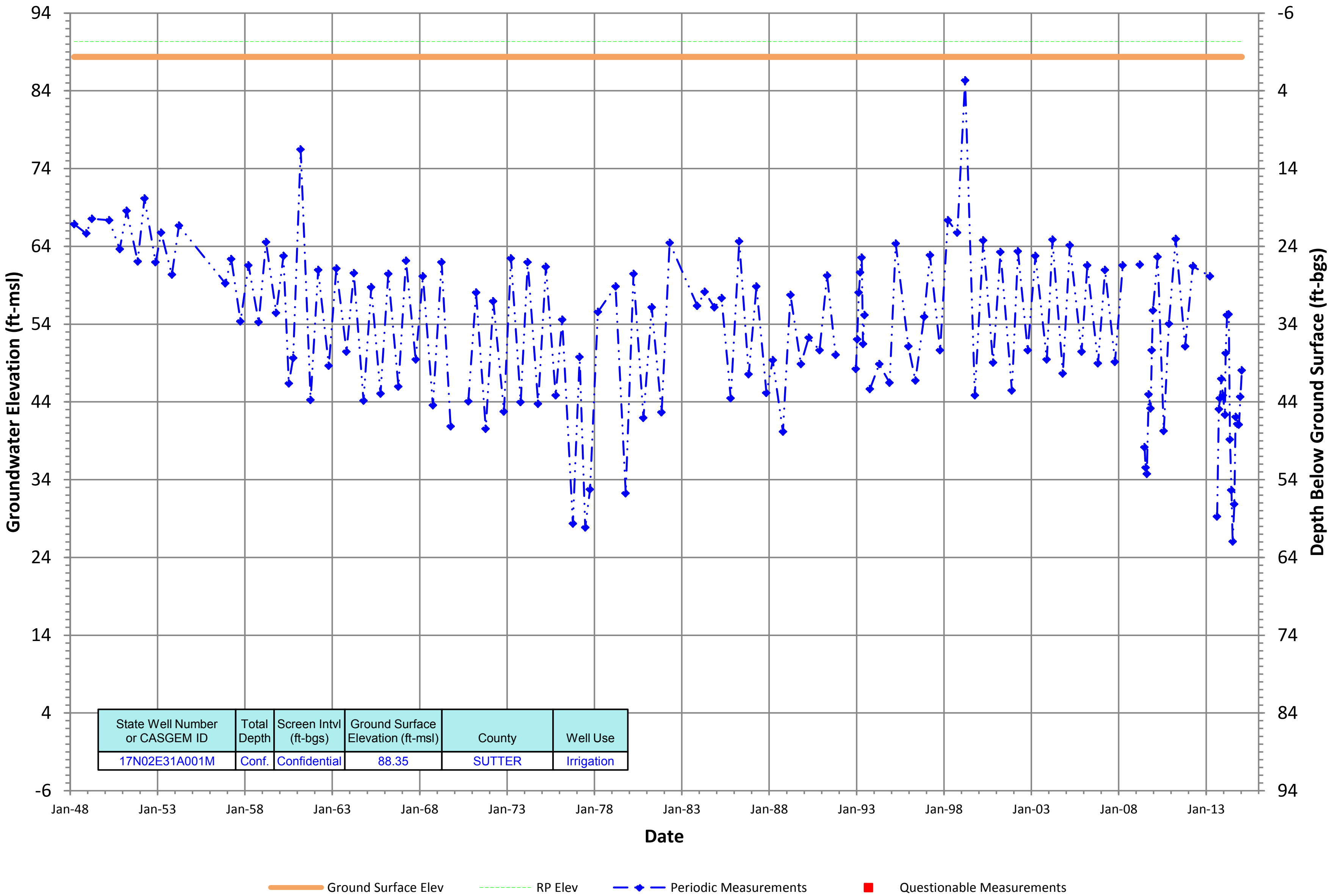
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02E26R001M	Conf.	Confidential	73	SUTTER	Irrigation

17N02E31A001M
Period Of Record: 03/25/1948 to 01/16/2015

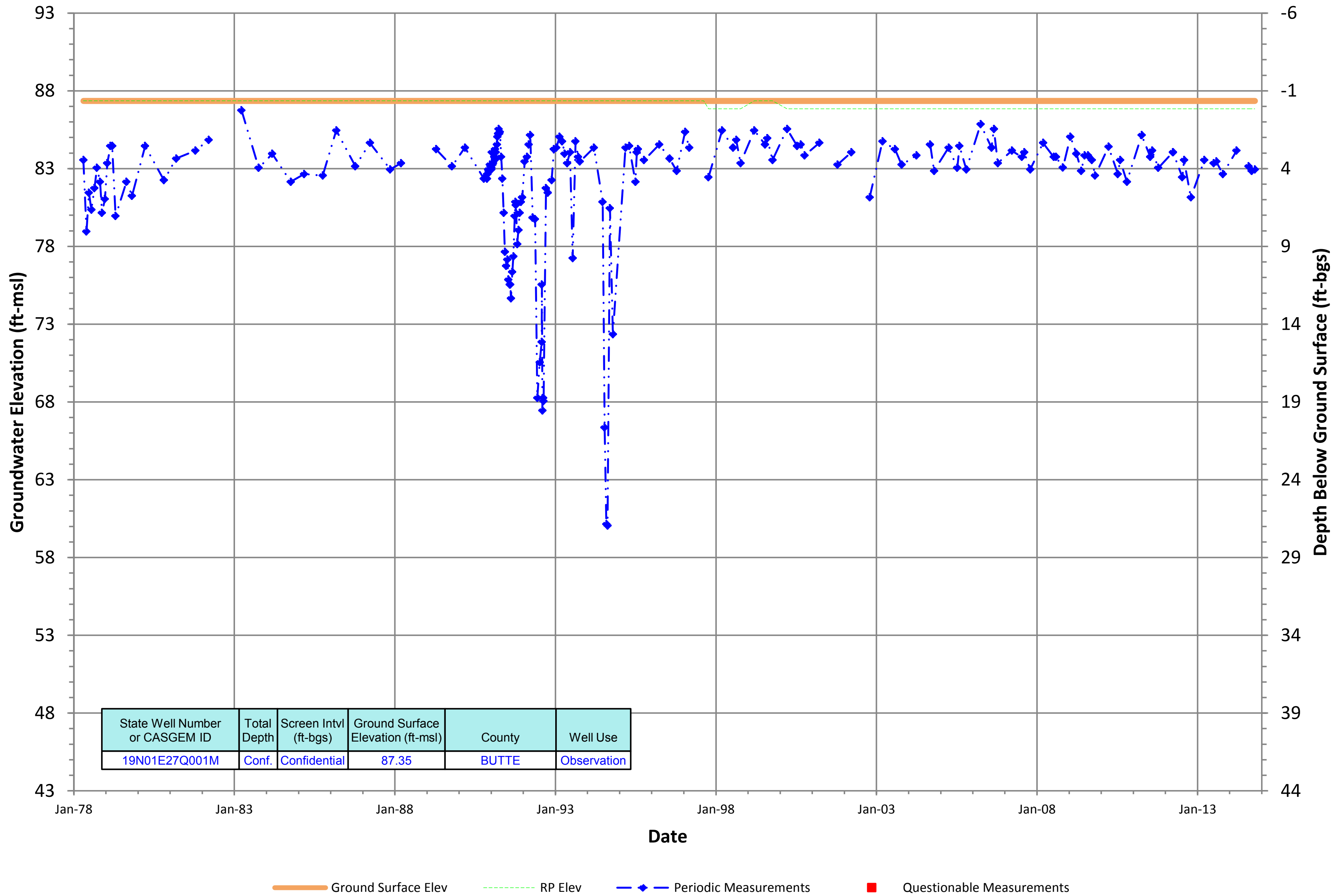
Hydrograph Criteria



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N02E31A001M	Conf.	Confidential	88.35	SUTTER	Irrigation

19N01E27Q001M
Period Of Record: 04/19/1978 to 10/14/2014

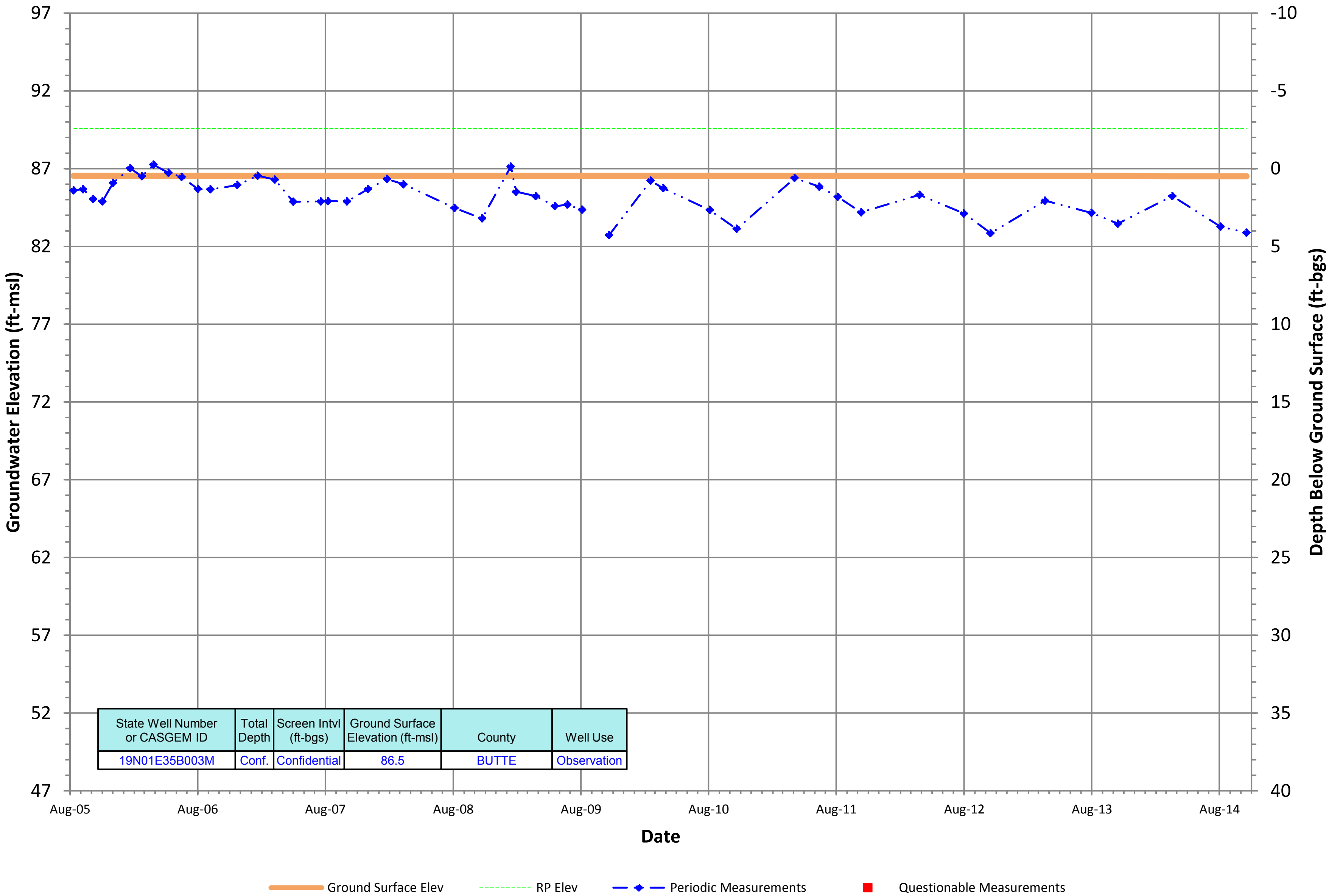
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01E27Q001M	Conf.	Confidential	87.35	BUTTE	Observation

19N01E35B003M
Period Of Record: 08/11/2005 to 10/17/2014

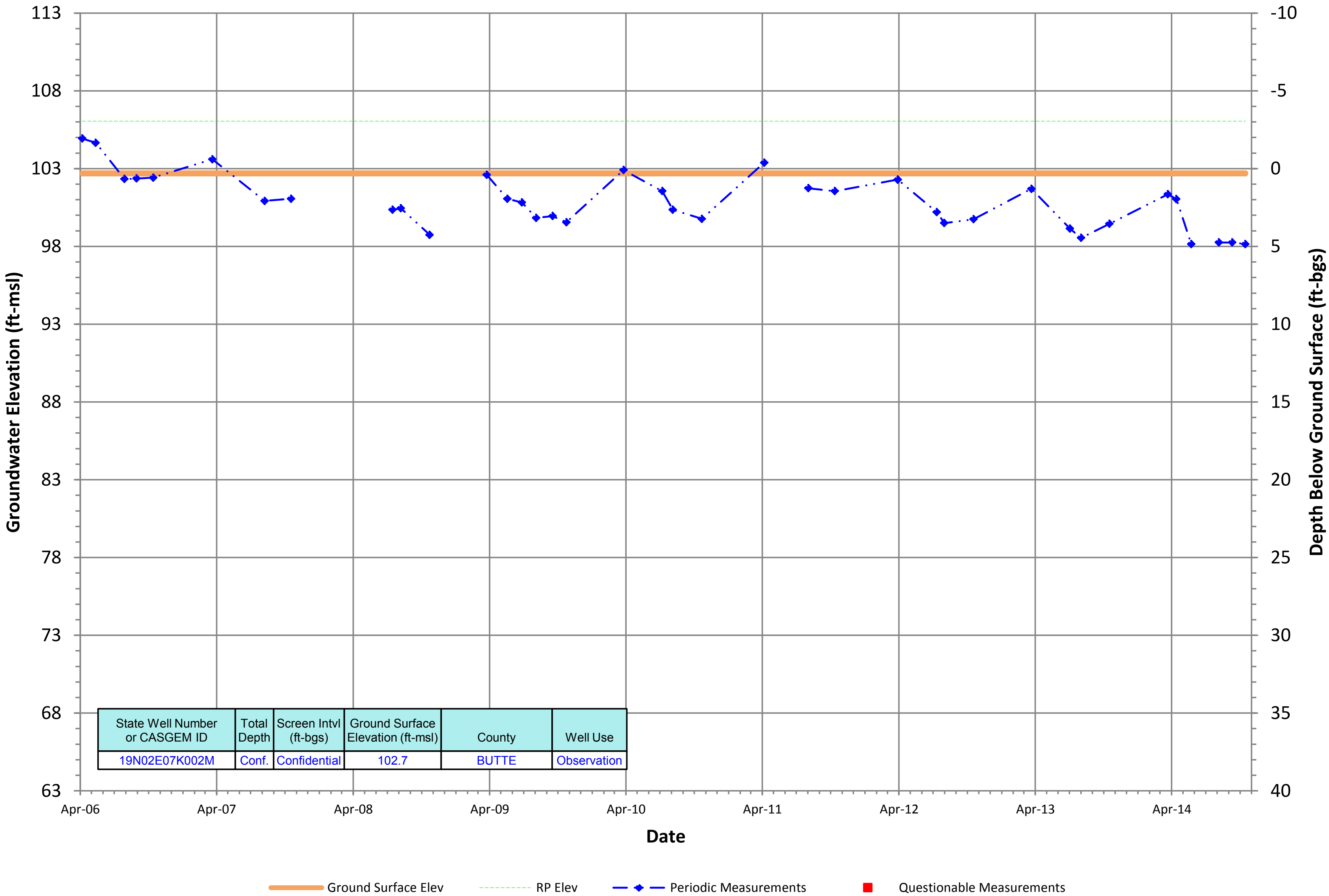
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01E35B003M	Conf.	Confidential	86.5	BUTTE	Observation

19N02E07K002M
Period Of Record: 04/06/2006 to 10/15/2014

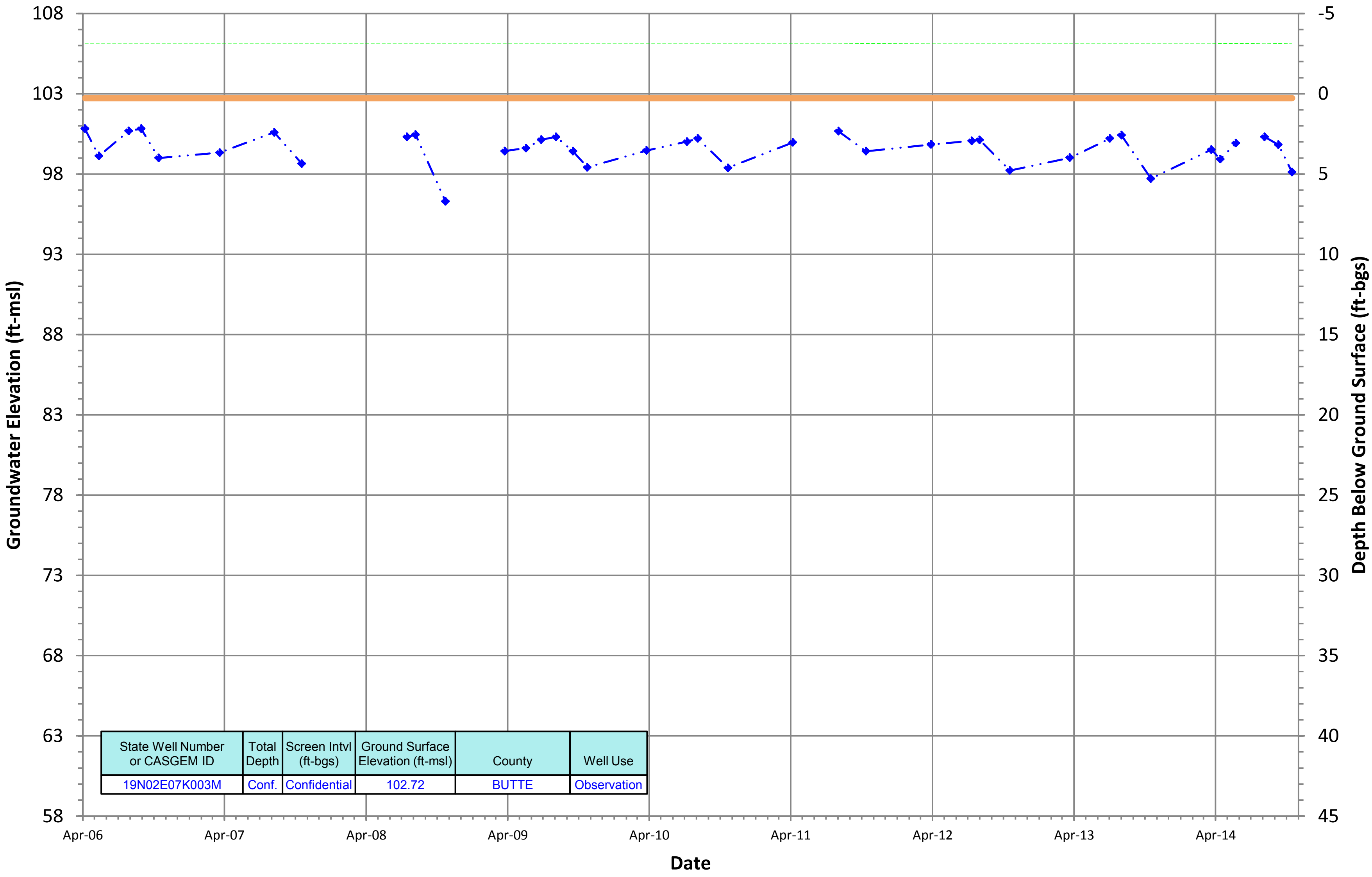
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02E07K002M	Conf.	Confidential	102.7	BUTTE	Observation

19N02E07K003M
Period Of Record: 04/06/2006 to 10/15/2014

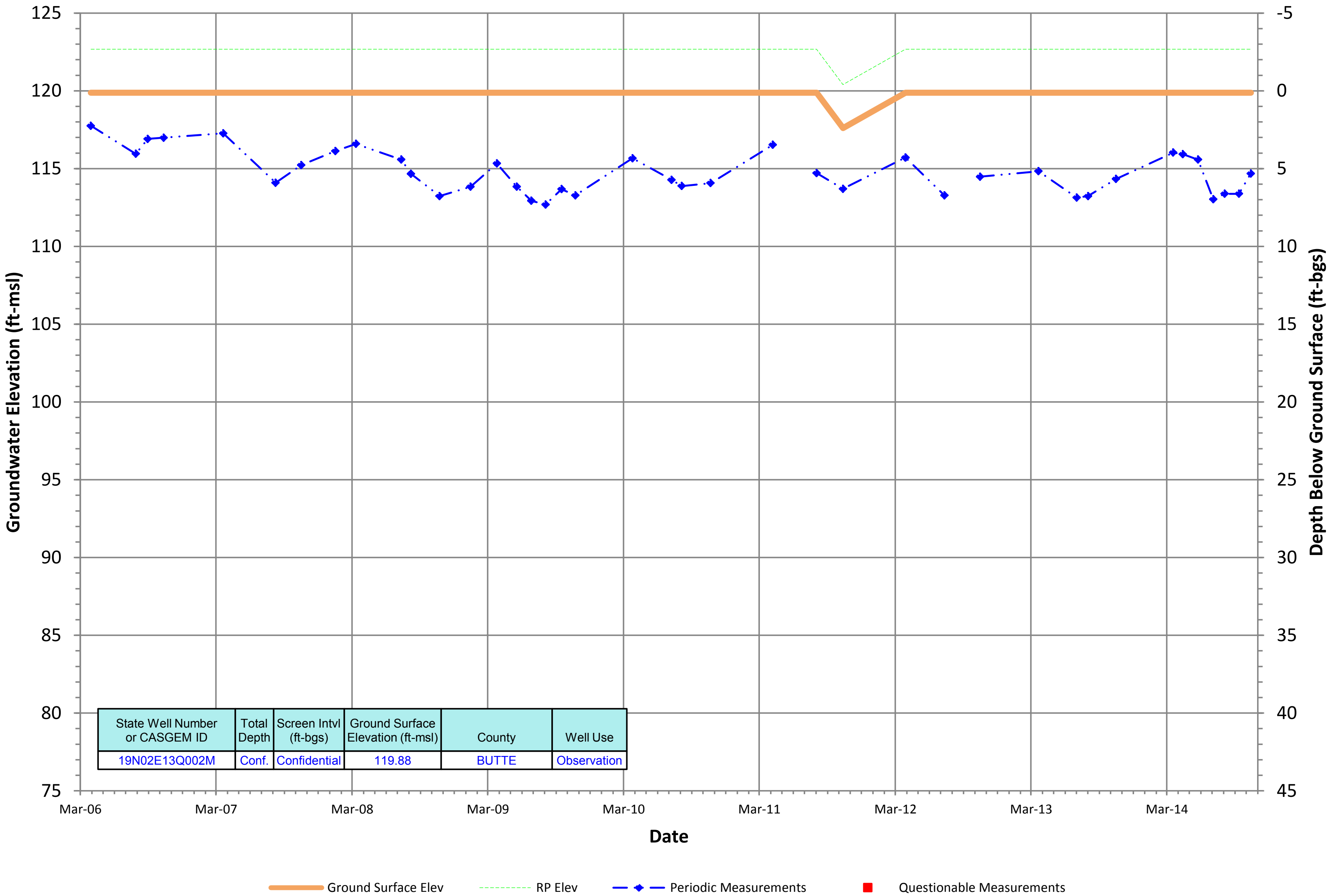
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



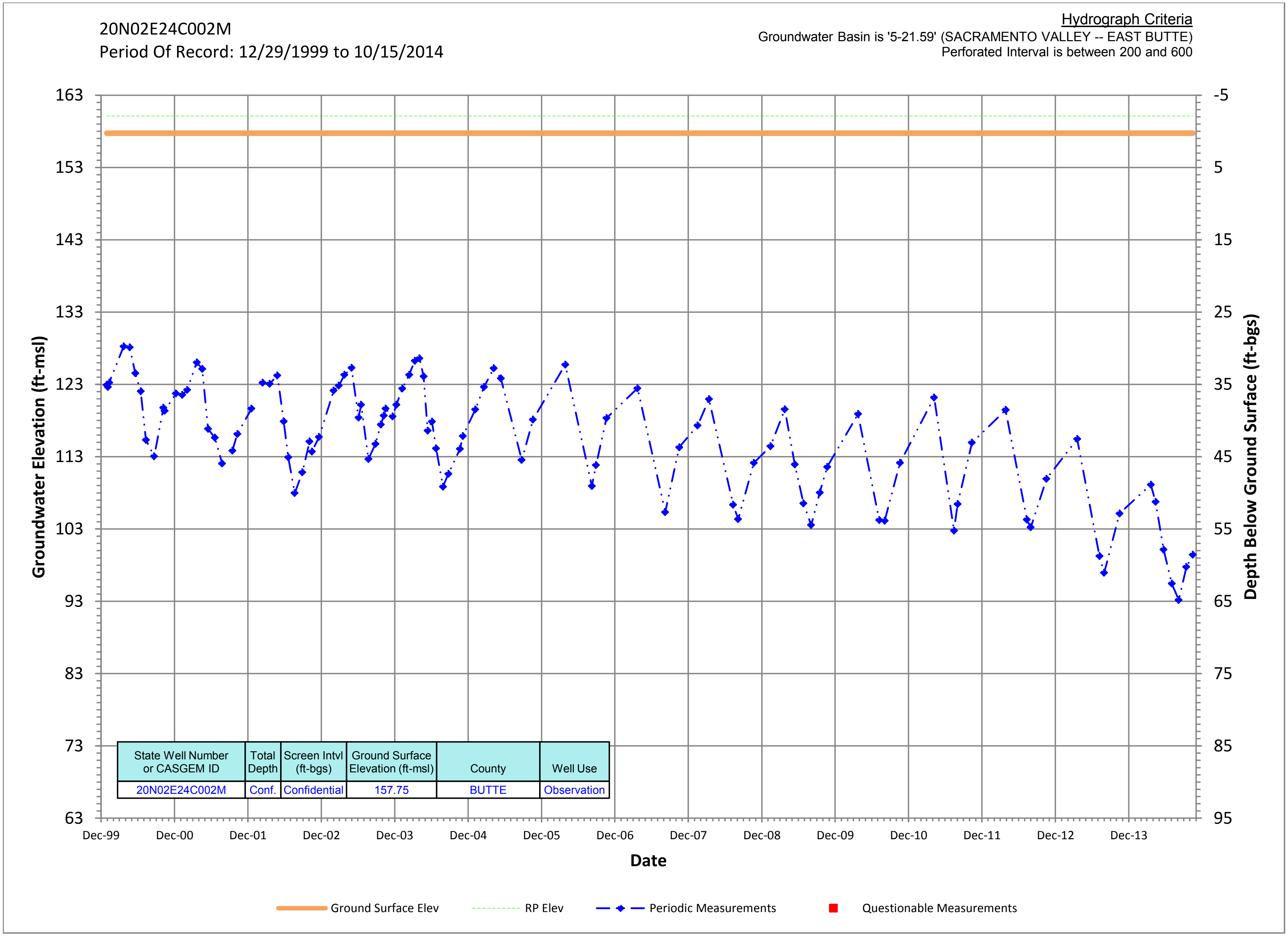
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02E07K003M	Conf.	Confidential	102.72	BUTTE	Observation

19N02E13Q002M
Period Of Record: 03/29/2006 to 10/13/2014

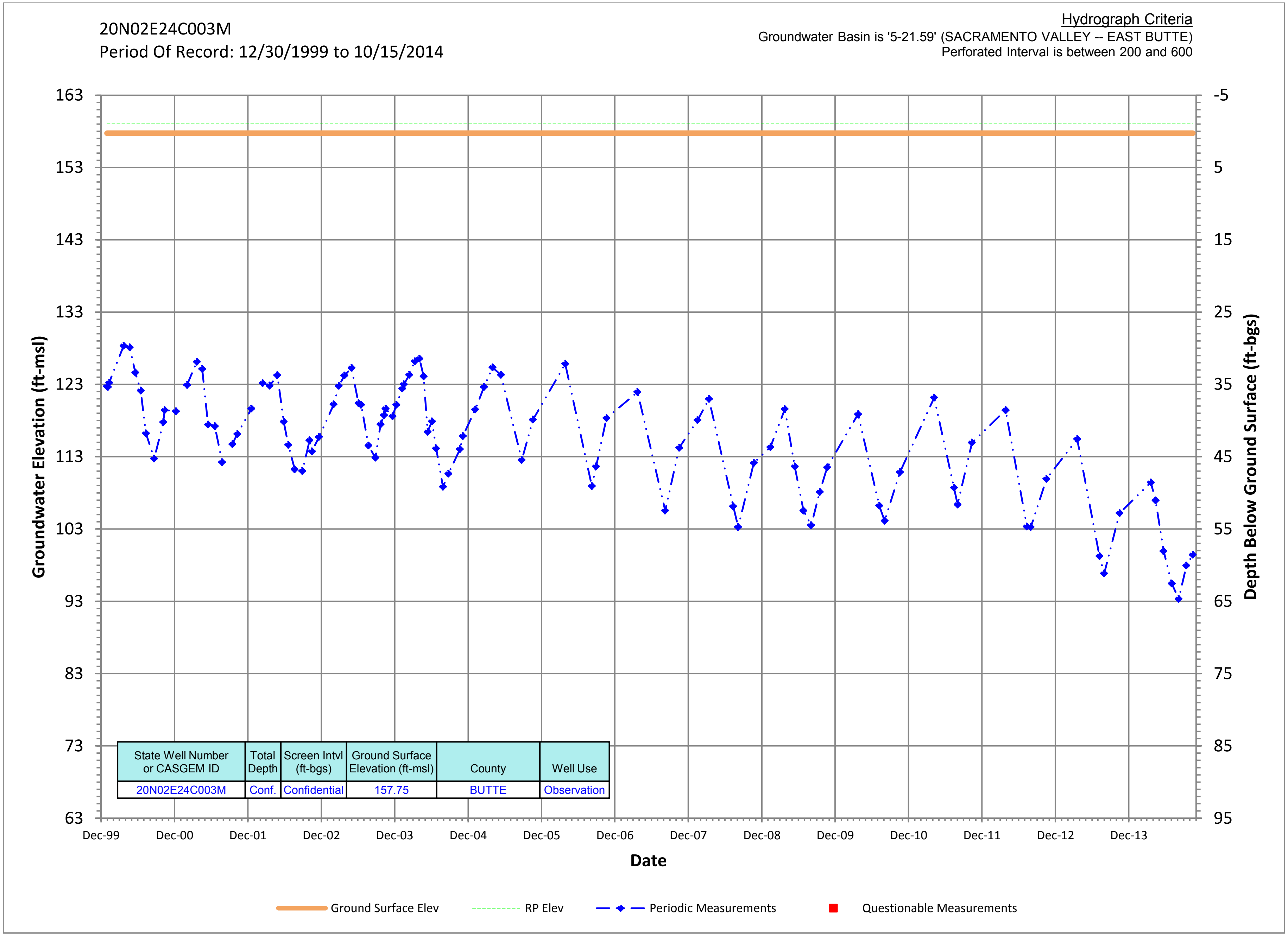
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N02E13Q002M	Conf.	Confidential	119.88	BUTTE	Observation



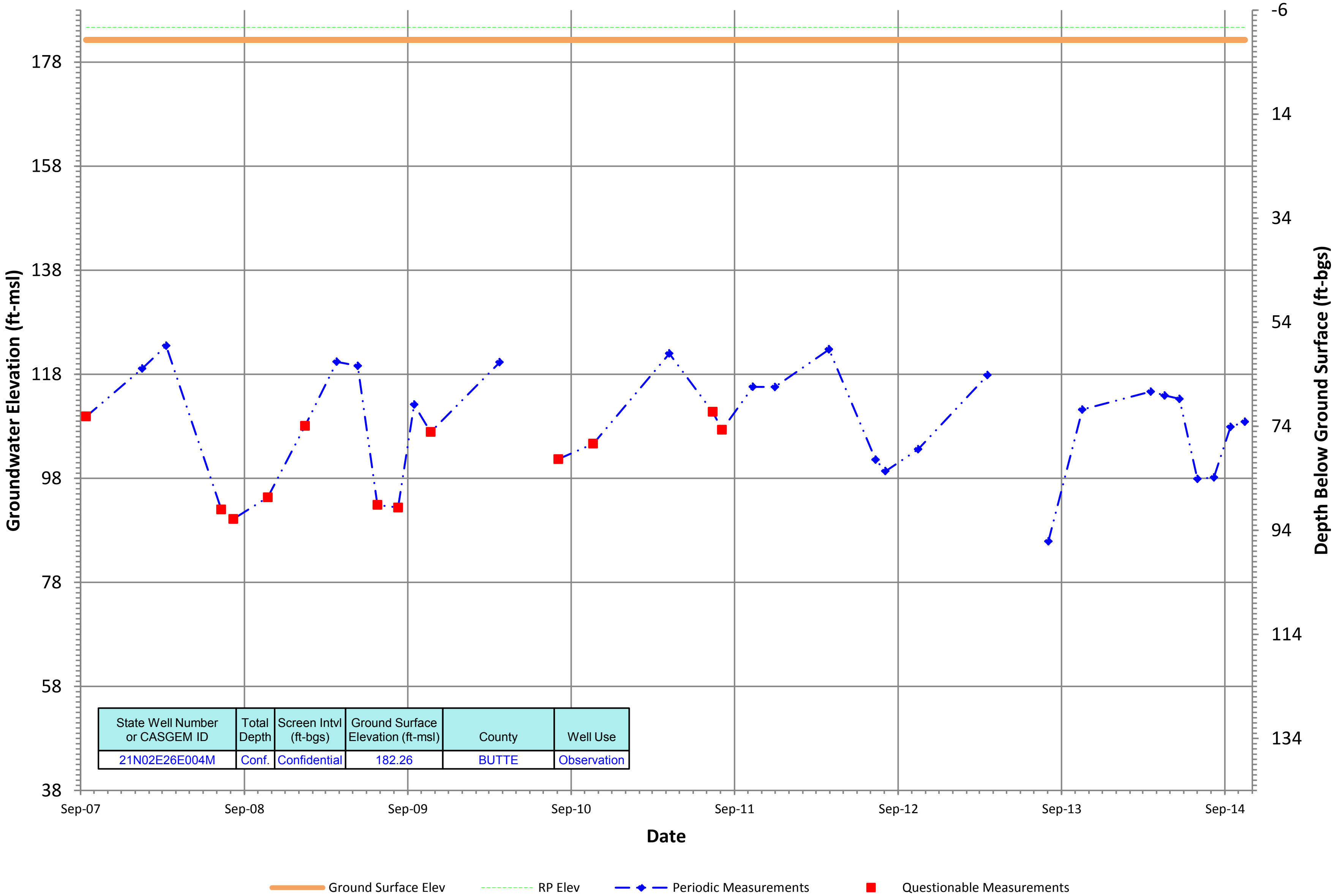
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02E24C002M	Conf.	Confidential	157.75	BUTTE	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02E24C003M	Conf.	Confidential	157.75	BUTTE	Observation

21N02E26E004M
Period Of Record: 09/13/2007 to 10/15/2014

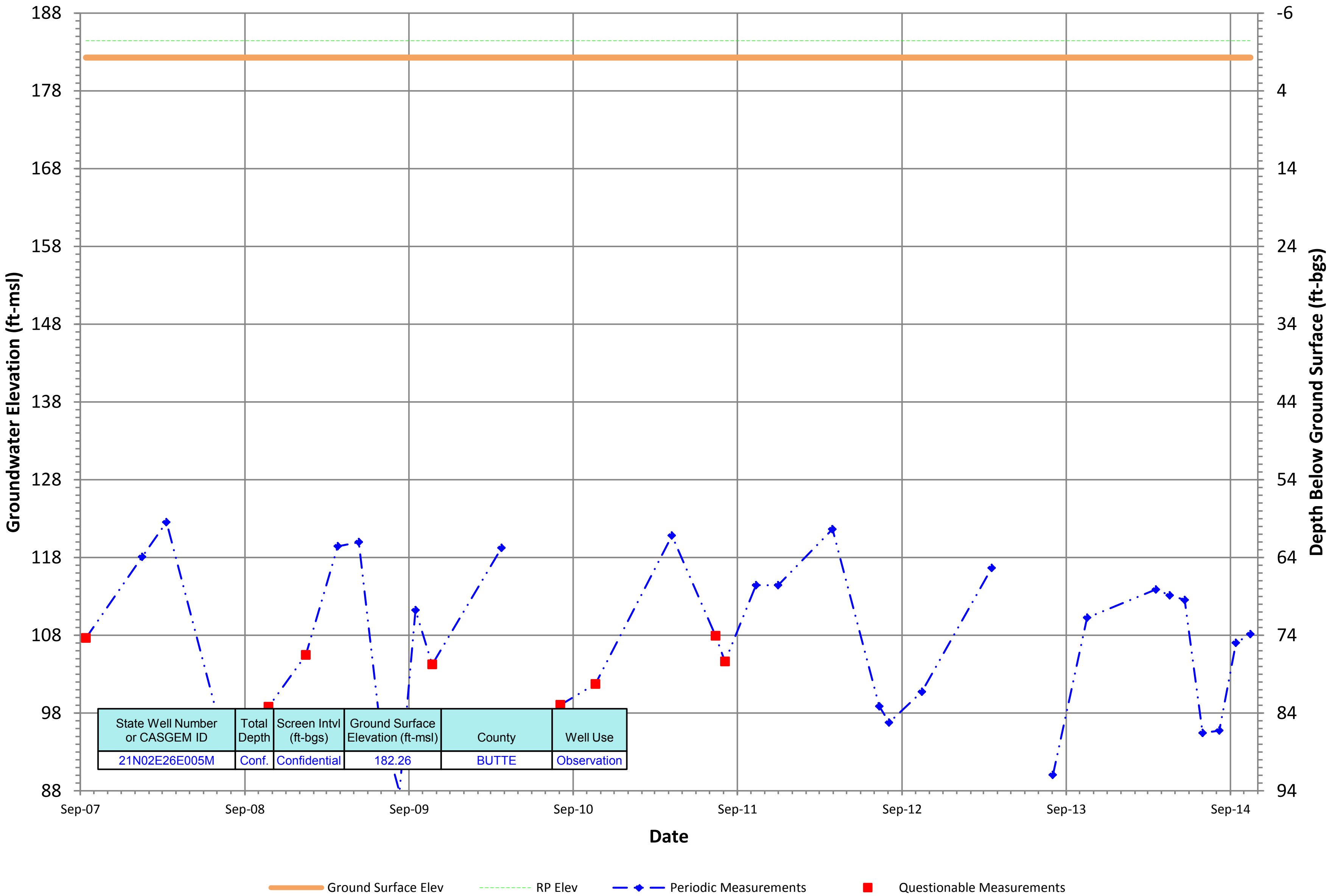
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E26E004M	Conf.	Confidential	182.26	BUTTE	Observation

21N02E26E005M
Period Of Record: 09/13/2007 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E26E005M	Conf.	Confidential	182.26	BUTTE	Observation

Deep Groundwater Monitoring Well Hydrographs- East Butte Subbasin

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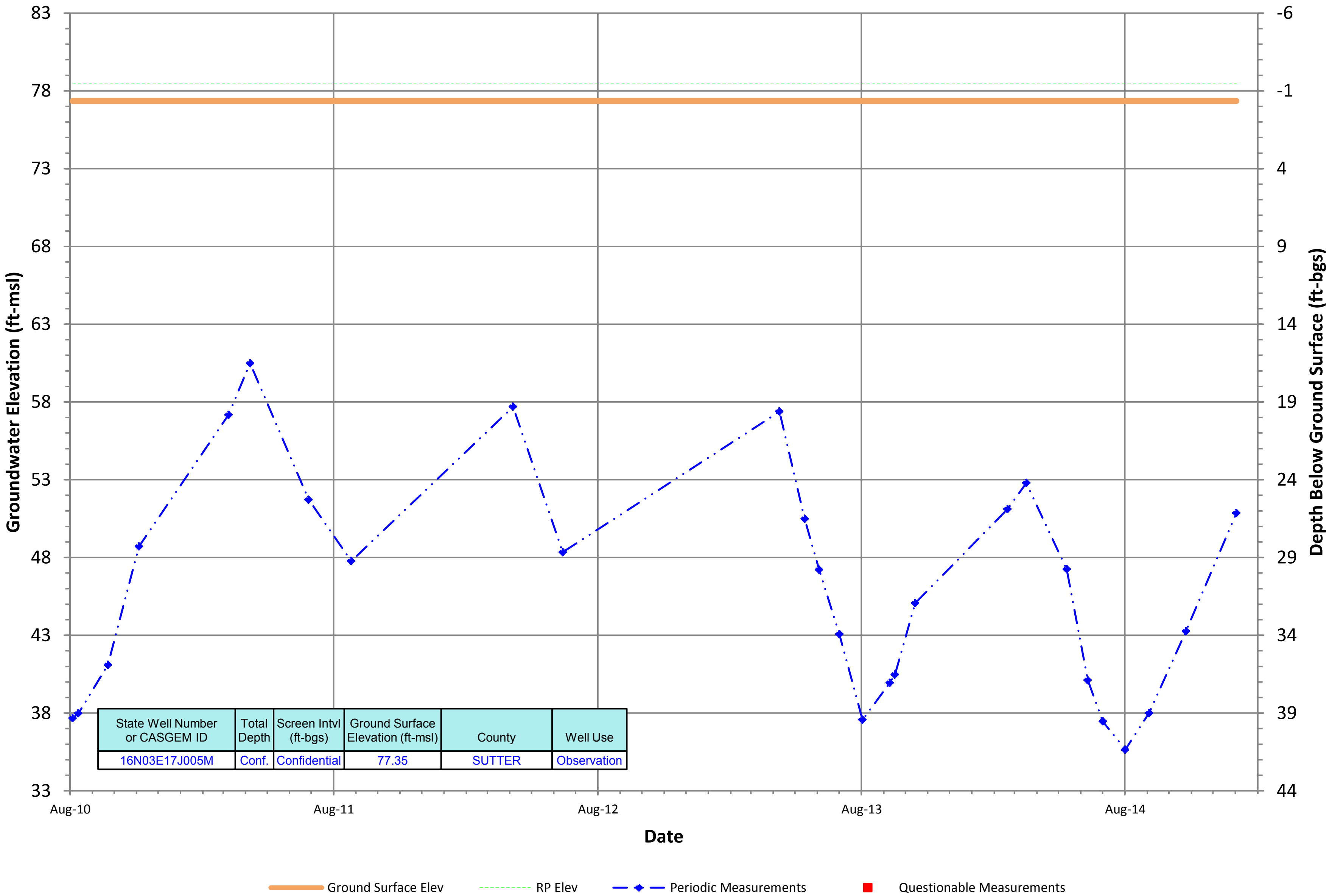
16N03E17J005M
Period Of Record: 08/04/2010 to 01/02/2015

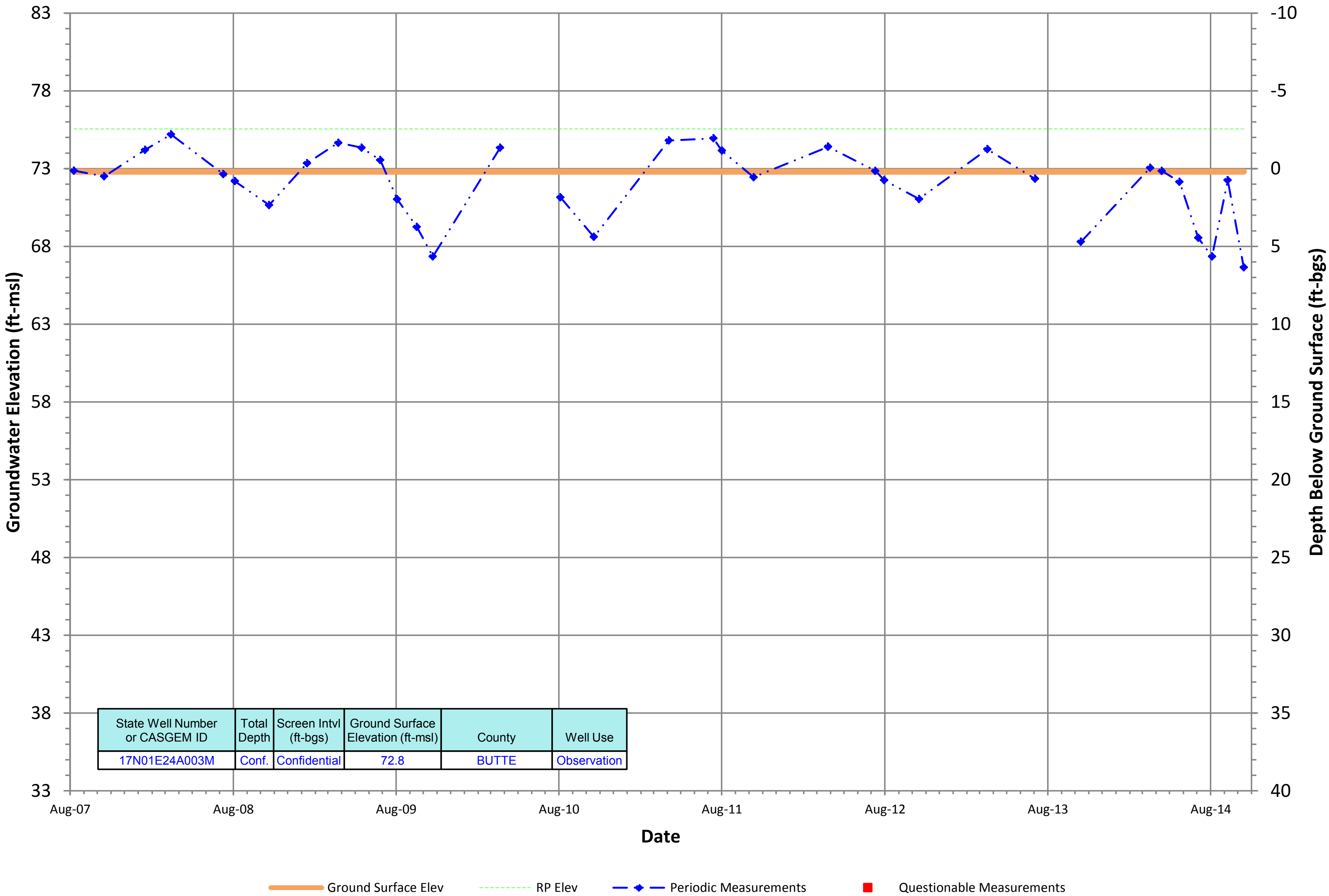
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N03E17J005M	Conf.	Confidential	77.35	SUTTER	Observation

17N01E24A003M
Period Of Record: 08/09/2007 to 10/14/2014

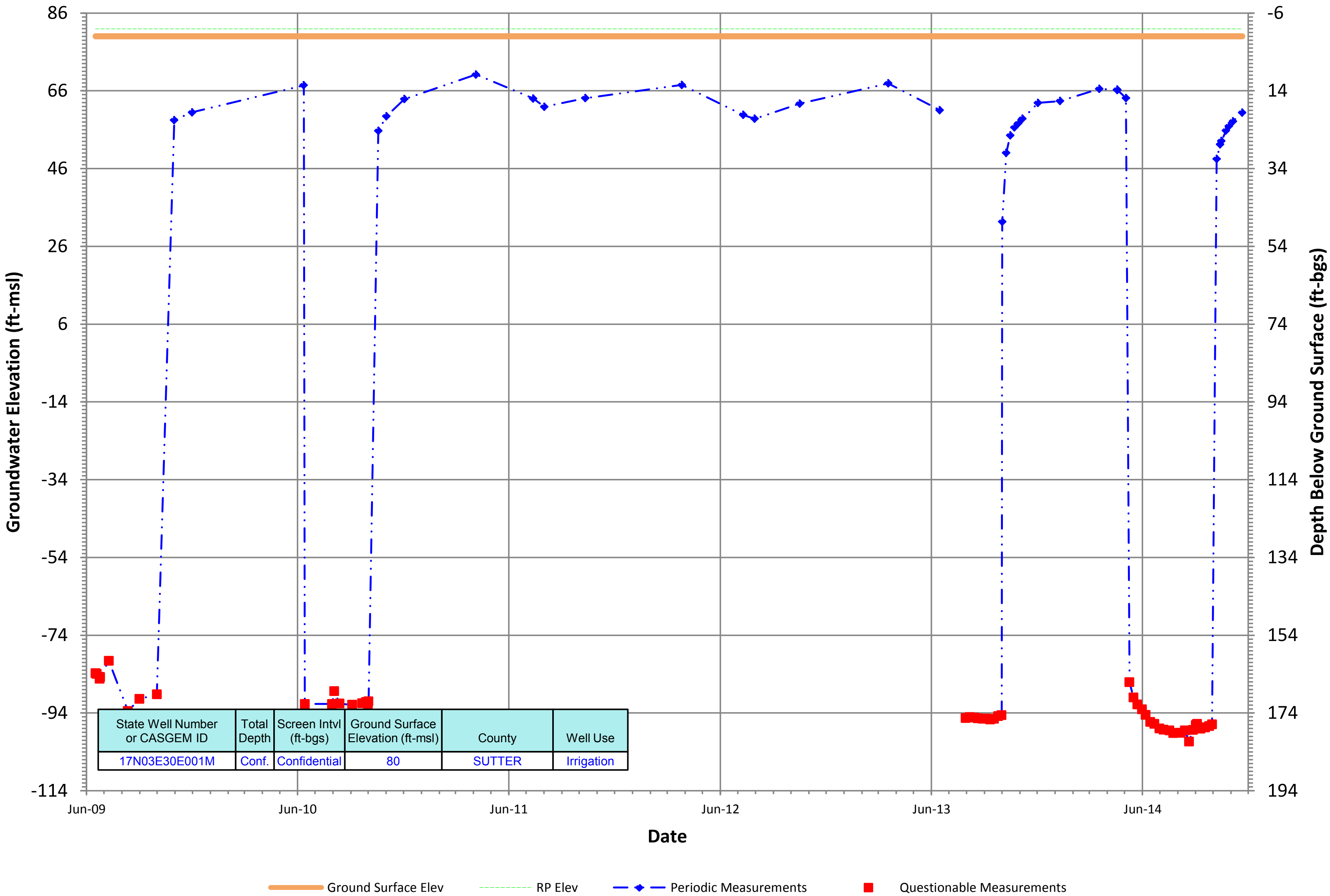
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E24A003M	Conf.	Confidential	72.8	BUTTE	Observation

17N03E30E001M
Period Of Record: 06/16/2009 to 11/20/2014

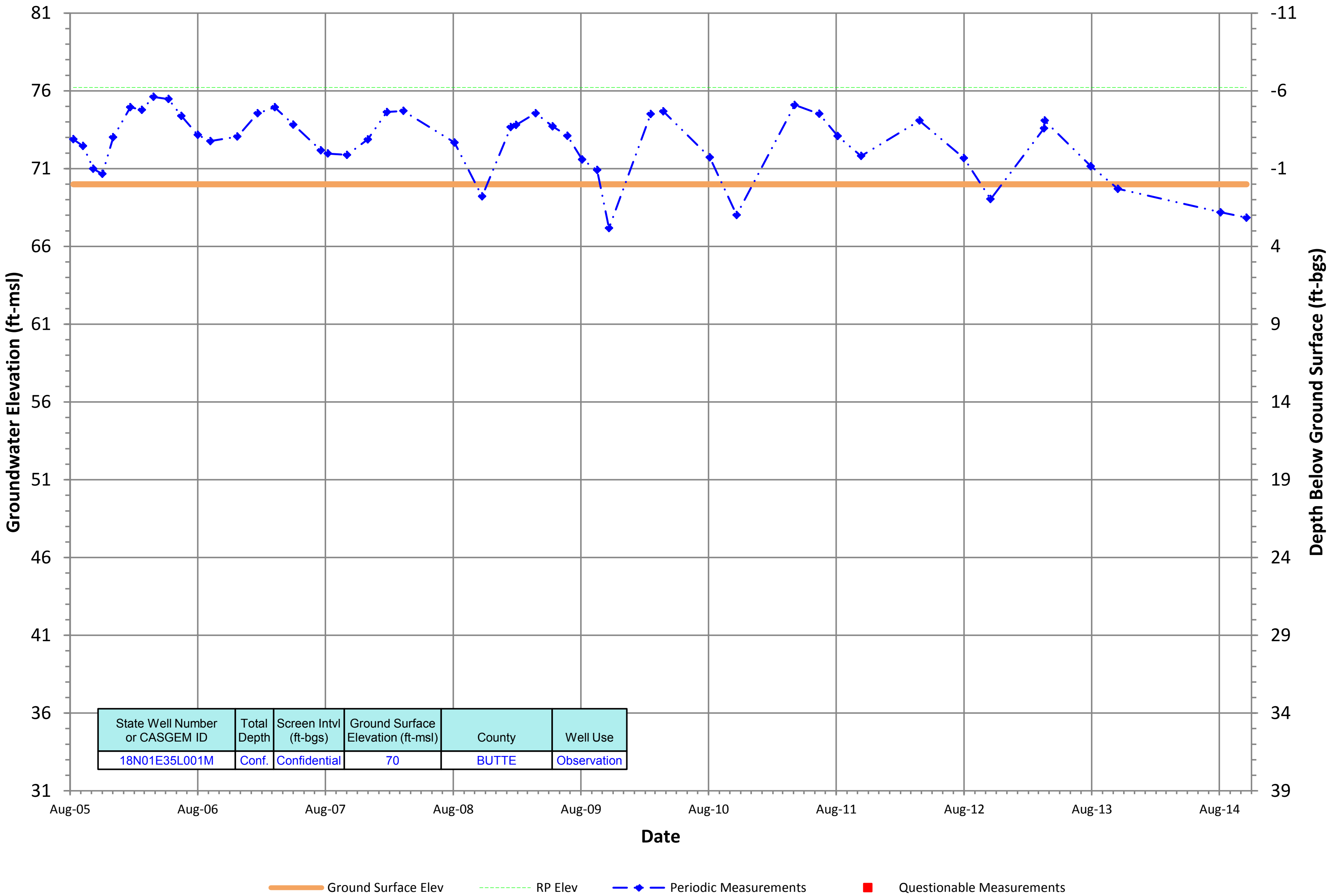
Hydrograph Criteria



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N03E30E001M	Conf.	Confidential	80	SUTTER	Irrigation

18N01E35L001M
Period Of Record: 08/10/2005 to 10/17/2014

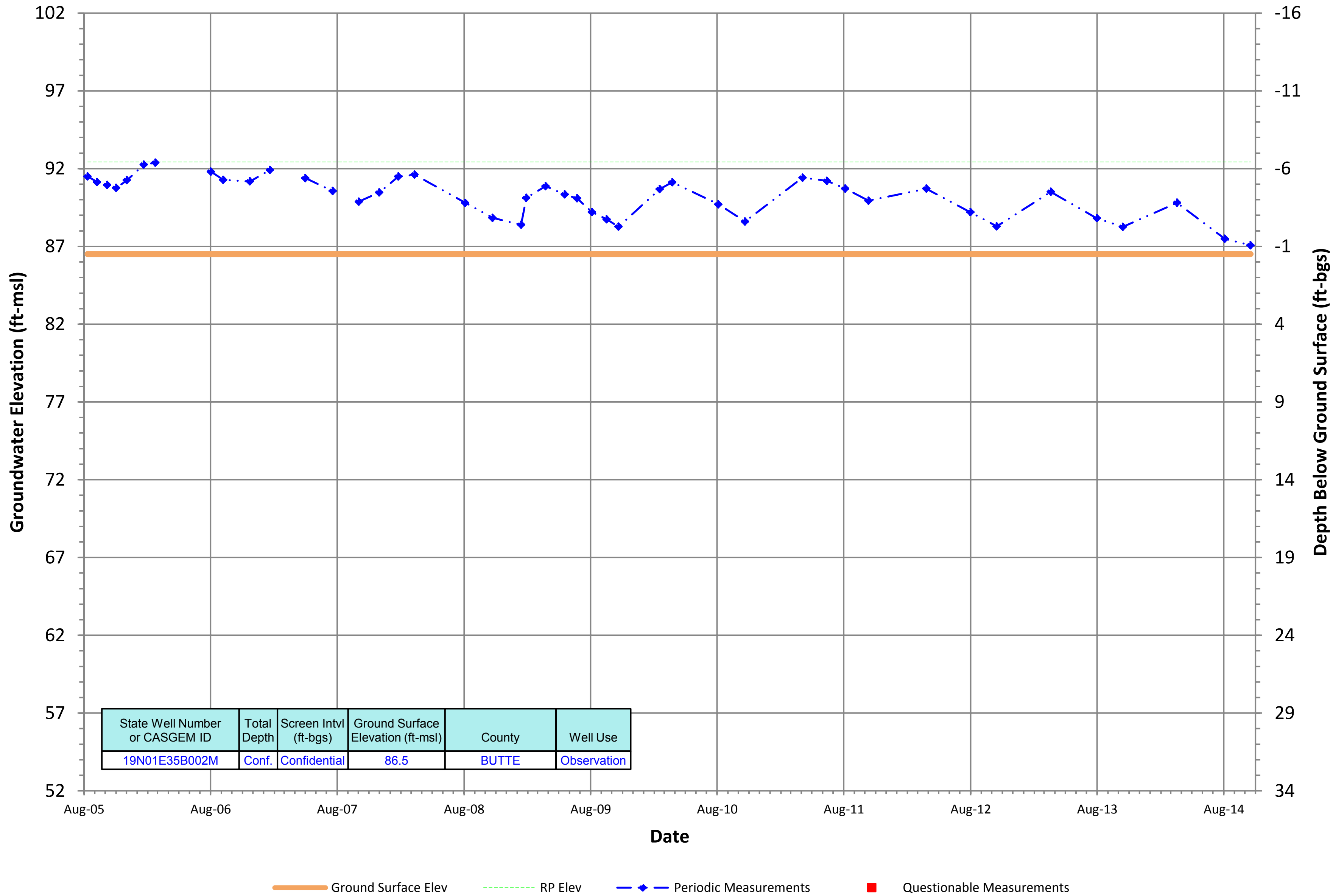
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is at or greater than 600



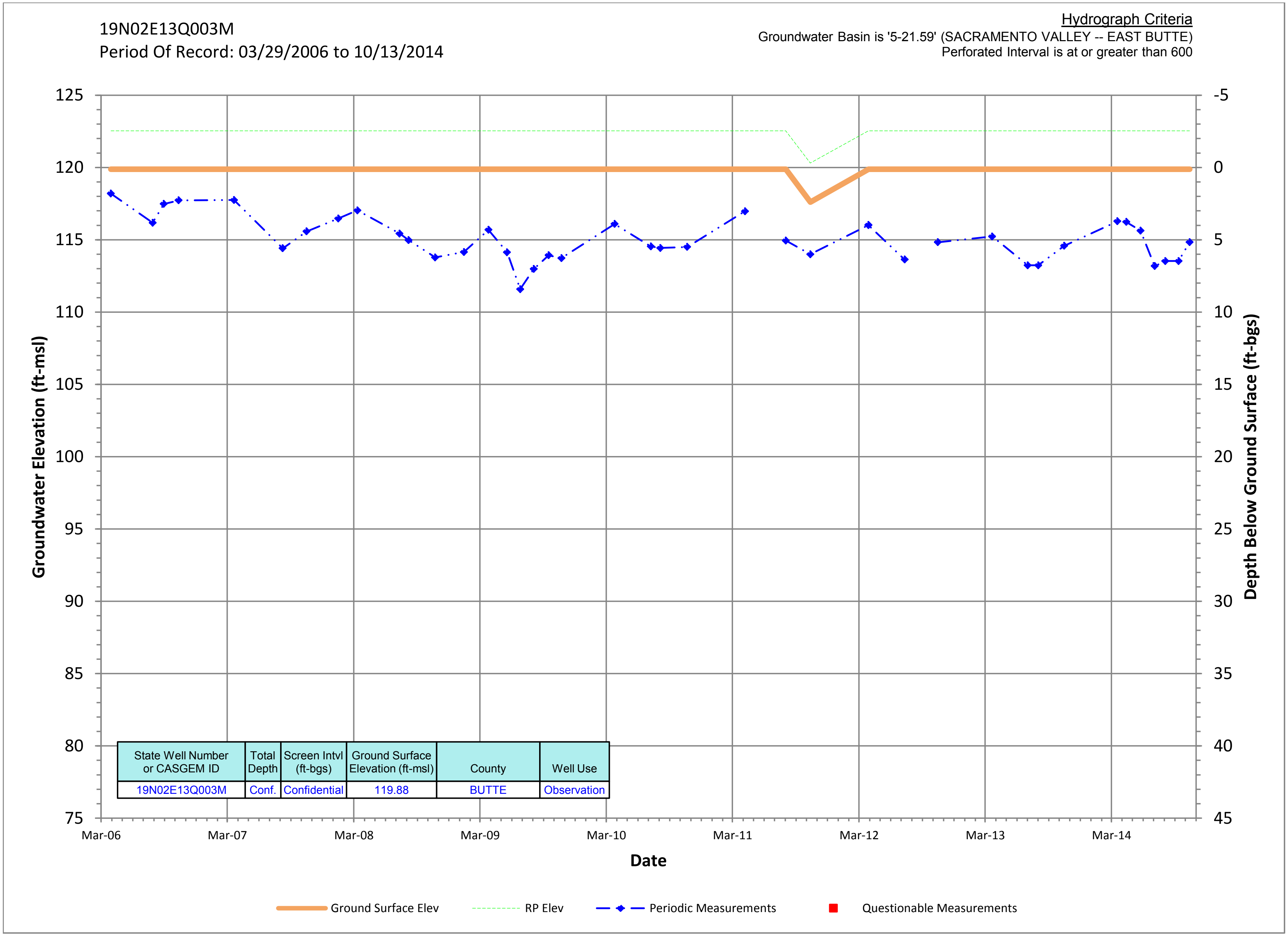
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01E35L001M	Conf.	Confidential	70	BUTTE	Observation

19N01E35B002M
Period Of Record: 08/11/2005 to 10/17/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is at or greater than 600

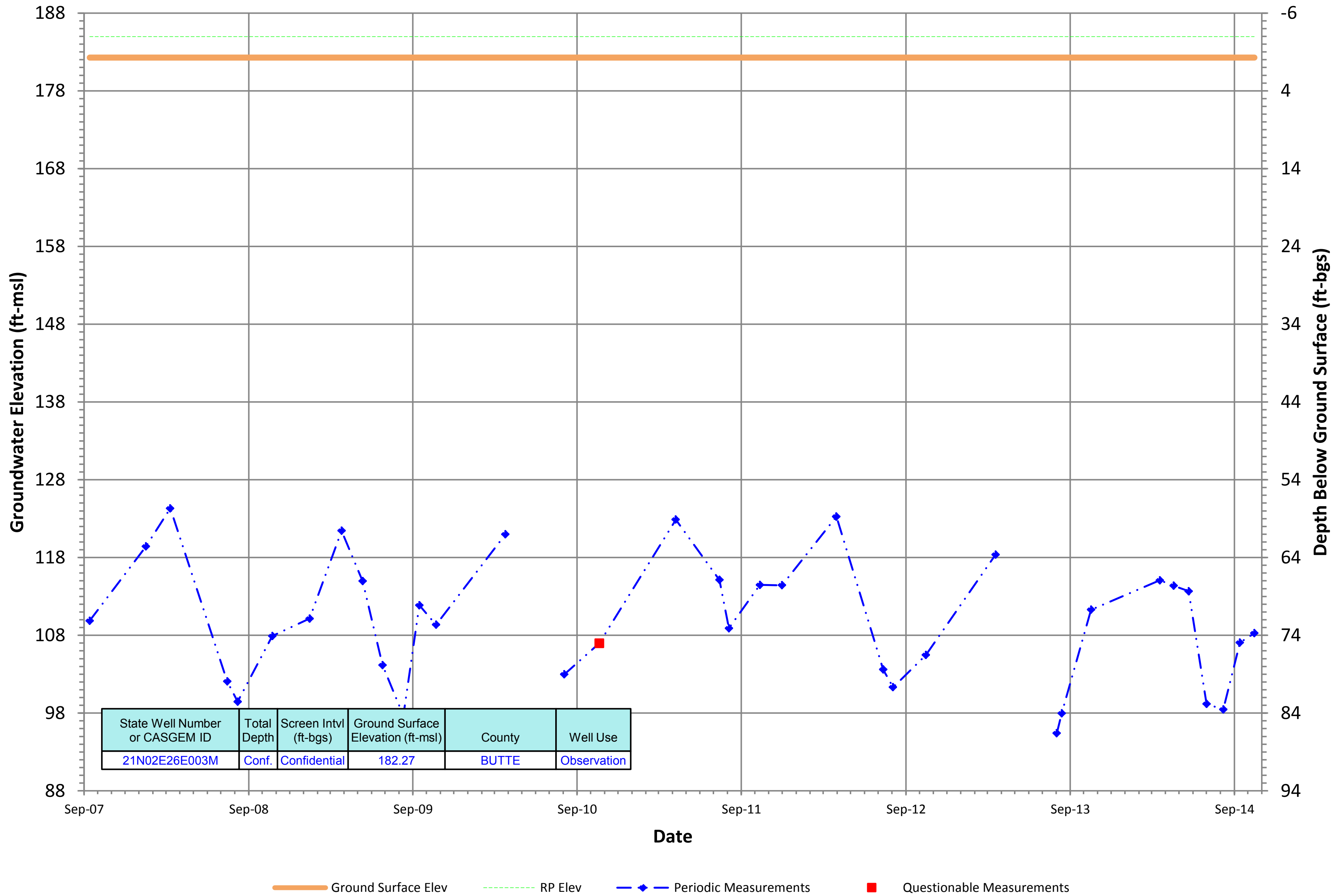


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01E35B002M	Conf.	Confidential	86.5	BUTTE	Observation


19N02E13Q003M
Period Of Record: 03/29/2006 to 10/13/2014
Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is at or greater than 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
Date
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
19N02E13Q003M
Conf.
Confidential
119.88
BUTTE
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

21N02E26E003M
Period Of Record: 09/13/2007 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.59' (SACRAMENTO VALLEY -- EAST BUTTE)
Perforated Interval is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E26E003M	Conf.	Confidential	182.27	BUTTE	Observation

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Shallow Groundwater Monitoring Well Hydrographs- North American Subbasin

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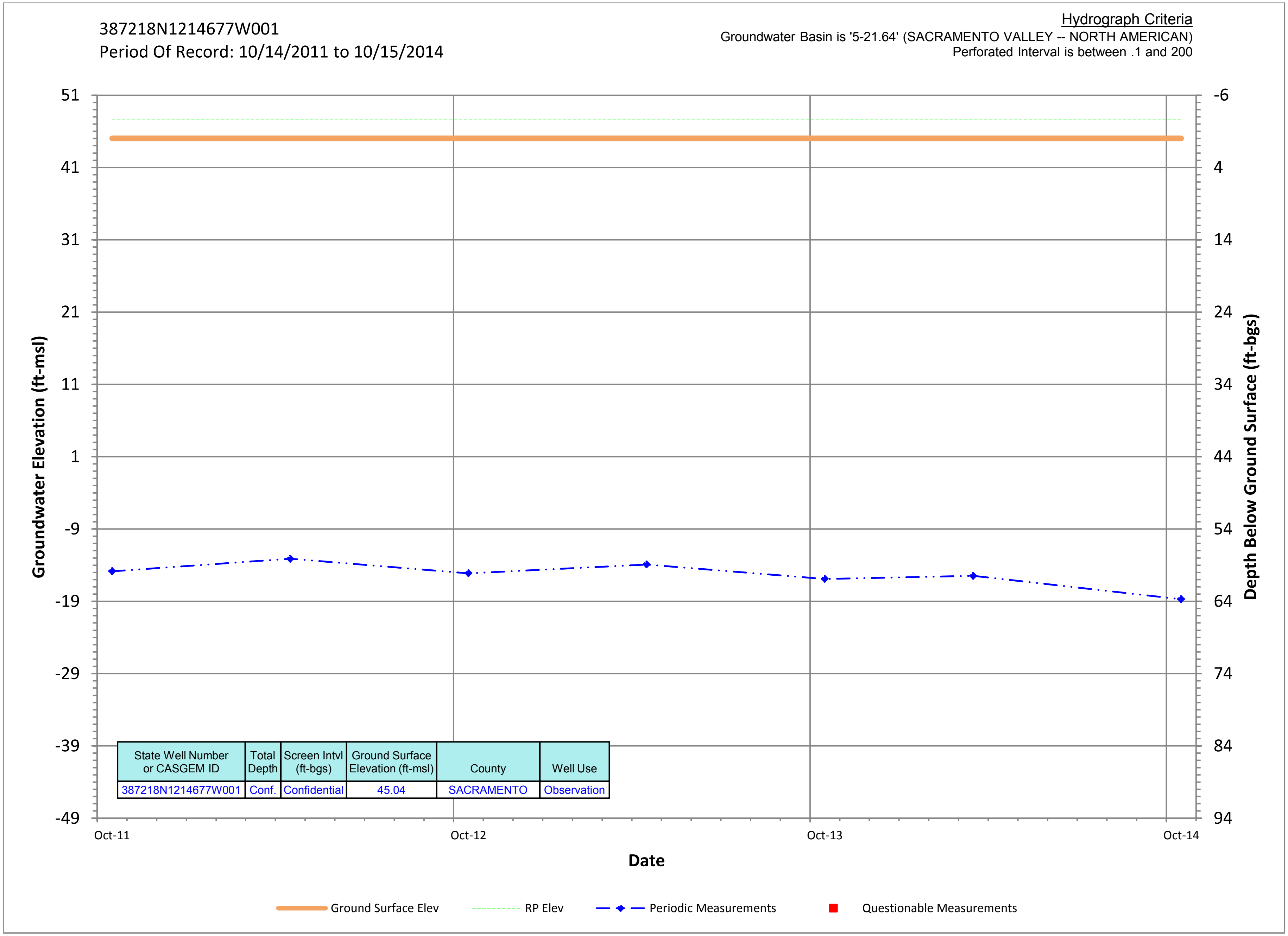
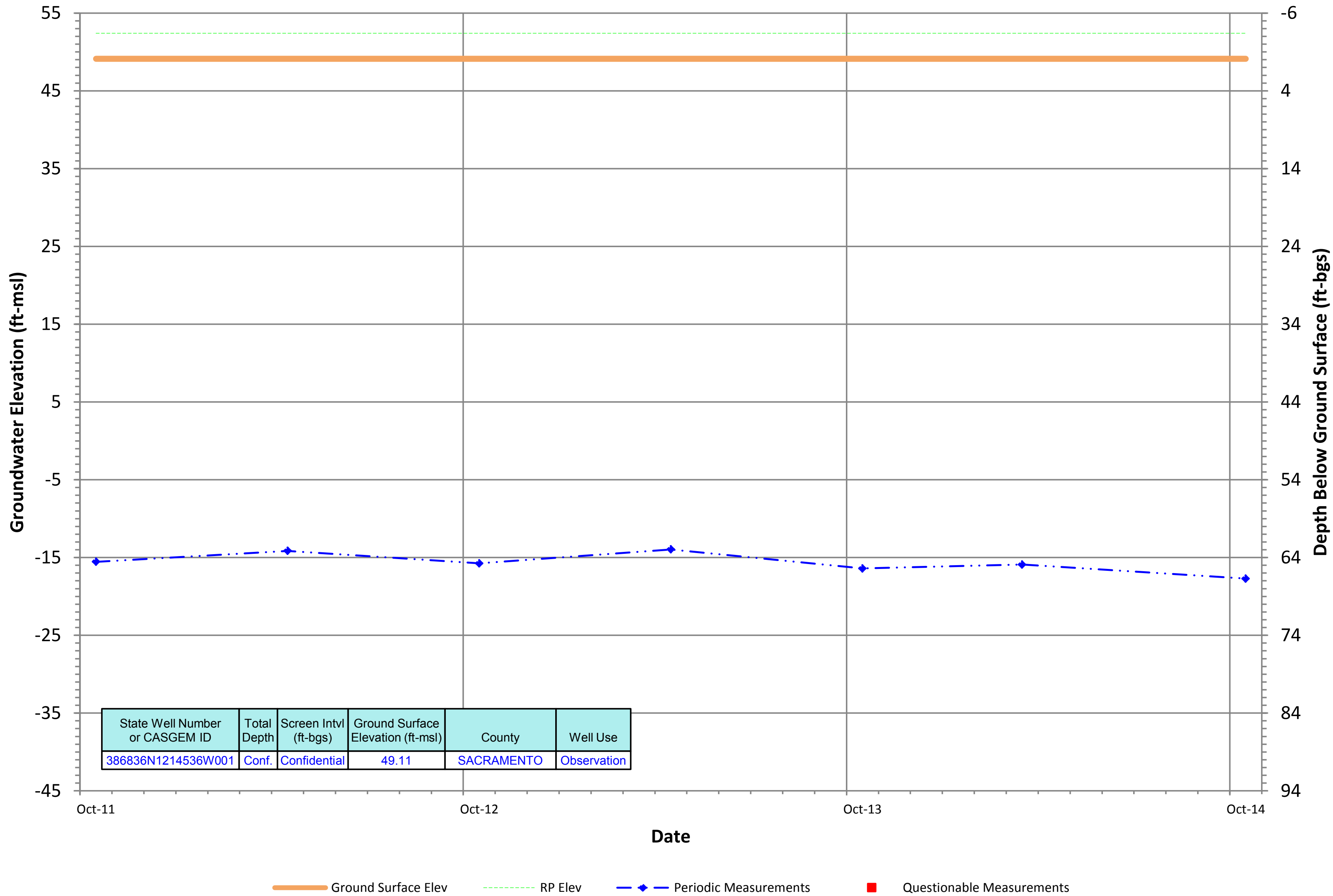


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387218N1214677W001	Conf.	Confidential	45.04	SACRAMENTO	Observation

386836N1214536W001
Period Of Record: 10/14/2011 to 10/15/2014

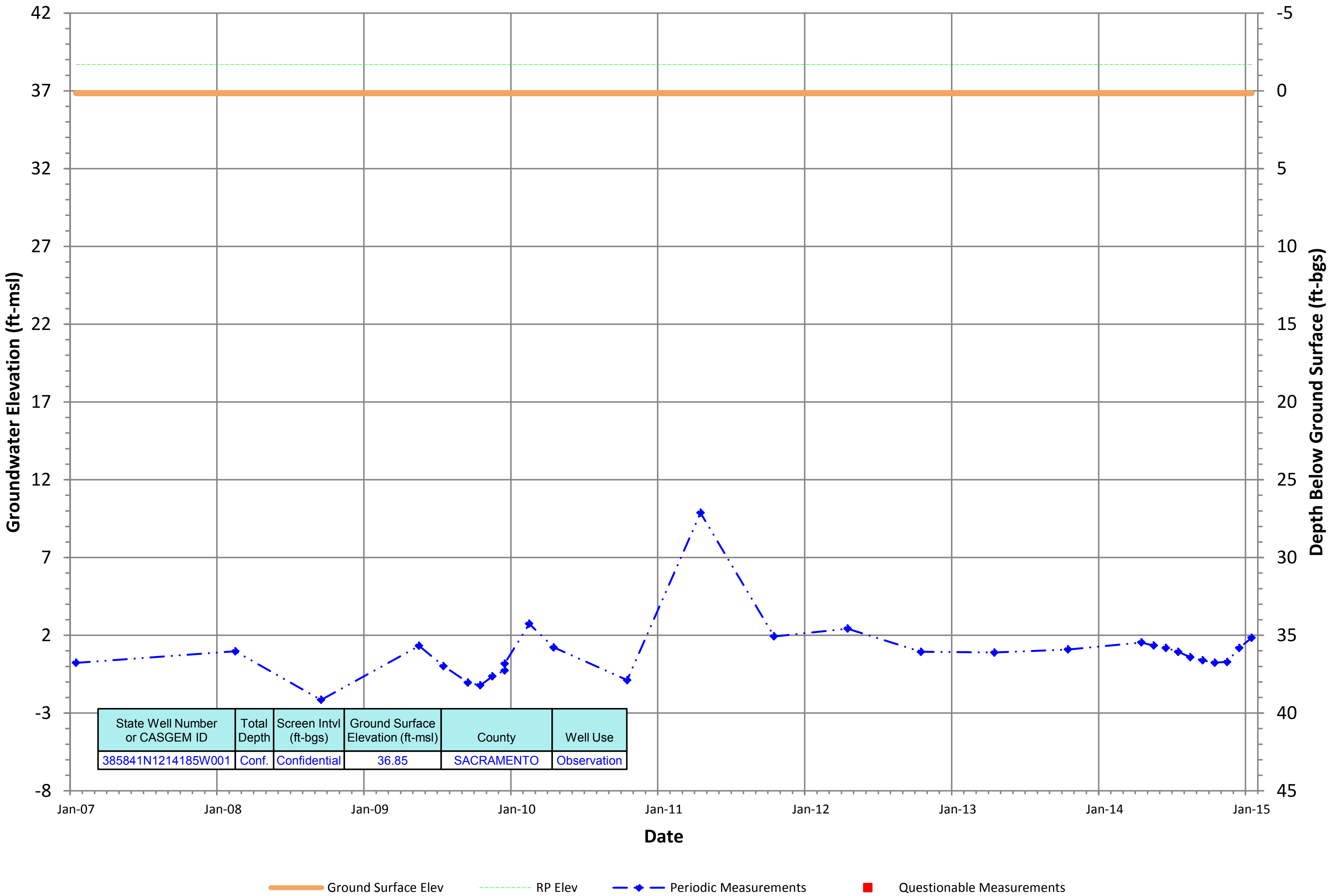
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
386836N1214536W001	Conf.	Confidential	49.11	SACRAMENTO	Observation

385841N1214185W001
Period Of Record: 01/15/2007 to 01/15/2015

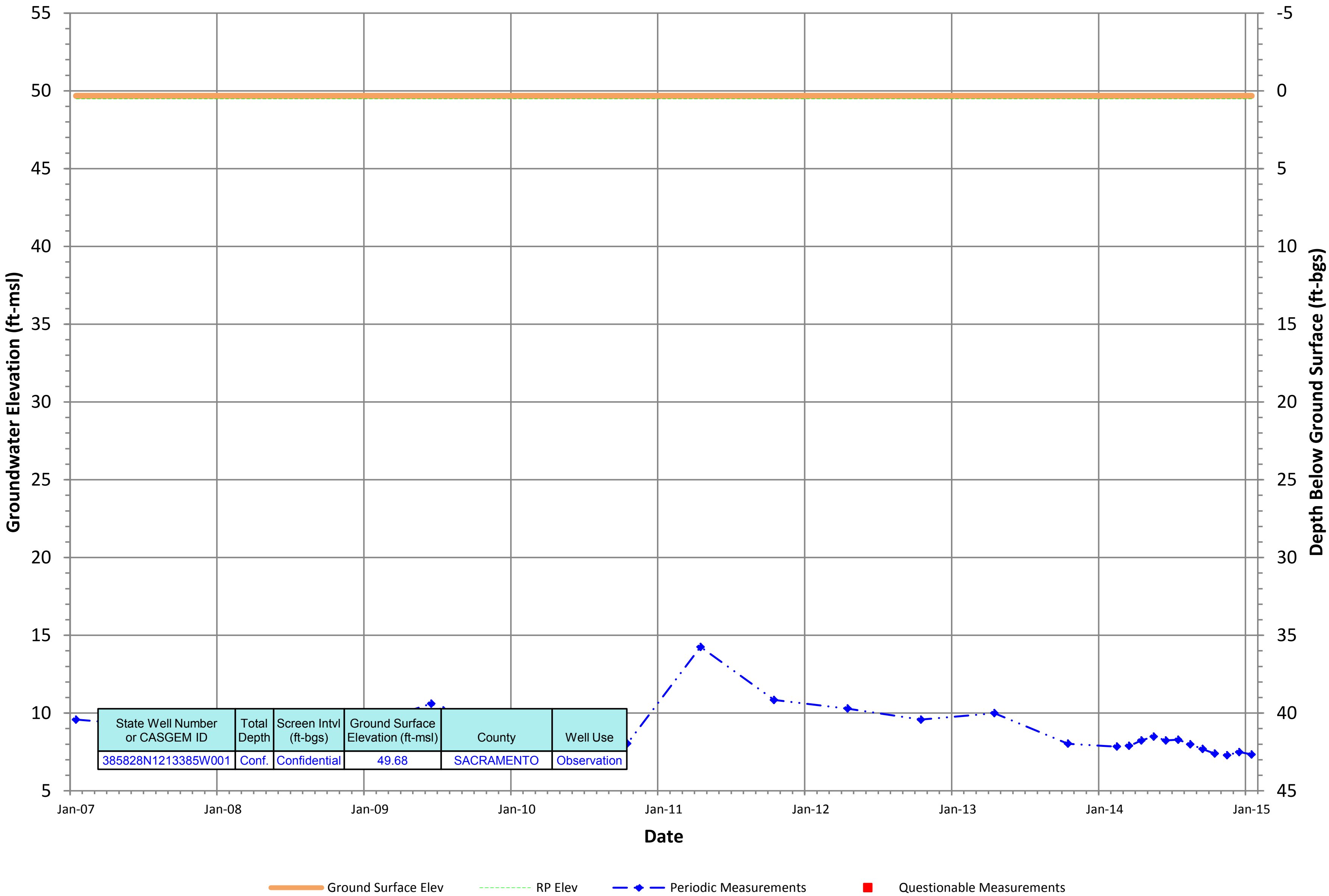
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



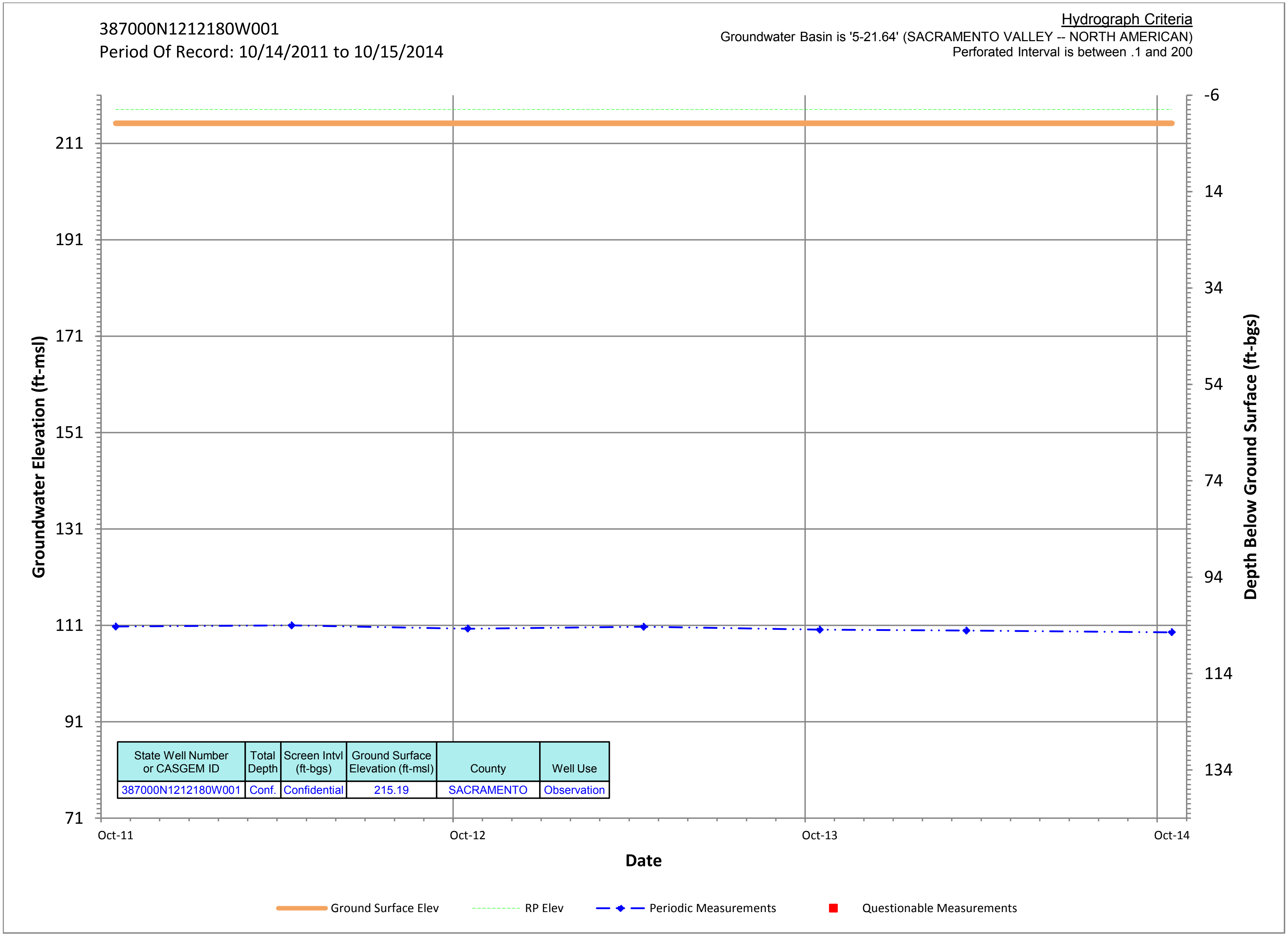
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
385841N1214185W001	Conf.	Confidential	36.85	SACRAMENTO	Observation

385828N1213385W001
Period Of Record: 01/15/2007 to 01/15/2015

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



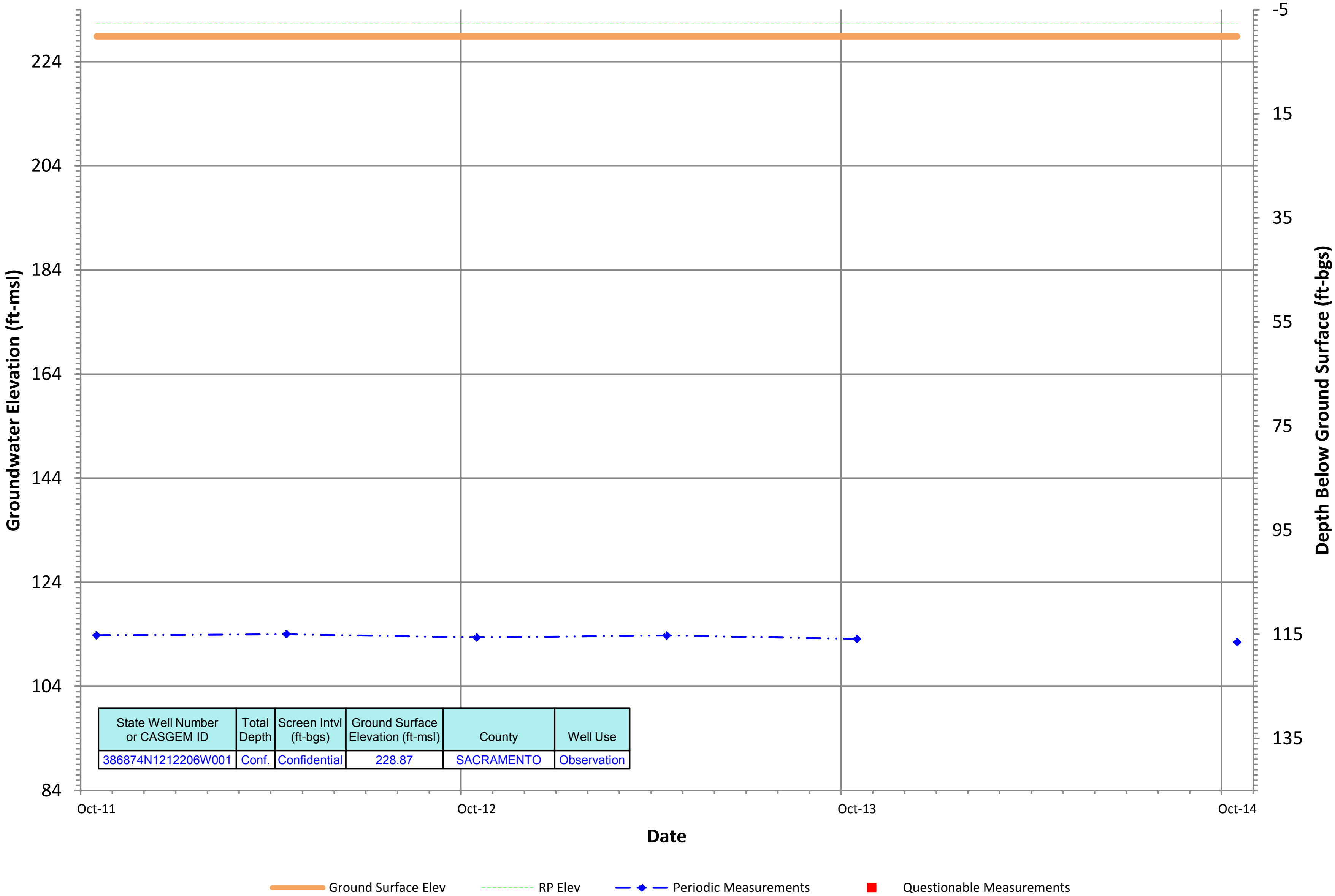
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
385828N1213385W001	Conf.	Confidential	49.68	SACRAMENTO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387000N1212180W001	Conf.	Confidential	215.19	SACRAMENTO	Observation

386874N1212206W001
Period Of Record: 10/14/2011 to 10/15/2014

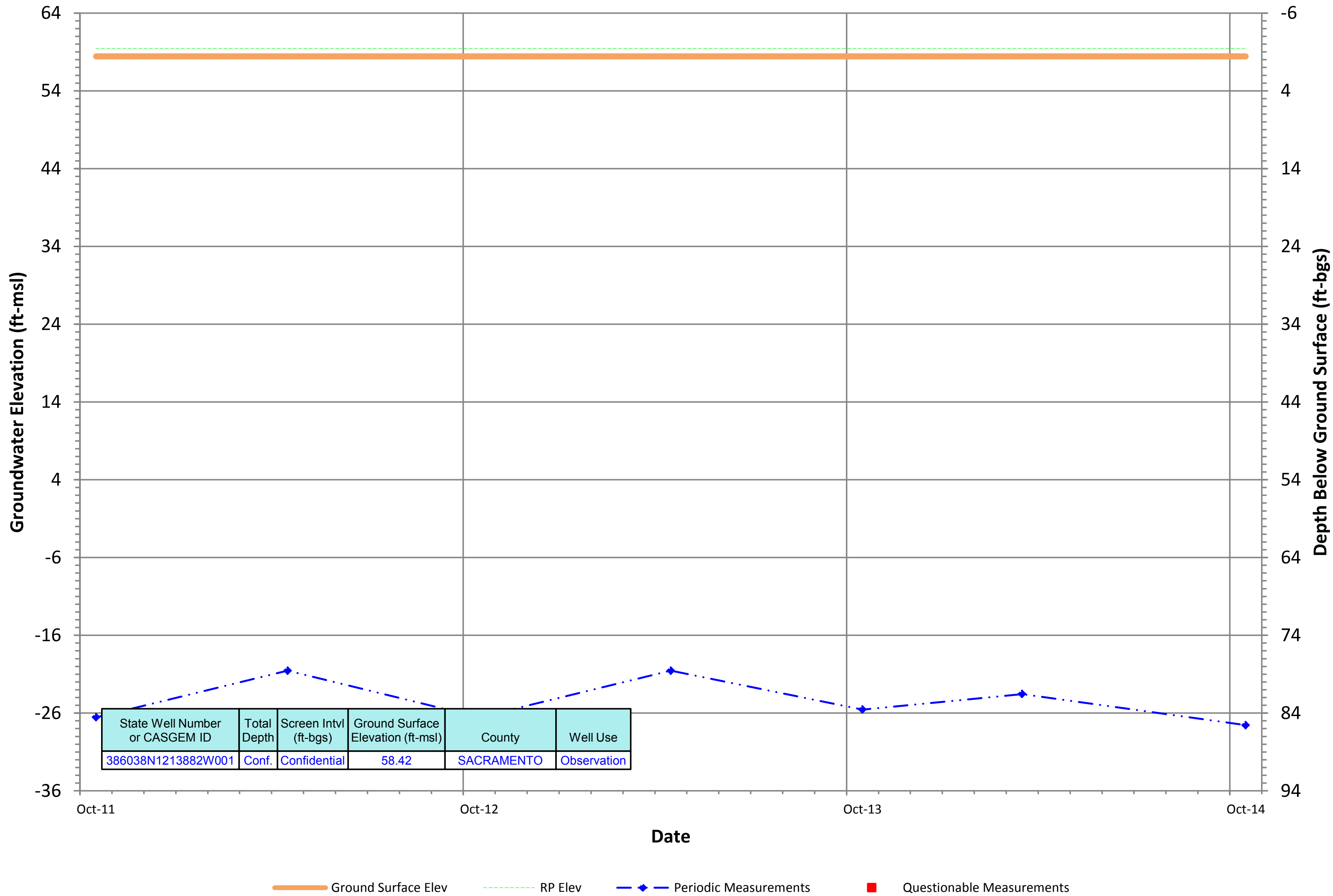
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
386874N1212206W001	Conf.	Confidential	228.87	SACRAMENTO	Observation

386038N1213882W001
Period Of Record: 10/13/2011 to 10/15/2014

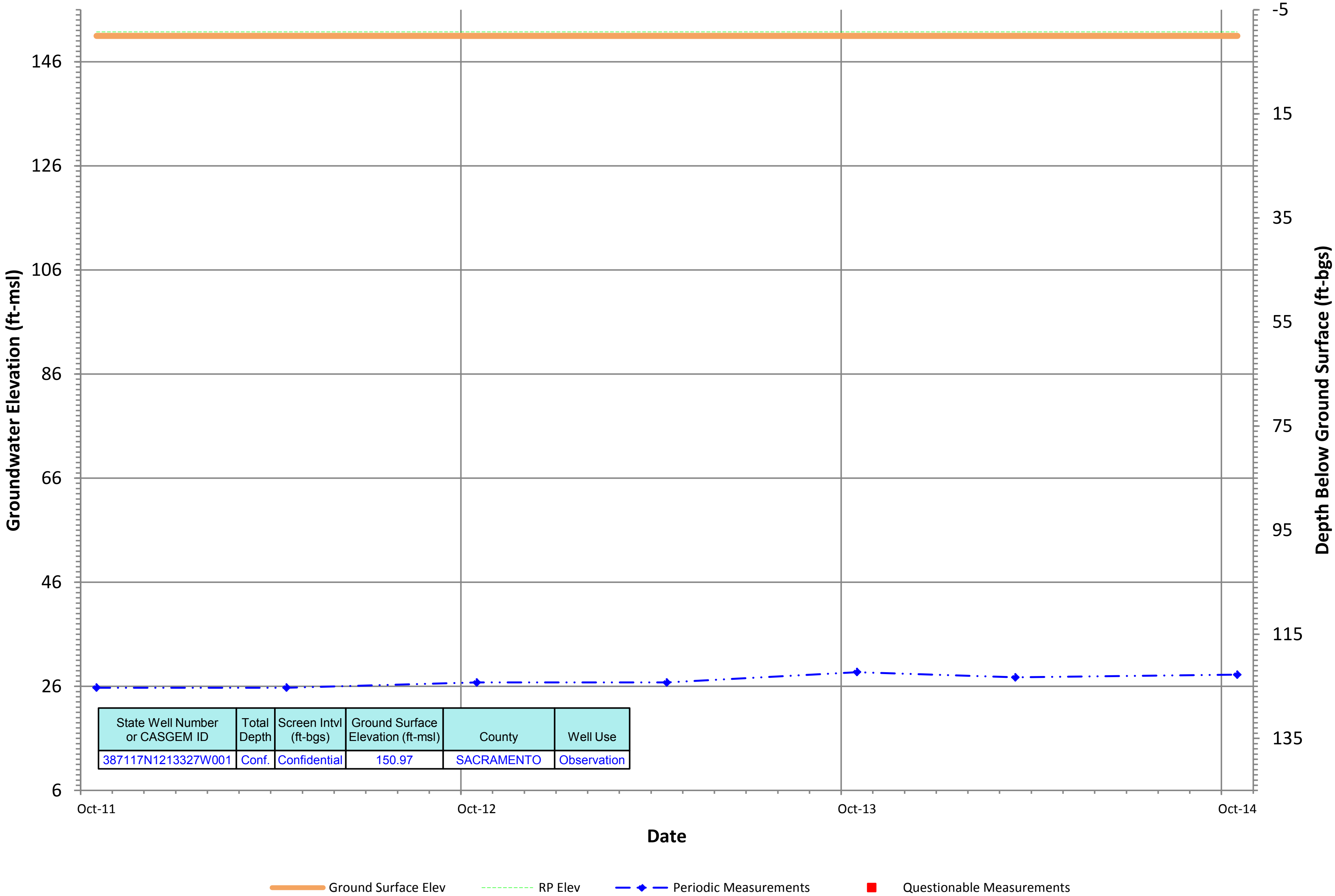
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
386038N1213882W001	Conf.	Confidential	58.42	SACRAMENTO	Observation

387117N1213327W001
Period Of Record: 10/13/2011 to 10/15/2014

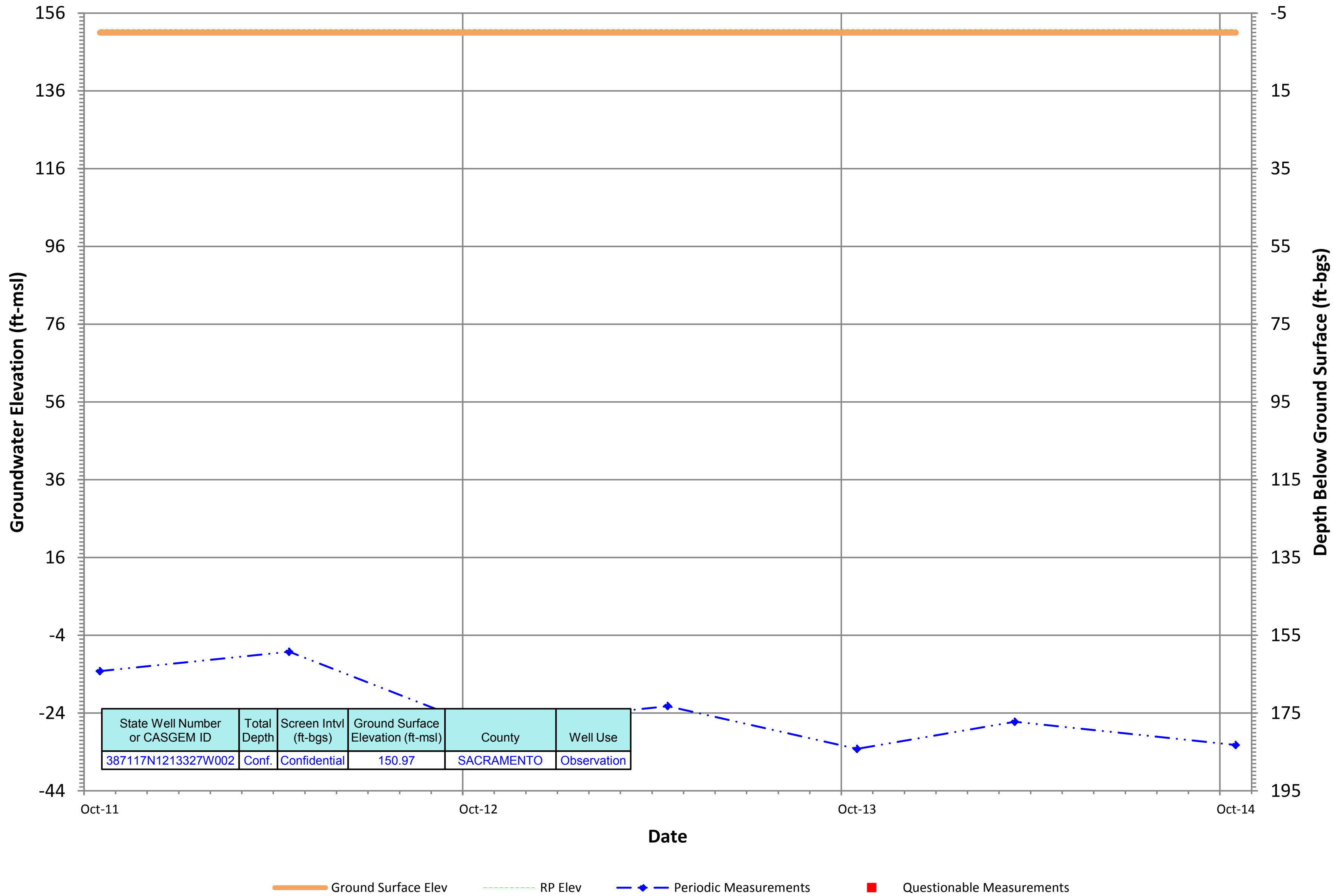
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387117N1213327W001	Conf.	Confidential	150.97	SACRAMENTO	Observation

387117N1213327W002
Period Of Record: 10/13/2011 to 10/15/2014

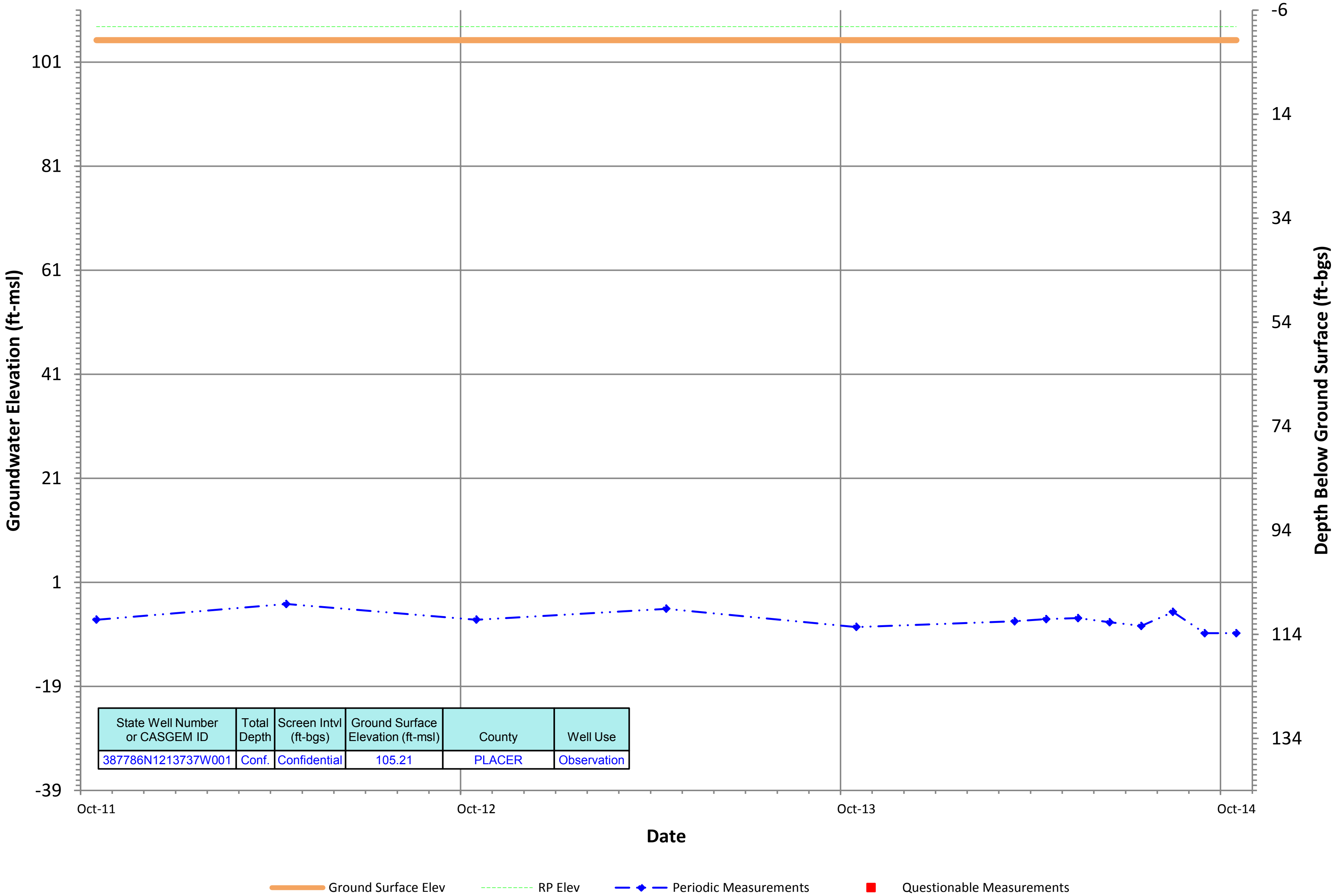
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387117N1213327W002	Conf.	Confidential	150.97	SACRAMENTO	Observation

387786N1213737W001
Period Of Record: 10/18/2011 to 10/09/2014

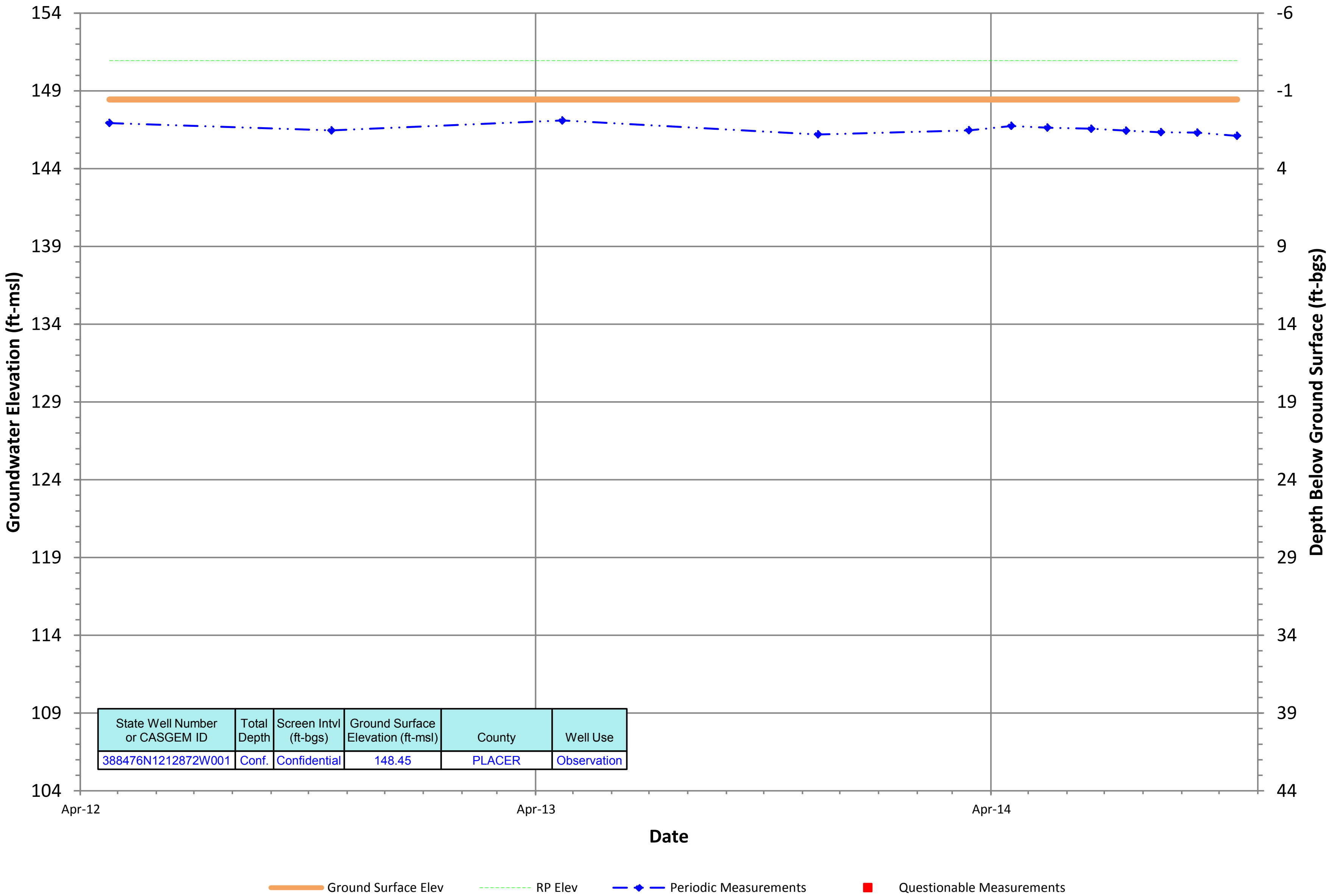
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387786N1213737W001	Conf.	Confidential	105.21	PLACER	Observation

388476N1212872W001
Period Of Record: 04/24/2012 to 10/15/2014

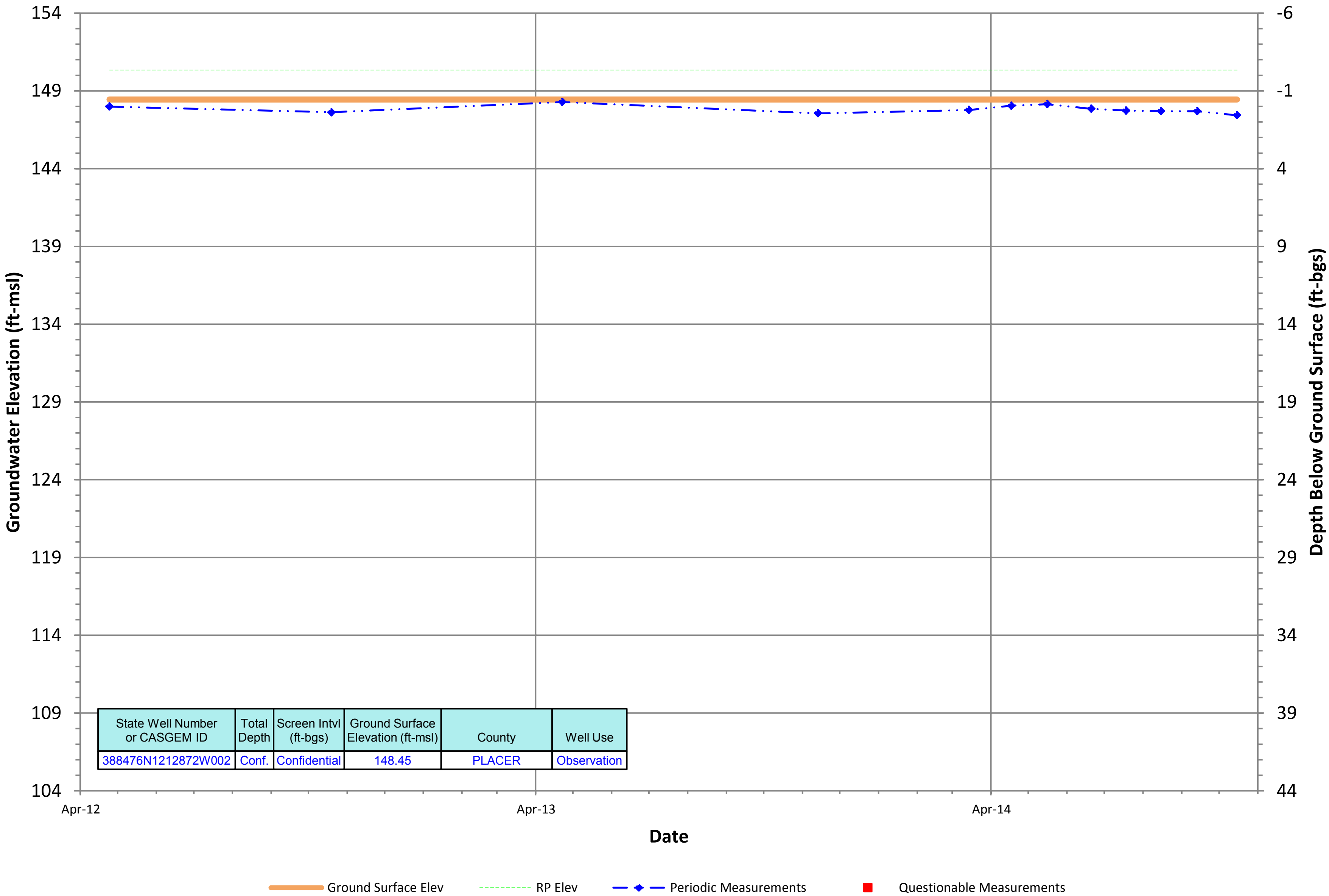
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388476N1212872W001	Conf.	Confidential	148.45	PLACER	Observation

388476N1212872W002
Period Of Record: 04/24/2012 to 10/15/2014

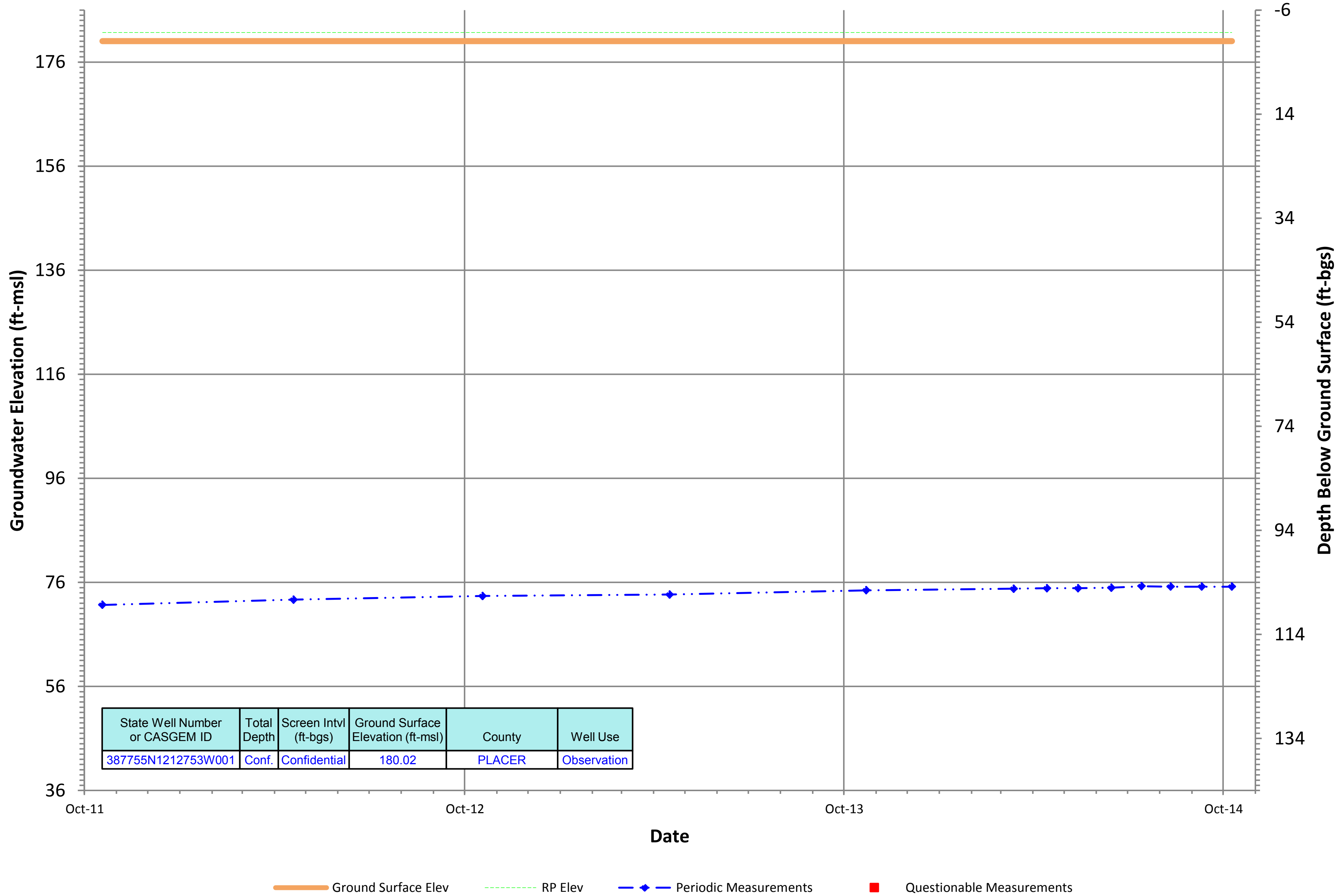
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388476N1212872W002	Conf.	Confidential	148.45	PLACER	Observation

387755N1212753W001
Period Of Record: 10/18/2011 to 10/09/2014

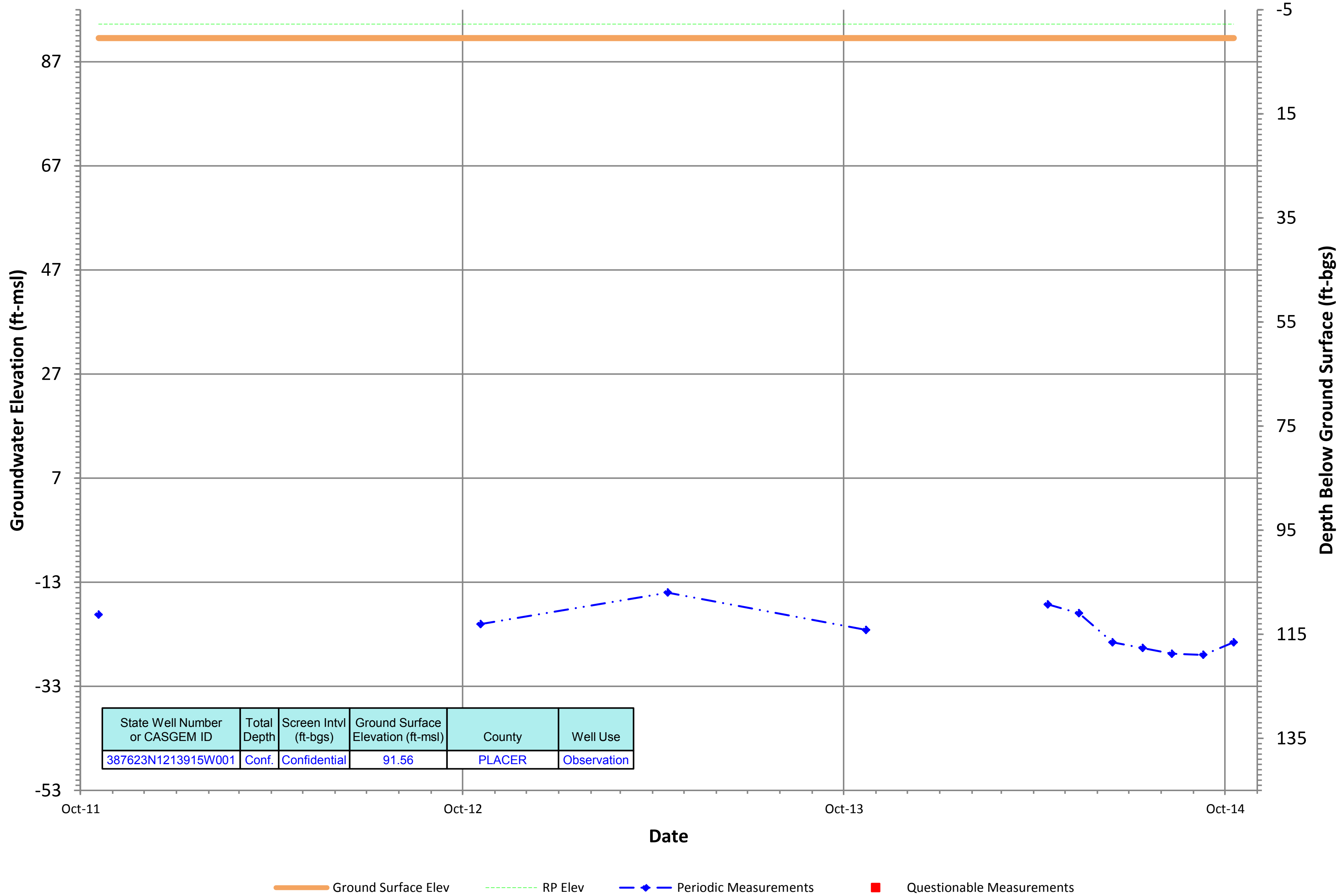
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387755N1212753W001	Conf.	Confidential	180.02	PLACER	Observation

387623N1213915W001
Period Of Record: 10/18/2011 to 10/09/2014

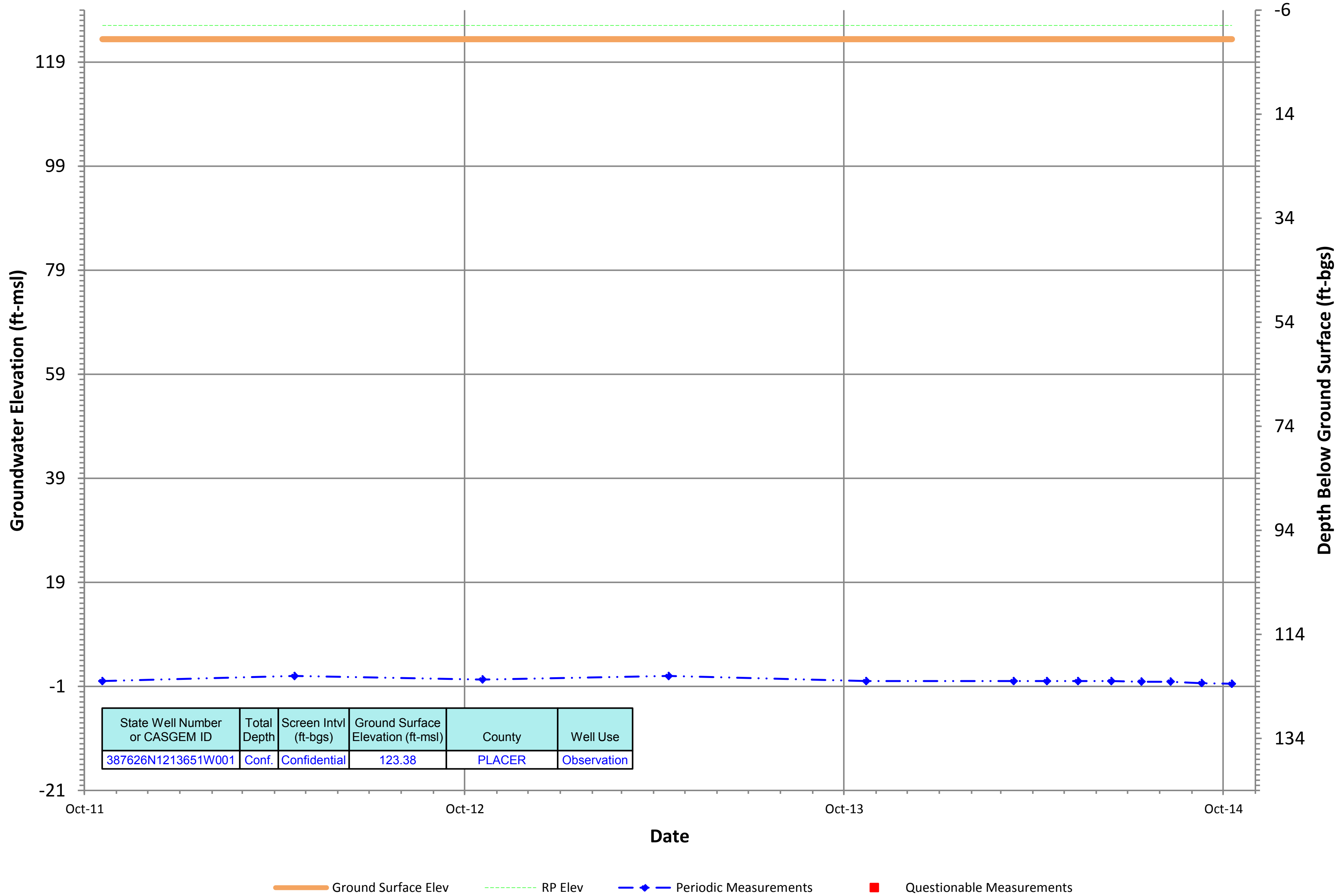
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387623N1213915W001	Conf.	Confidential	91.56	PLACER	Observation

387626N1213651W001
Period Of Record: 10/18/2011 to 10/09/2014

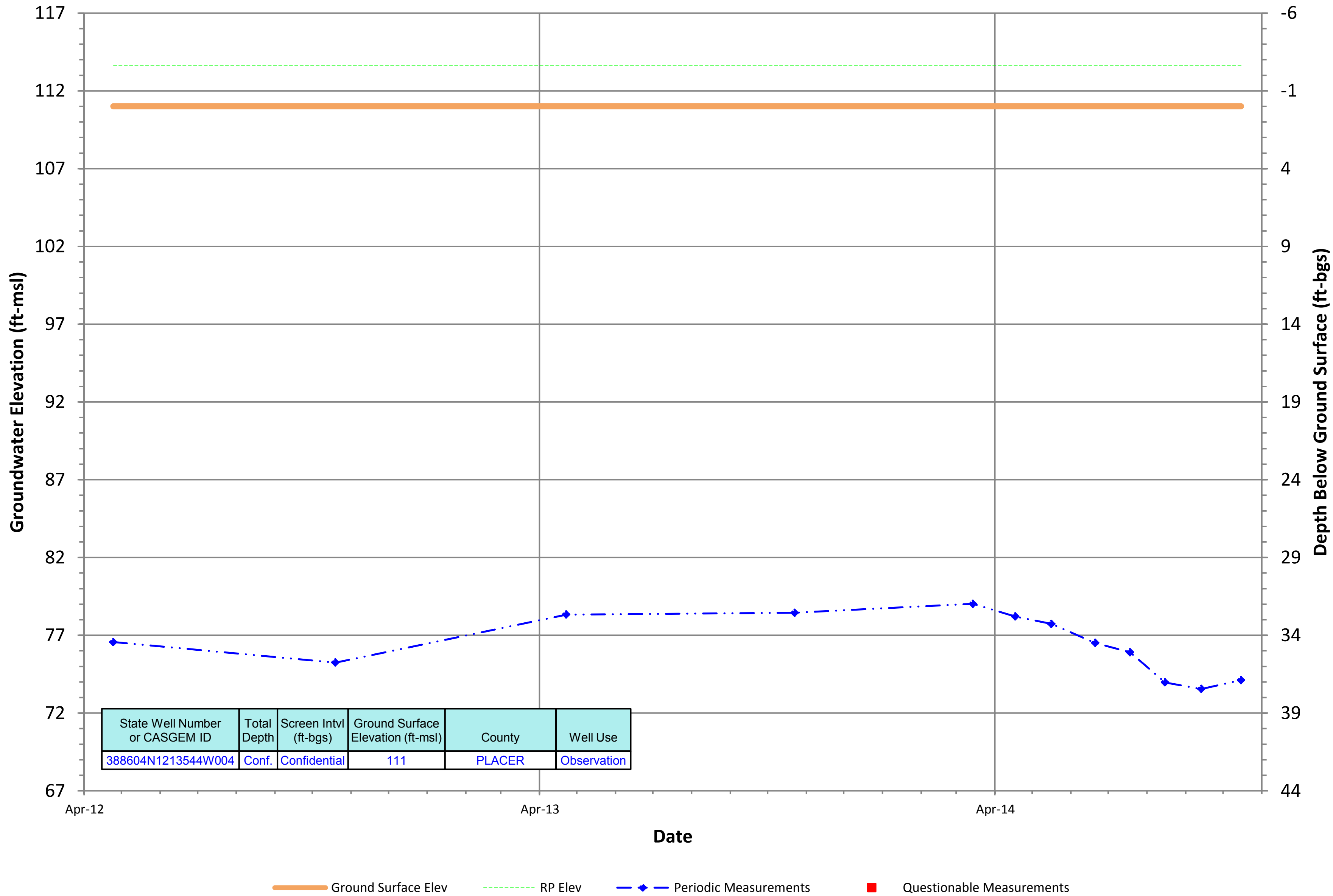
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387626N1213651W001	Conf.	Confidential	123.38	PLACER	Observation

388604N1213544W004
Period Of Record: 04/24/2012 to 10/15/2014

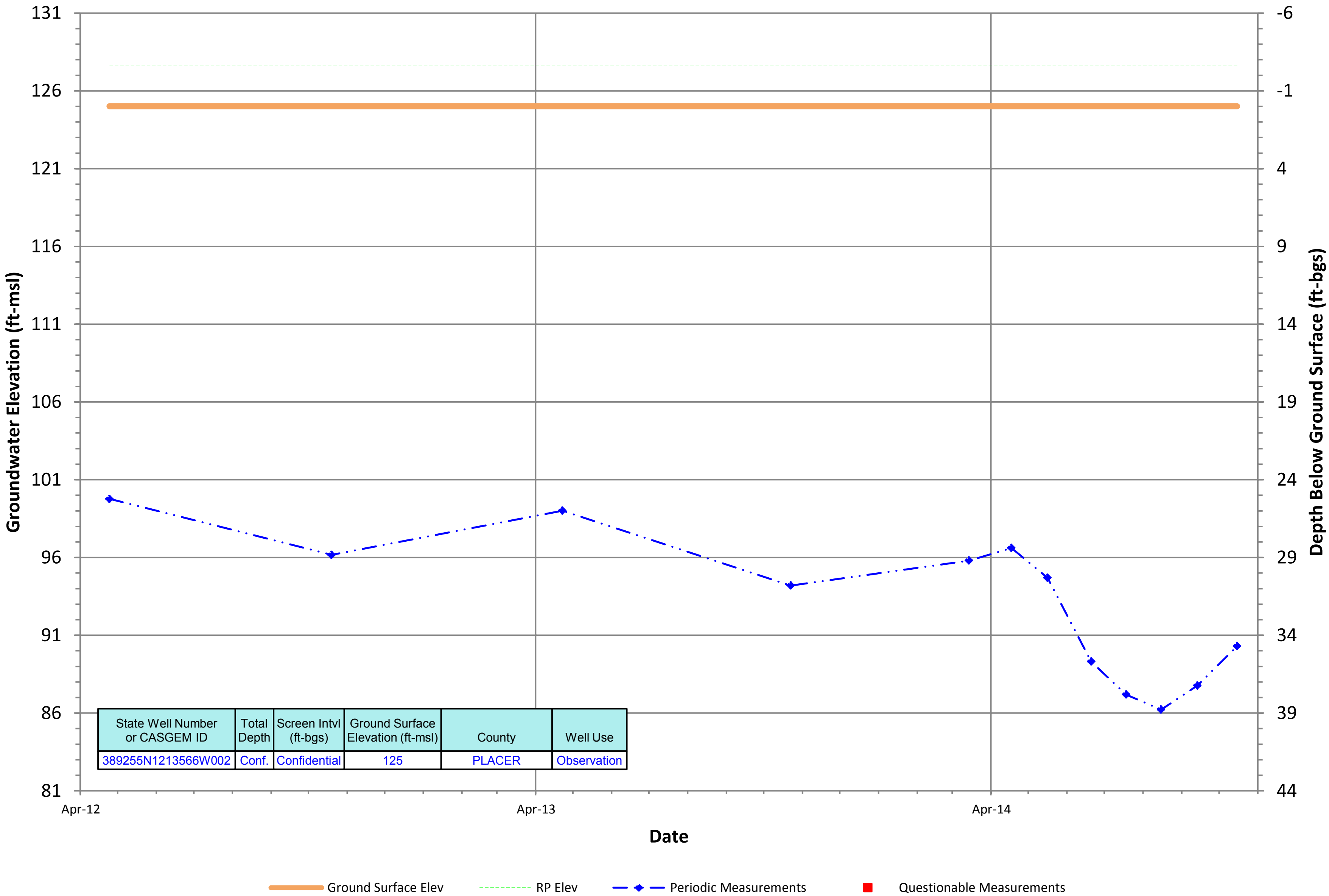
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388604N1213544W004	Conf.	Confidential	111	PLACER	Observation

389255N1213566W002
Period Of Record: 04/24/2012 to 10/15/2014

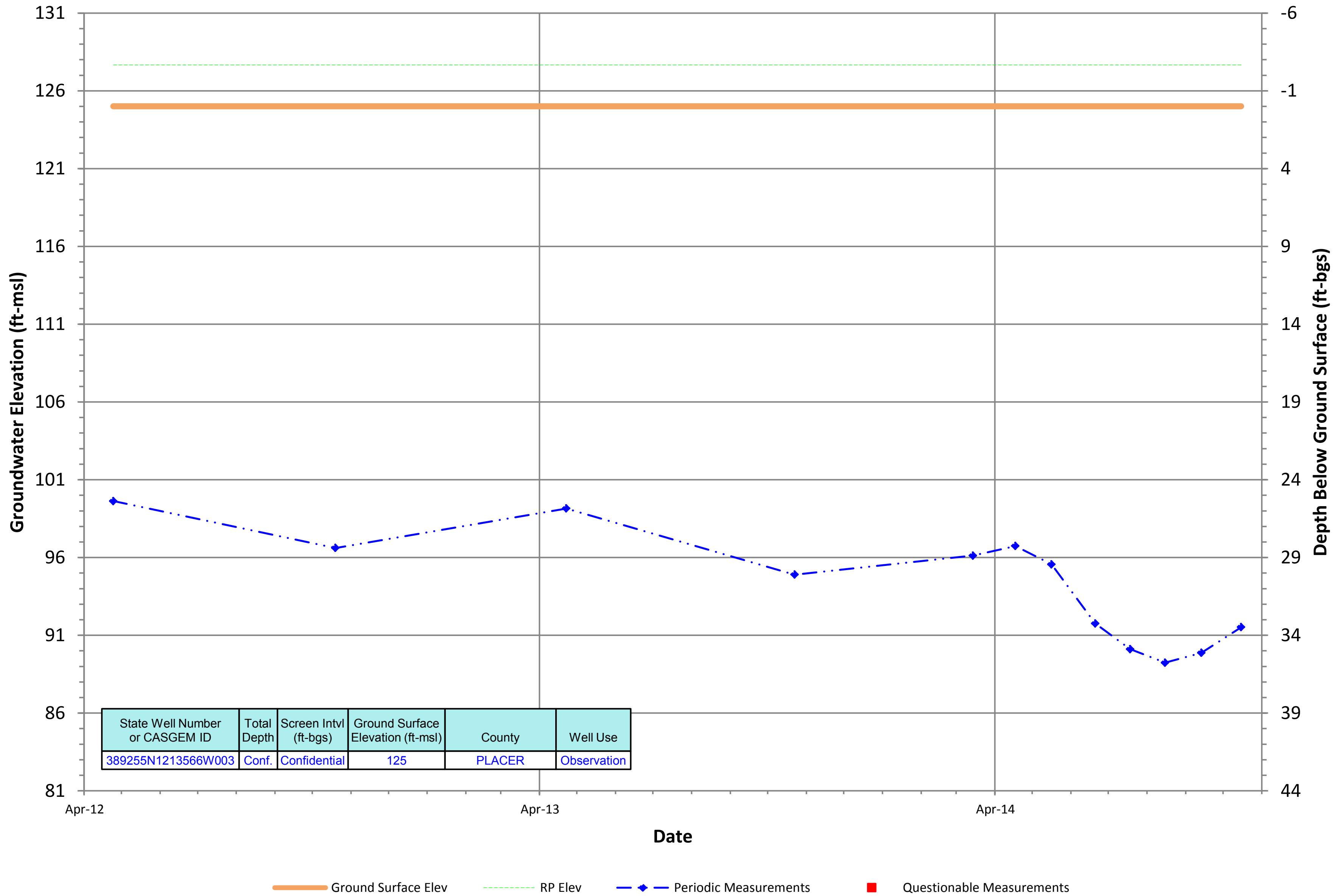
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
389255N1213566W002	Conf.	Confidential	125	PLACER	Observation

389255N1213566W003
Period Of Record: 04/24/2012 to 10/15/2014

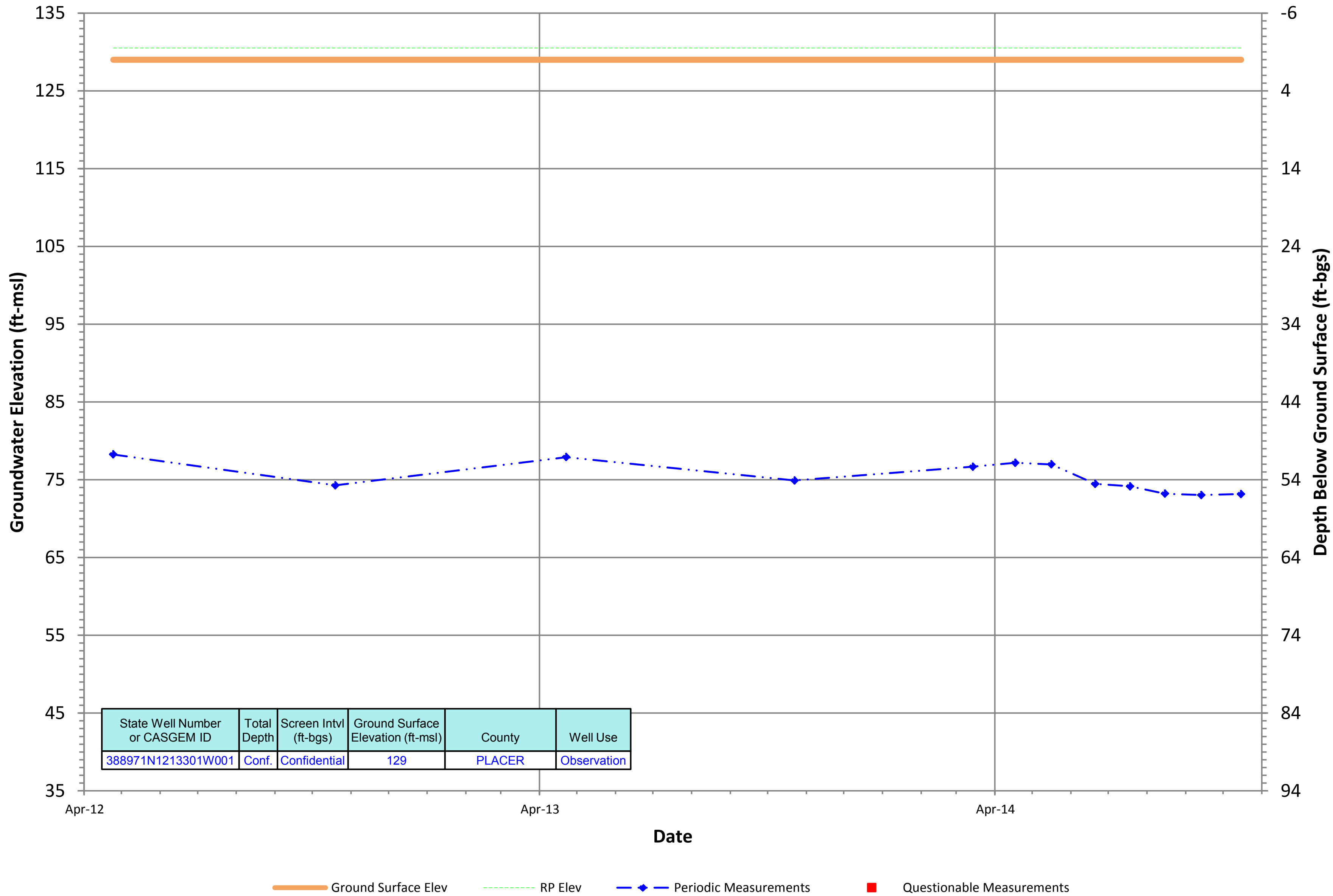
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
389255N1213566W003	Conf.	Confidential	125	PLACER	Observation

388971N1213301W001
Period Of Record: 04/24/2012 to 10/15/2014

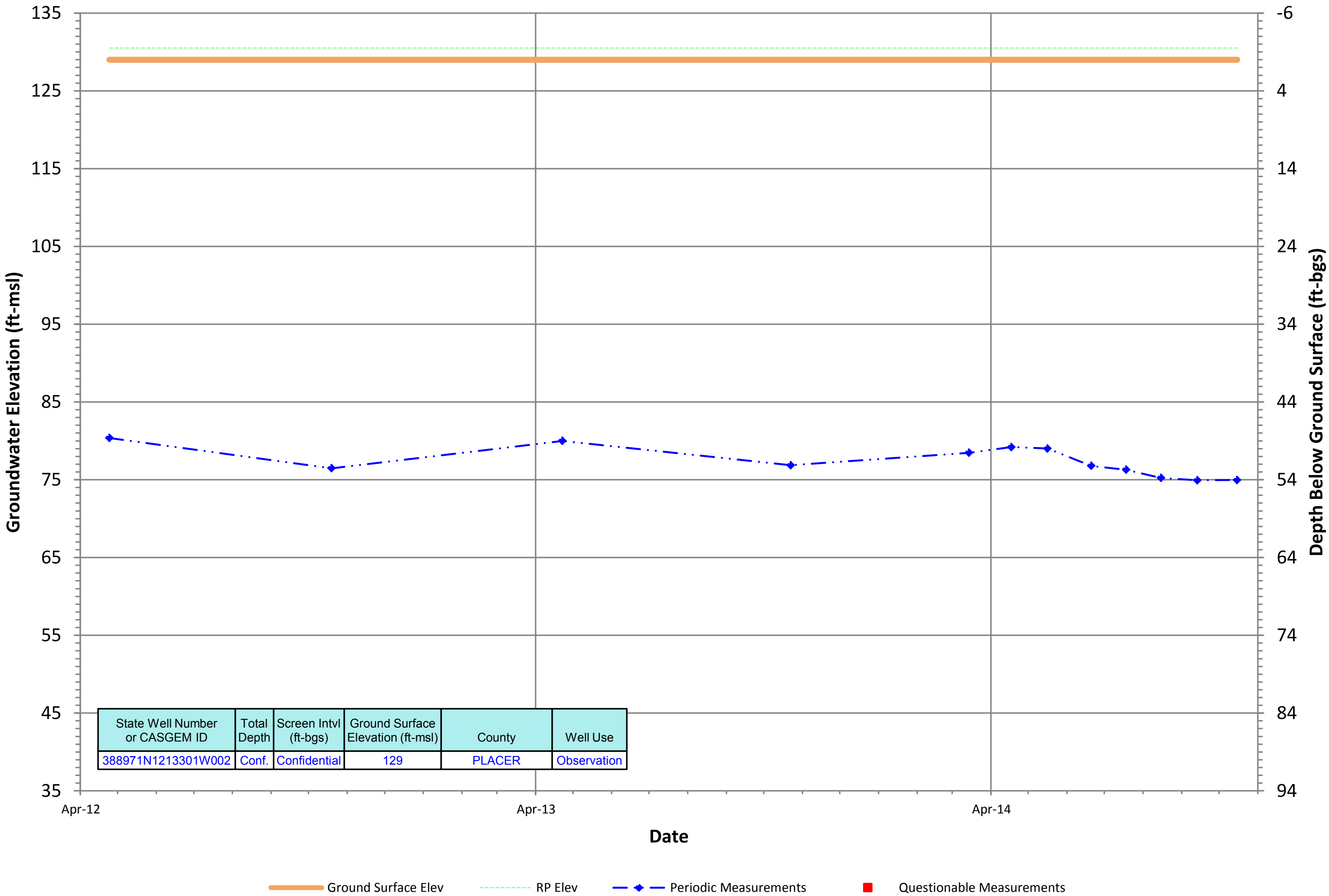
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388971N1213301W001	Conf.	Confidential	129	PLACER	Observation

388971N1213301W002
Period Of Record: 04/24/2012 to 10/15/2014

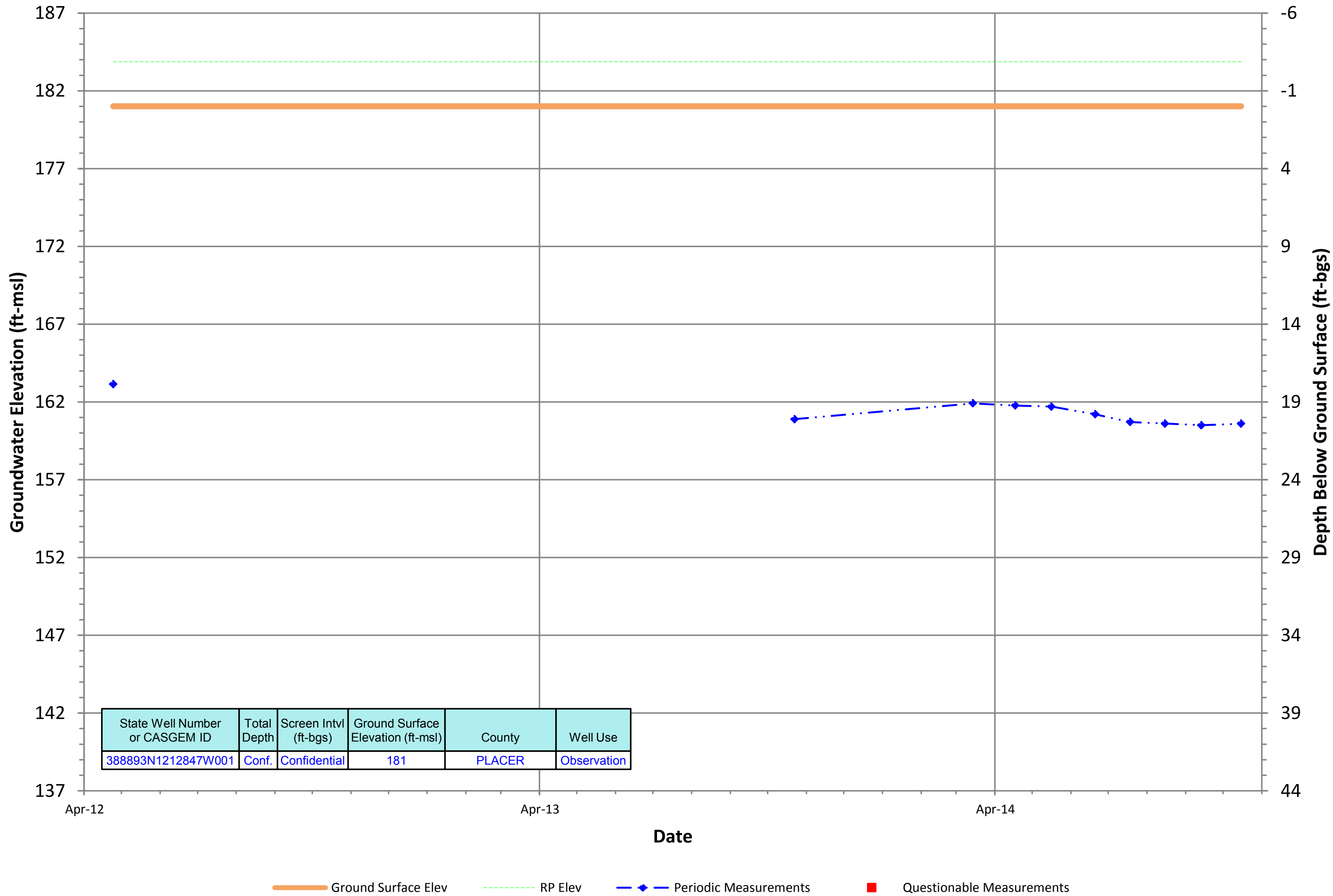
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



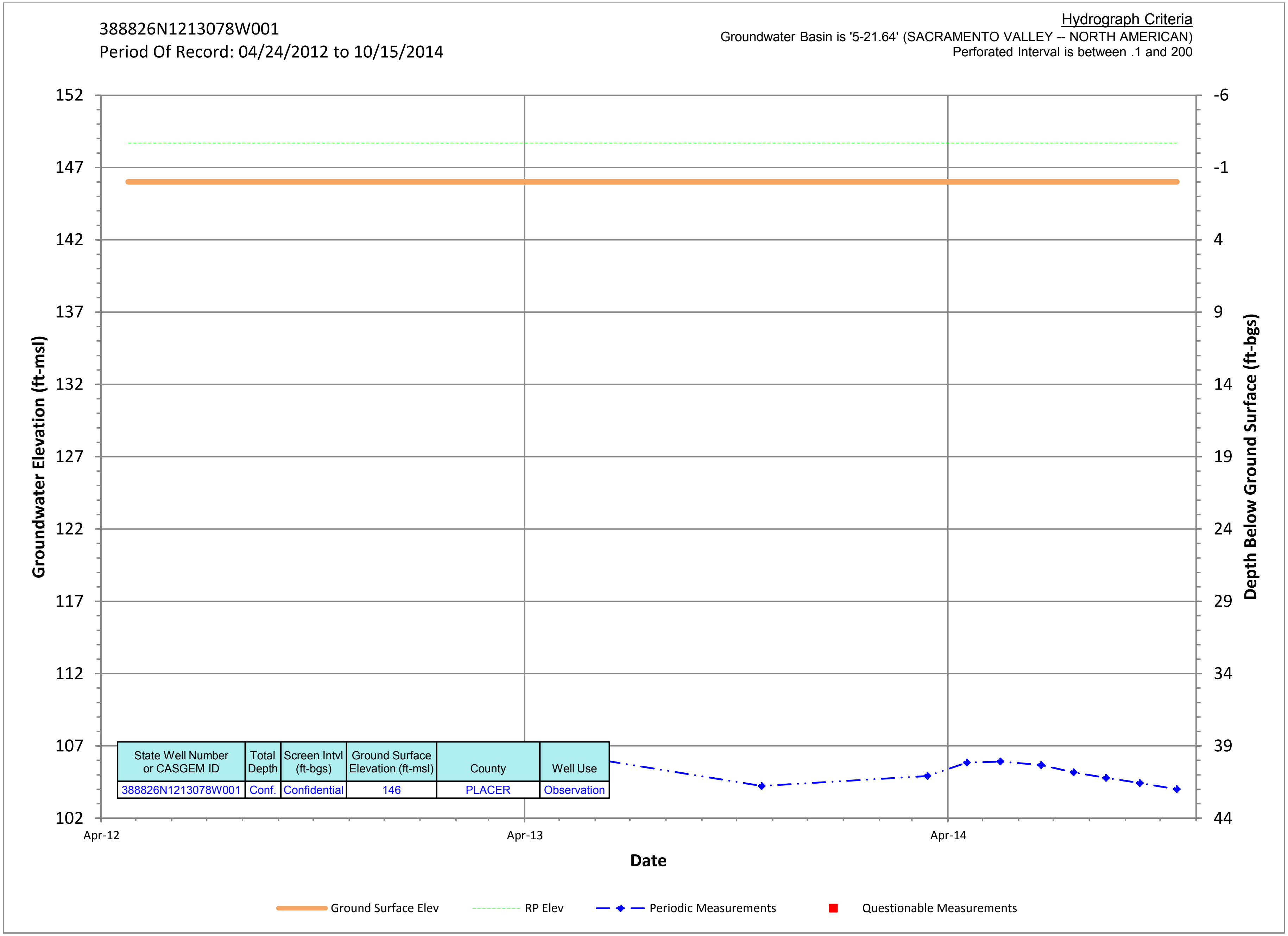
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388971N1213301W002	Conf.	Confidential	129	PLACER	Observation

388893N1212847W001
Period Of Record: 04/24/2012 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



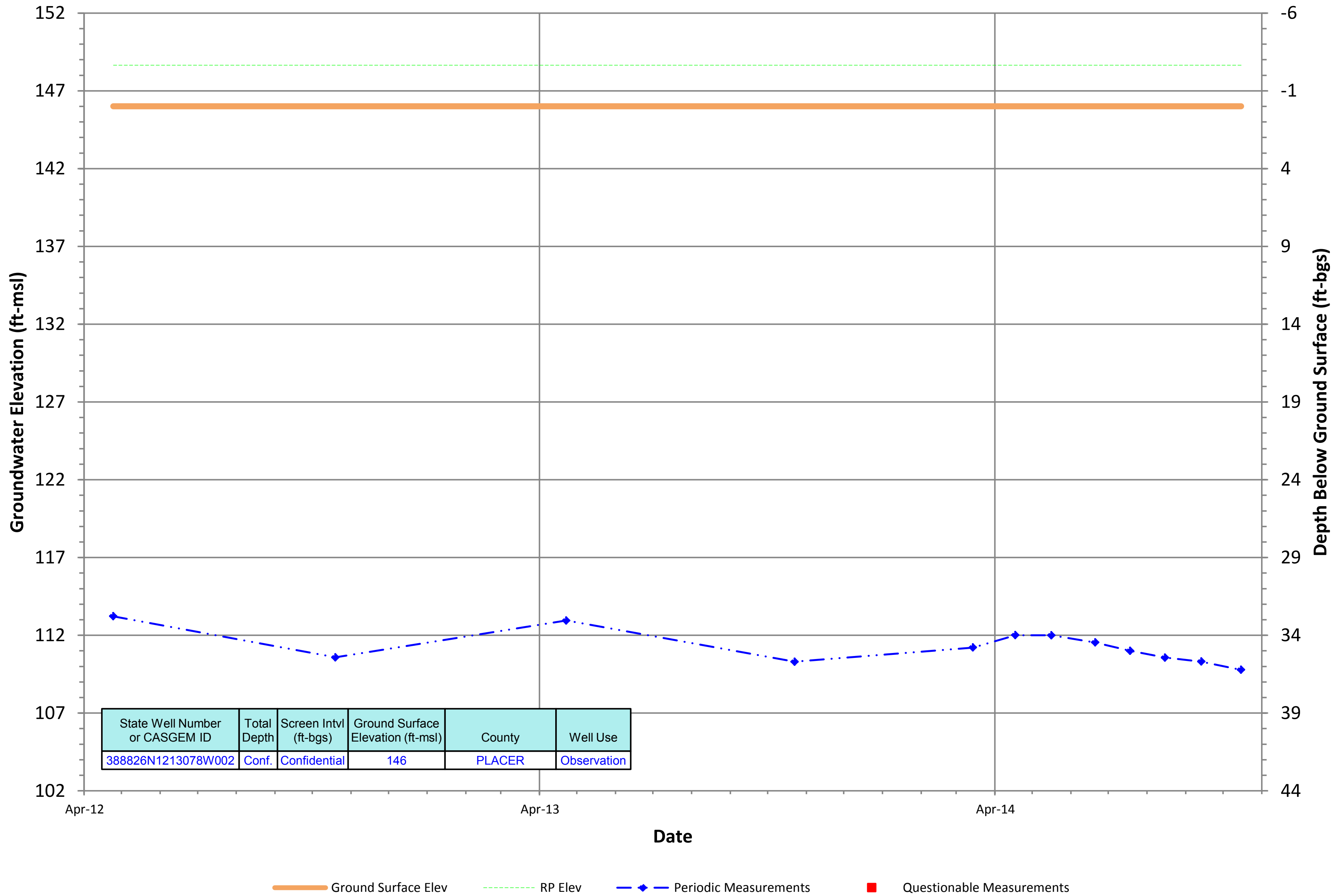
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388893N1212847W001	Conf.	Confidential	181	PLACER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388826N1213078W001	Conf.	Confidential	146	PLACER	Observation

388826N1213078W002
Period Of Record: 04/24/2012 to 10/15/2014

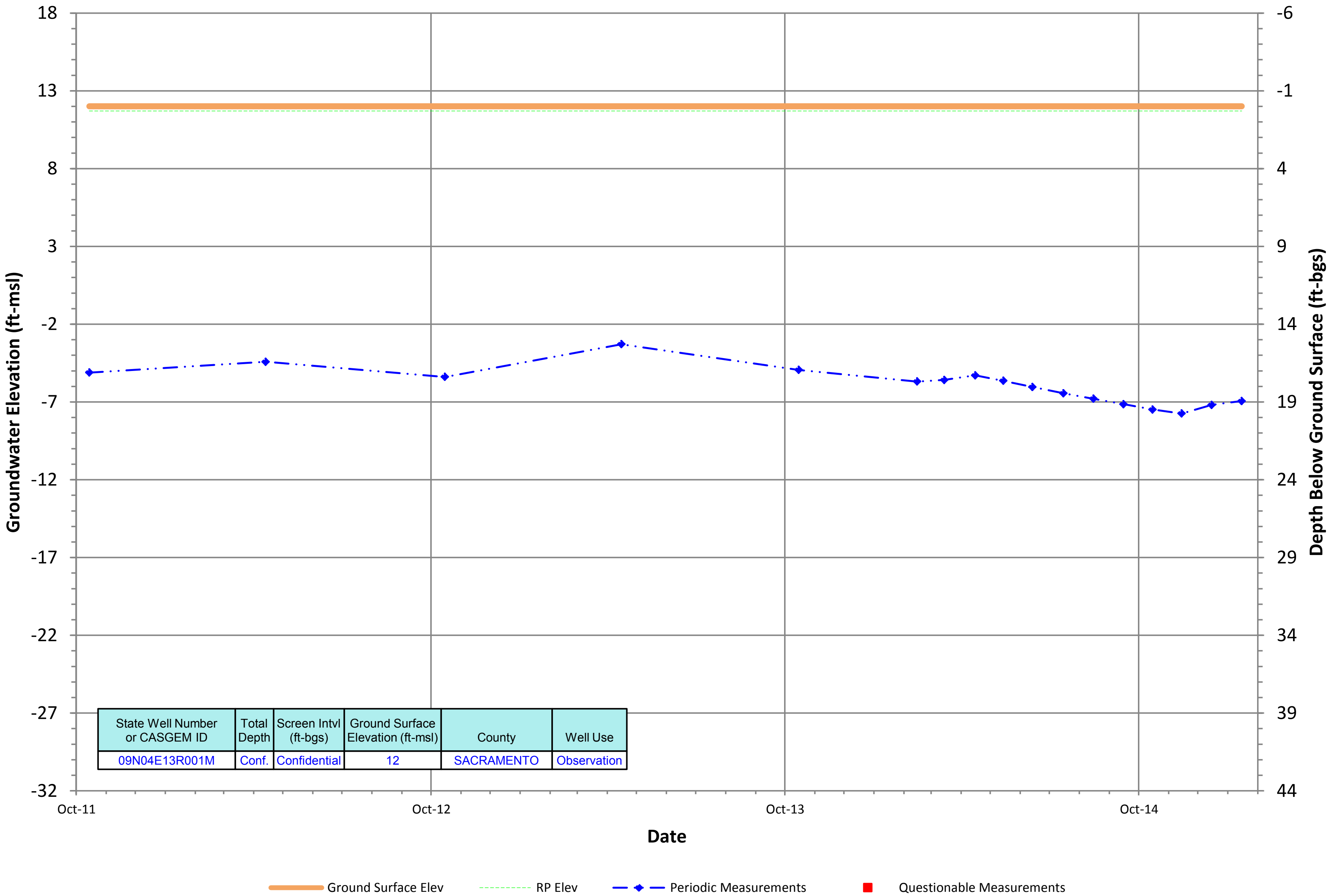
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388826N1213078W002	Conf.	Confidential	146	PLACER	Observation

09N04E13R001M
Period Of Record: 10/14/2011 to 01/15/2015

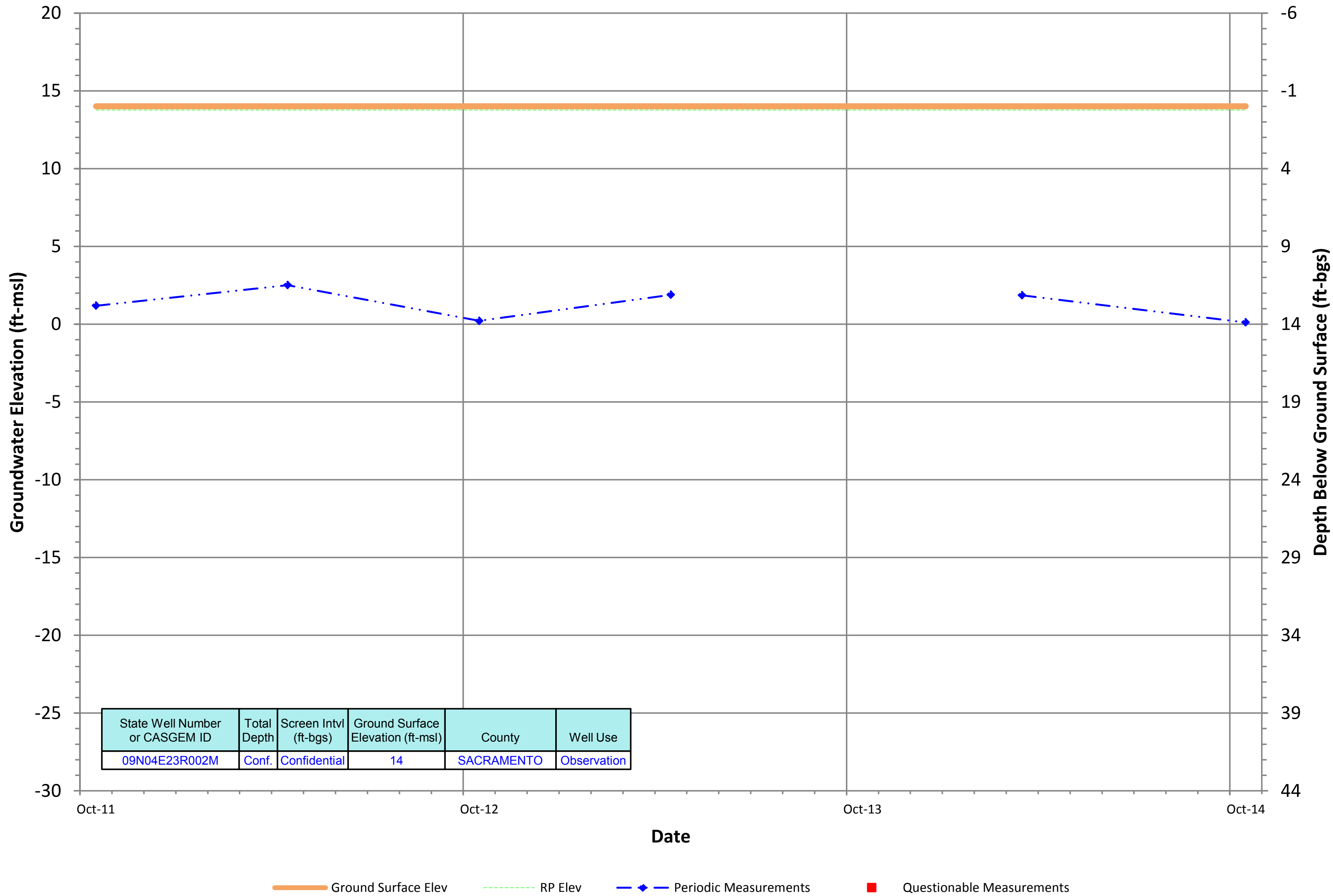
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N04E13R001M	Conf.	Confidential	12	SACRAMENTO	Observation

09N04E23R002M
Period Of Record: 10/18/2011 to 10/15/2014

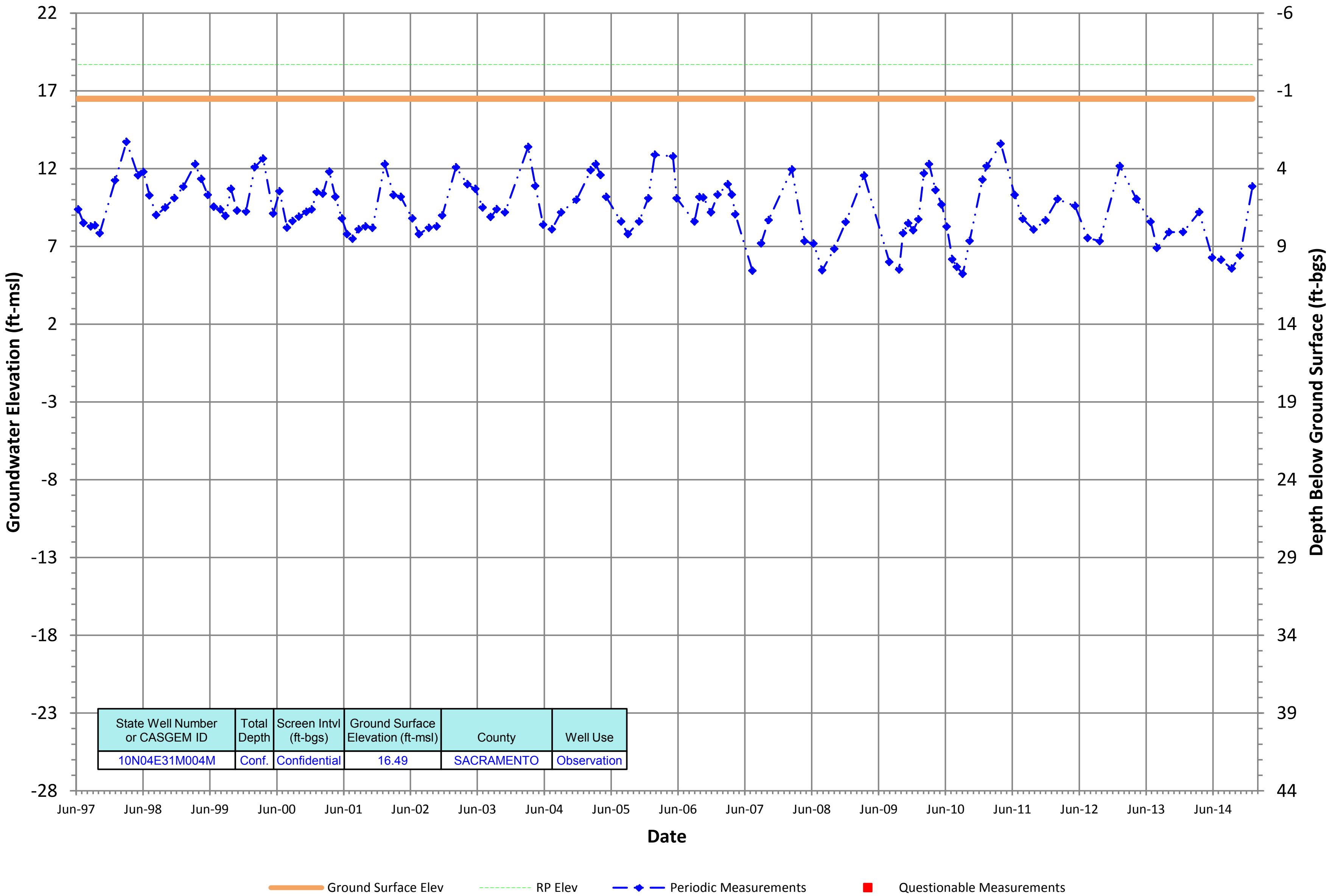
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



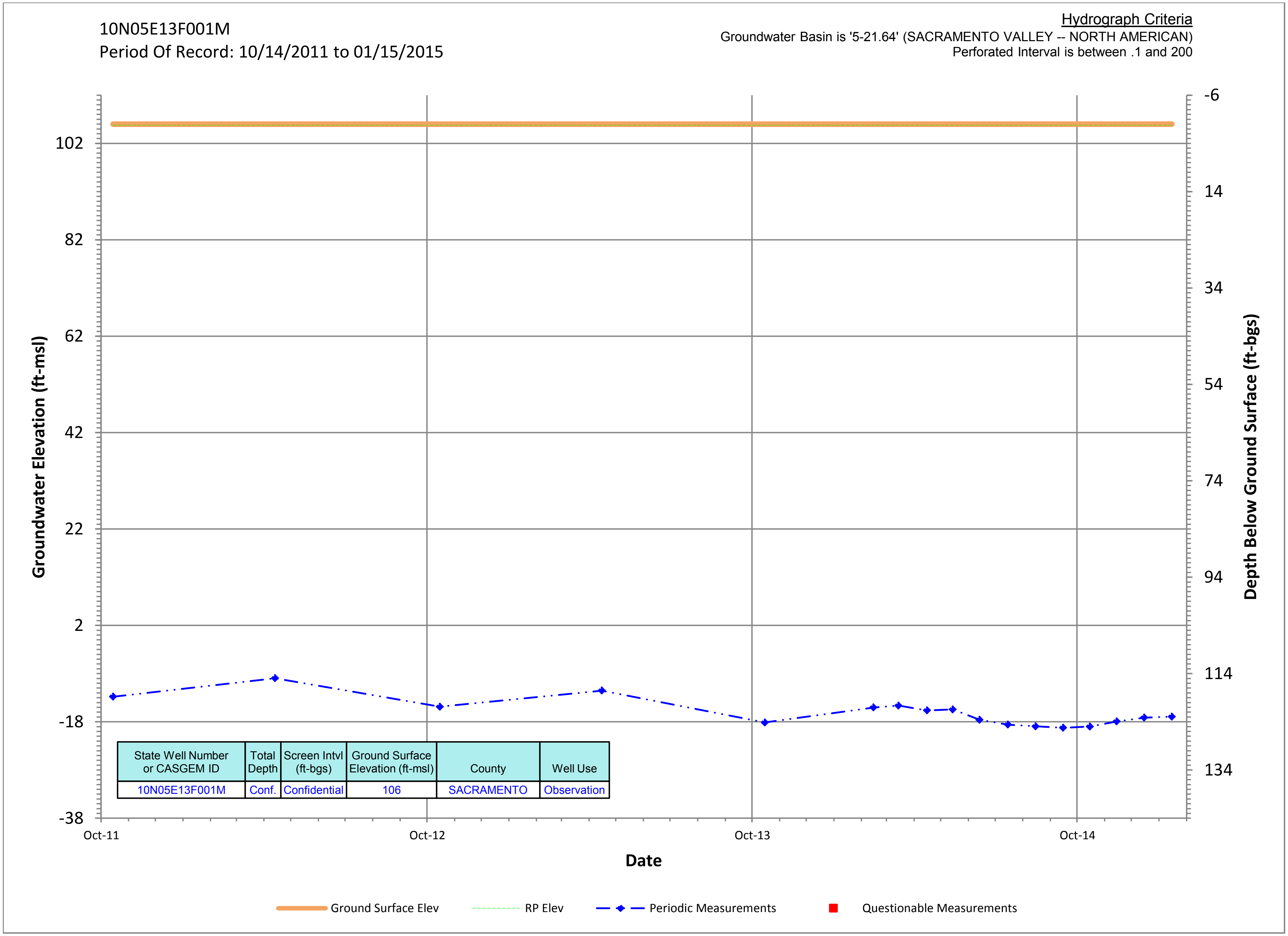
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N04E23R002M	Conf.	Confidential	14	SACRAMENTO	Observation

10N04E31M004M
Period Of Record: 06/11/1997 to 01/02/2015

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



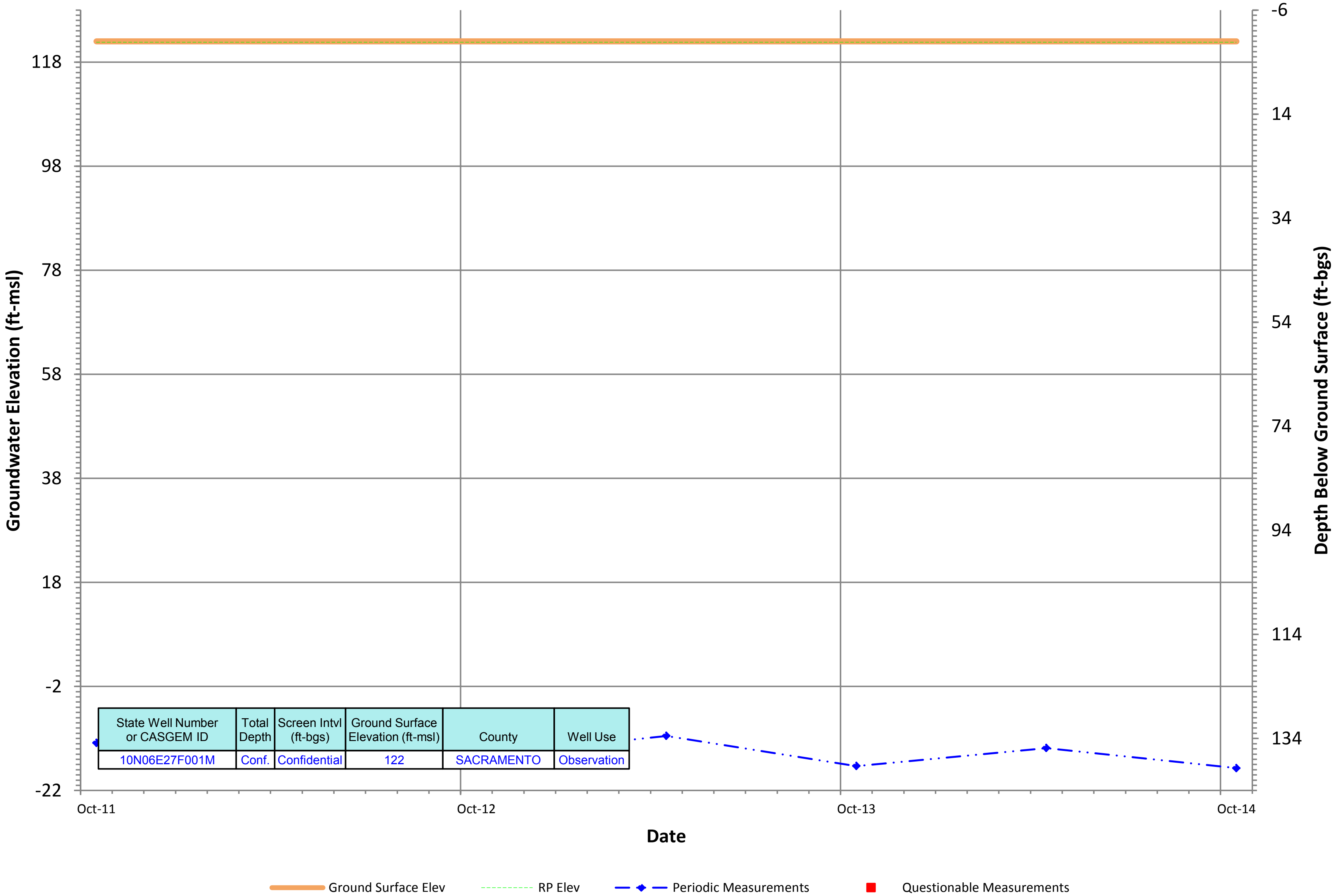
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E31M004M	Conf.	Confidential	16.49	SACRAMENTO	Observation



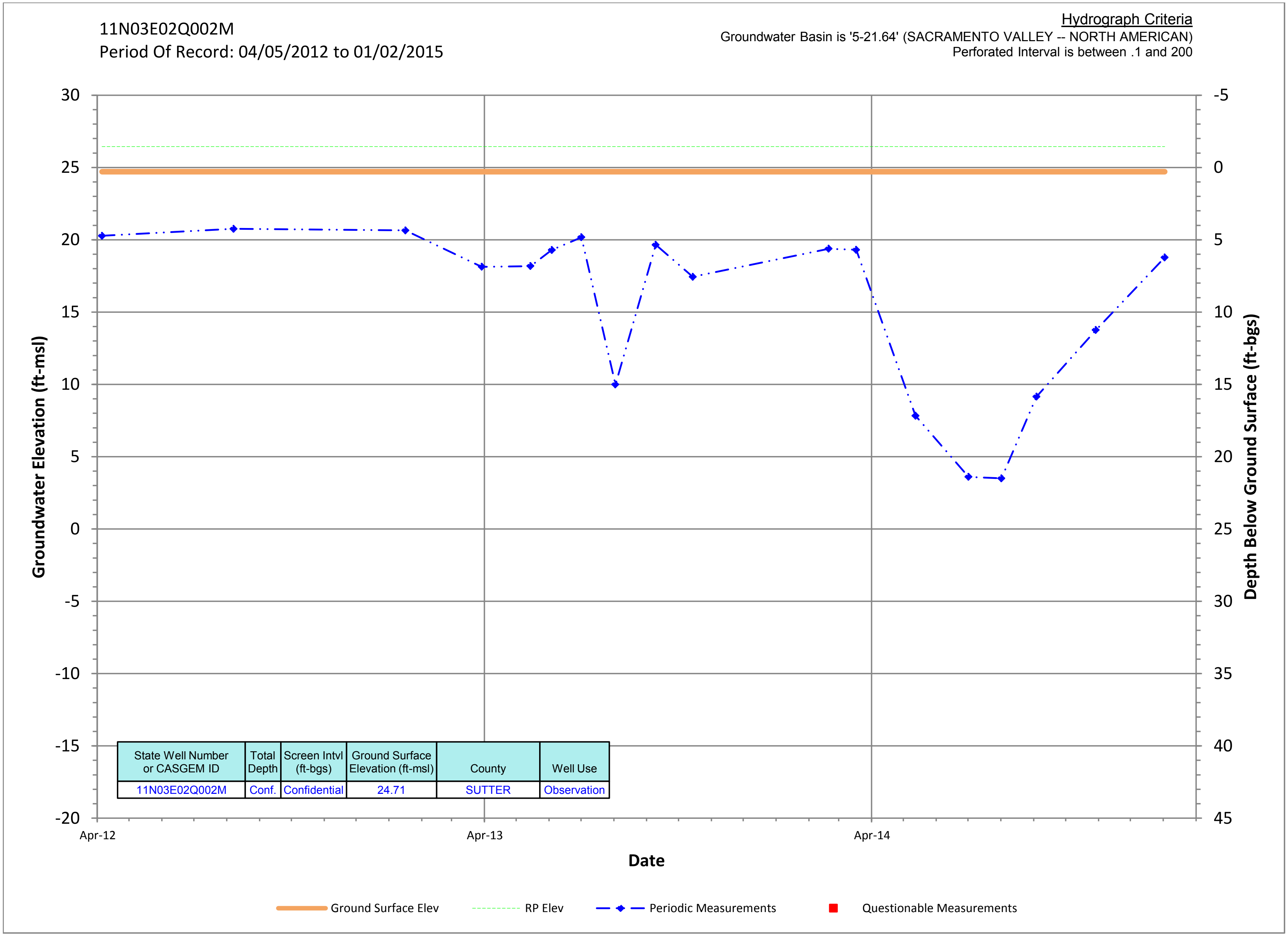
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N05E13F001M	Conf.	Confidential	106	SACRAMENTO	Observation

10N06E27F001M
Period Of Record: 10/14/2011 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



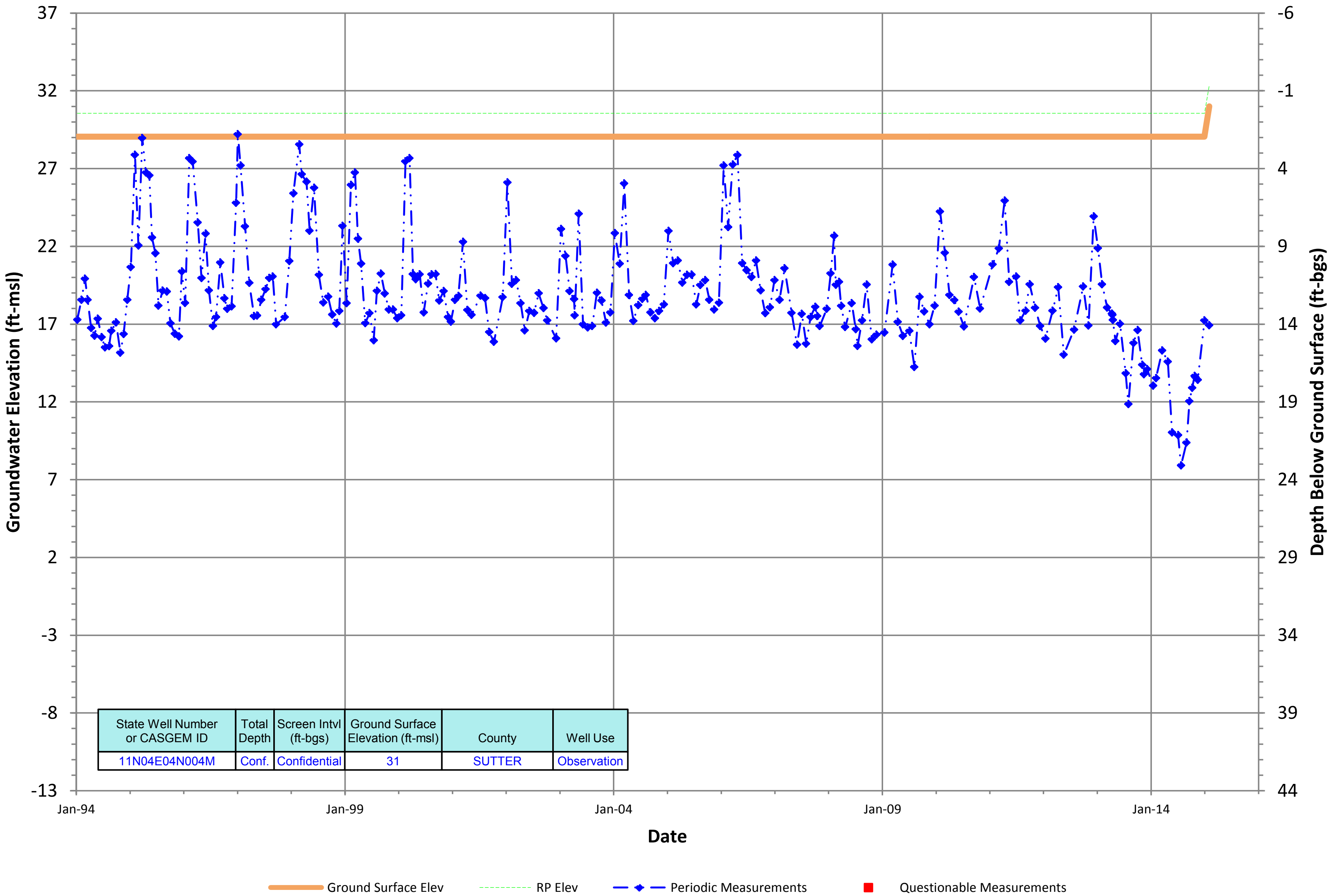
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N06E27F001M	Conf.	Confidential	122	SACRAMENTO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N03E02Q002M	Conf.	Confidential	24.71	SUTTER	Observation

11N04E04N004M
Period Of Record: 01/07/1994 to 01/30/2015

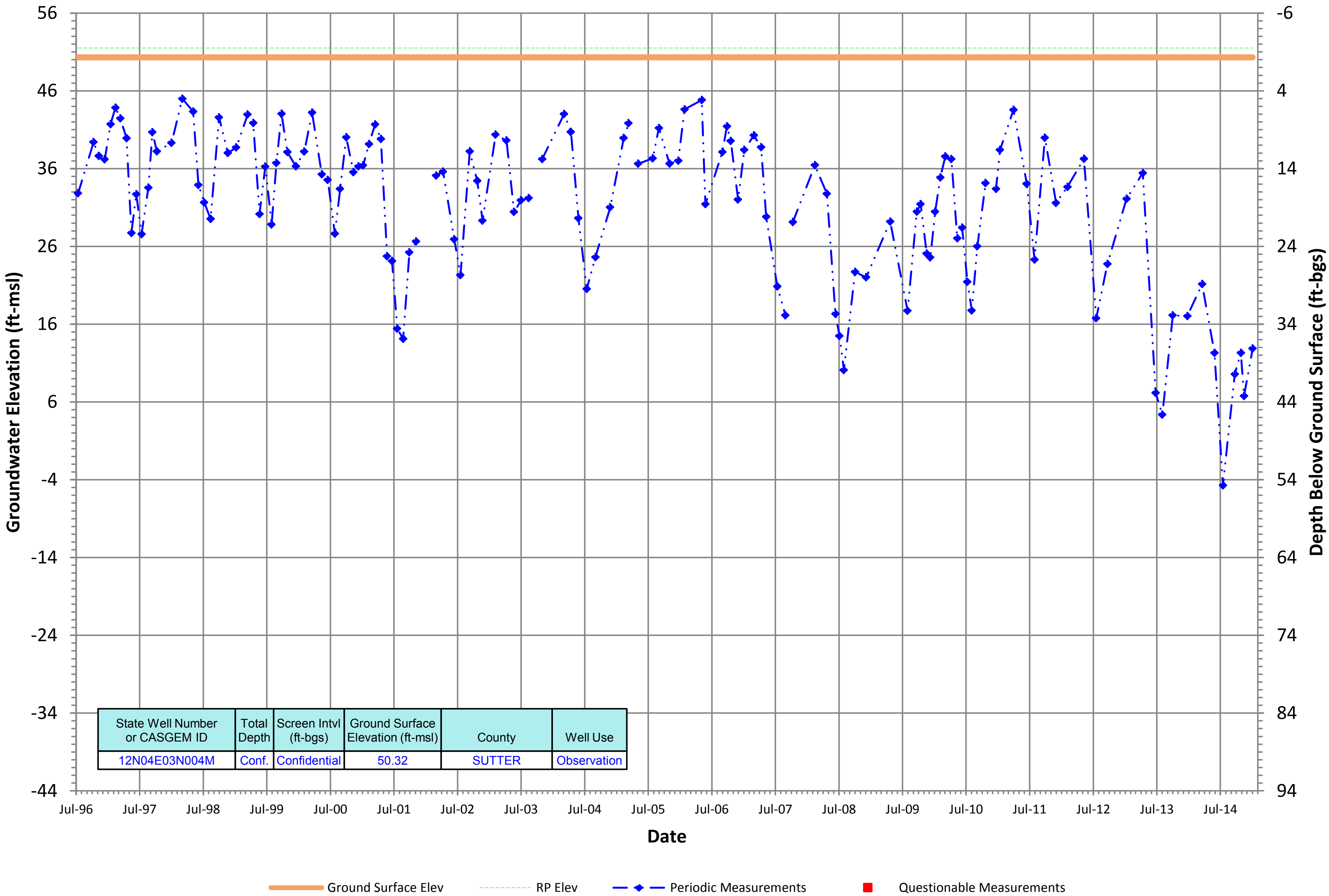
Hydrograph Criteria



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N04E04N004M	Conf.	Confidential	31	SUTTER	Observation

12N04E03N004M
Period Of Record: 07/11/1996 to 01/02/2015

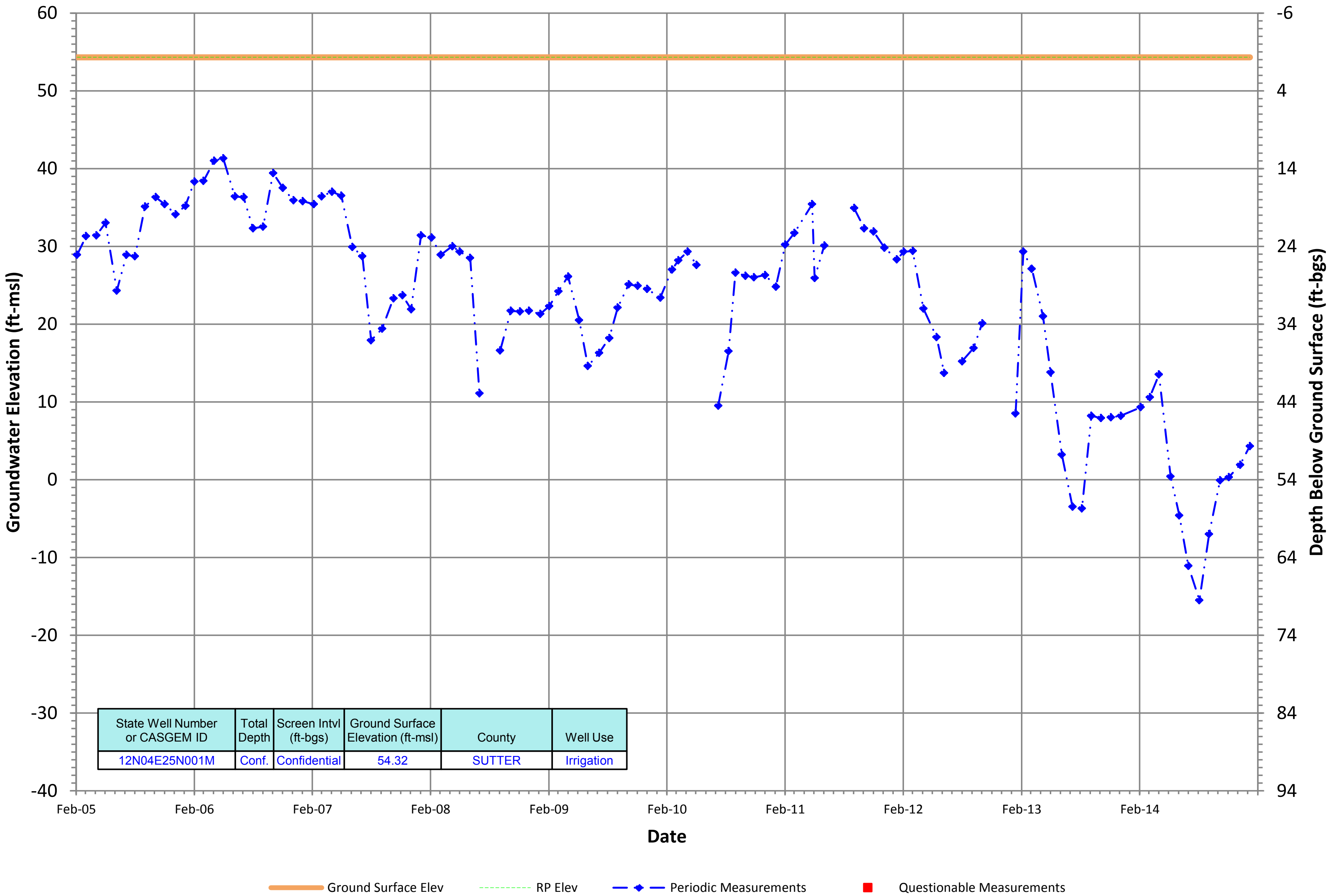
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



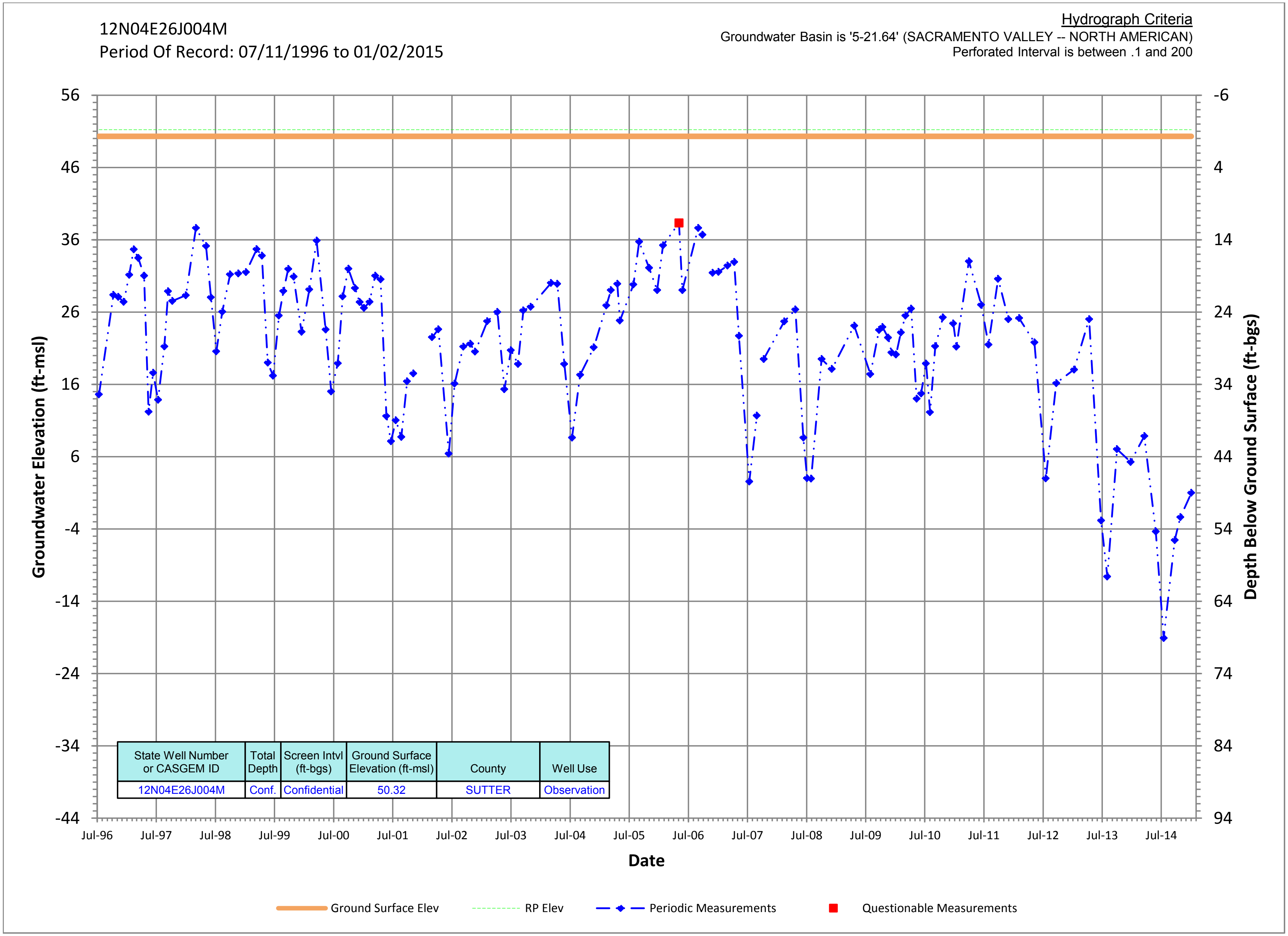
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E03N004M	Conf.	Confidential	50.32	SUTTER	Observation

12N04E25N001M
Period Of Record: 02/03/2005 to 01/07/2015

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E25N001M	Conf.	Confidential	54.32	SUTTER	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E26J004M	Conf.	Confidential	50.32	SUTTER	Observation

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Intermediate Depth Groundwater Monitoring Well Hydrographs- North American Subbasin

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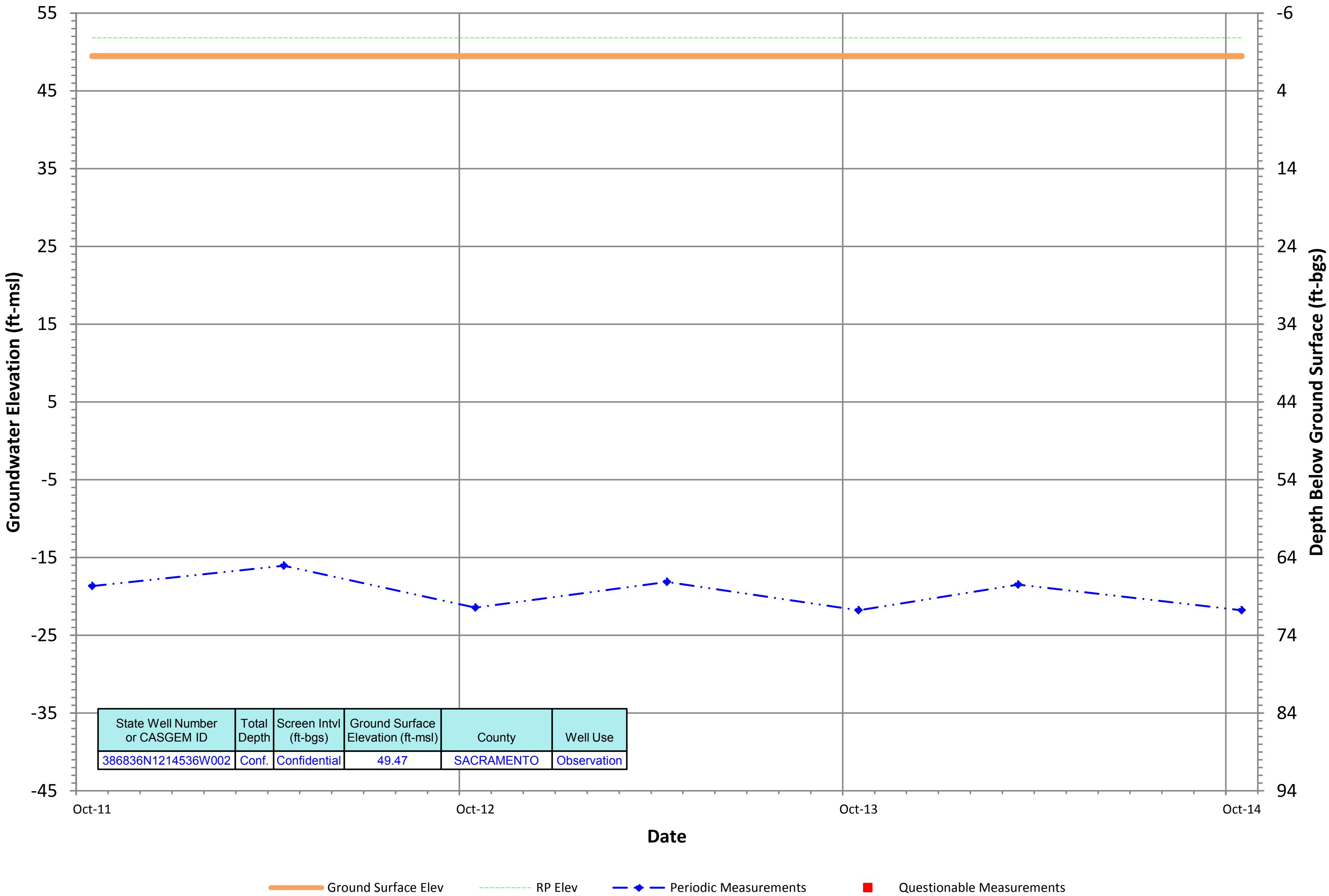
386836N1214536W002
Period Of Record: 10/14/2011 to 10/15/2014

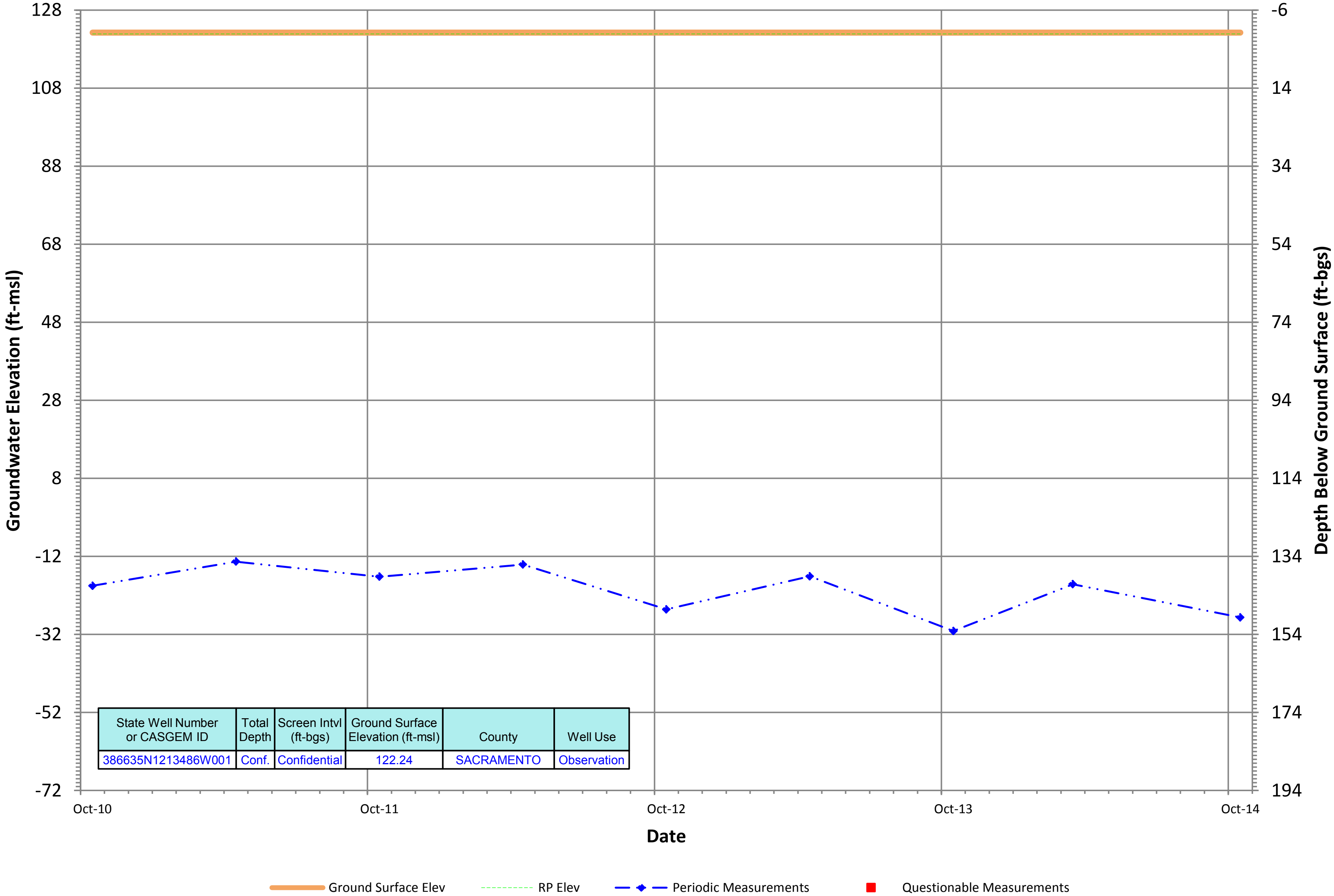
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
386836N1214536W002	Conf.	Confidential	49.47	SACRAMENTO	Observation

386635N1213486W001
Period Of Record: 10/15/2010 to 10/15/2014

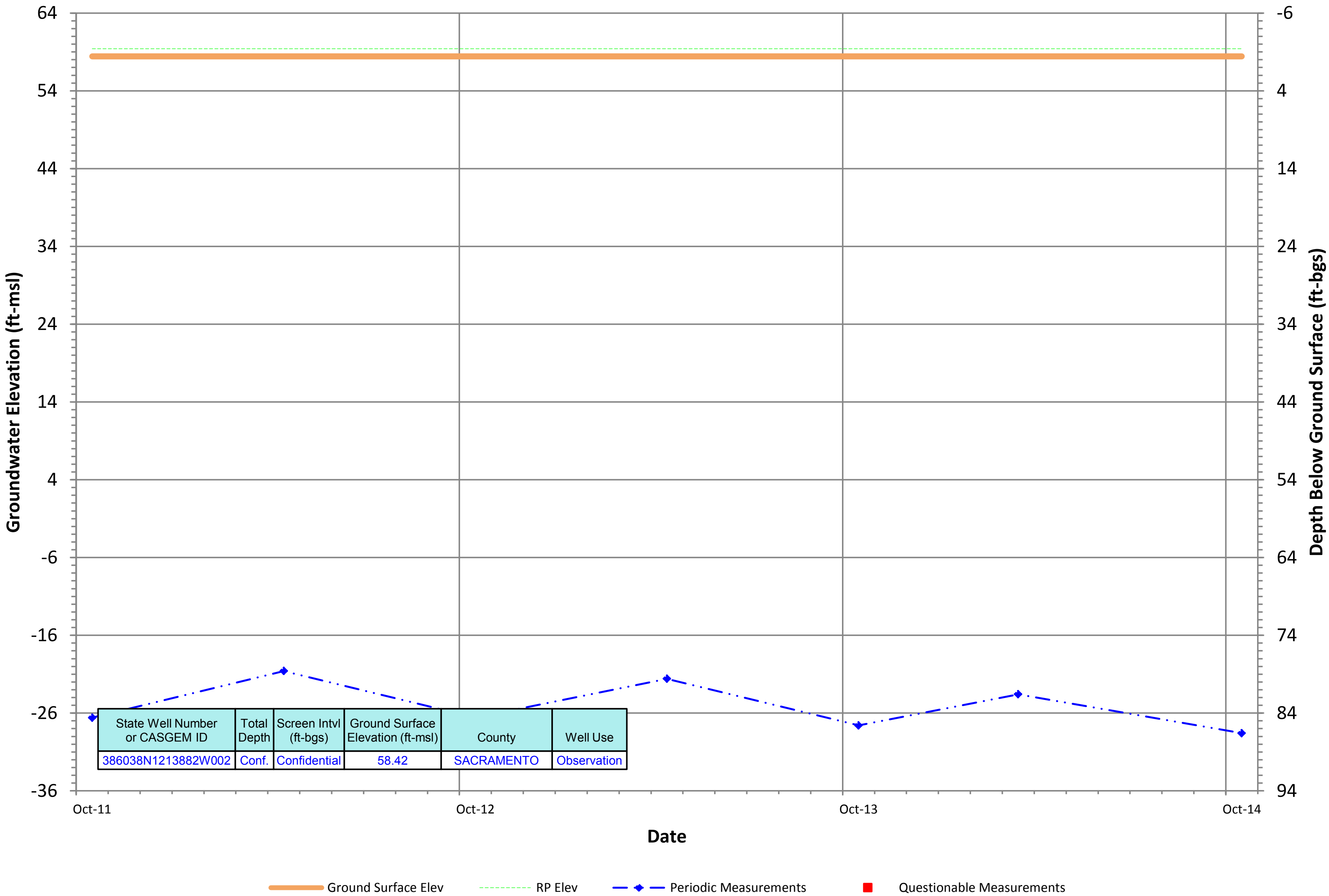
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
386635N1213486W001	Conf.	Confidential	122.24	SACRAMENTO	Observation

386038N1213882W002
Period Of Record: 10/13/2011 to 10/15/2014

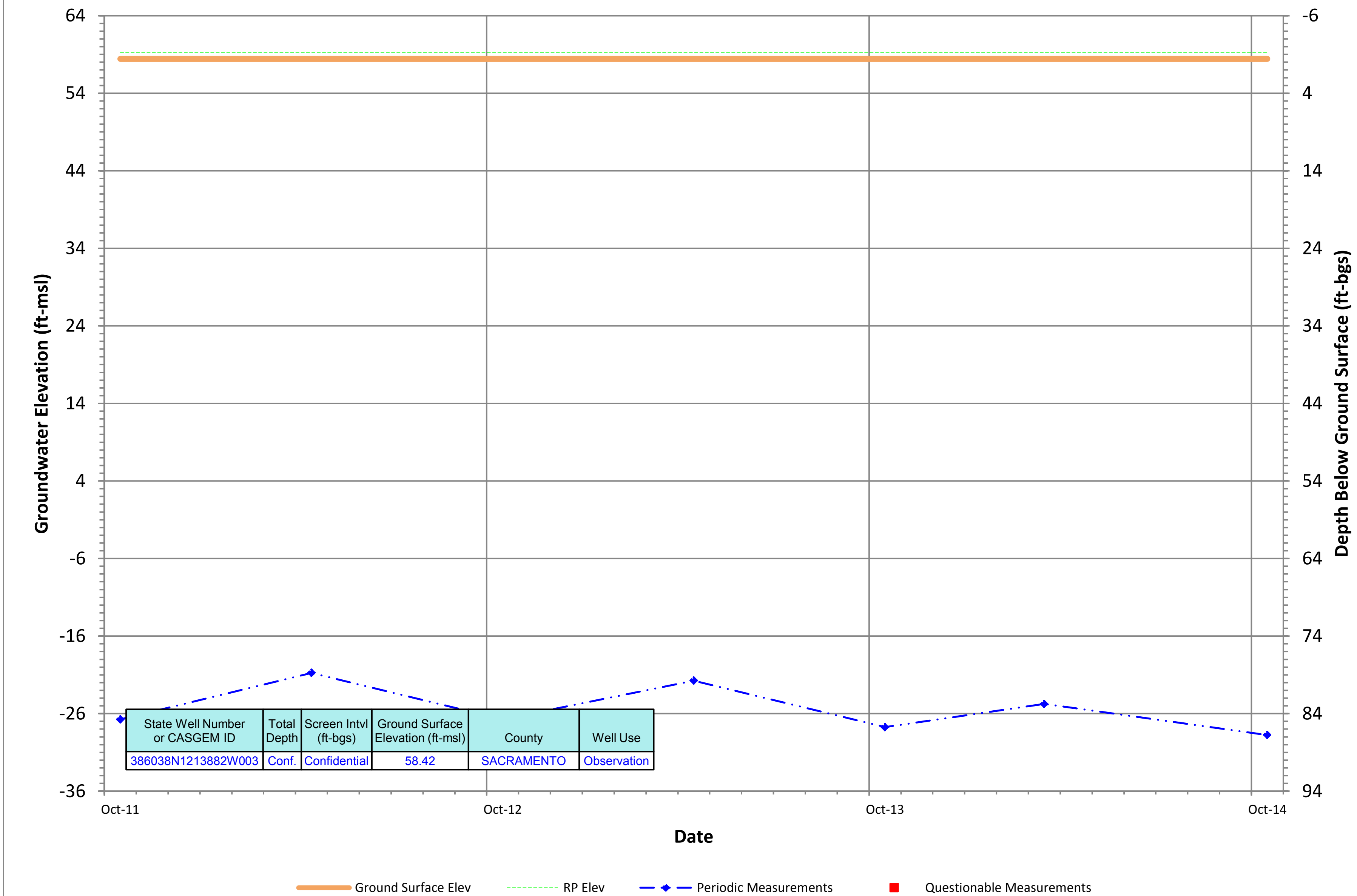
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



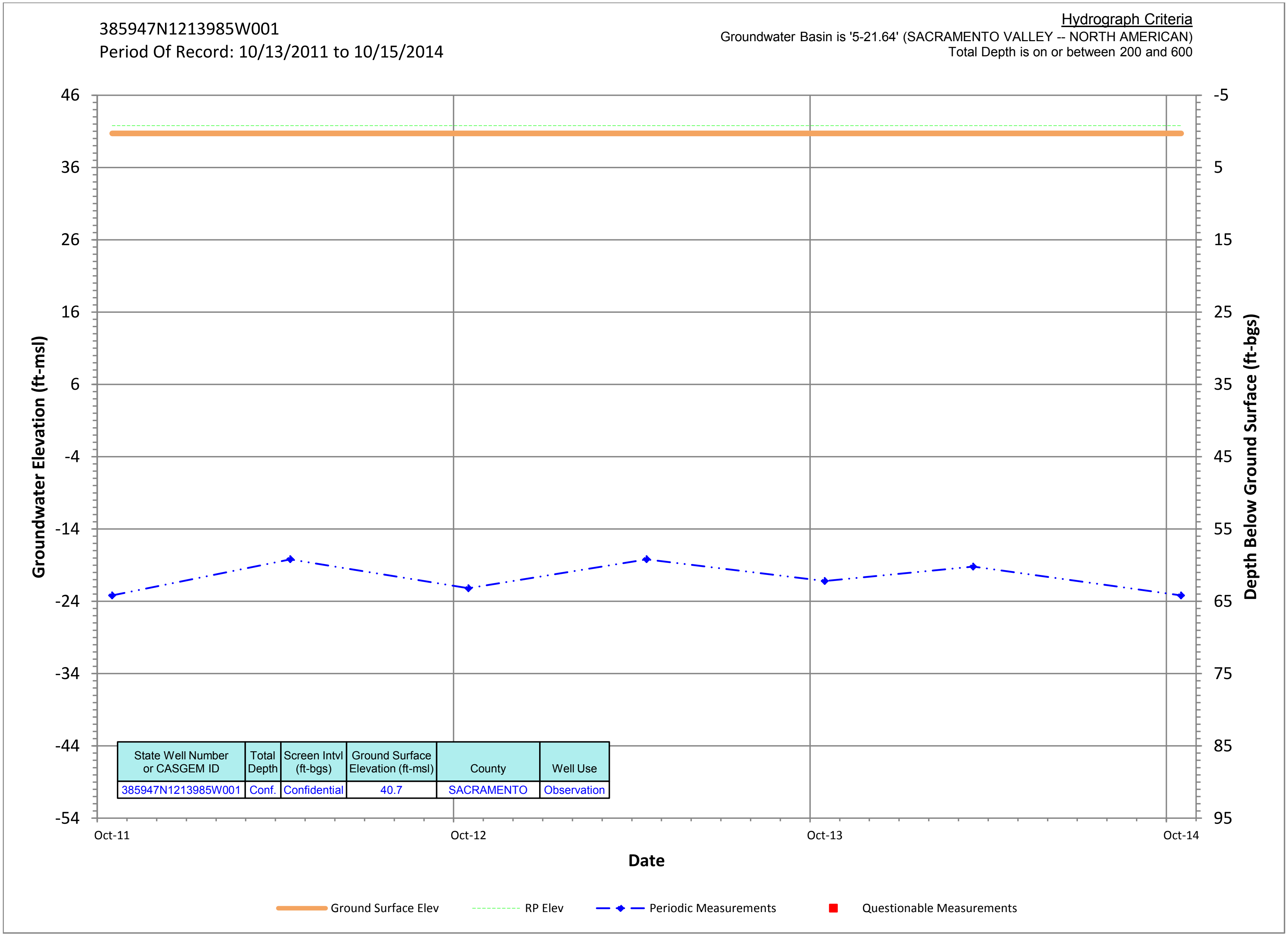
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
386038N1213882W002	Conf.	Confidential	58.42	SACRAMENTO	Observation

386038N1213882W003
Period Of Record: 10/13/2011 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



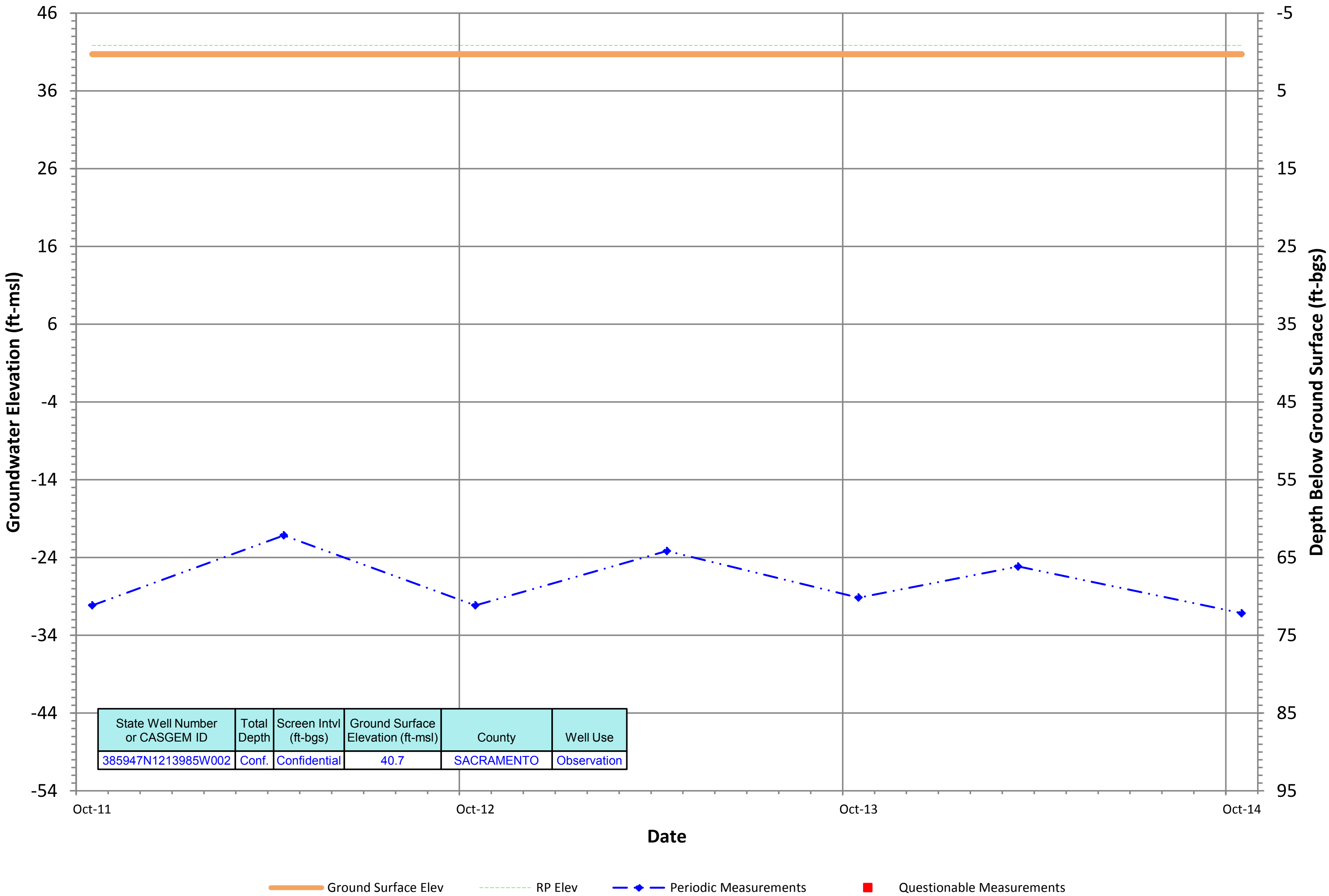
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
386038N1213882W003	Conf.	Confidential	58.42	SACRAMENTO	Observation



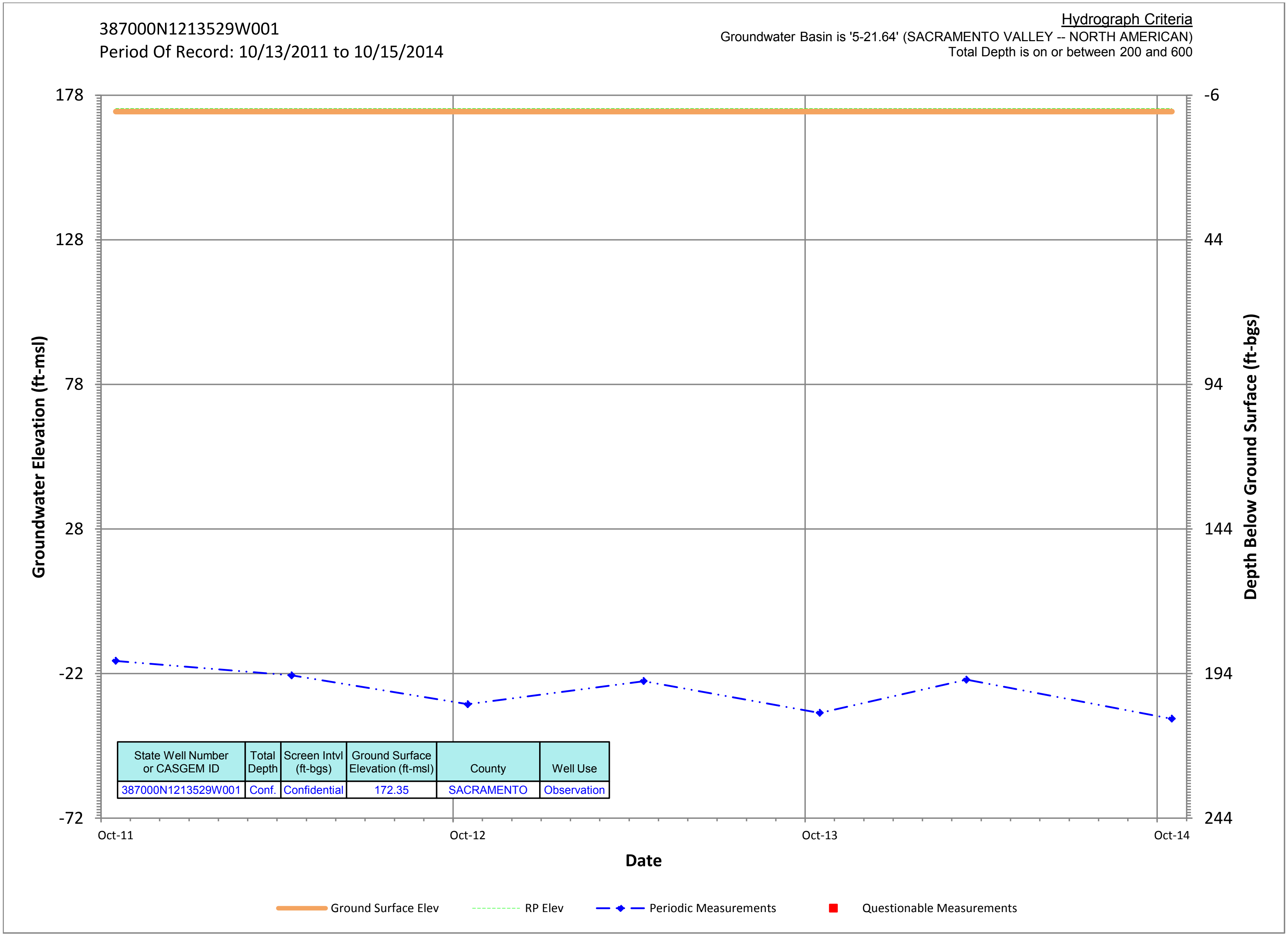
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
385947N1213985W001	Conf.	Confidential	40.7	SACRAMENTO	Observation

385947N1213985W002
Period Of Record: 10/13/2011 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



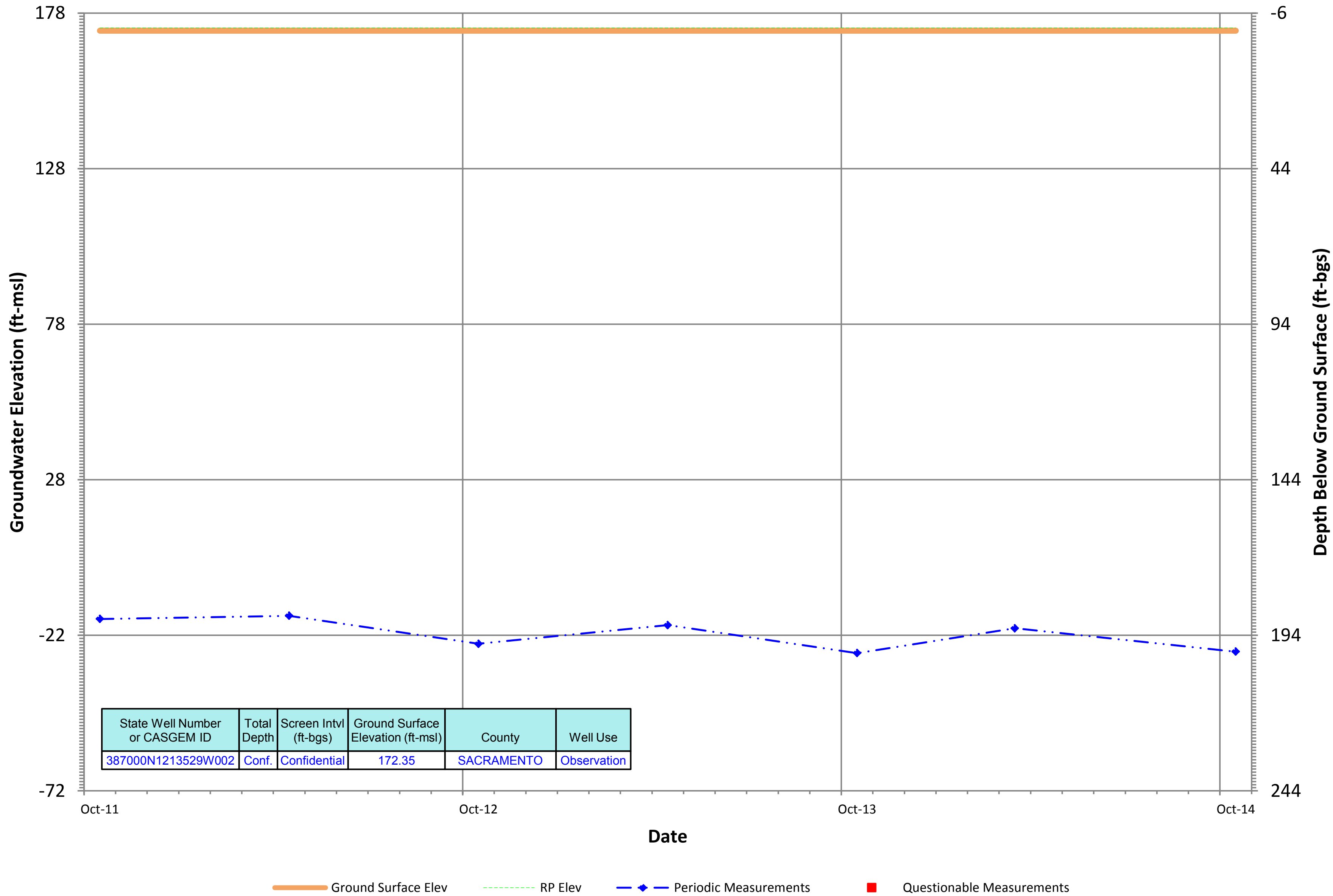
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
385947N1213985W002	Conf.	Confidential	40.7	SACRAMENTO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387000N1213529W001	Conf.	Confidential	172.35	SACRAMENTO	Observation

387000N1213529W002
Period Of Record: 10/13/2011 to 10/15/2014

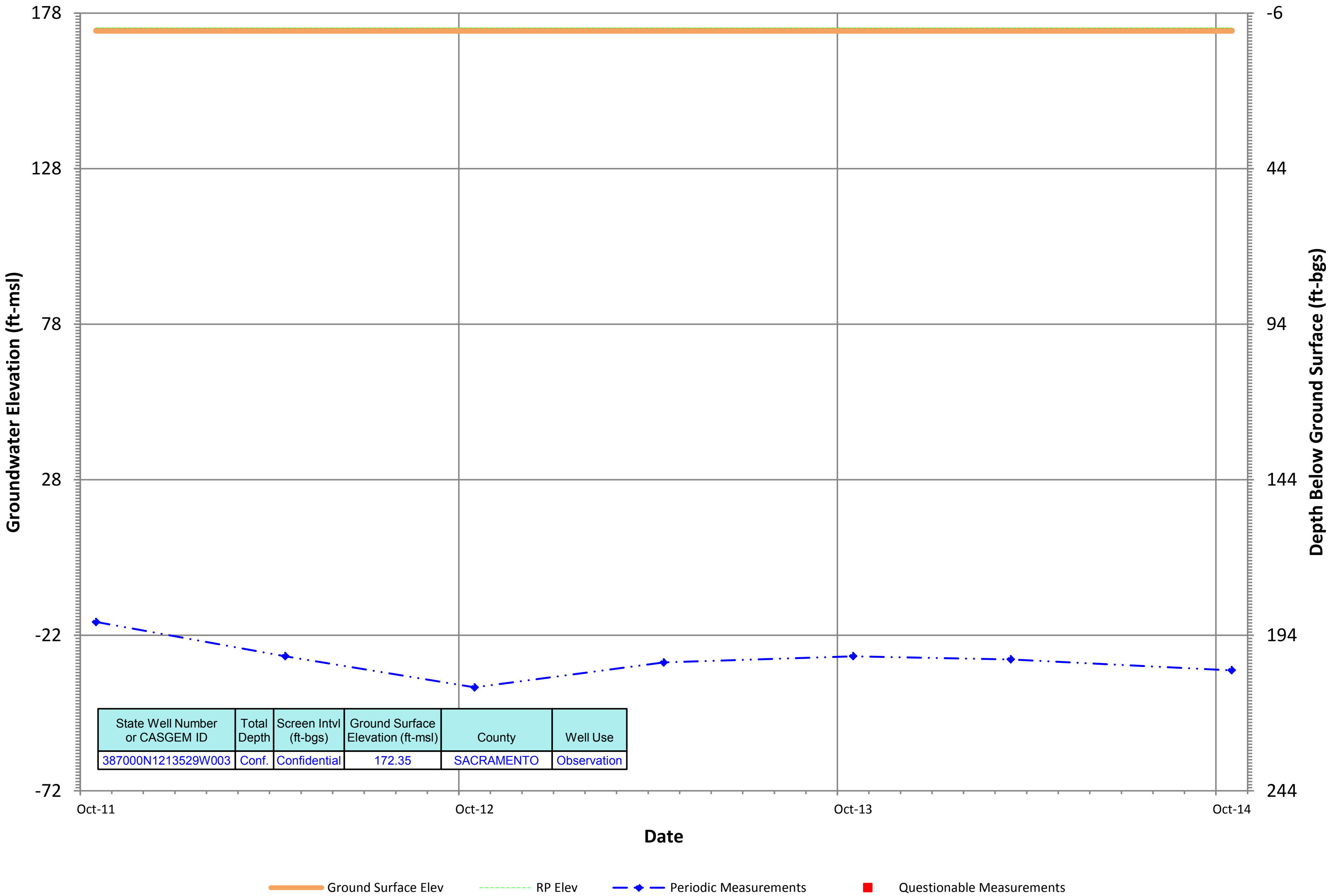
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387000N1213529W002	Conf.	Confidential	172.35	SACRAMENTO	Observation

387000N1213529W003
Period Of Record: 10/13/2011 to 10/15/2014

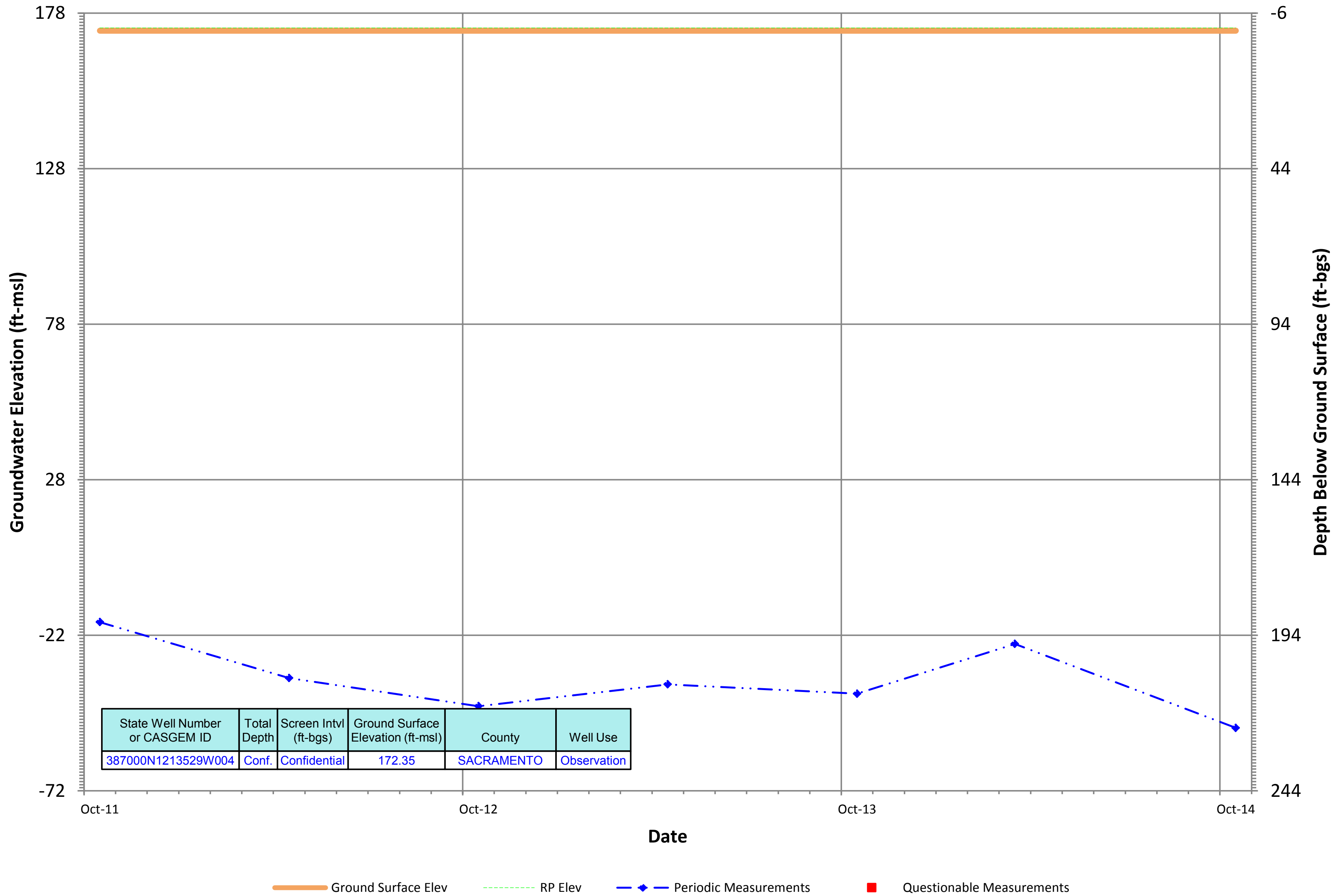
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387000N1213529W003	Conf.	Confidential	172.35	SACRAMENTO	Observation

387000N1213529W004
Period Of Record: 10/13/2011 to 10/15/2014

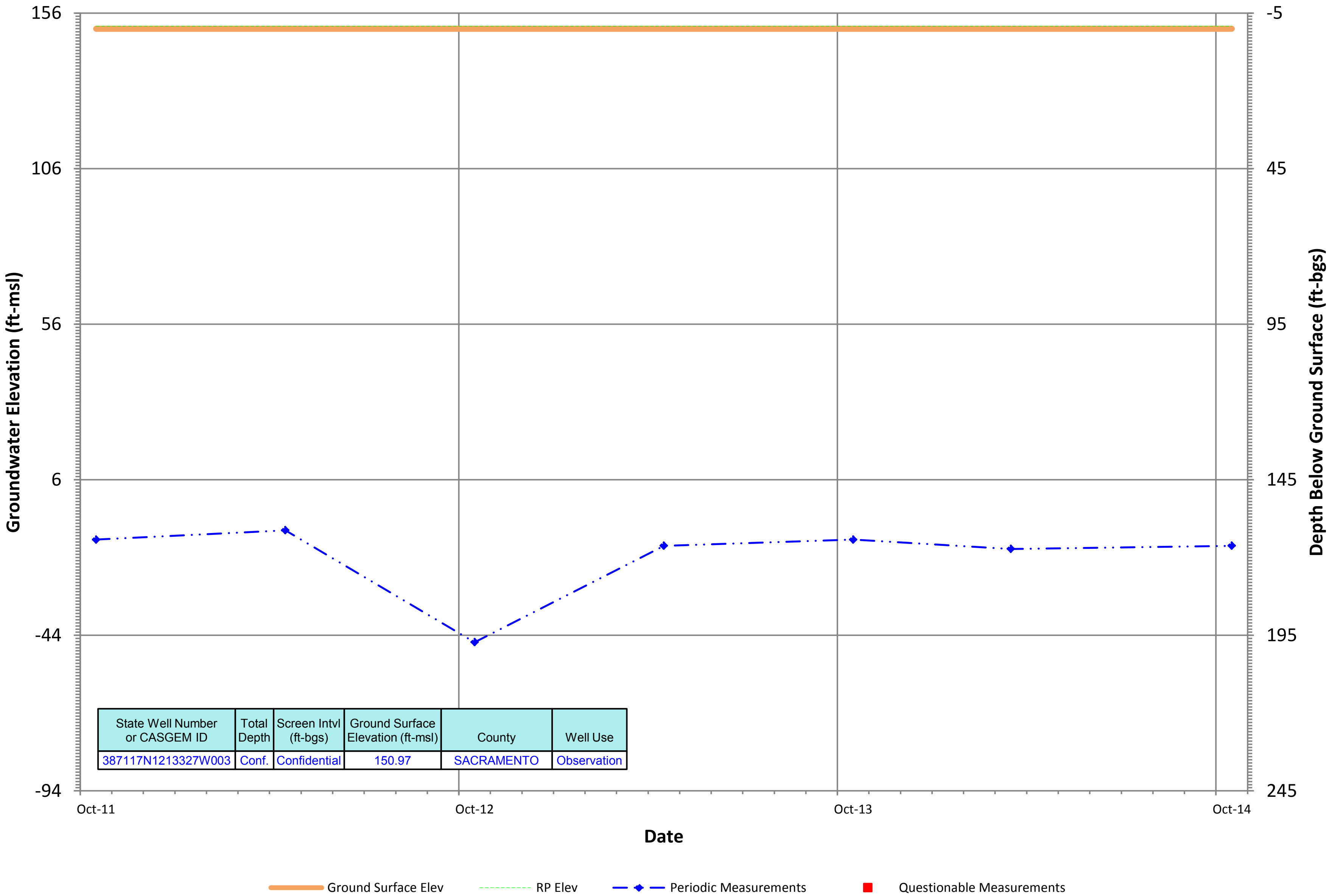
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387000N1213529W004	Conf.	Confidential	172.35	SACRAMENTO	Observation

387117N1213327W003
Period Of Record: 10/13/2011 to 10/15/2014

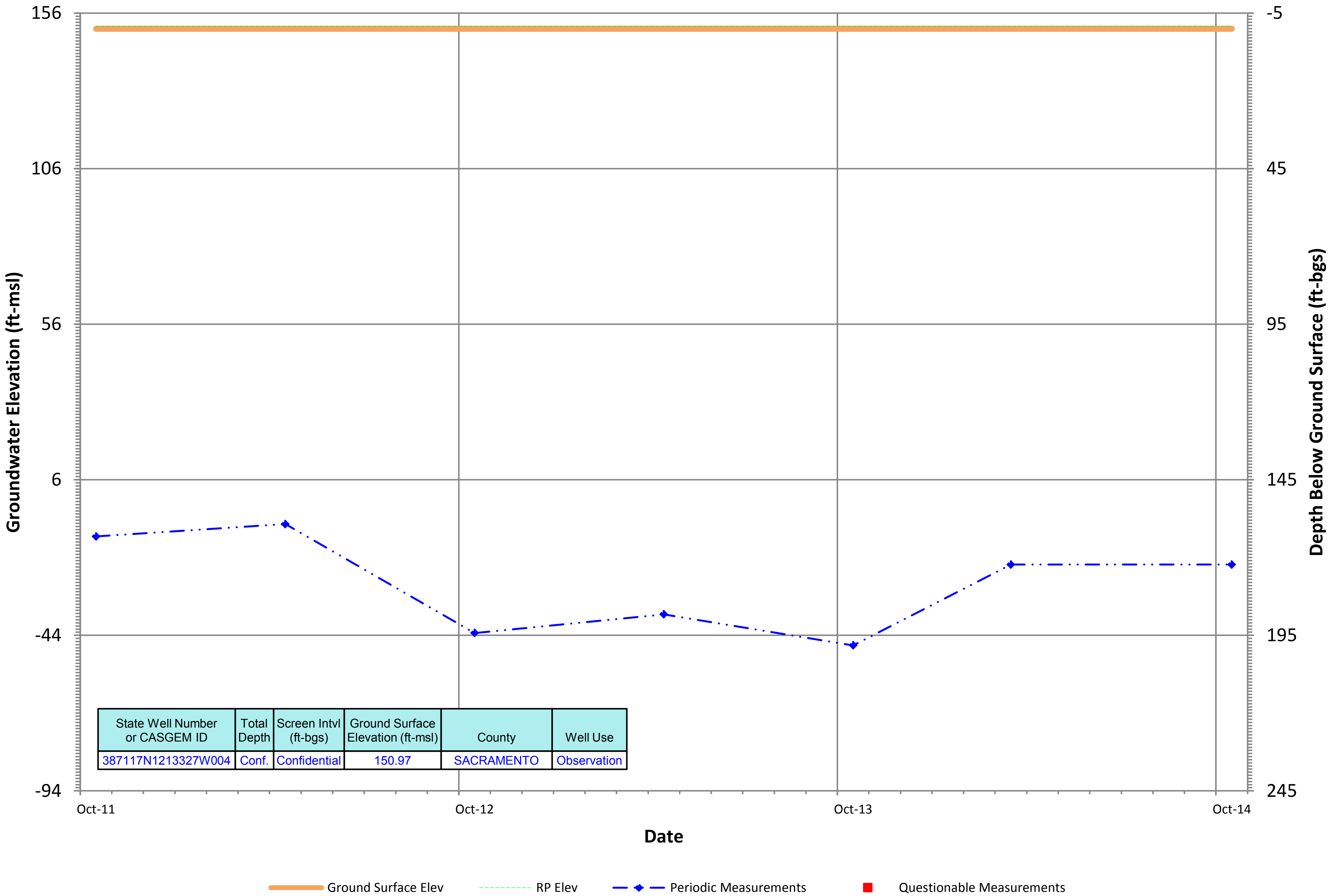
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387117N1213327W003	Conf.	Confidential	150.97	SACRAMENTO	Observation

387117N1213327W004
Period Of Record: 10/13/2011 to 10/15/2014

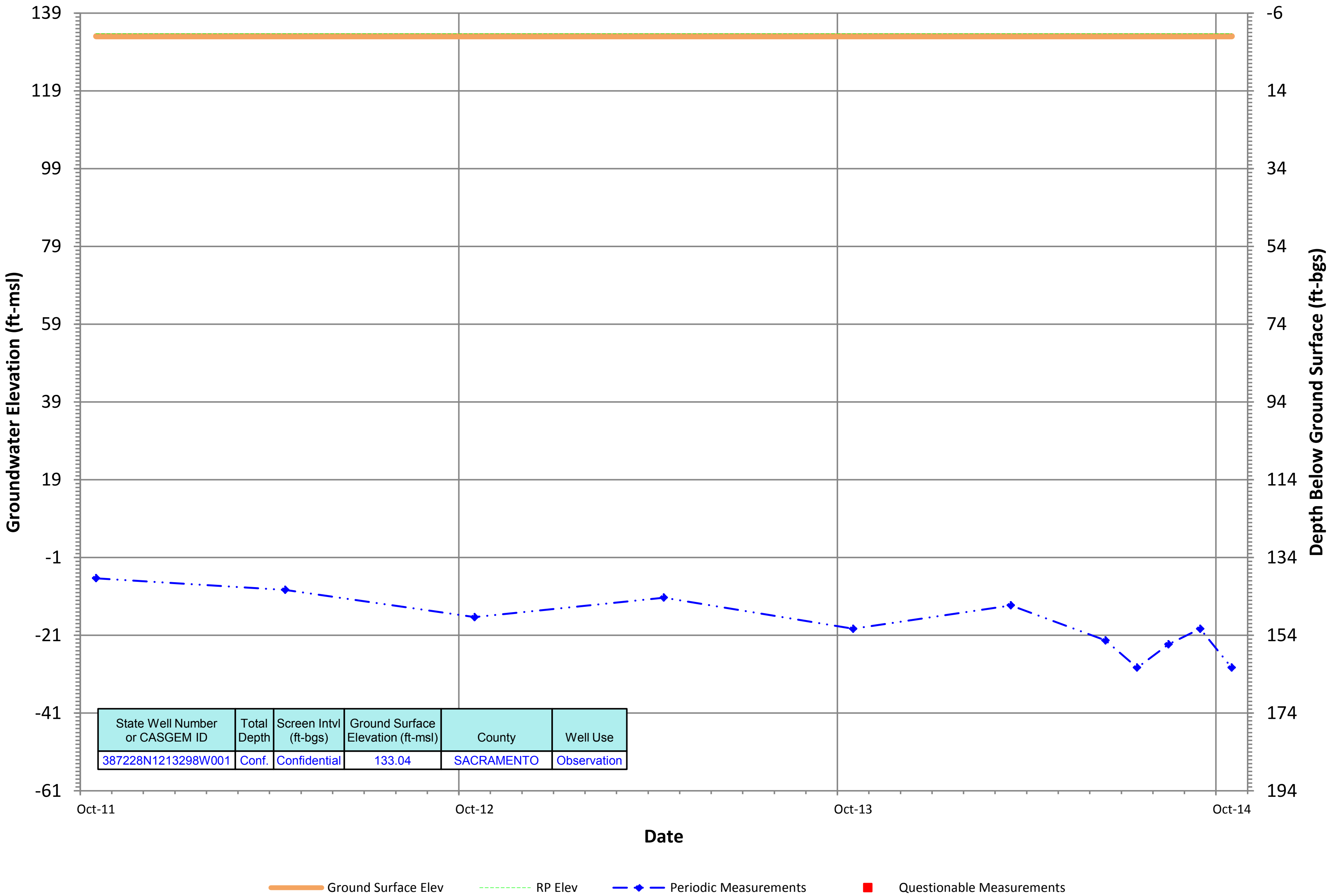
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387117N1213327W004	Conf.	Confidential	150.97	SACRAMENTO	Observation

387228N1213298W001
Period Of Record: 10/13/2011 to 10/15/2014

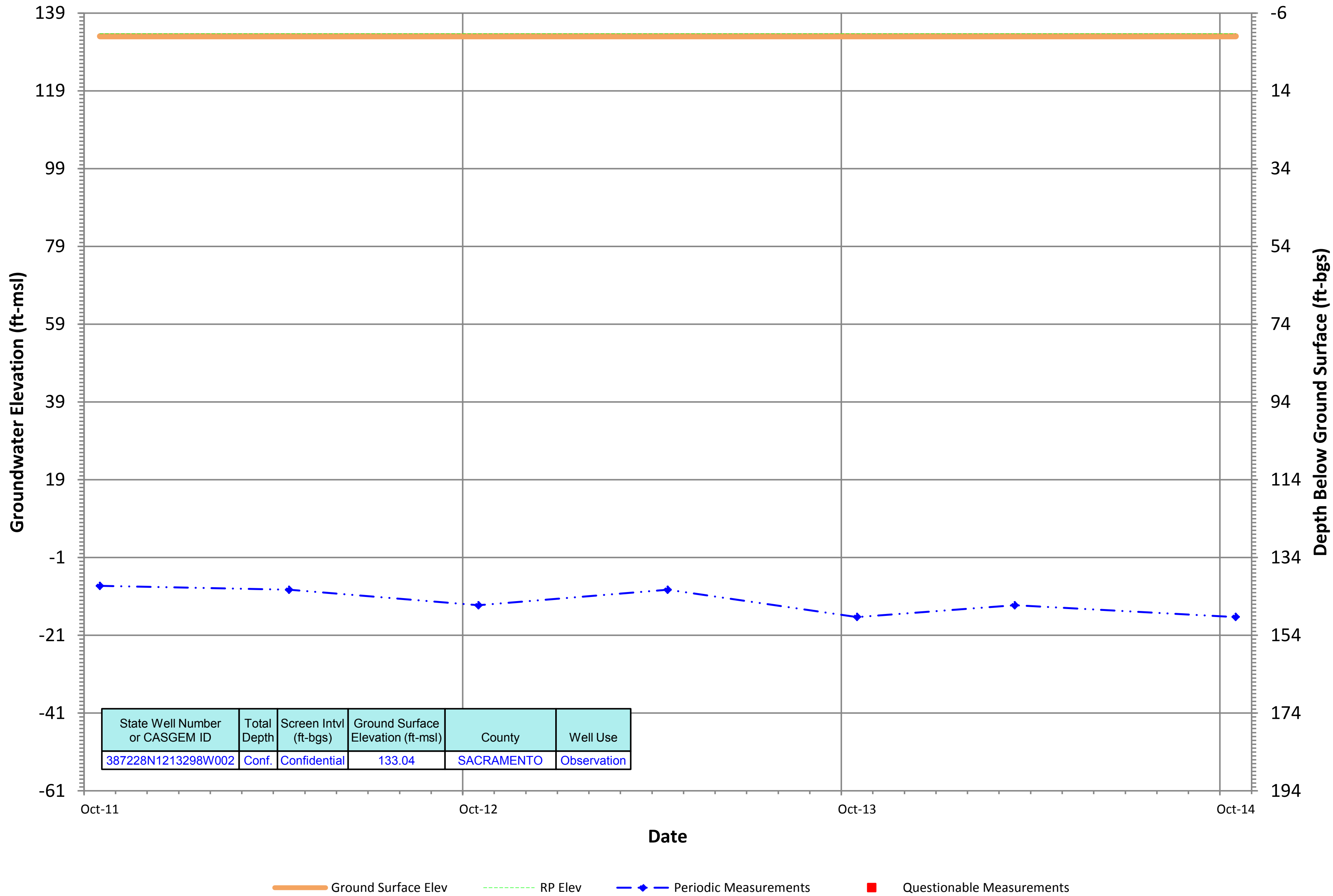
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387228N1213298W001	Conf.	Confidential	133.04	SACRAMENTO	Observation

387228N1213298W002
Period Of Record: 10/13/2011 to 10/15/2014

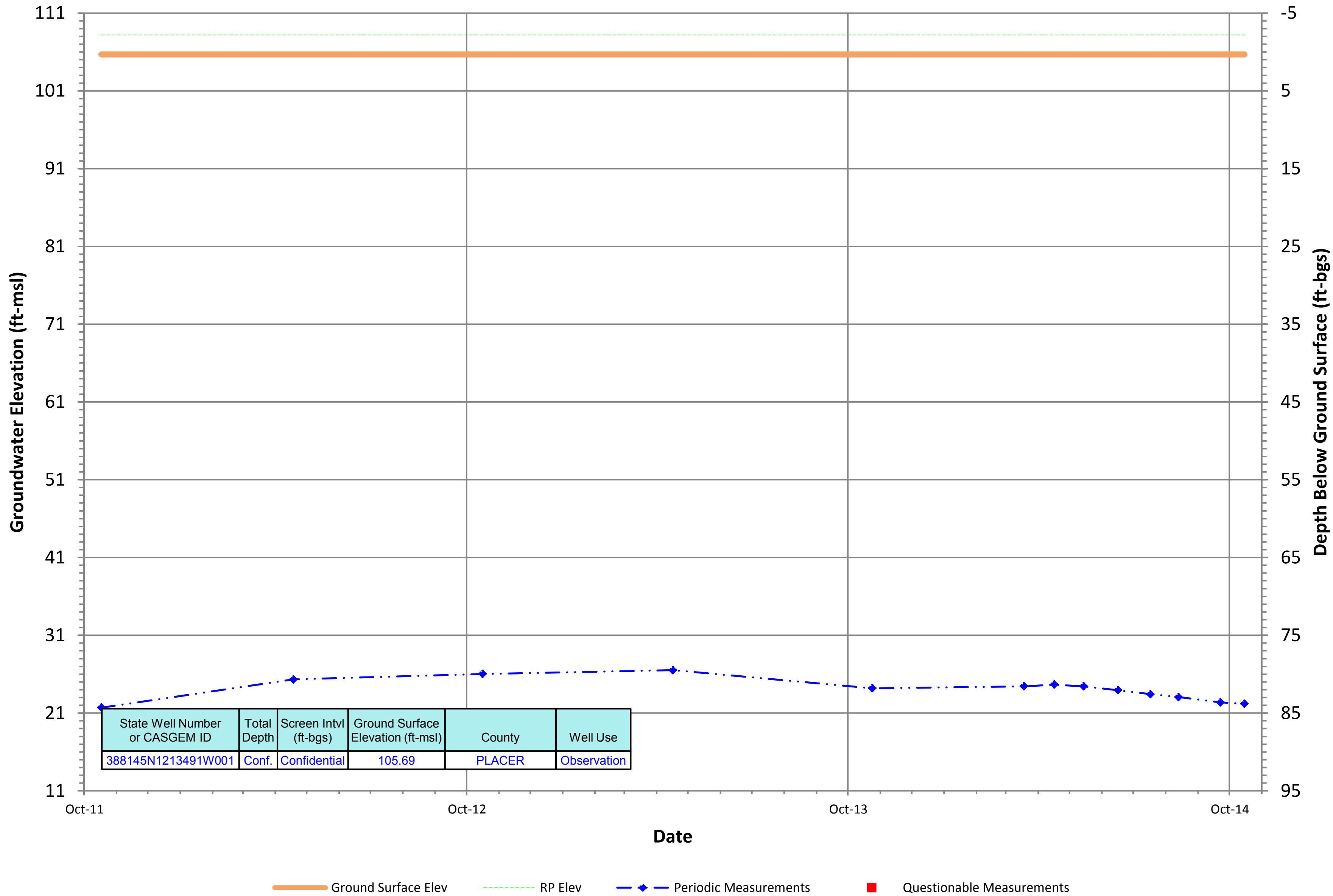
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



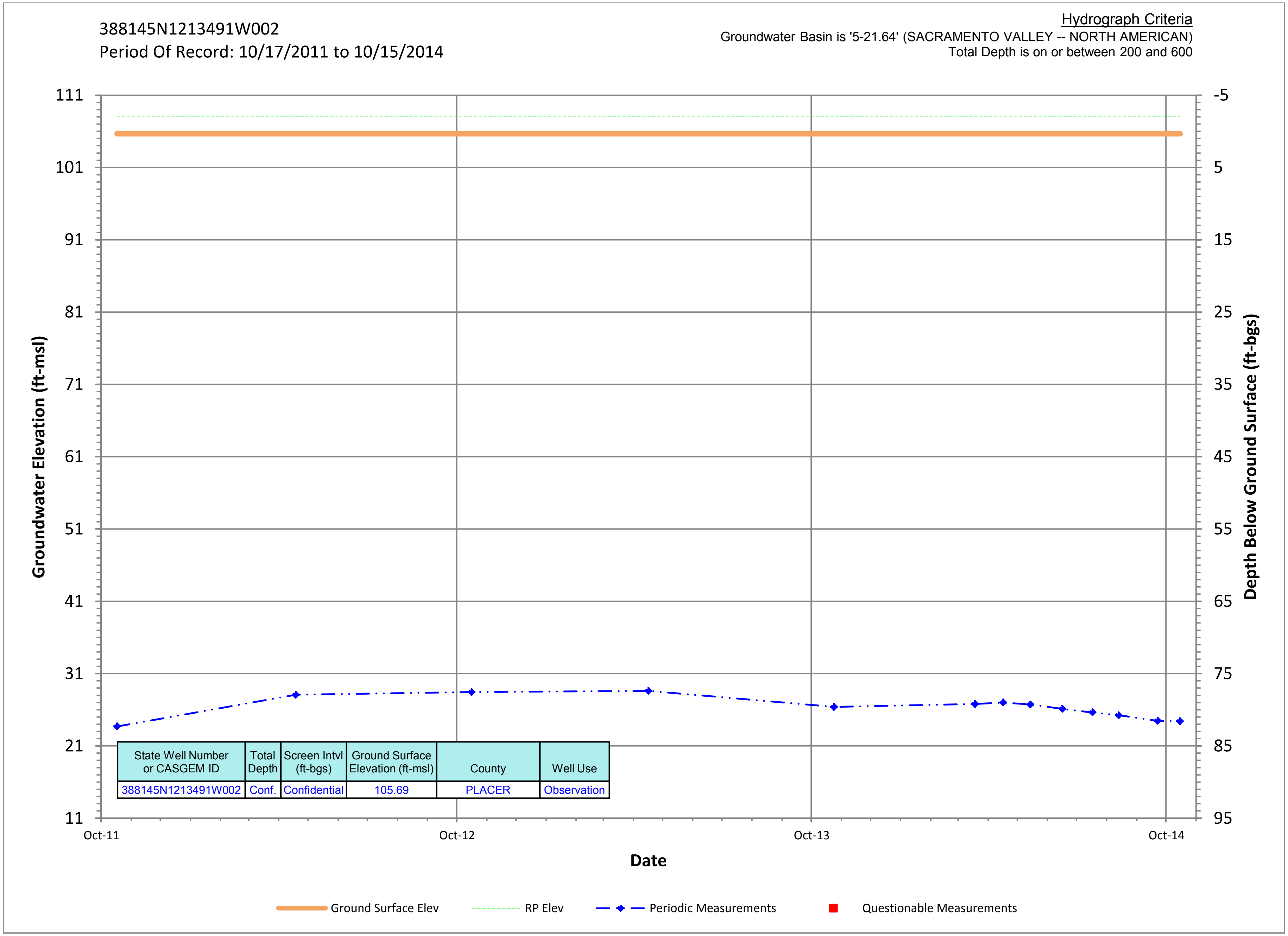
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387228N1213298W002	Conf.	Confidential	133.04	SACRAMENTO	Observation

388145N1213491W001
Period Of Record: 10/17/2011 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



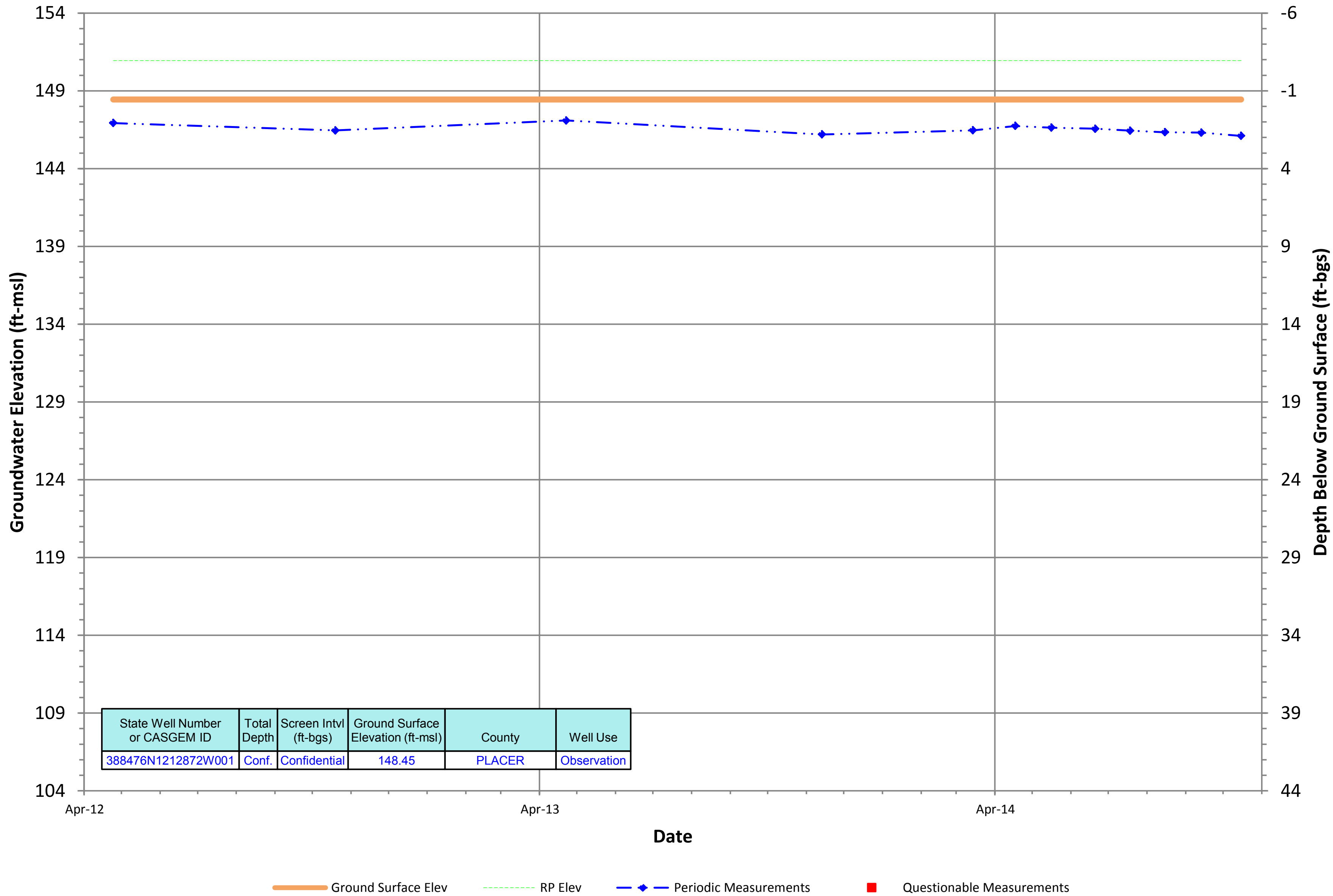
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388145N1213491W001	Conf.	Confidential	105.69	PLACER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388145N1213491W002	Conf.	Confidential	105.69	PLACER	Observation

388476N1212872W001
Period Of Record: 04/24/2012 to 10/15/2014

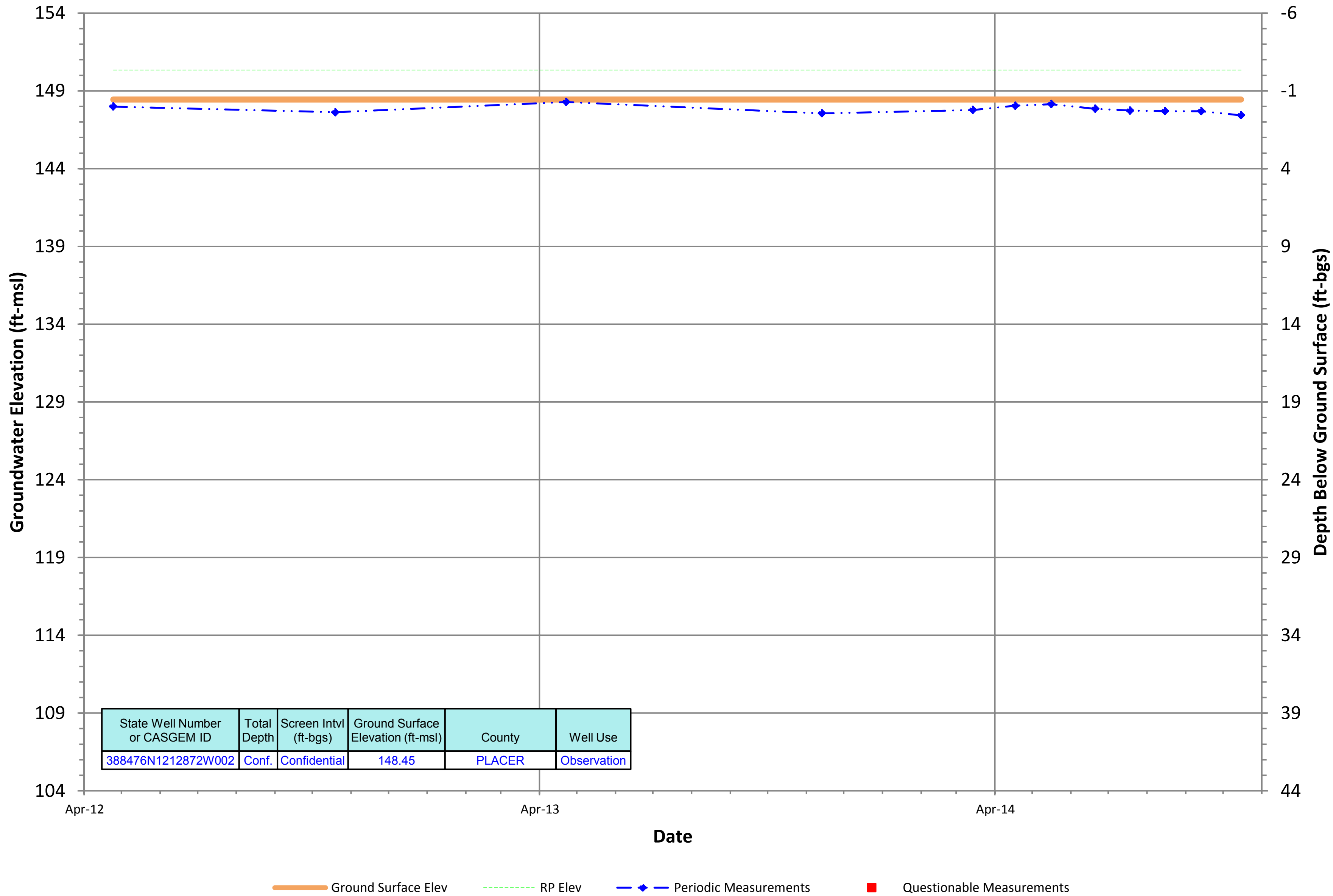
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388476N1212872W001	Conf.	Confidential	148.45	PLACER	Observation

388476N1212872W002
Period Of Record: 04/24/2012 to 10/15/2014

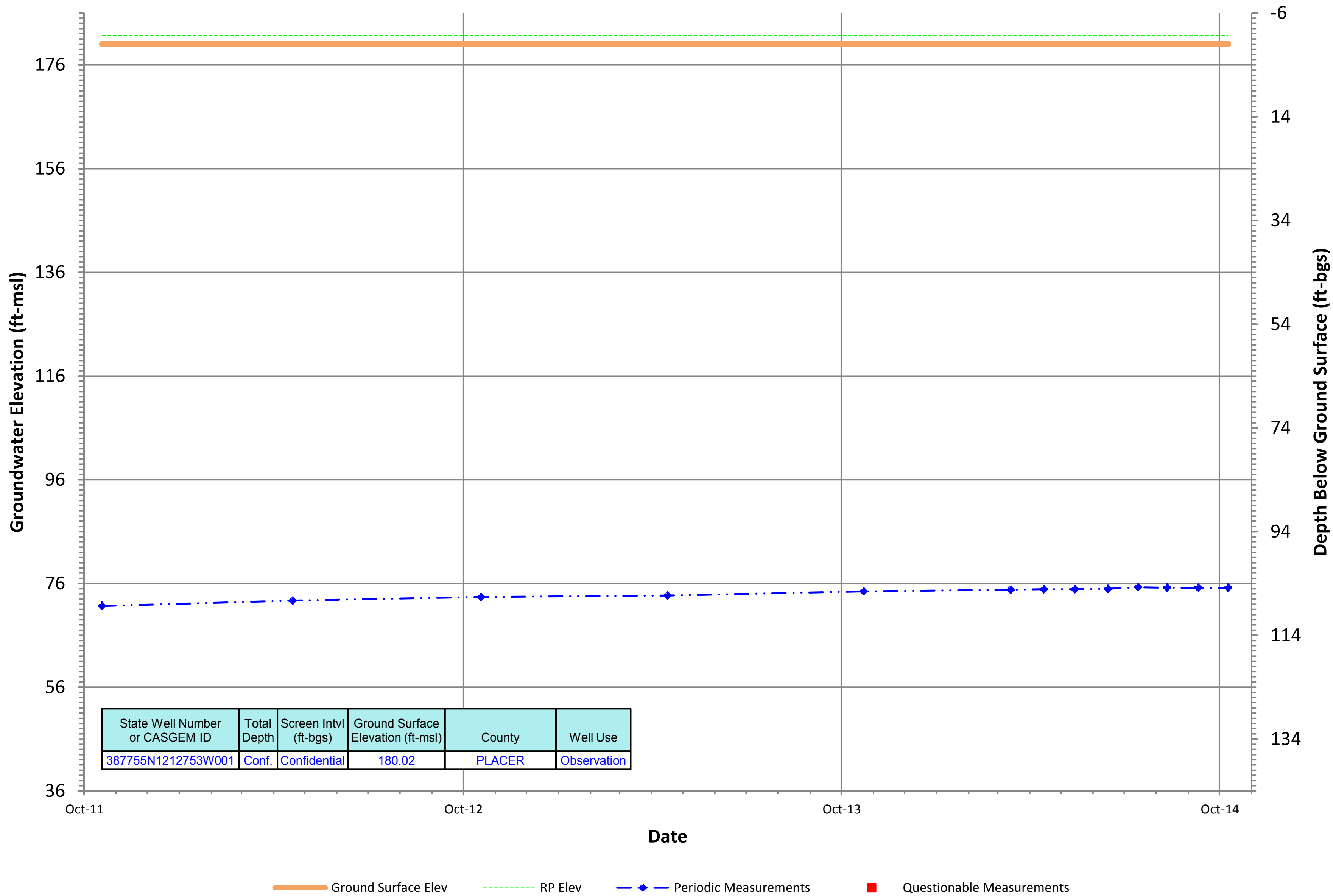
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388476N1212872W002	Conf.	Confidential	148.45	PLACER	Observation

387755N1212753W001
Period Of Record: 10/18/2011 to 10/09/2014

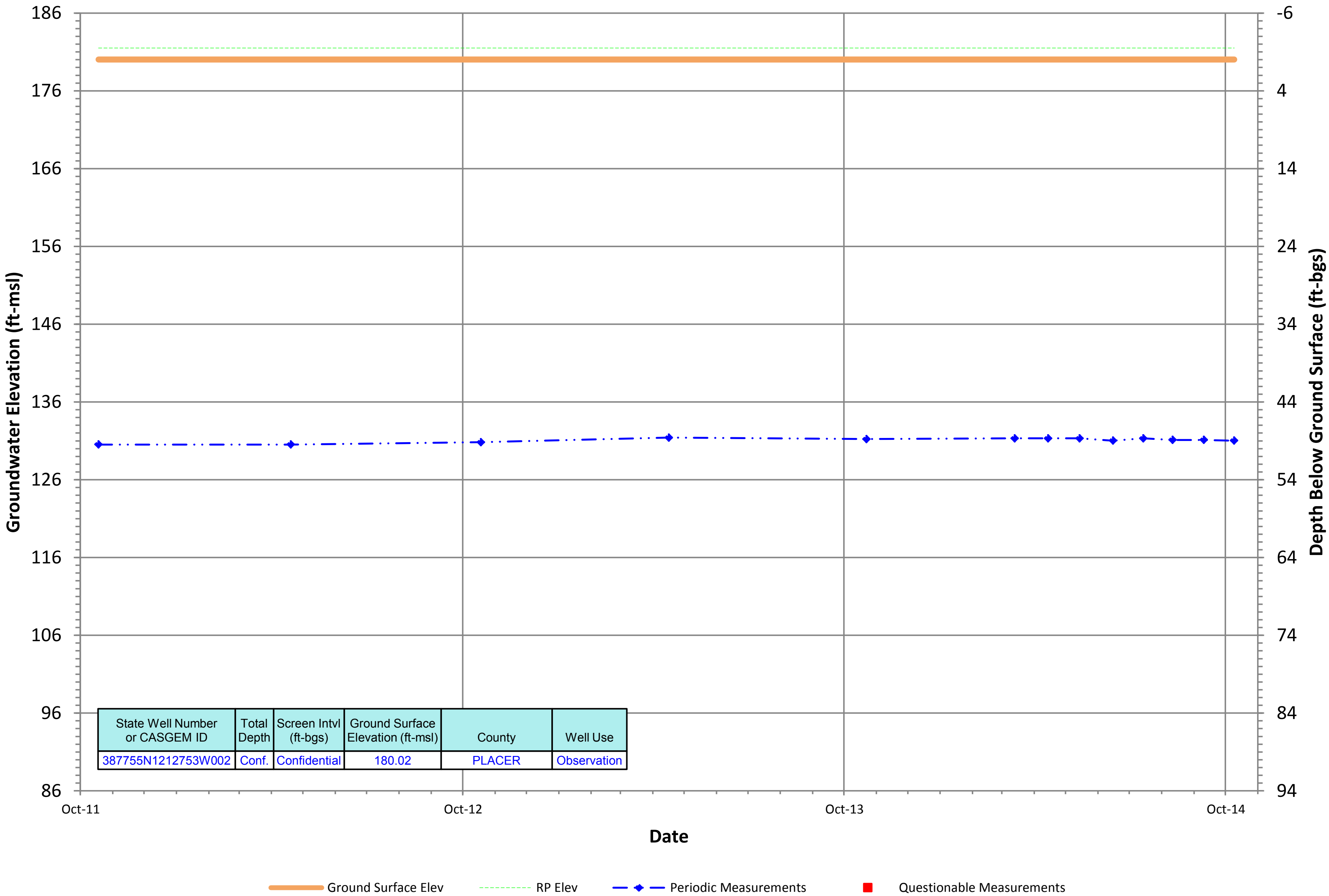
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



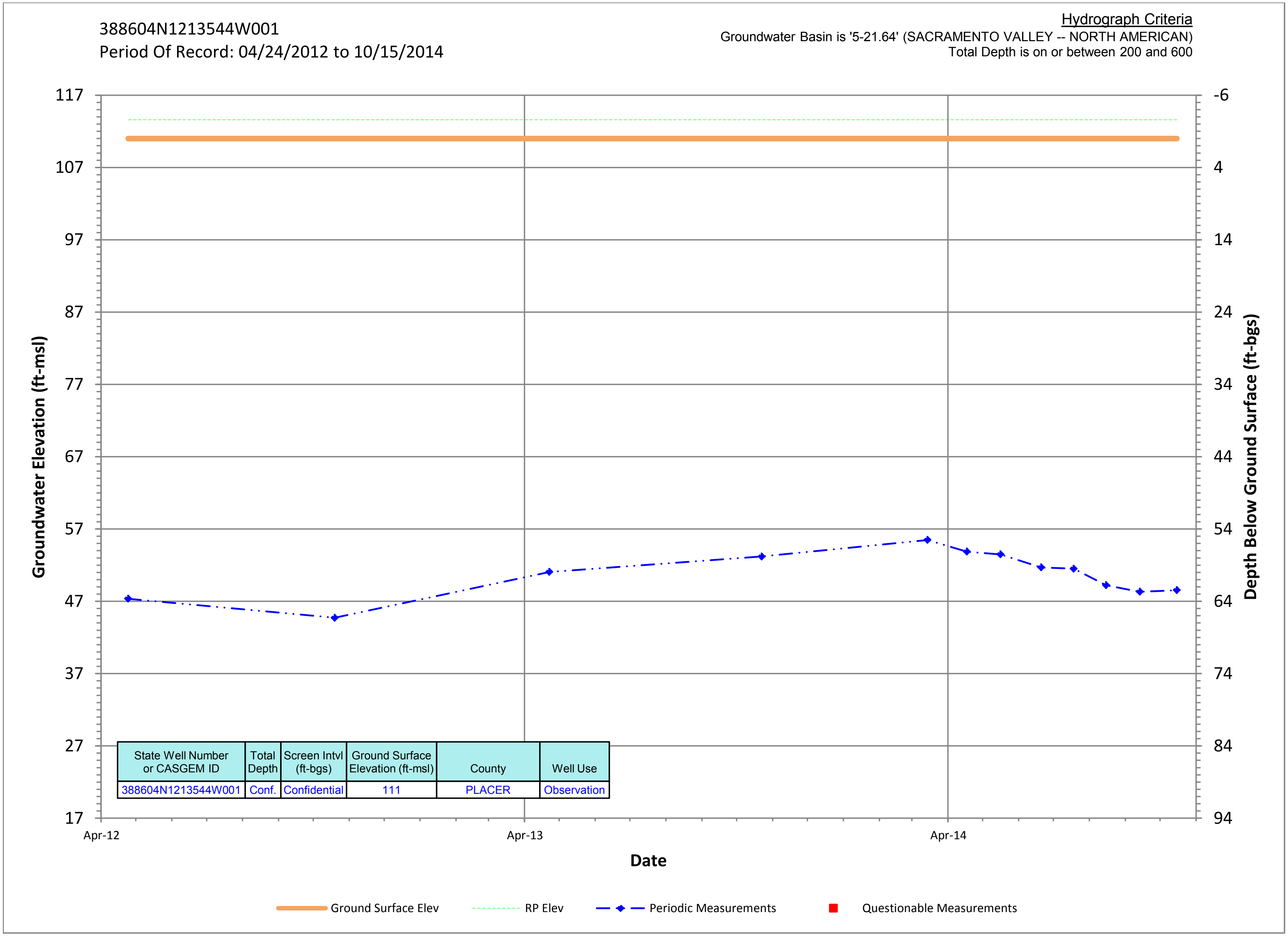
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387755N1212753W001	Conf.	Confidential	180.02	PLACER	Observation

387755N1212753W002
Period Of Record: 10/18/2011 to 10/09/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



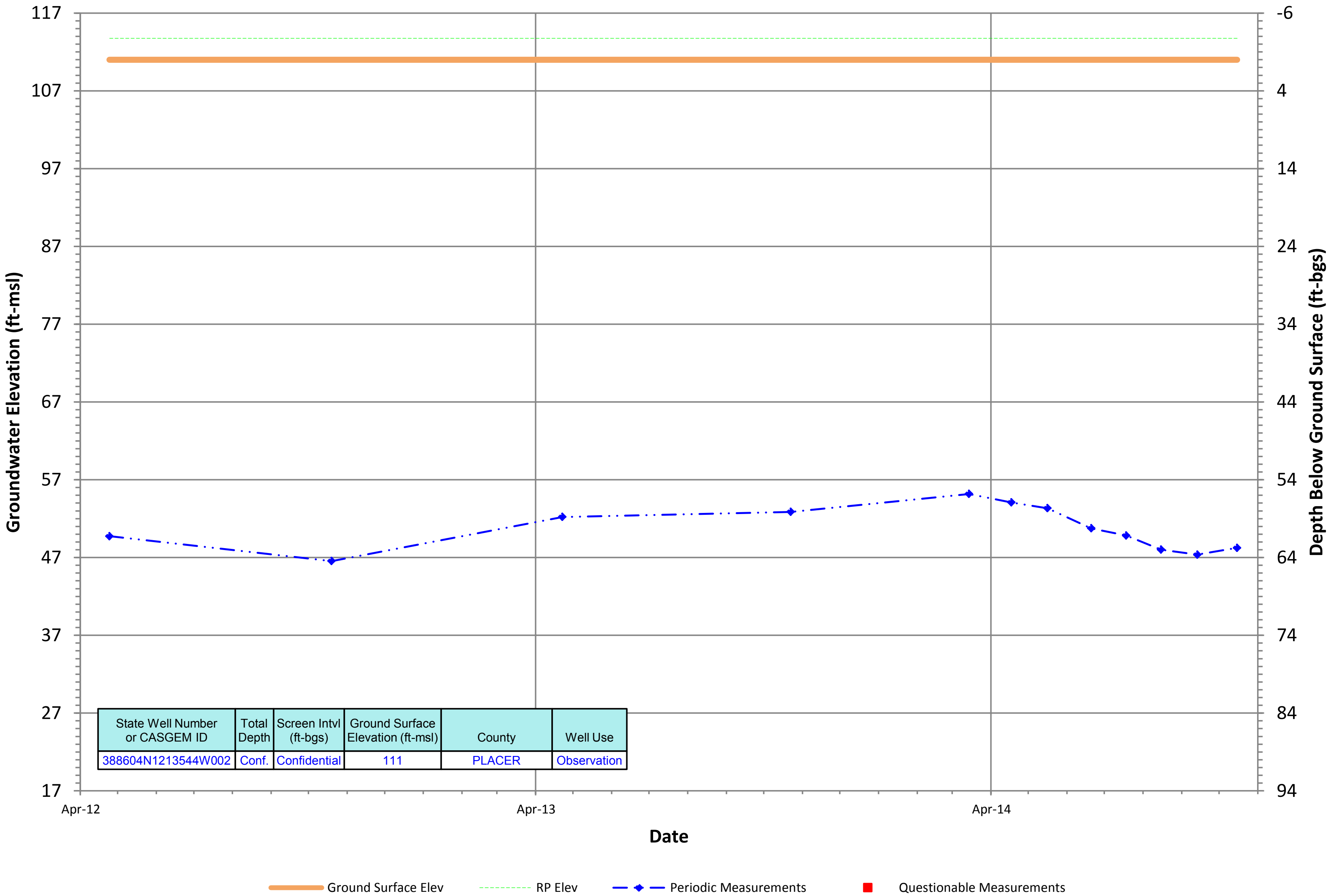
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387755N1212753W002	Conf.	Confidential	180.02	PLACER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388604N1213544W001	Conf.	Confidential	111	PLACER	Observation

388604N1213544W002
Period Of Record: 04/24/2012 to 10/15/2014

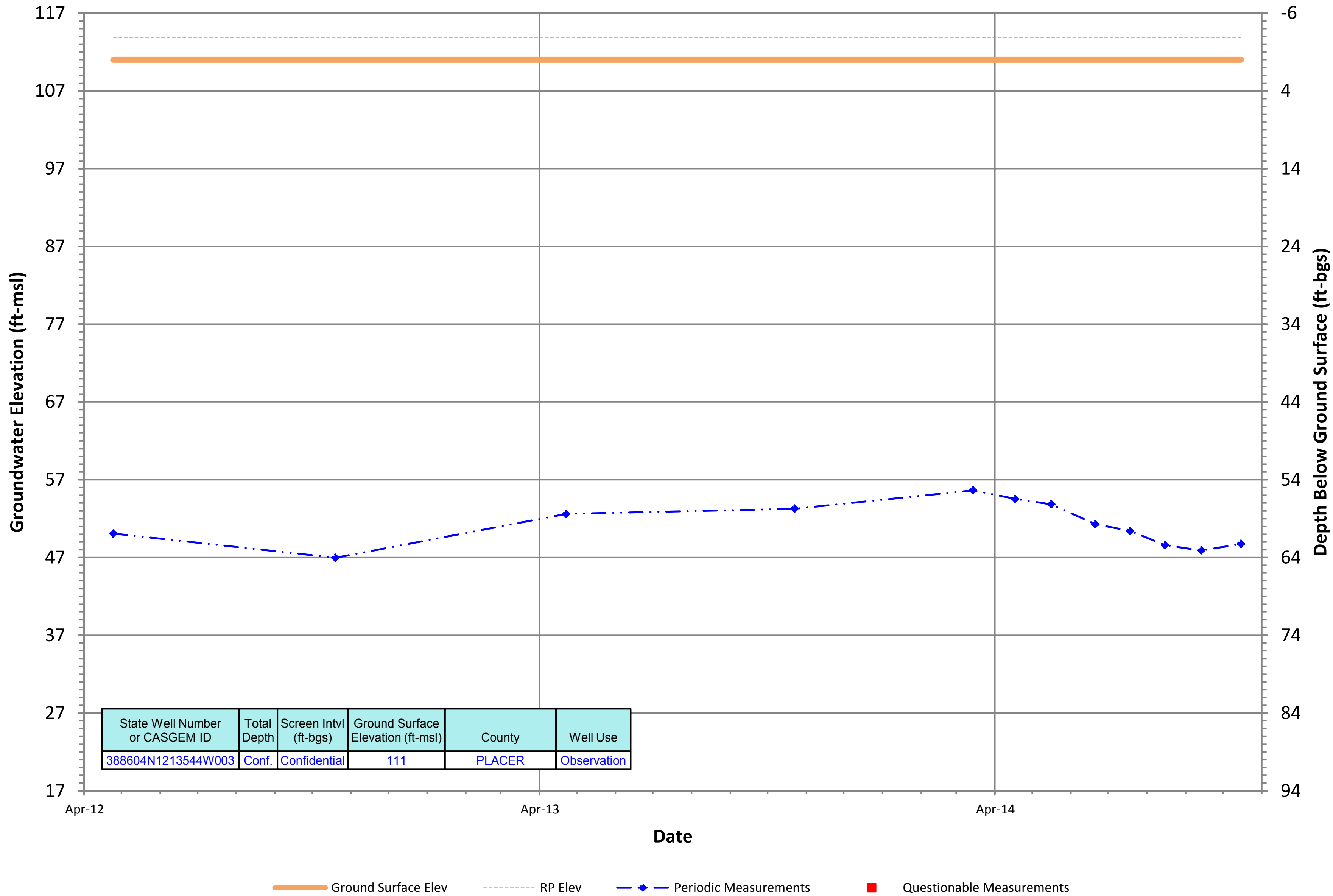
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388604N1213544W002	Conf.	Confidential	111	PLACER	Observation

388604N1213544W003
Period Of Record: 04/24/2012 to 10/15/2014

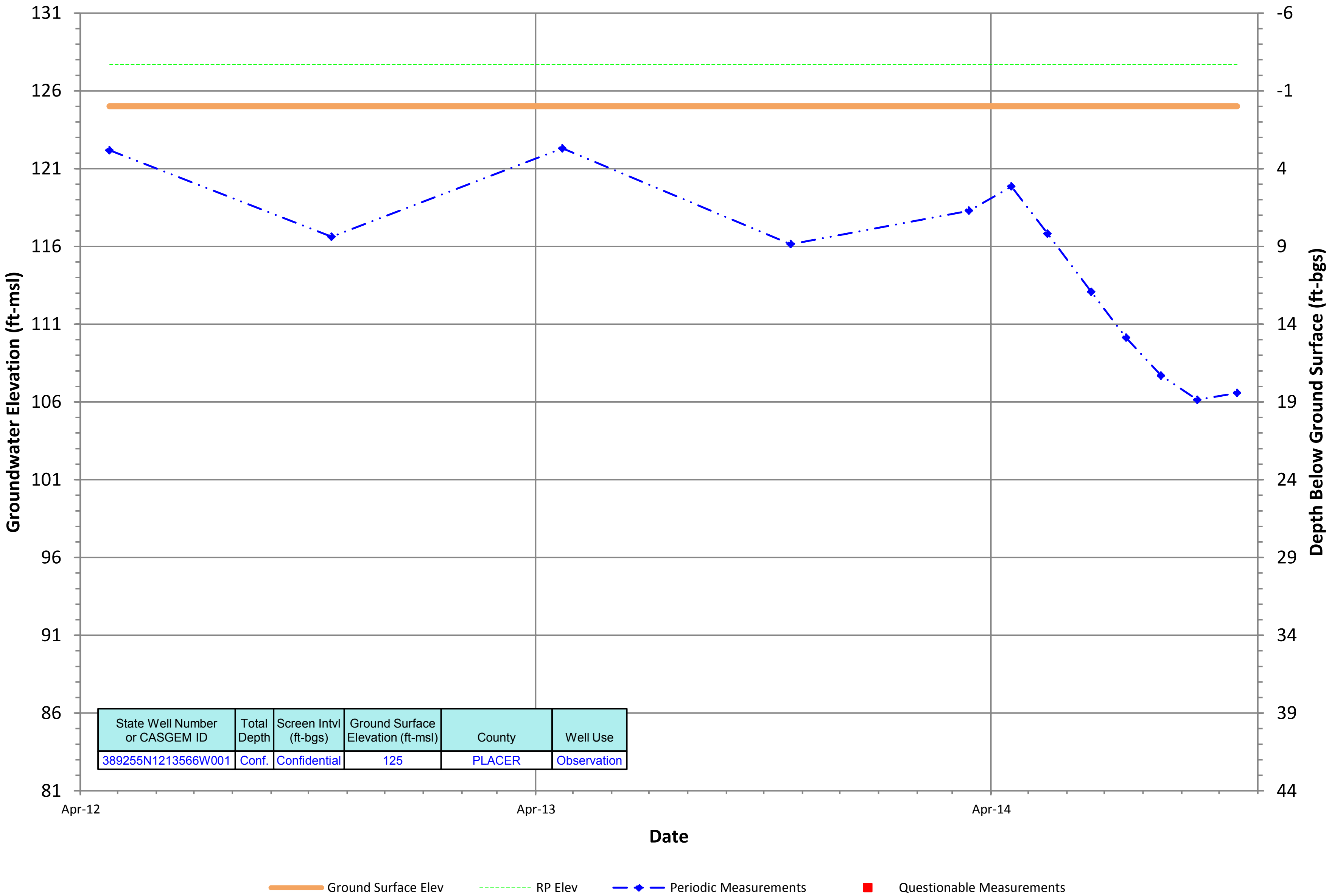
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388604N1213544W003	Conf.	Confidential	111	PLACER	Observation

389255N1213566W001
Period Of Record: 04/24/2012 to 10/15/2014

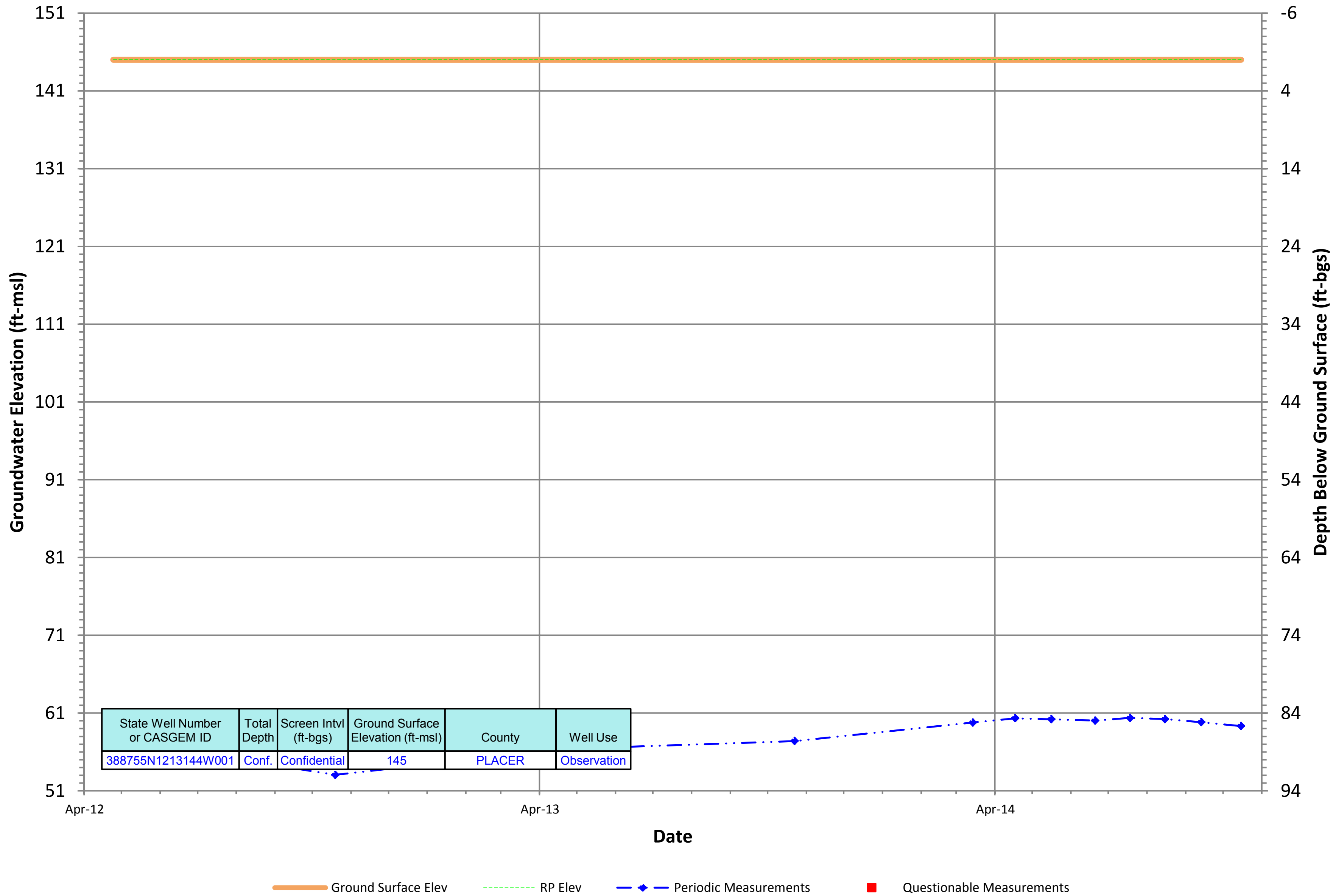
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
389255N1213566W001	Conf.	Confidential	125	PLACER	Observation

388755N1213144W001
Period Of Record: 04/24/2012 to 10/15/2014

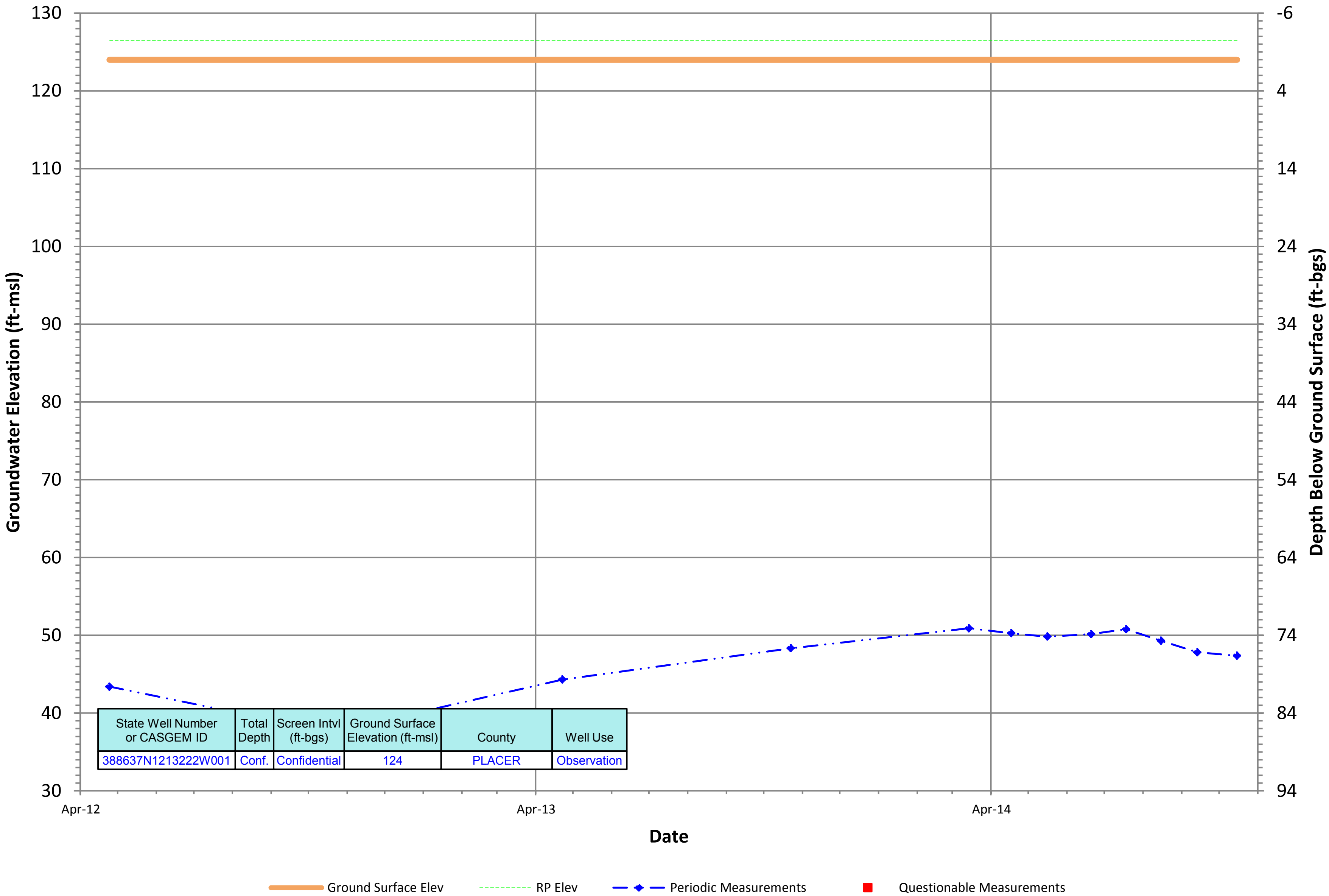
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388755N1213144W001	Conf.	Confidential	145	PLACER	Observation

388637N1213222W001
Period Of Record: 04/24/2012 to 10/15/2014

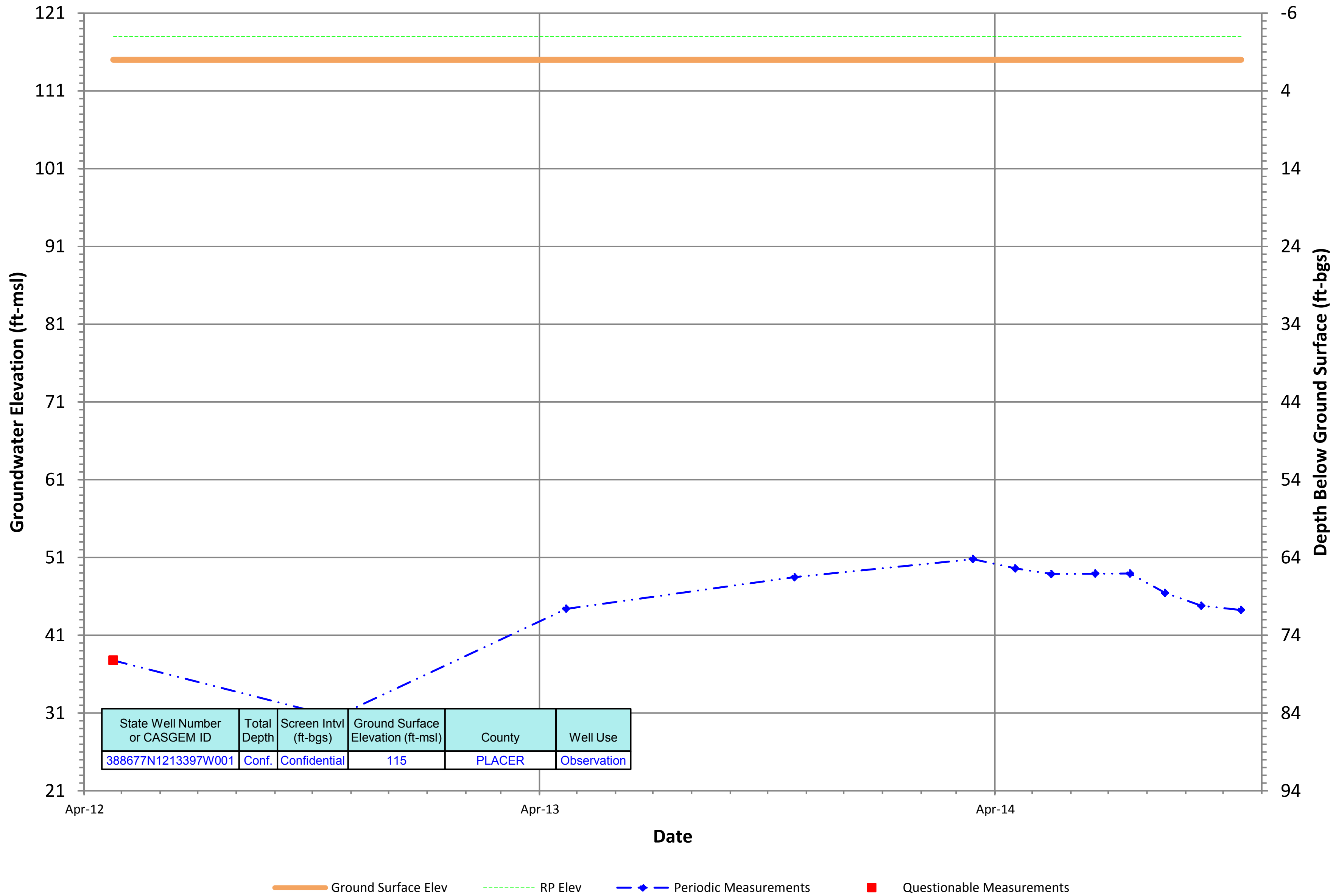
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388637N1213222W001	Conf.	Confidential	124	PLACER	Observation

388677N1213397W001
Period Of Record: 04/24/2012 to 10/15/2014

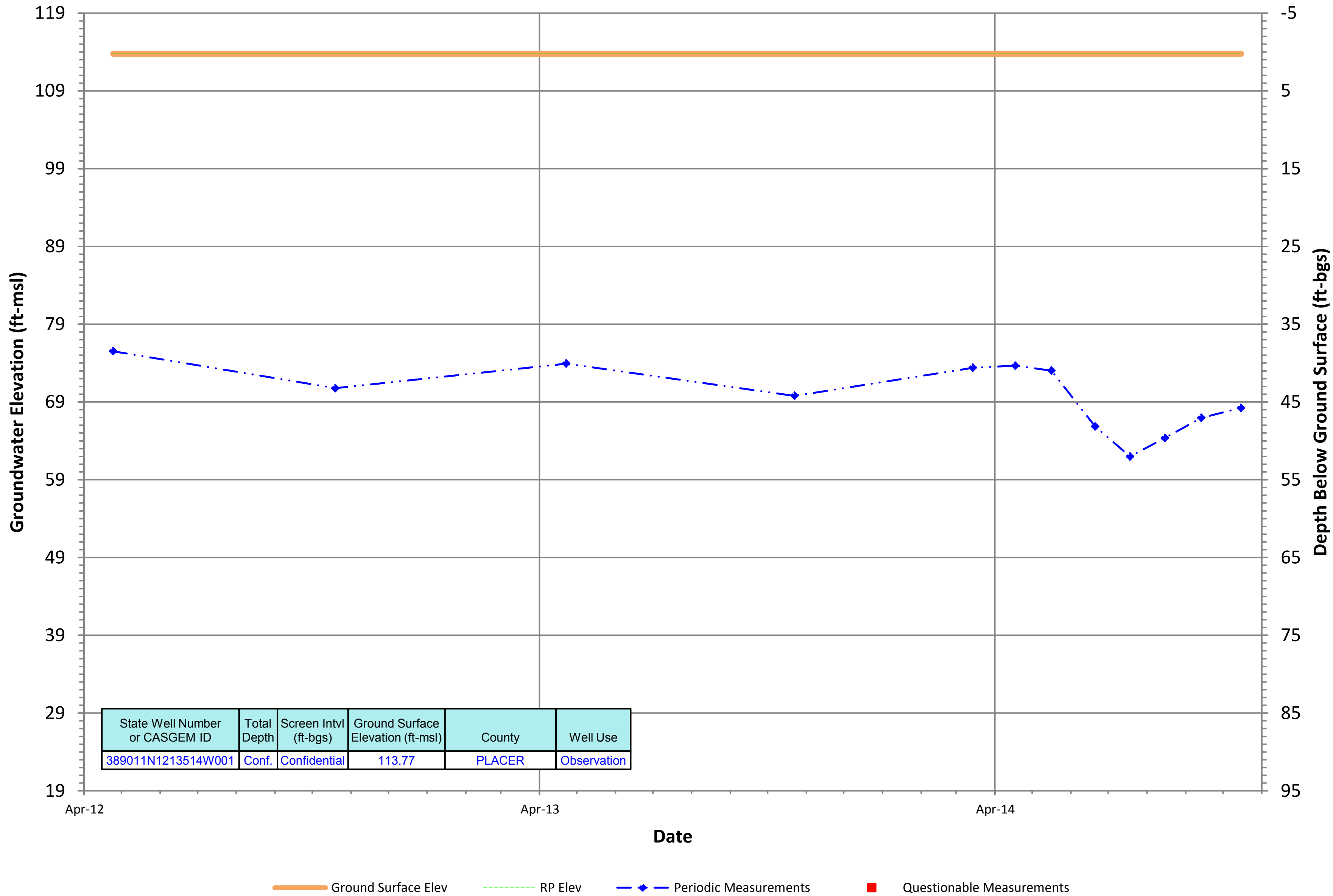
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
388677N1213397W001	Conf.	Confidential	115	PLACER	Observation

389011N1213514W001
Period Of Record: 04/24/2012 to 10/15/2014

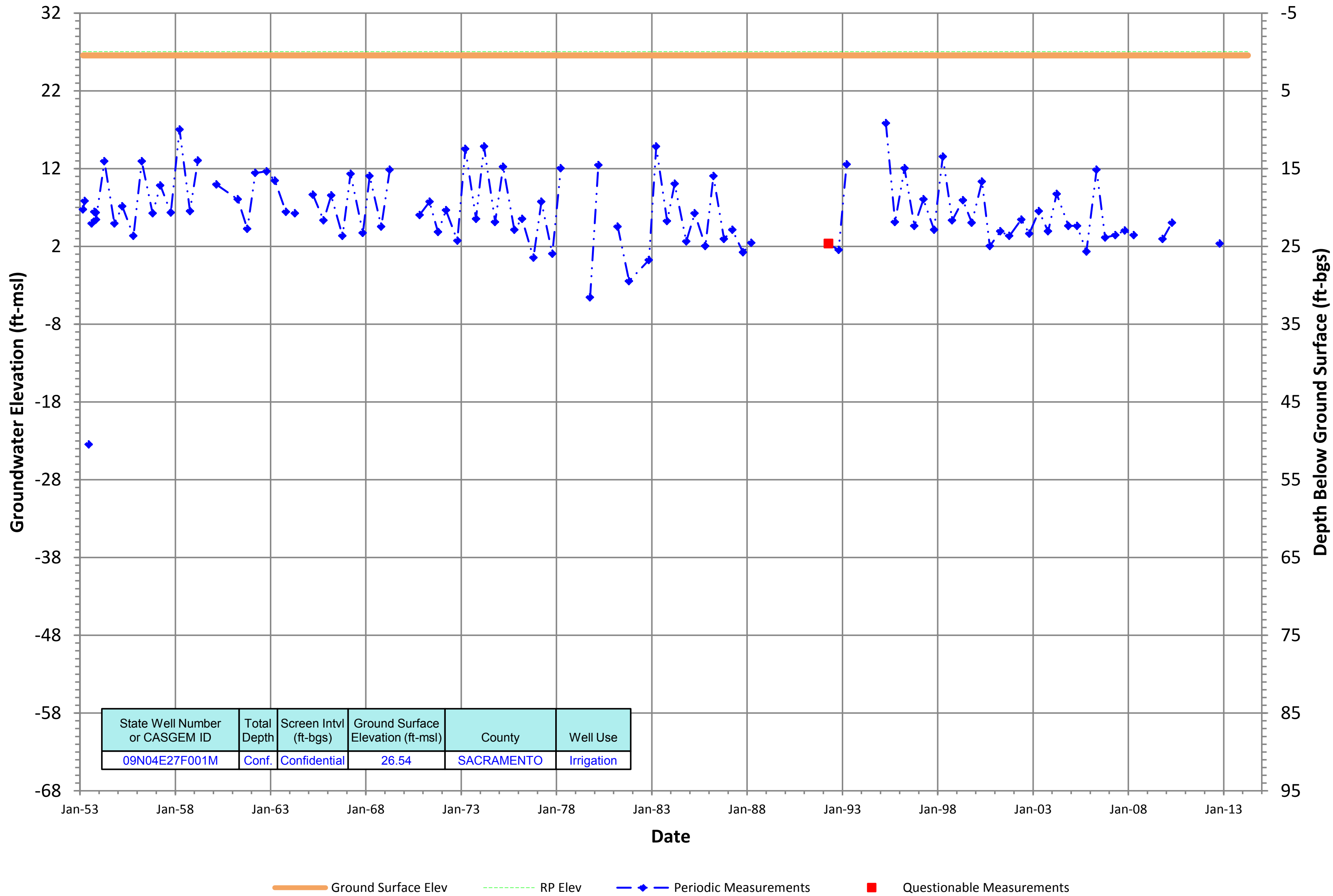
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



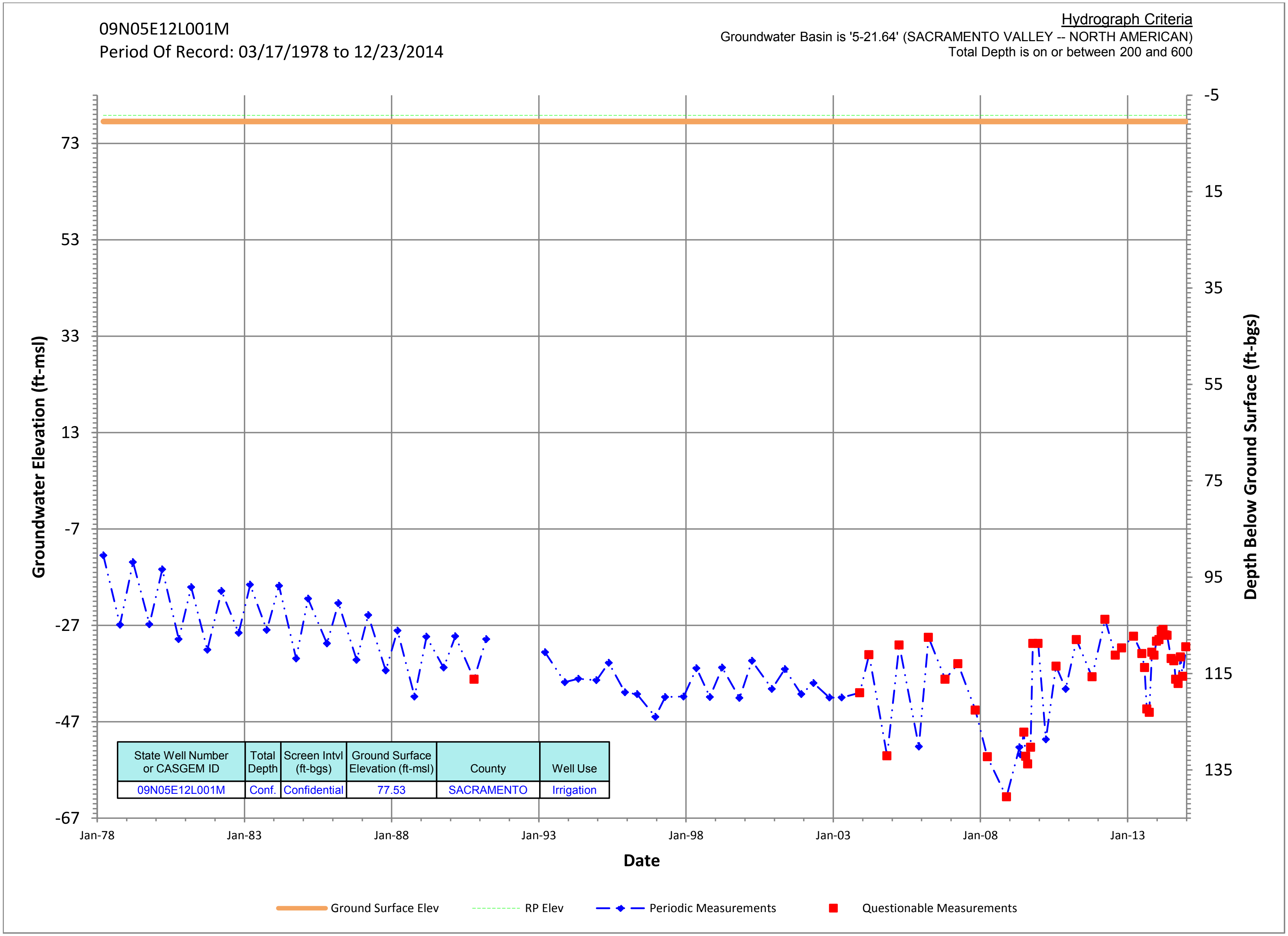
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
389011N1213514W001	Conf.	Confidential	113.77	PLACER	Observation

09N04E27F001M
Period Of Record: 02/26/1953 to 04/08/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



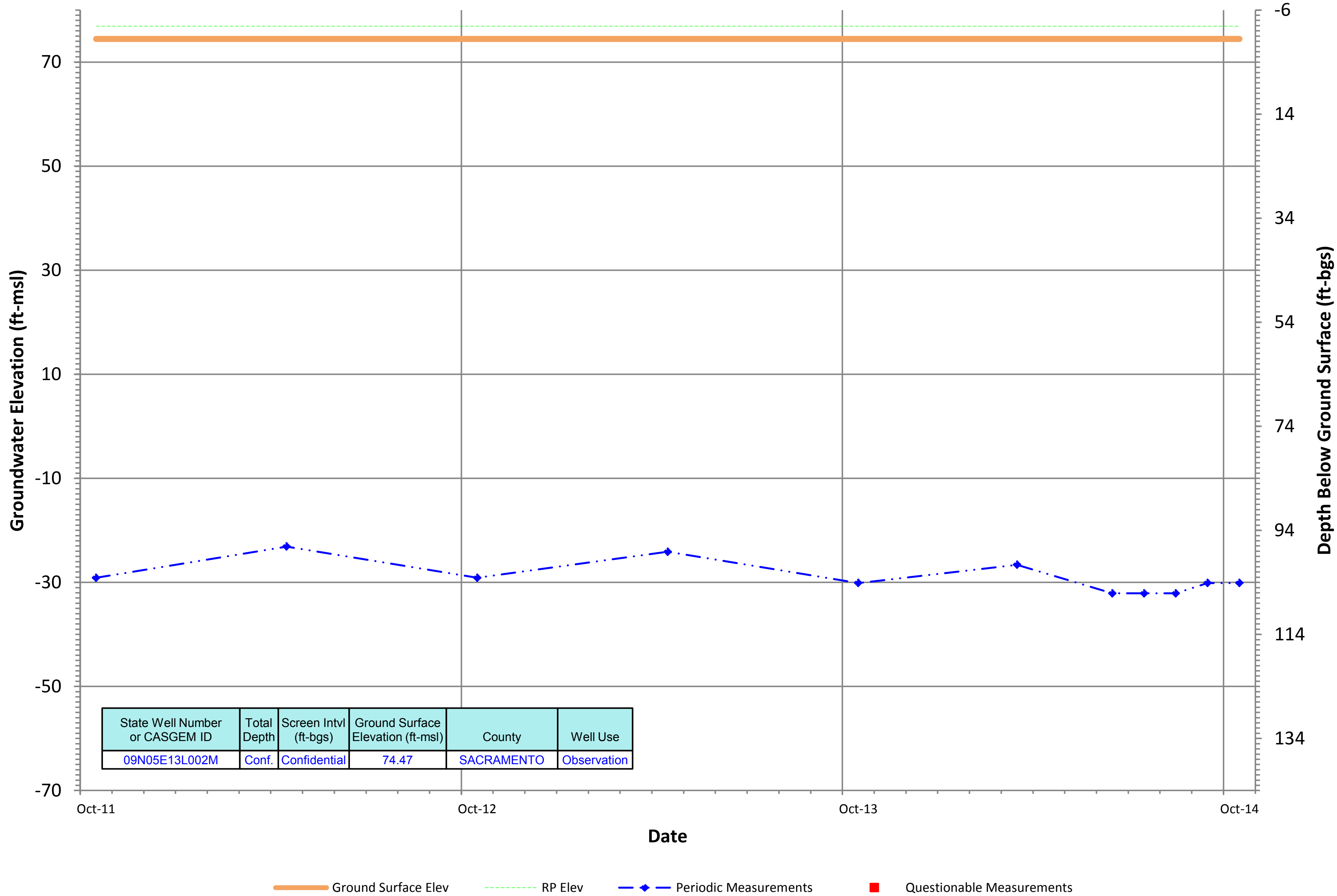
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N04E27F001M	Conf.	Confidential	26.54	SACRAMENTO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N05E12L001M	Conf.	Confidential	77.53	SACRAMENTO	Irrigation

09N05E13L002M
Period Of Record: 10/13/2011 to 10/14/2014

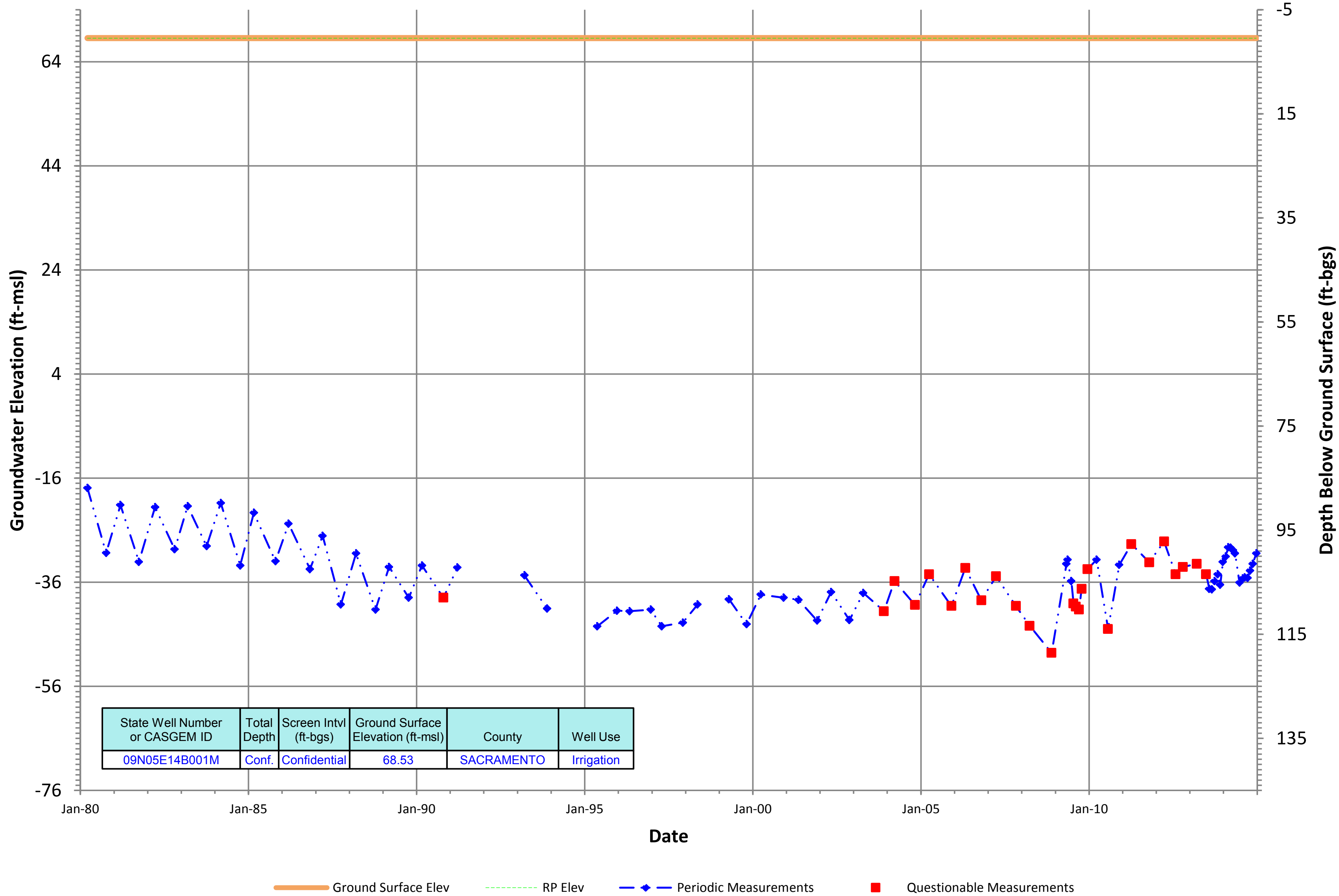
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N05E13L002M	Conf.	Confidential	74.47	SACRAMENTO	Observation

09N05E14B001M
Period Of Record: 03/17/1980 to 12/23/2014

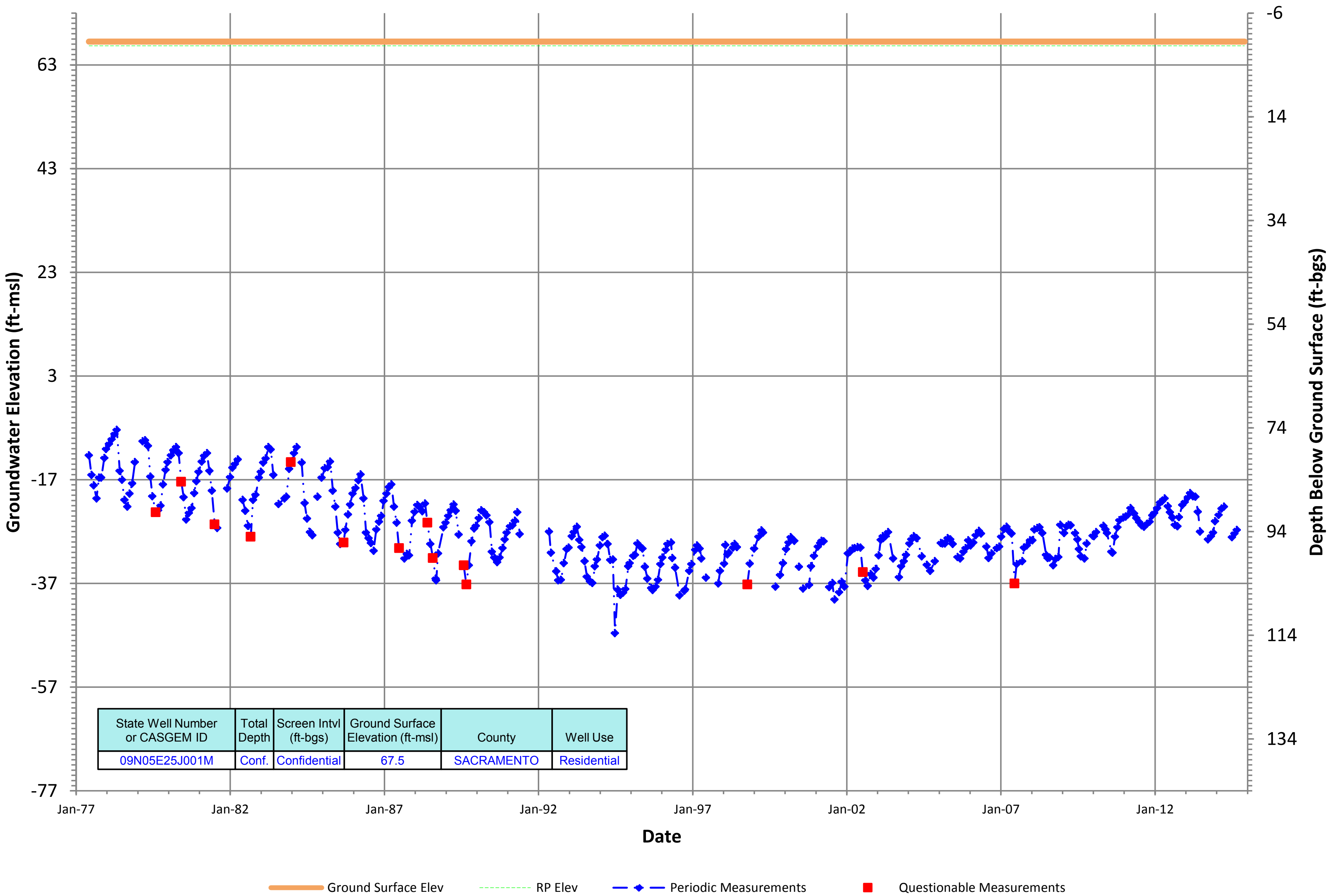
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



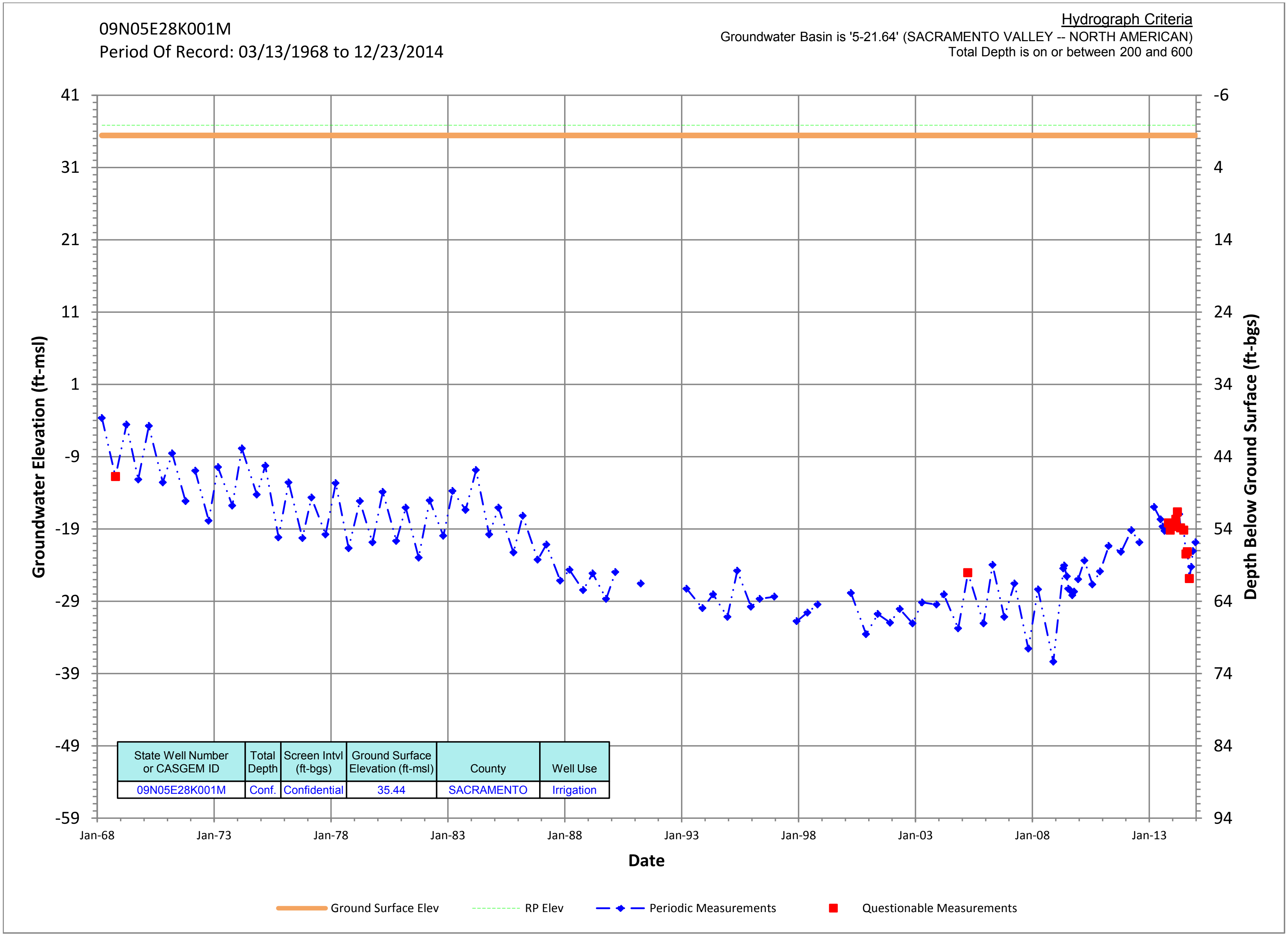
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N05E14B001M	Conf.	Confidential	68.53	SACRAMENTO	Irrigation

09N05E25J001M
Period Of Record: 05/31/1977 to 11/26/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N05E25J001M	Conf.	Confidential	67.5	SACRAMENTO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N05E28K001M	Conf.	Confidential	35.44	SACRAMENTO	Irrigation

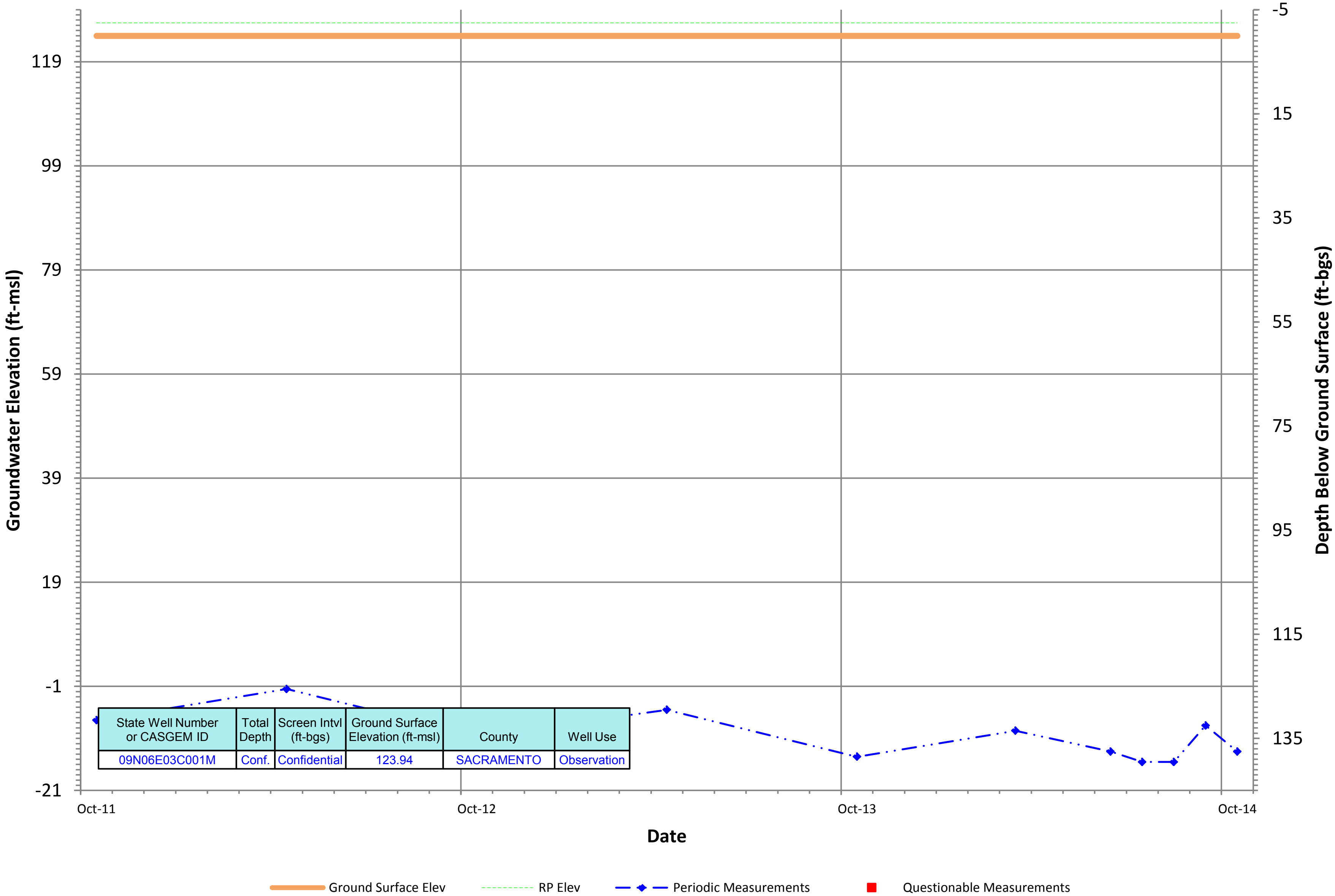
09N06E03C001M

Period Of Record: 10/13/2011 to 10/15/2014

Hydrograph Criteria

Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)

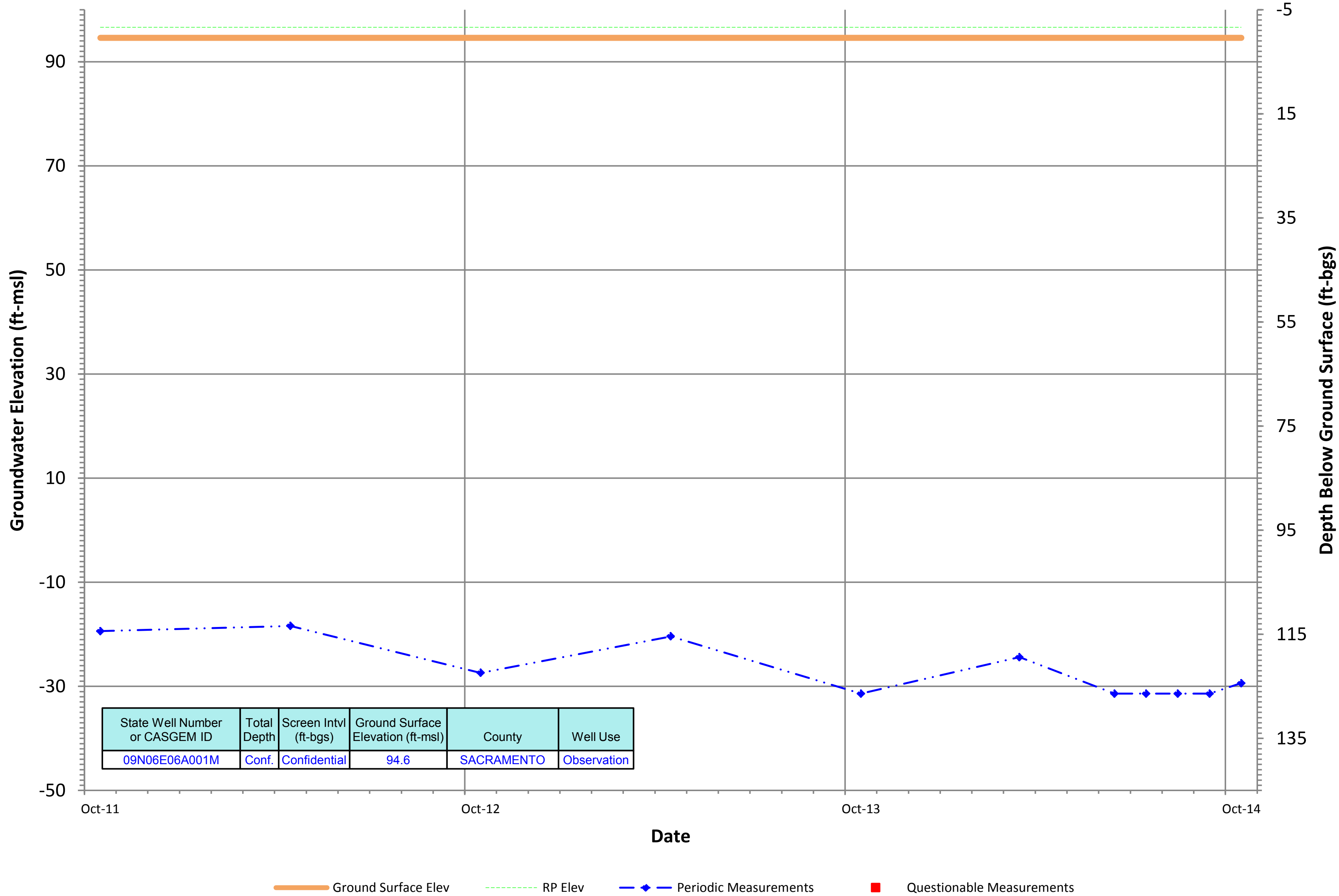
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N06E03C001M	Conf.	Confidential	123.94	SACRAMENTO	Observation

09N06E06A001M
Period Of Record: 10/13/2011 to 10/16/2014

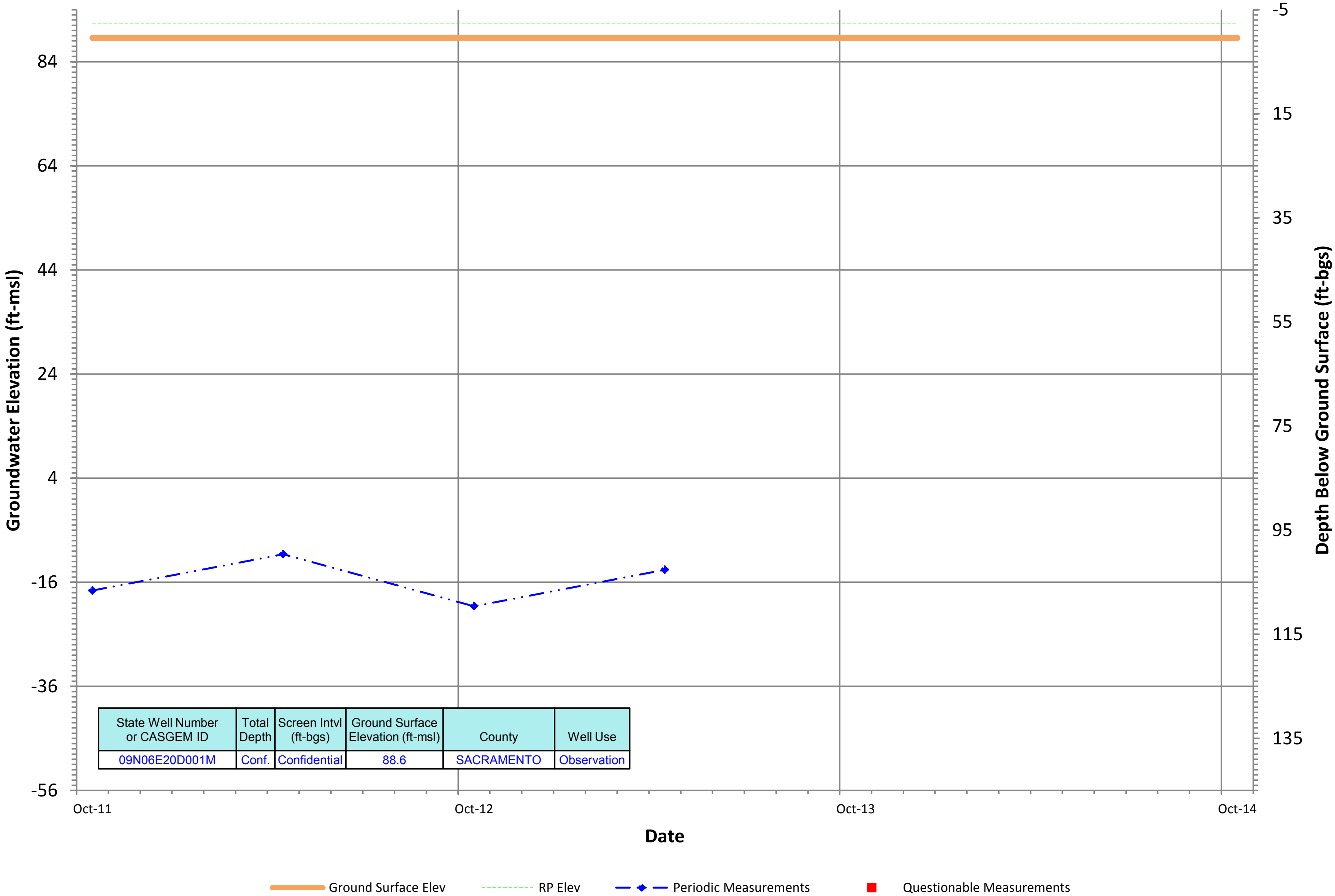
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



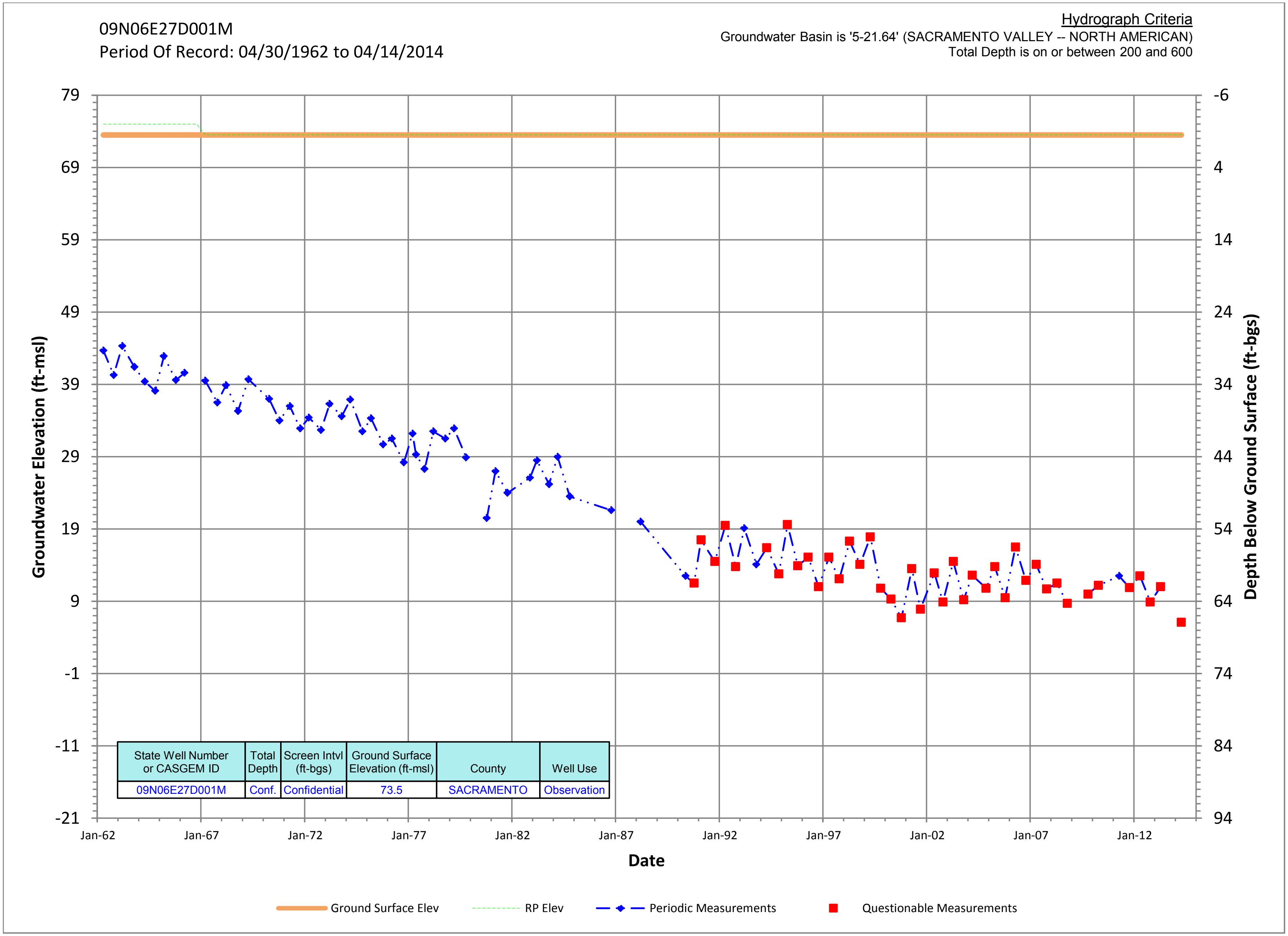
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N06E06A001M	Conf.	Confidential	94.6	SACRAMENTO	Observation

09N06E20D001M
Period Of Record: 10/13/2011 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



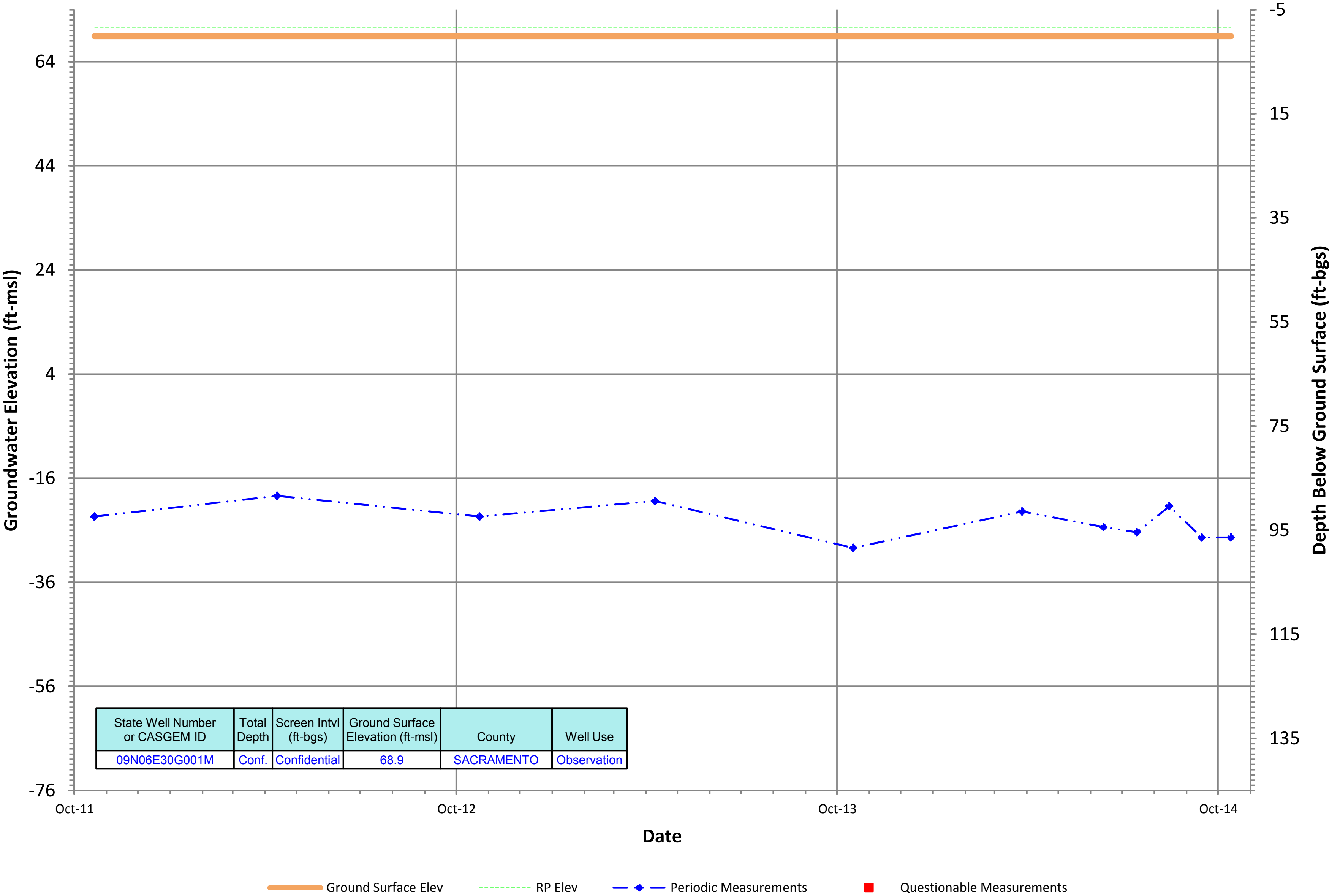
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N06E20D001M	Conf.	Confidential	88.6	SACRAMENTO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N06E27D001M	Conf.	Confidential	73.5	SACRAMENTO	Observation

09N06E30G001M
Period Of Record: 10/20/2011 to 10/13/2014

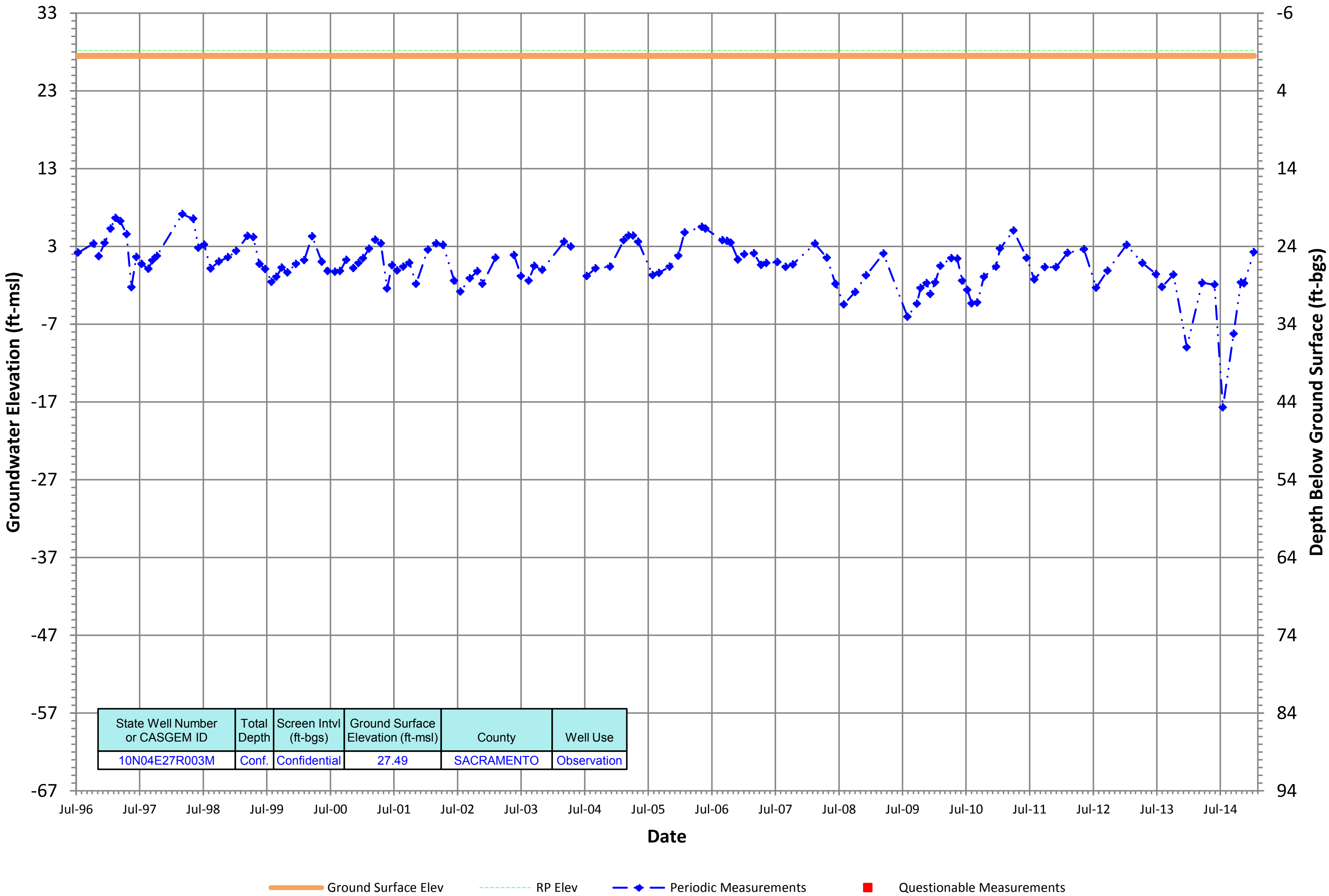
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N06E30G001M	Conf.	Confidential	68.9	SACRAMENTO	Observation

10N04E27R003M
Period Of Record: 07/11/1996 to 01/09/2015

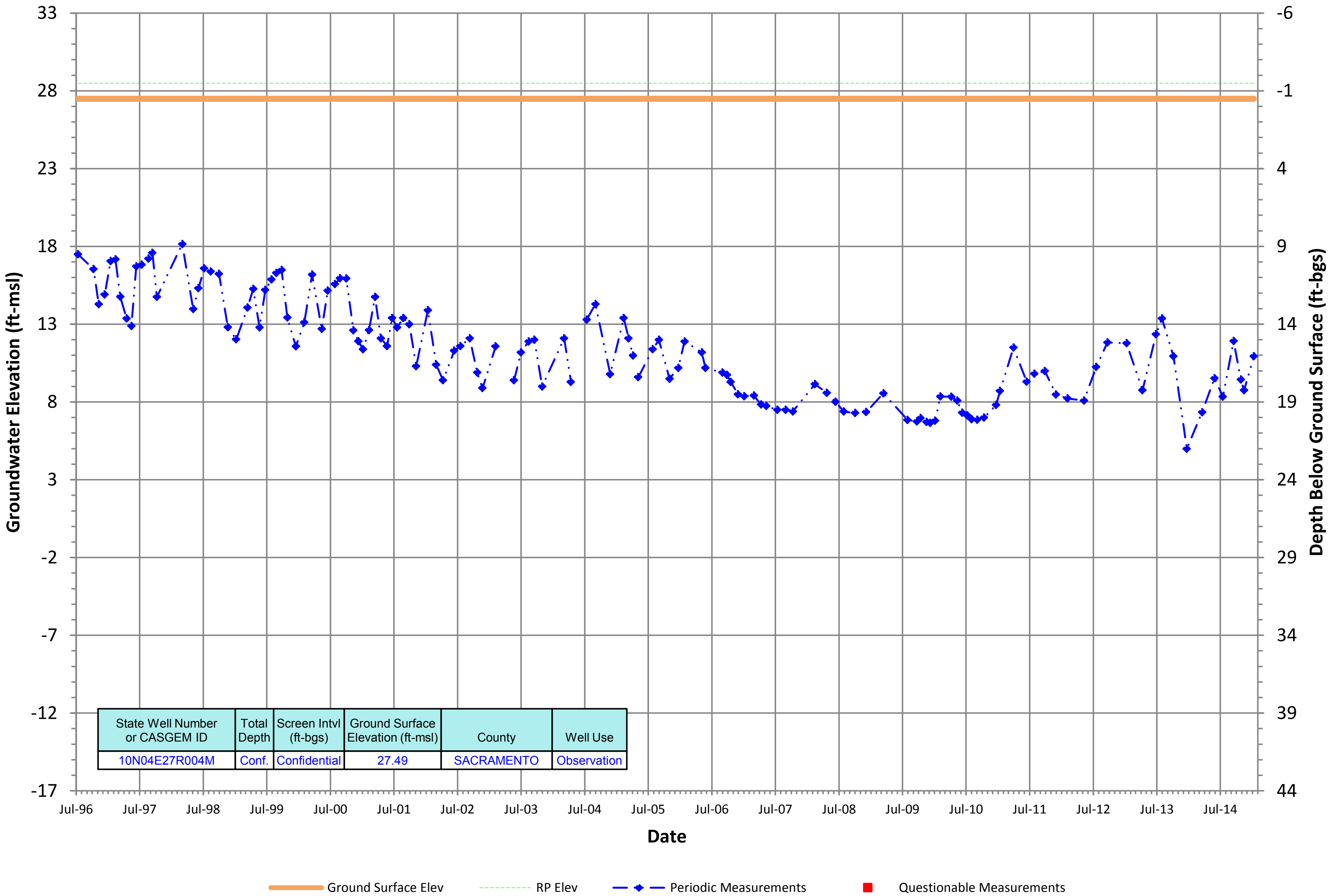
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



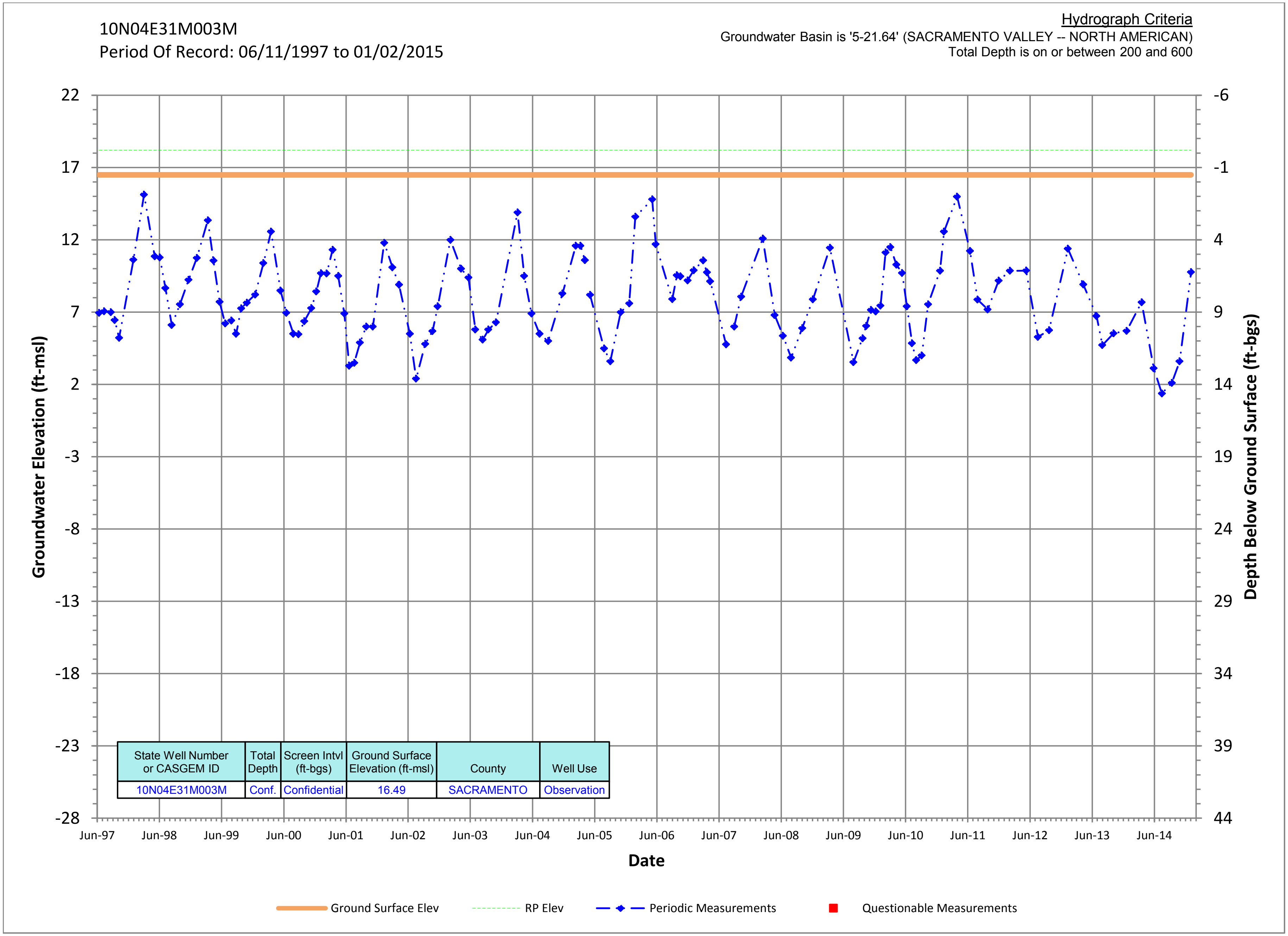
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E27R003M	Conf.	Confidential	27.49	SACRAMENTO	Observation

10N04E27R004M
Period Of Record: 07/11/1996 to 01/09/2015

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



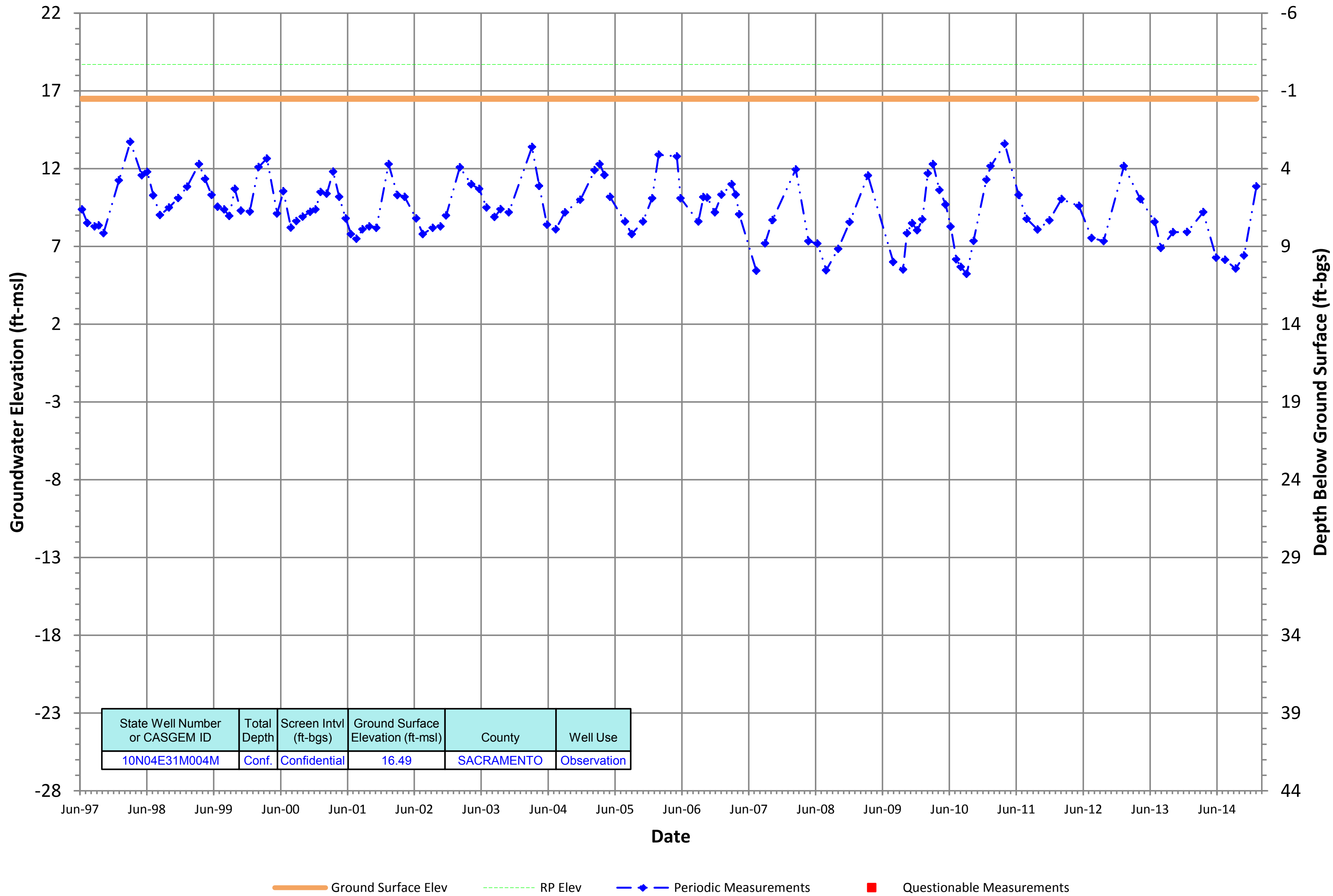
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E27R004M	Conf.	Confidential	27.49	SACRAMENTO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E31M003M	Conf.	Confidential	16.49	SACRAMENTO	Observation

10N04E31M004M
Period Of Record: 06/11/1997 to 01/02/2015

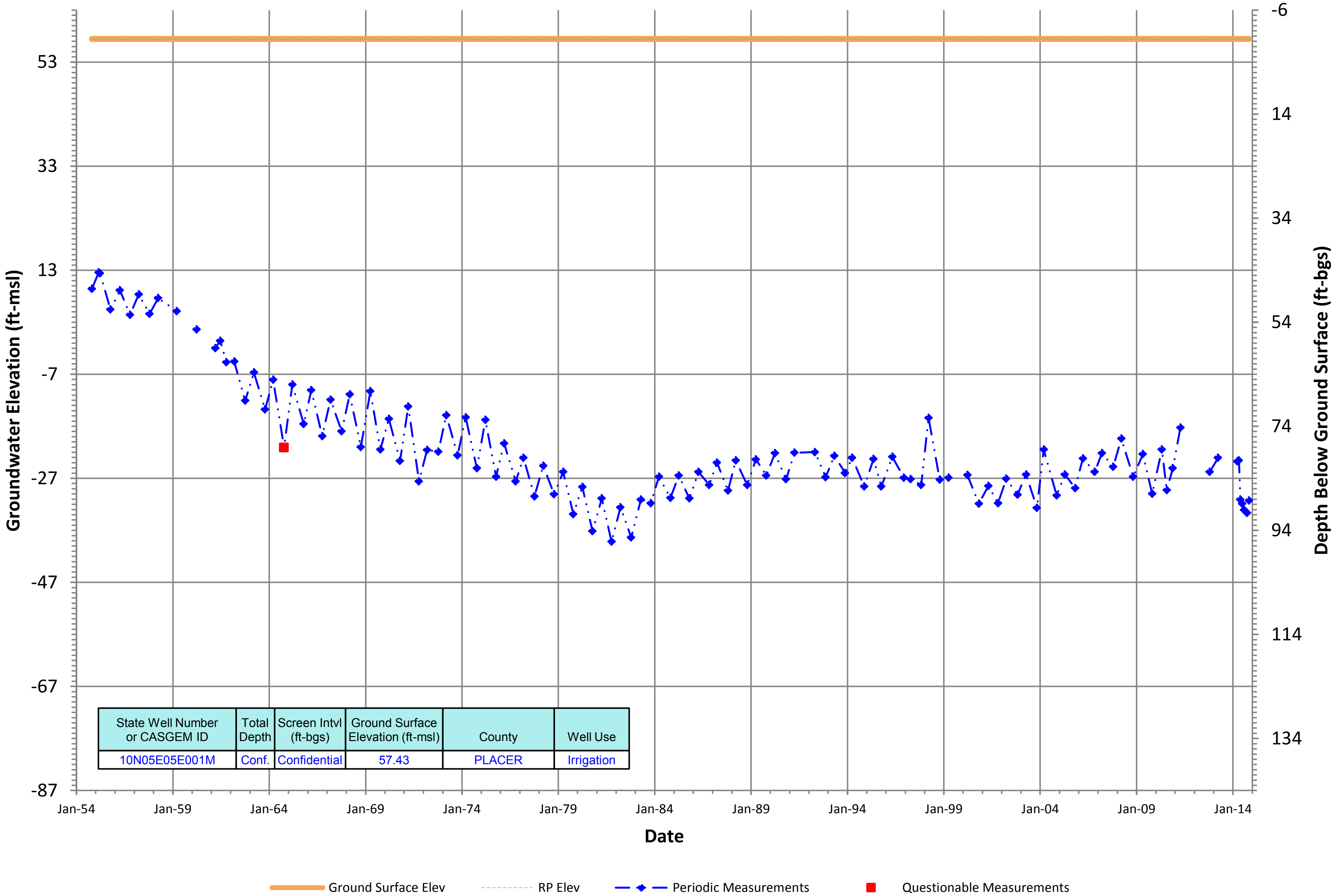
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E31M004M	Conf.	Confidential	16.49	SACRAMENTO	Observation

10N05E05E001M
Period Of Record: 10/20/1954 to 10/31/2014

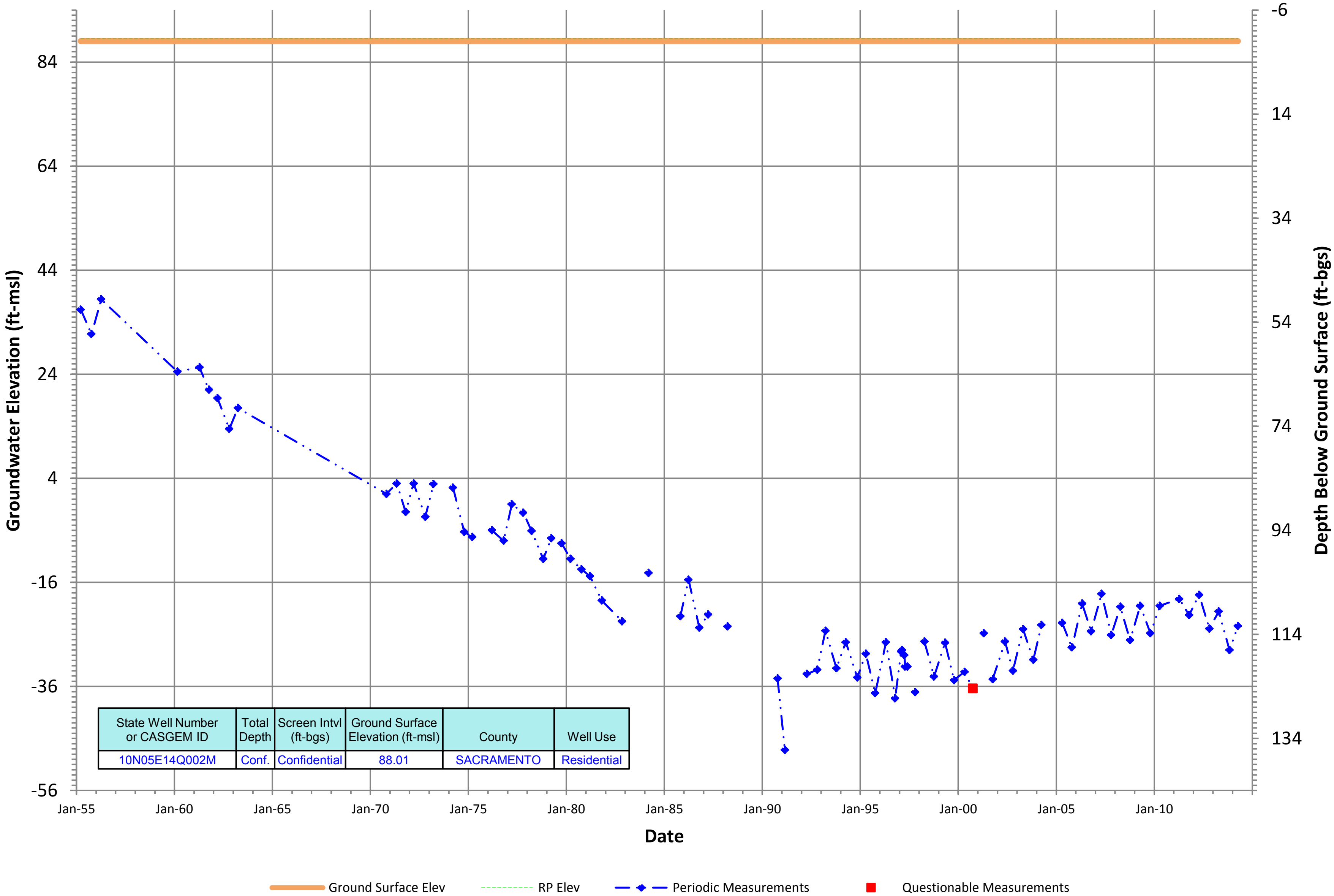
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



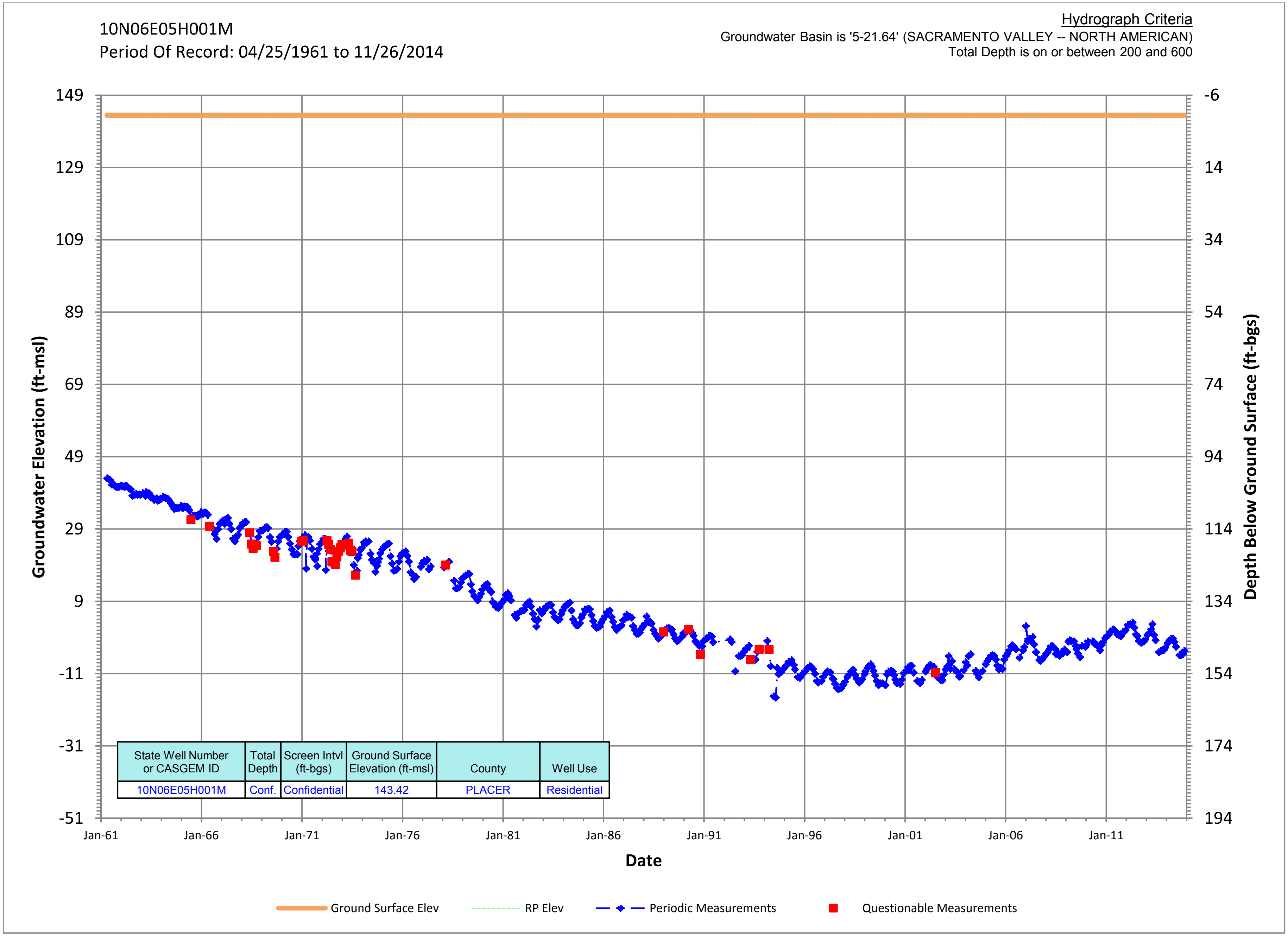
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N05E05E001M	Conf.	Confidential	57.43	PLACER	Irrigation

10N05E14Q002M
Period Of Record: 03/22/1955 to 04/08/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



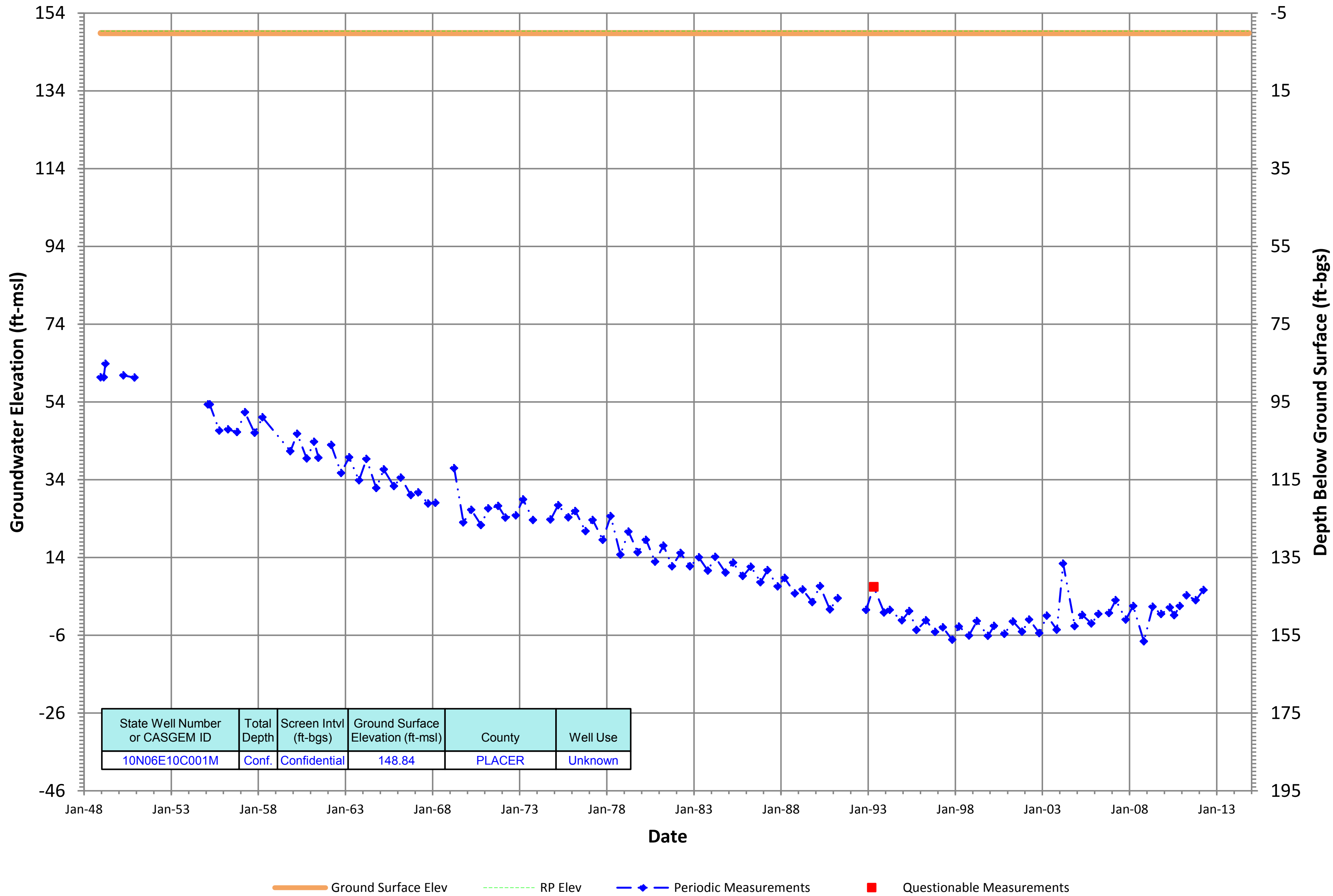
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N05E14Q002M	Conf.	Confidential	88.01	SACRAMENTO	Residential



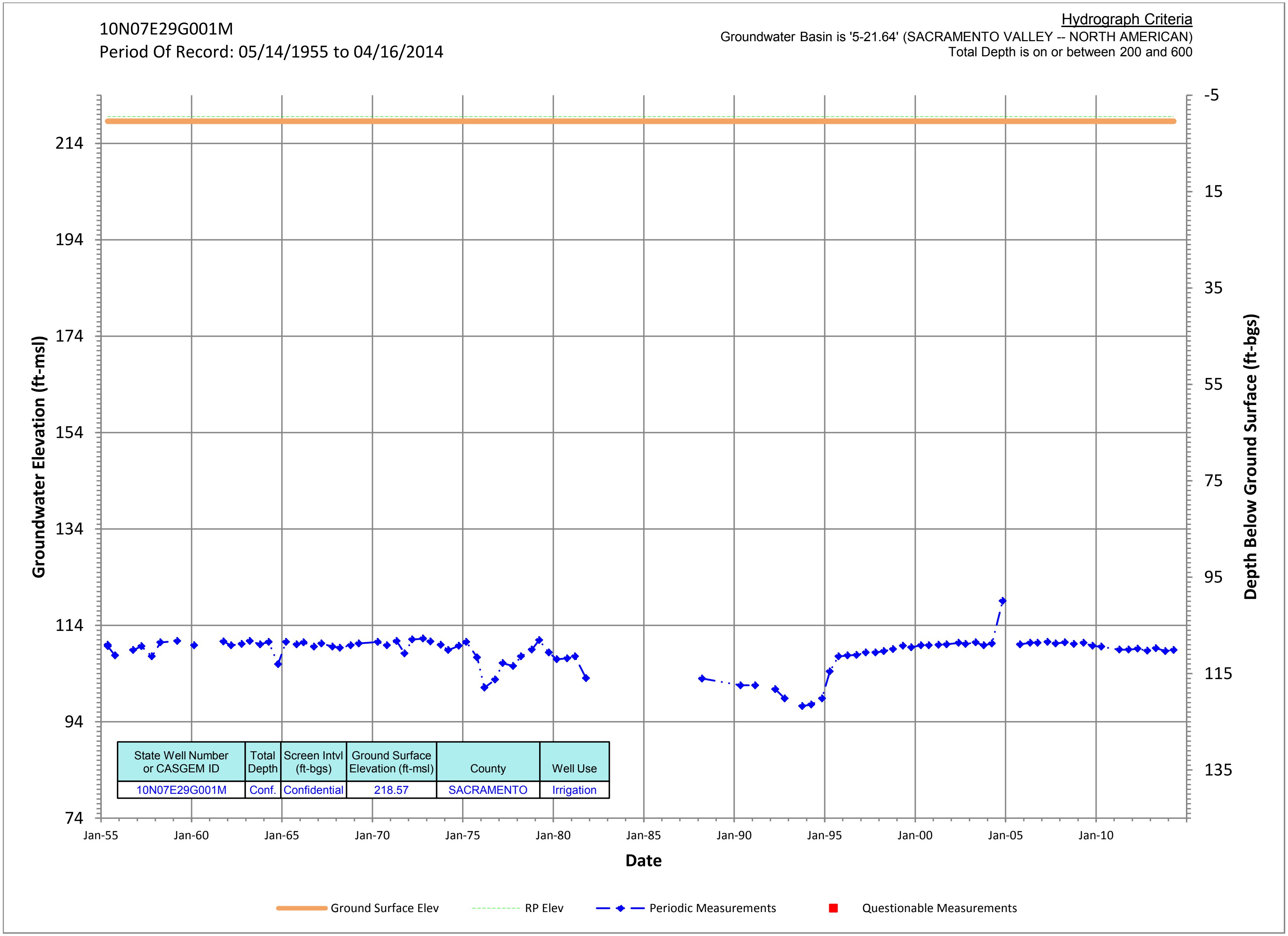
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N06E05H001M	Conf.	Confidential	143.42	PLACER	Residential

10N06E10C001M
Period Of Record: 12/15/1948 to 10/31/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



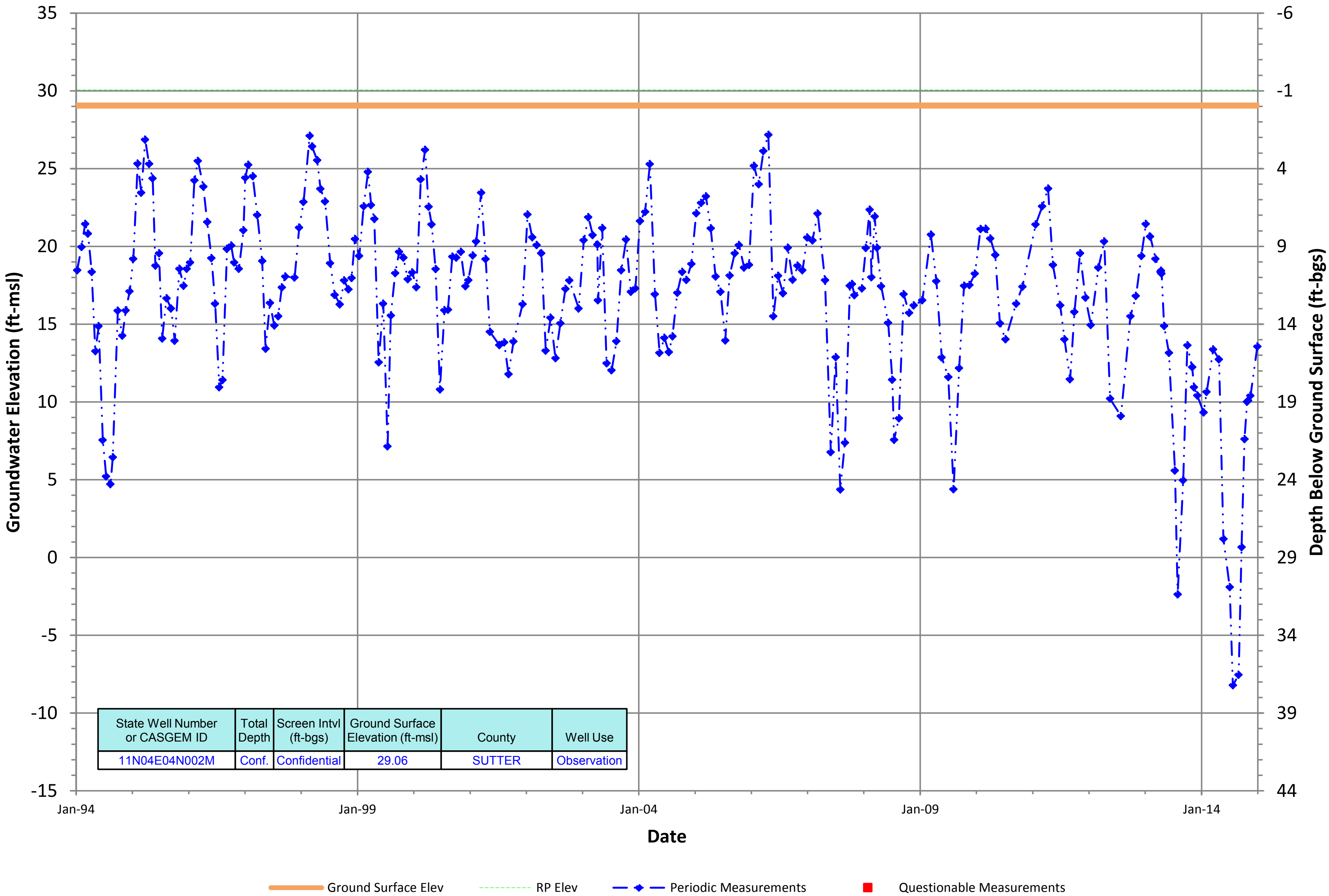
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N06E10C001M	Conf.	Confidential	148.84	PLACER	Unknown



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N07E29G001M	Conf.	Confidential	218.57	SACRAMENTO	Irrigation

11N04E04N002M
Period Of Record: 01/07/1994 to 12/29/2014

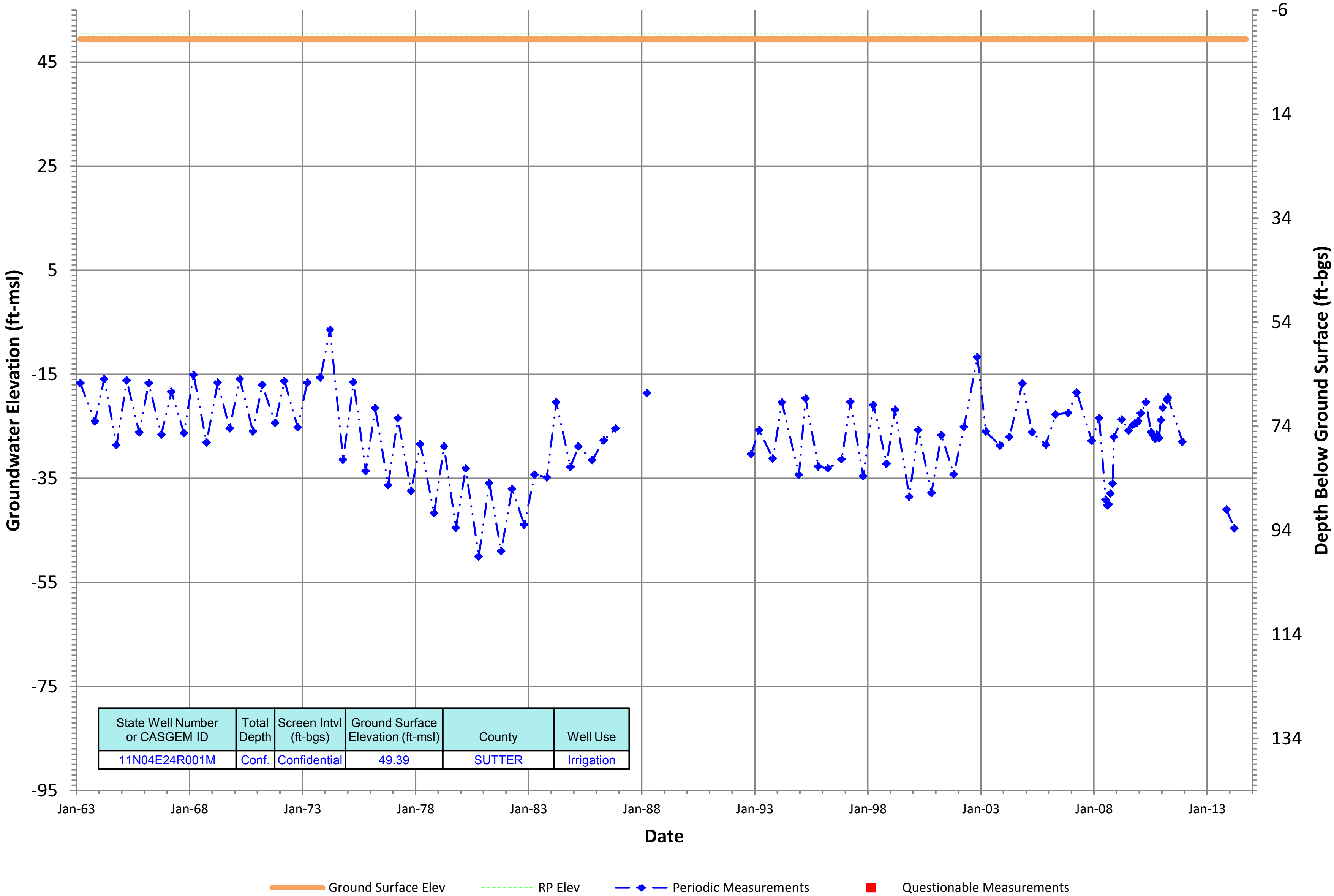
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N04E04N002M	Conf.	Confidential	29.06	SUTTER	Observation

11N04E24R001M
Period Of Record: 03/04/1963 to 09/15/2014

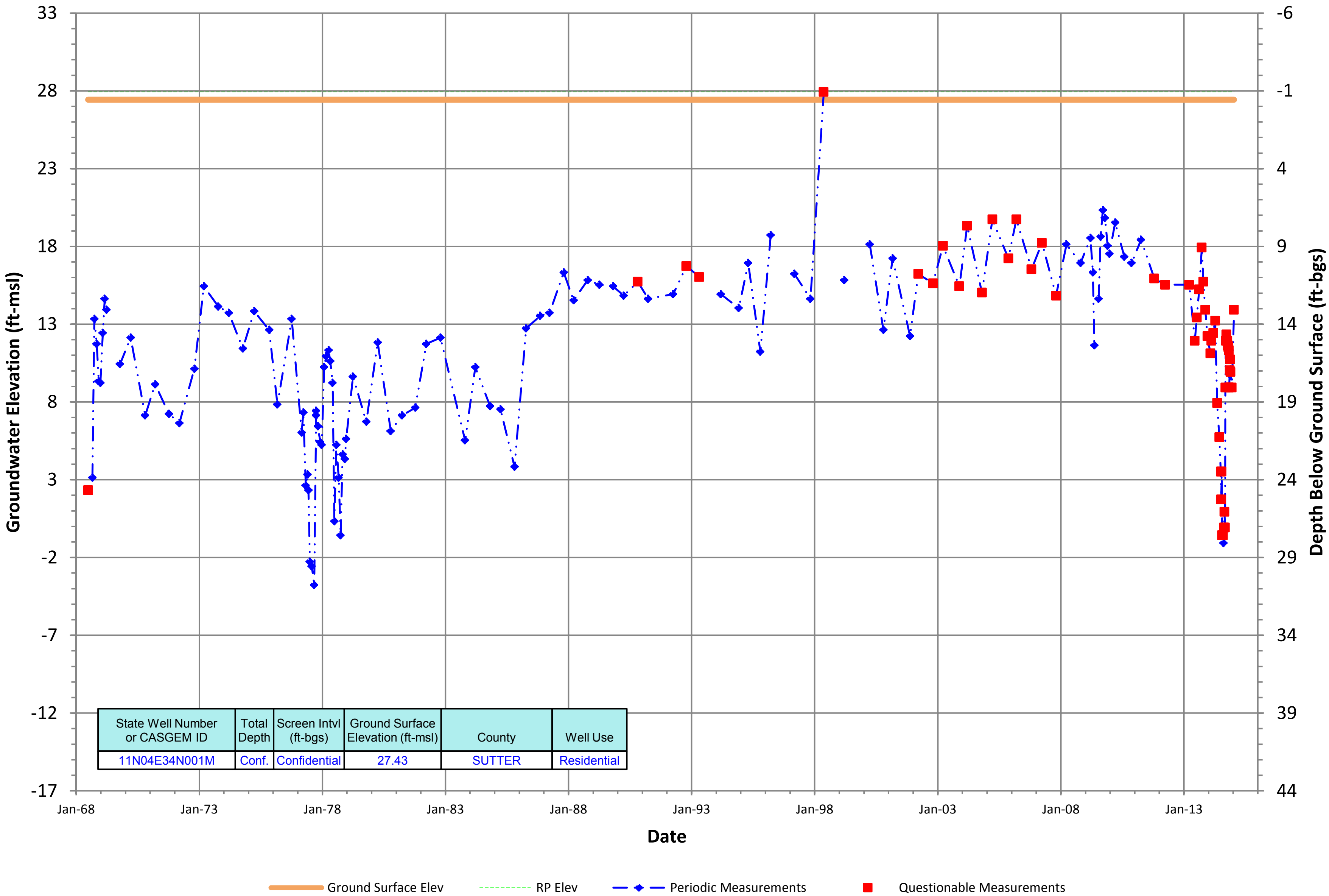
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



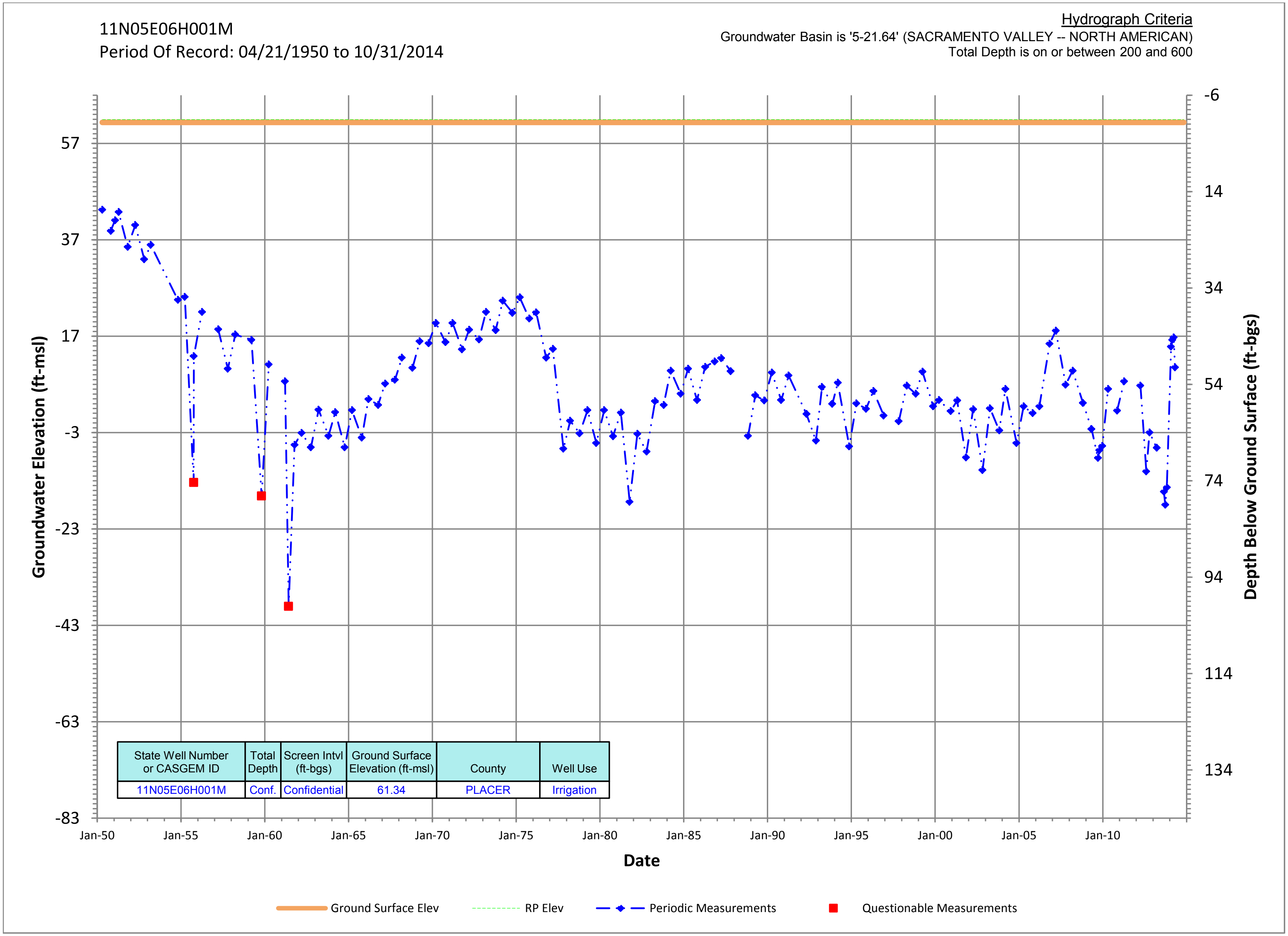
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N04E24R001M	Conf.	Confidential	49.39	SUTTER	Irrigation

11N04E34N001M
Period Of Record: 06/27/1968 to 01/13/2015

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



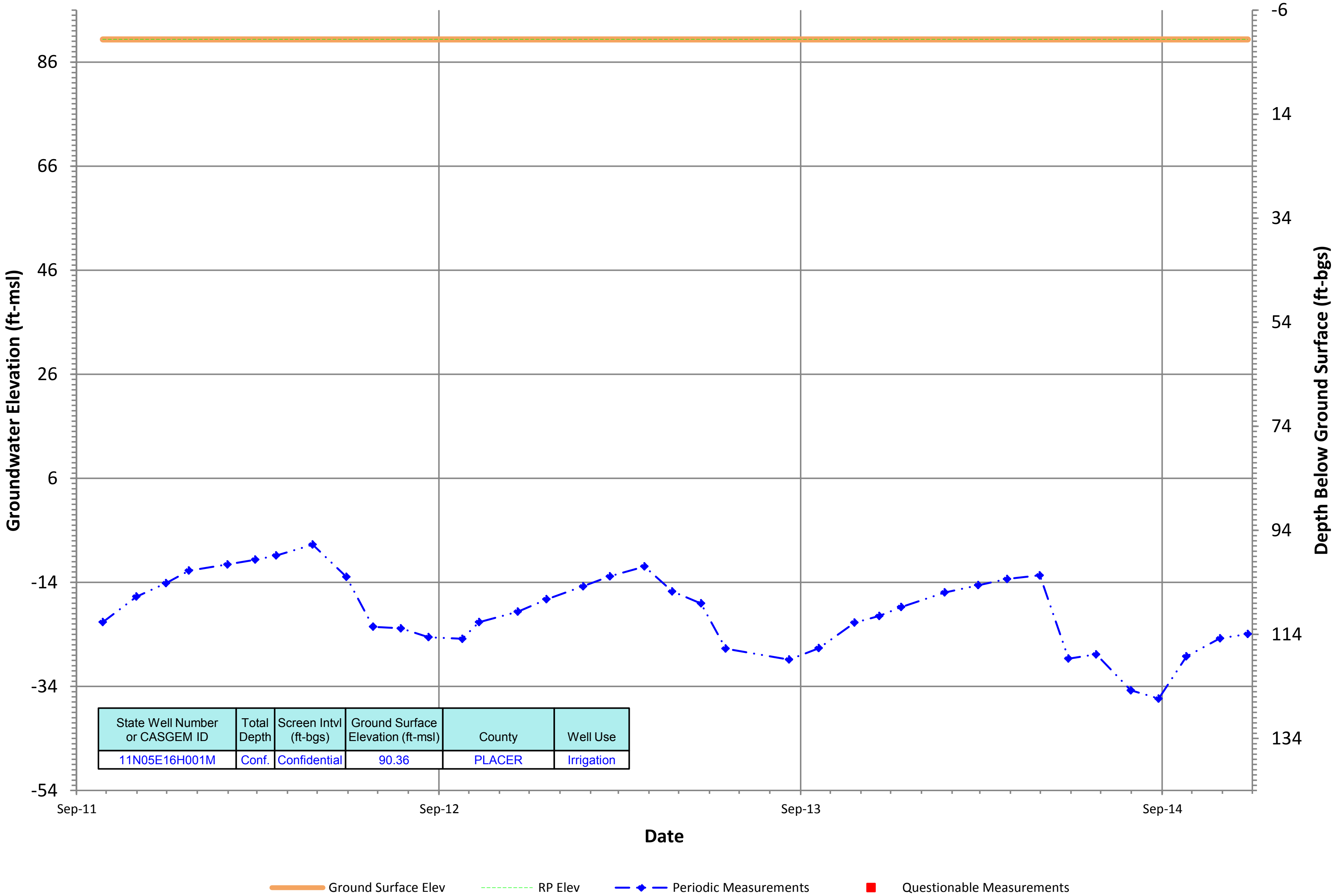
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N04E34N001M	Conf.	Confidential	27.43	SUTTER	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N05E06H001M	Conf.	Confidential	61.34	PLACER	Irrigation

11N05E16H001M
Period Of Record: 09/27/2011 to 11/26/2014

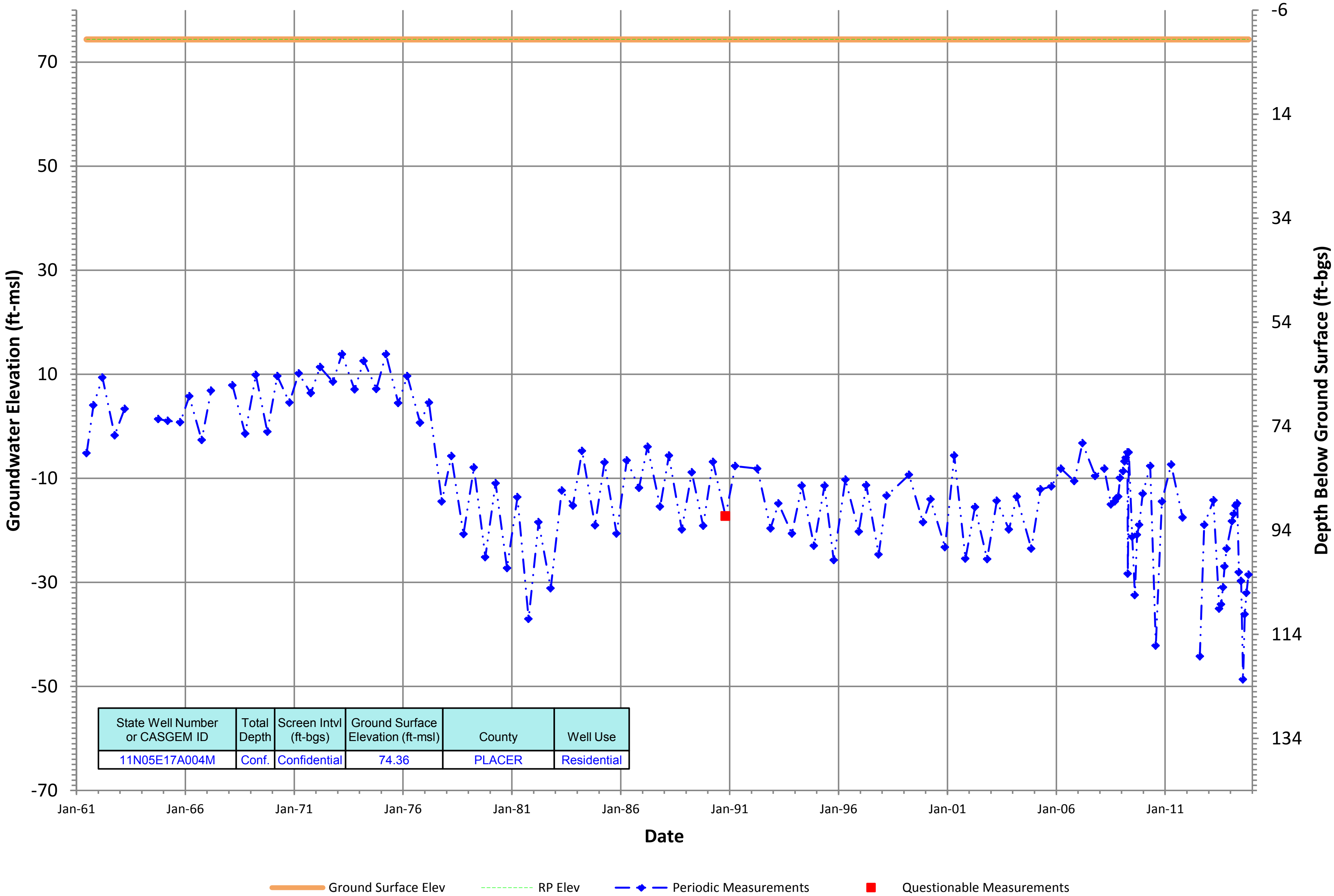
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N05E16H001M	Conf.	Confidential	90.36	PLACER	Irrigation

11N05E17A004M
Period Of Record: 06/19/1961 to 10/31/2014

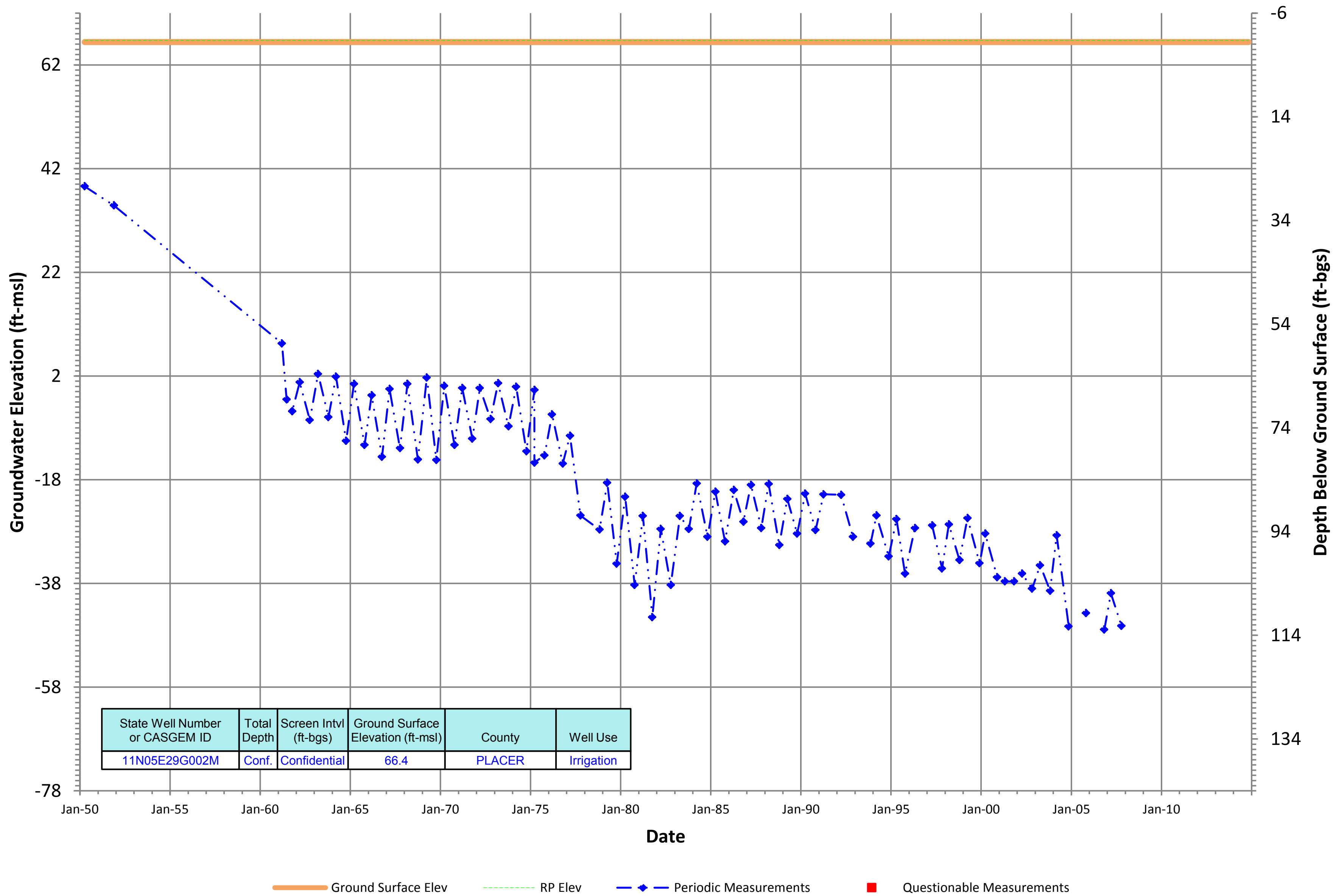
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N05E17A004M	Conf.	Confidential	74.36	PLACER	Residential

11N05E29G002M
Period Of Record: 04/04/1950 to 10/31/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N05E29G002M	Conf.	Confidential	66.4	PLACER	Irrigation

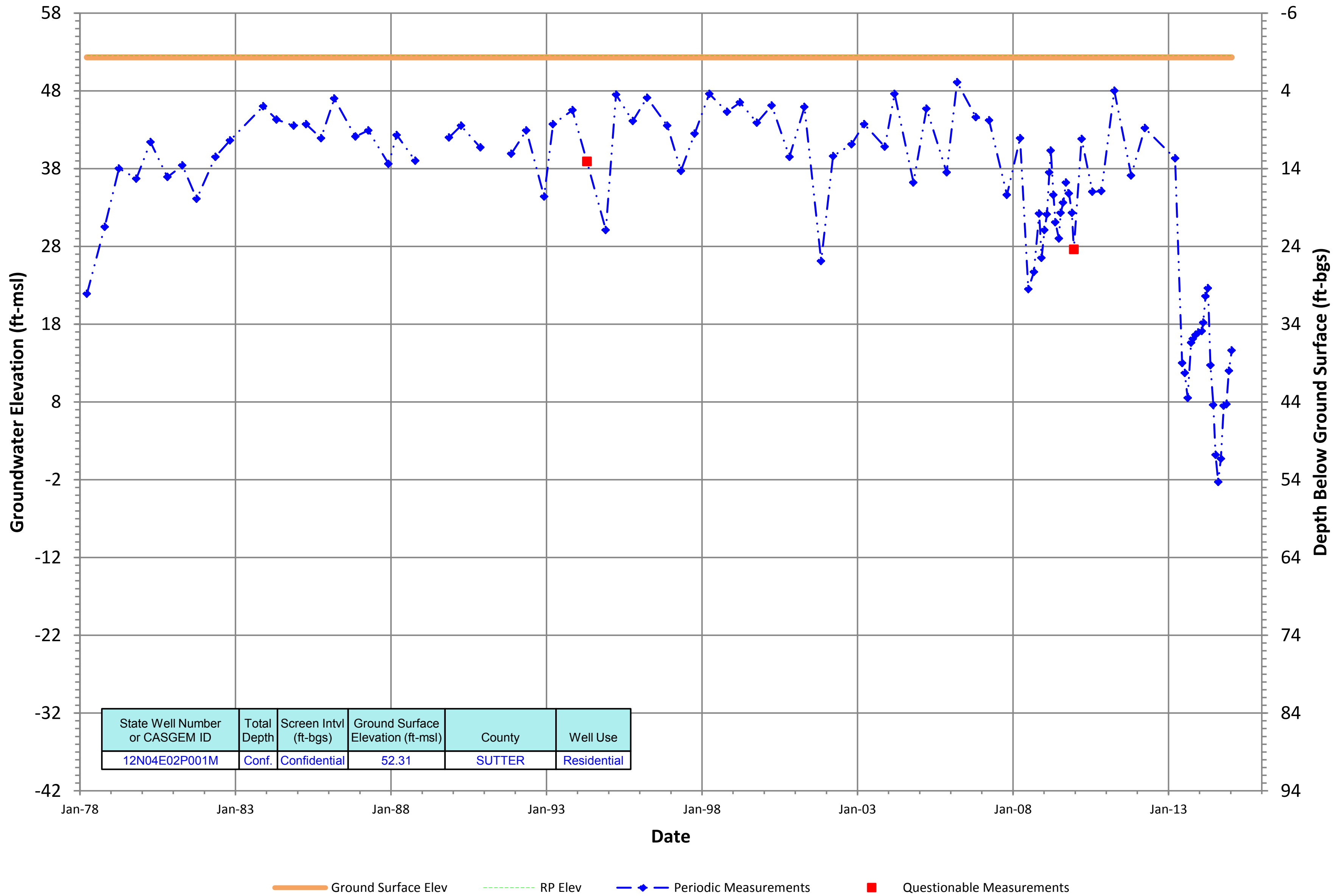
12N04E02P001M

Period Of Record: 03/23/1978 to 01/13/2015

Hydrograph Criteria

Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)

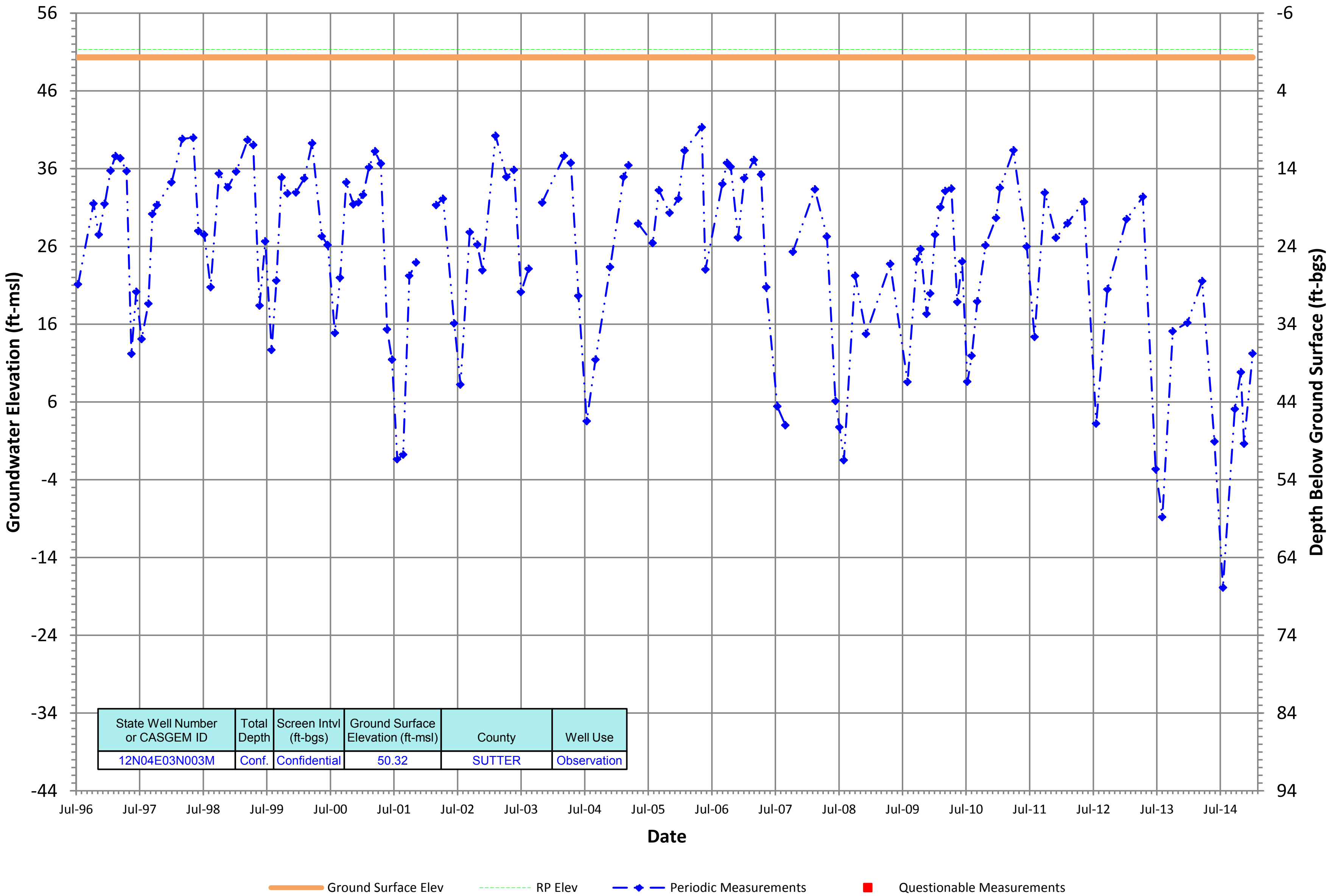
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E02P001M	Conf.	Confidential	52.31	SUTTER	Residential

12N04E03N003M
Period Of Record: 07/11/1996 to 01/02/2015

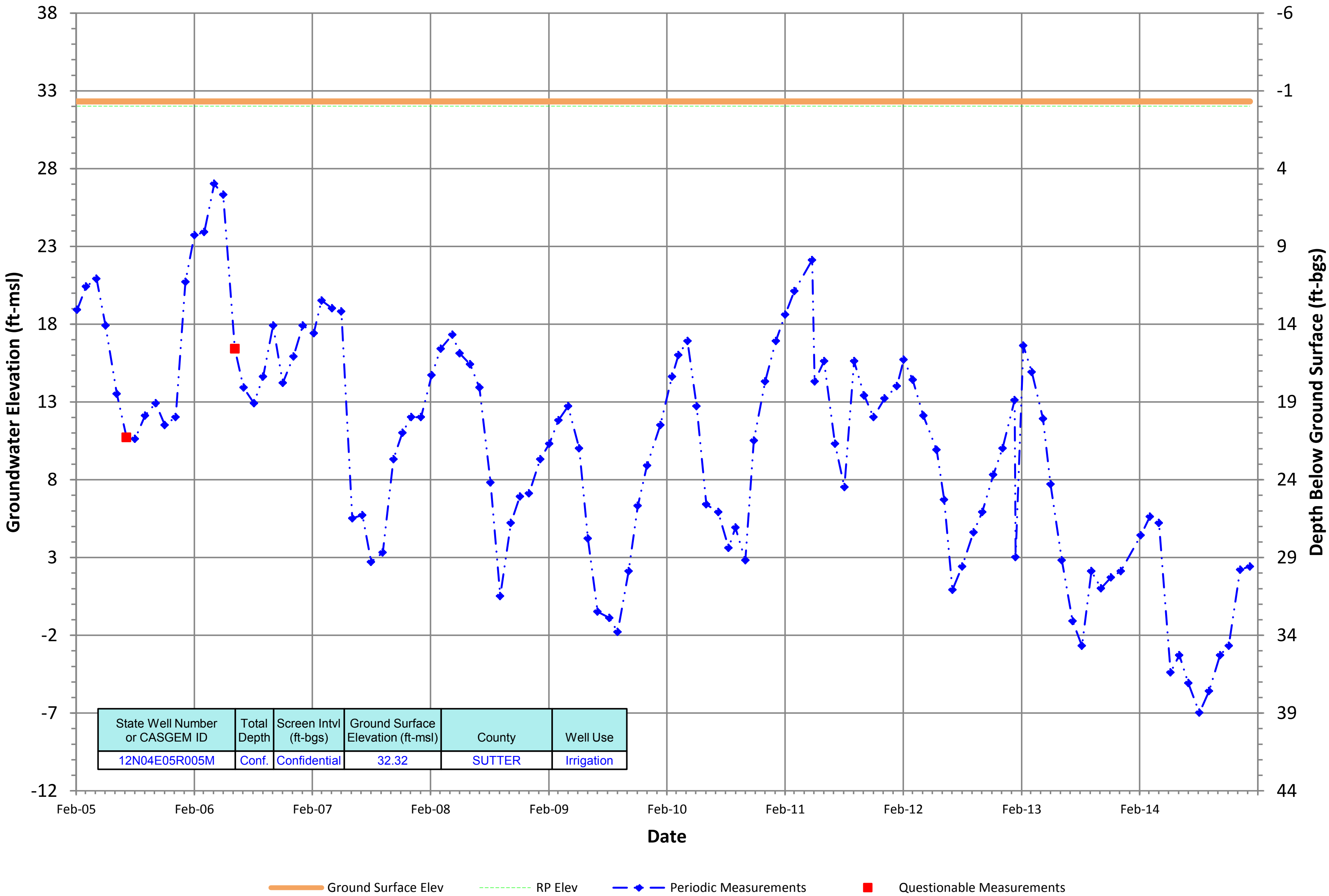
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



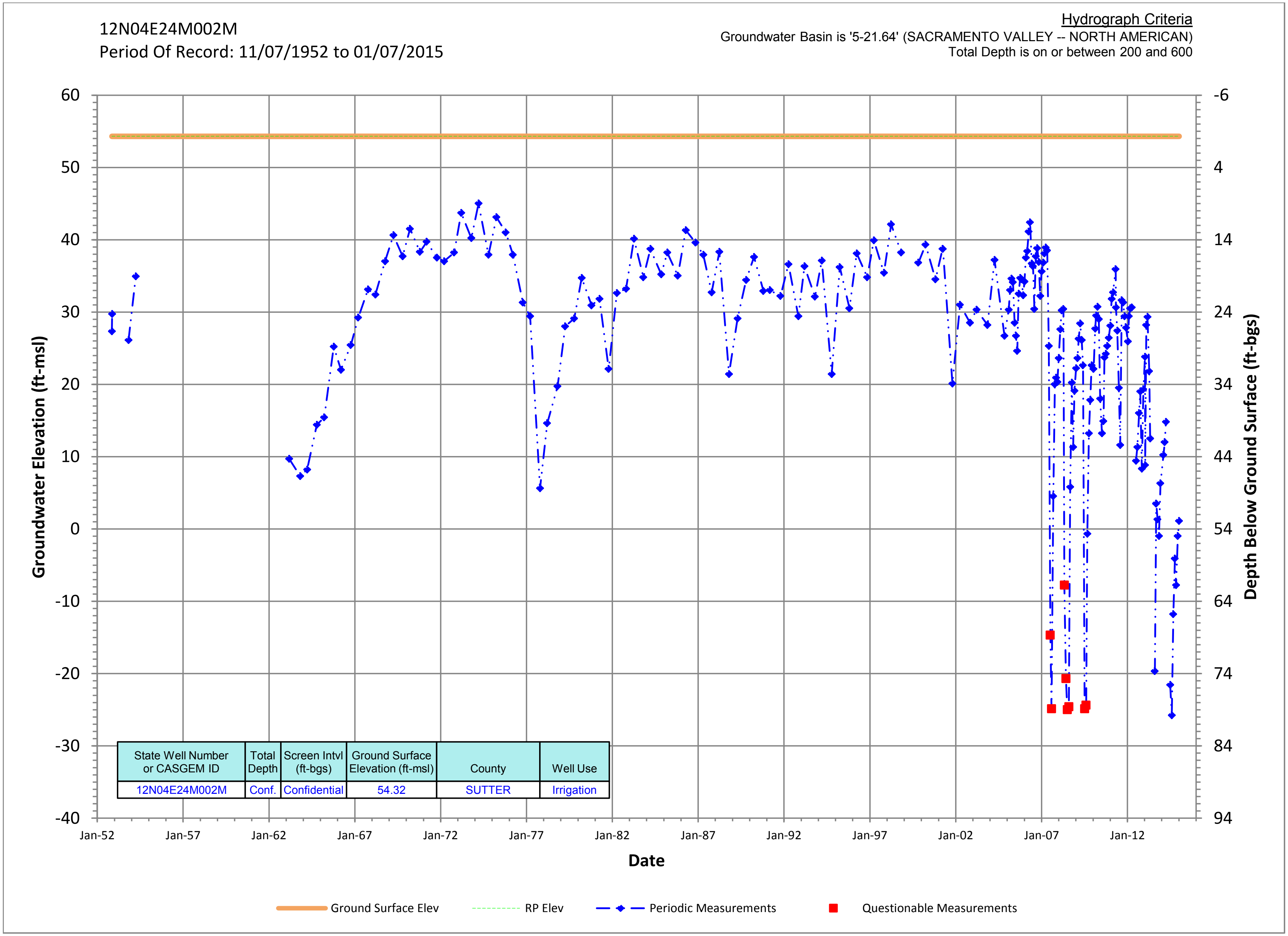
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E03N003M	Conf.	Confidential	50.32	SUTTER	Observation

12N04E05R005M
Period Of Record: 02/03/2005 to 01/07/2015

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600

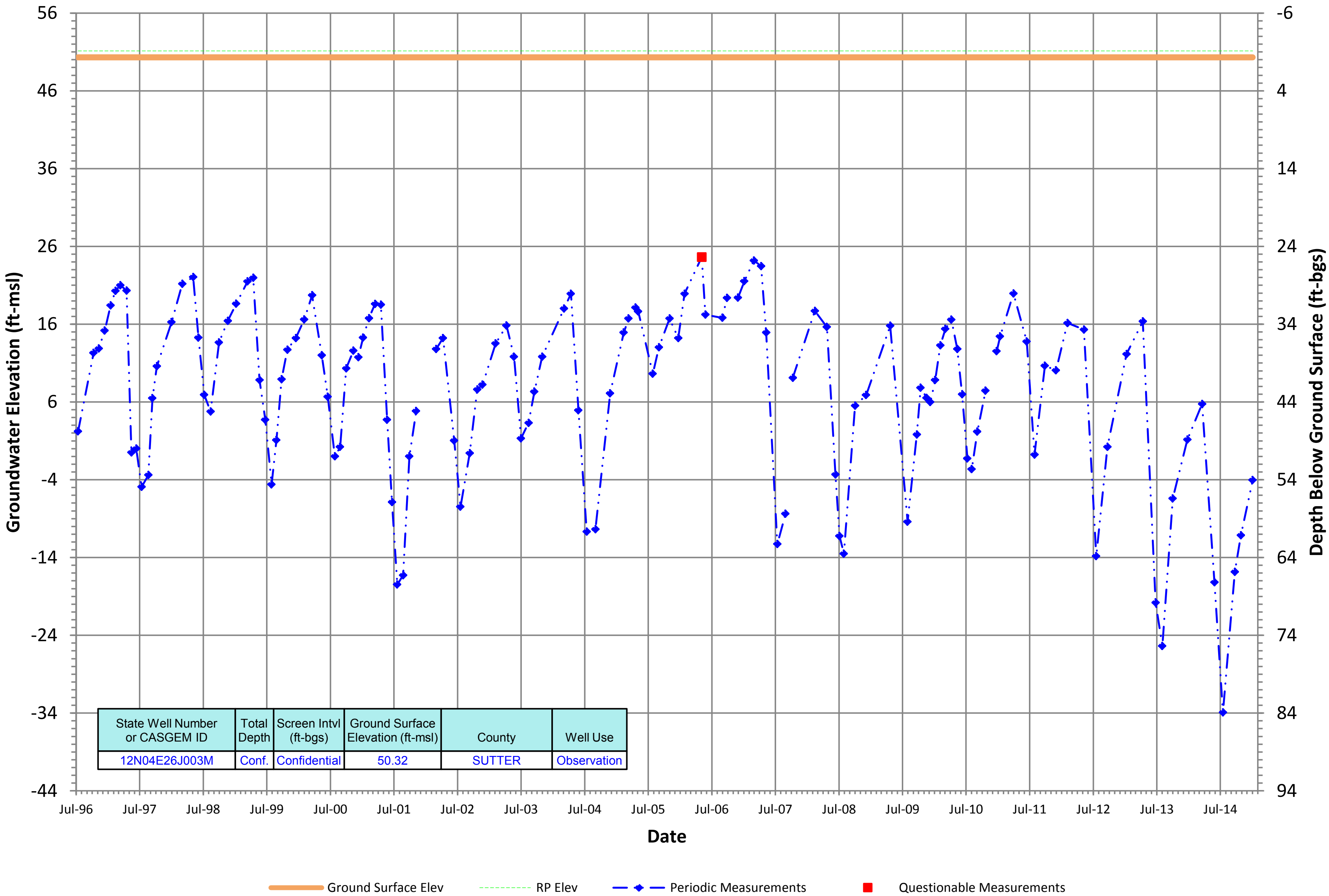


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E05R005M	Conf.	Confidential	32.32	SUTTER	Irrigation


12N04E24M002M
Period Of Record: 11/07/1952 to 01/07/2015
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
12N04E24M002M
Conf.
Confidential
54.32
SUTTER
Irrigation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

12N04E26J003M
Period Of Record: 07/11/1996 to 01/02/2015

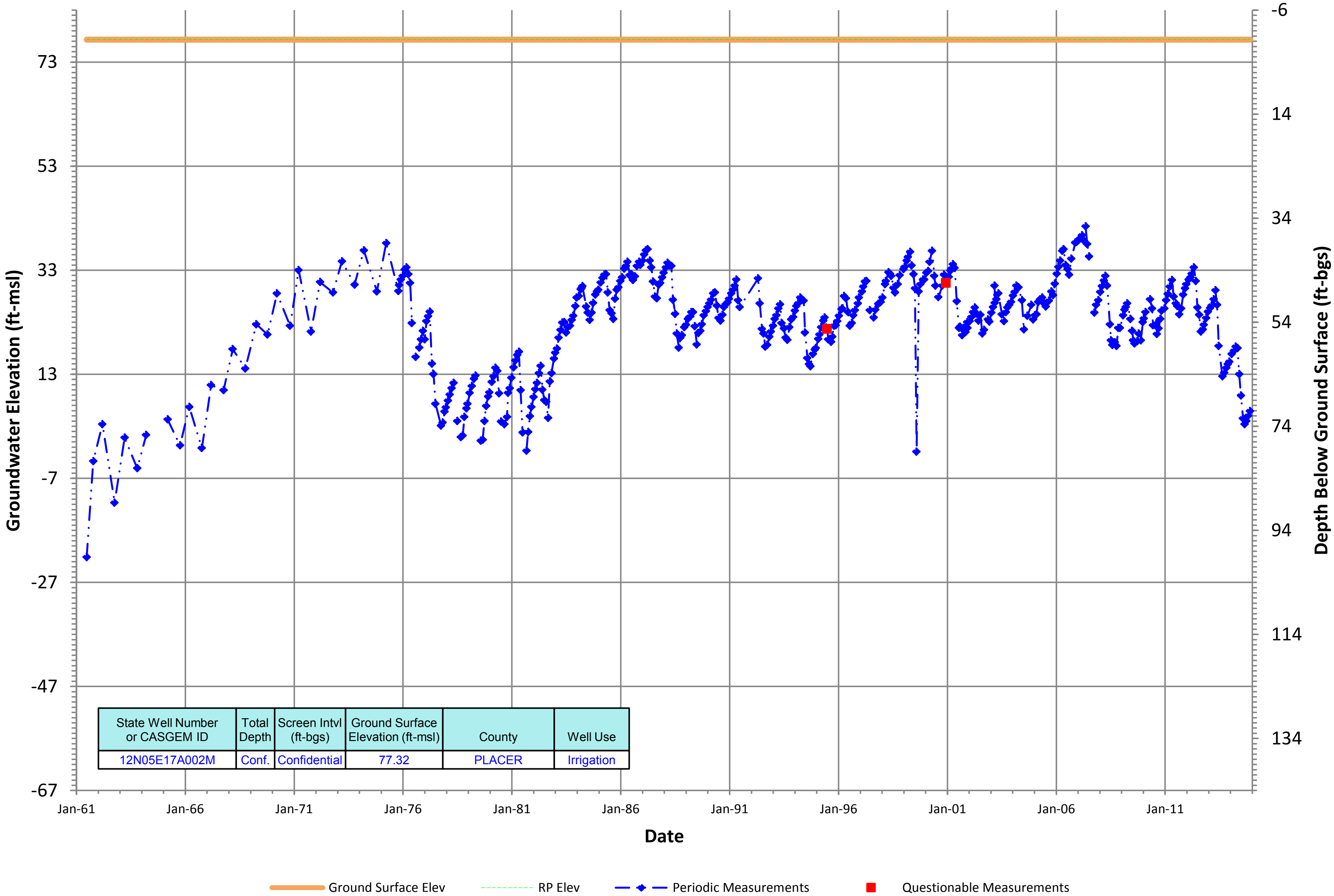
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E26J003M	Conf.	Confidential	50.32	SUTTER	Observation

12N05E17A002M
Period Of Record: 06/22/1961 to 11/26/2014

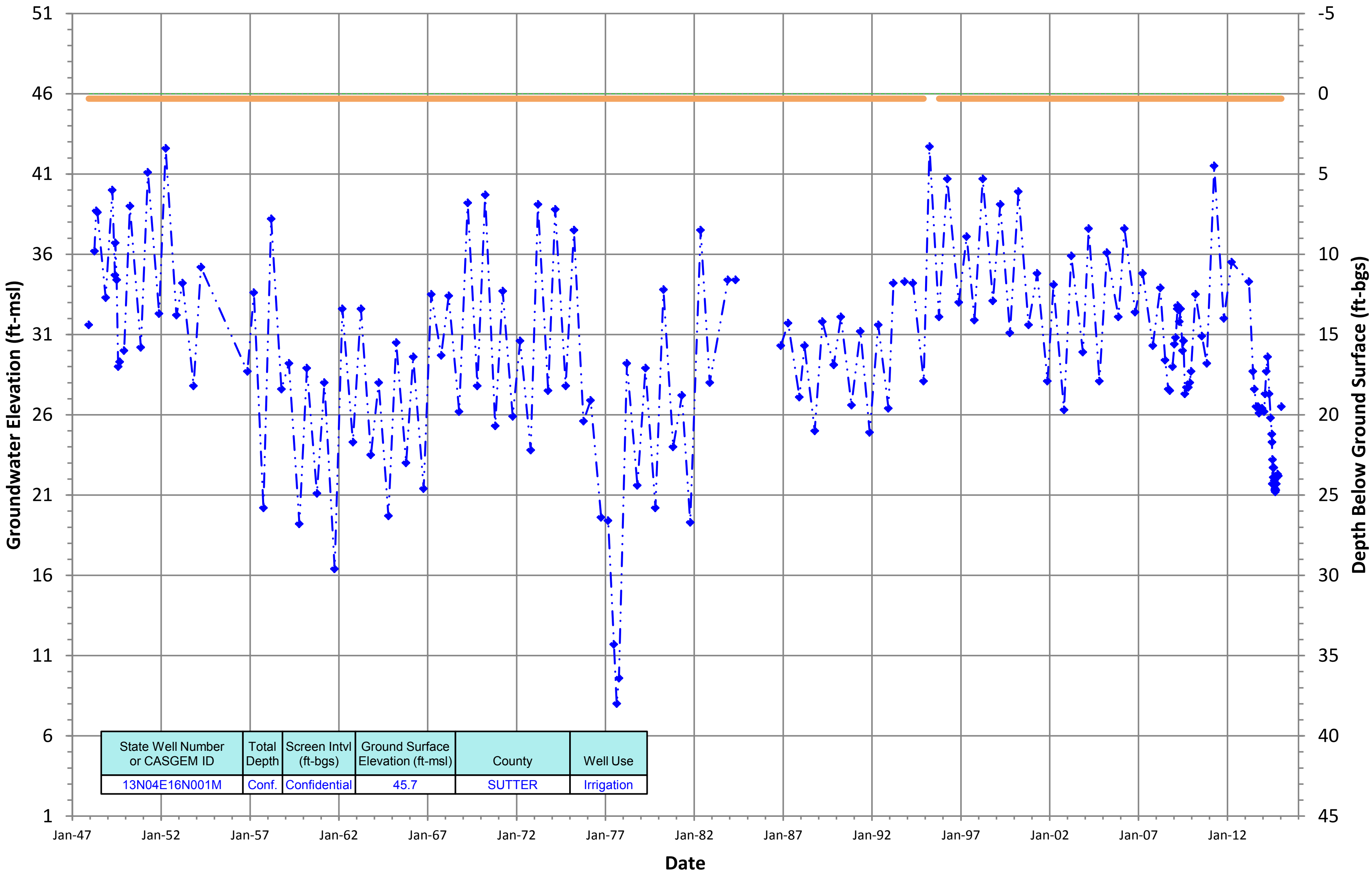
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



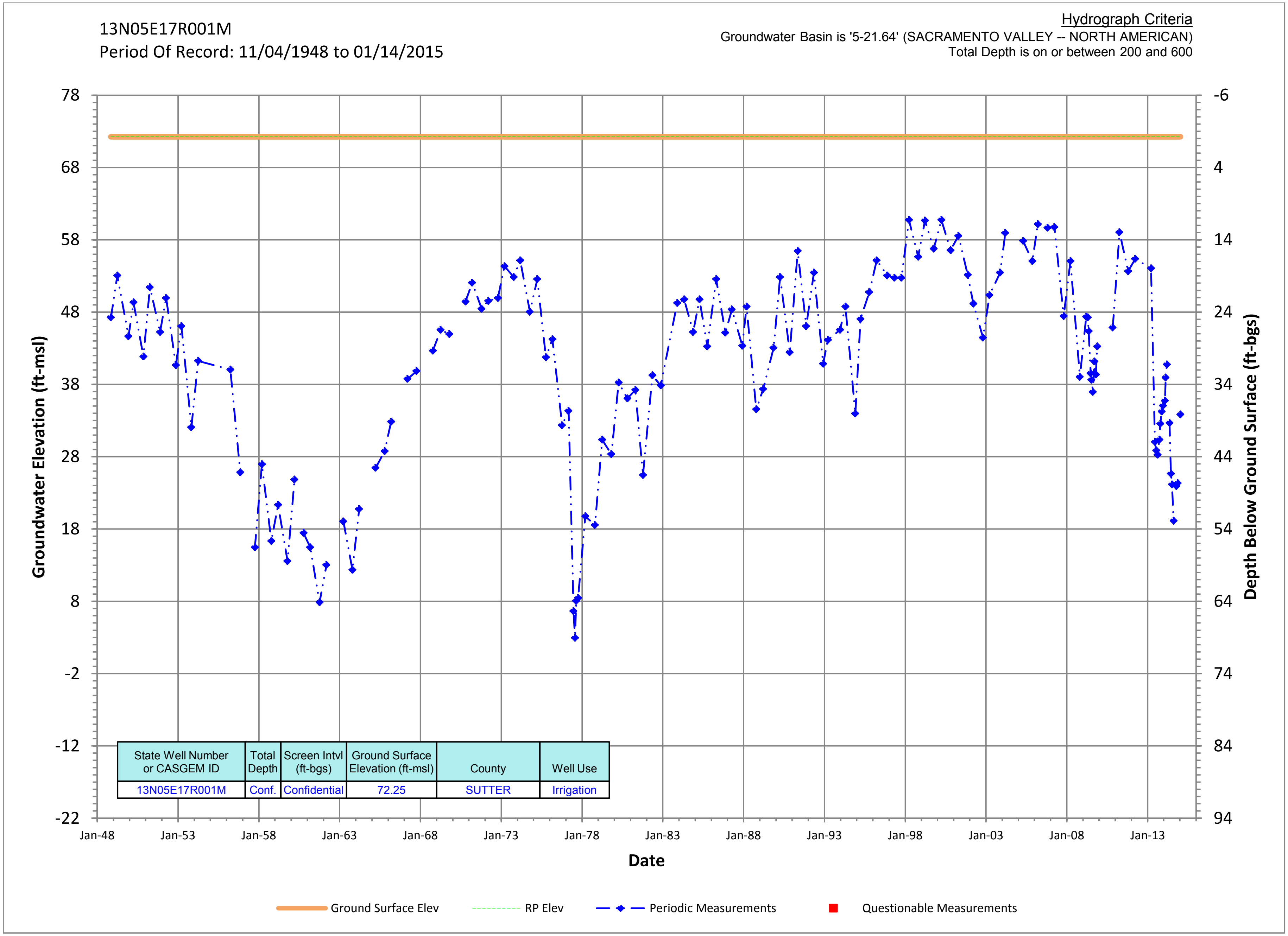
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N05E17A002M	Conf.	Confidential	77.32	PLACER	Irrigation

13N04E16N001M
Period Of Record: 12/06/1947 to 01/13/2015

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



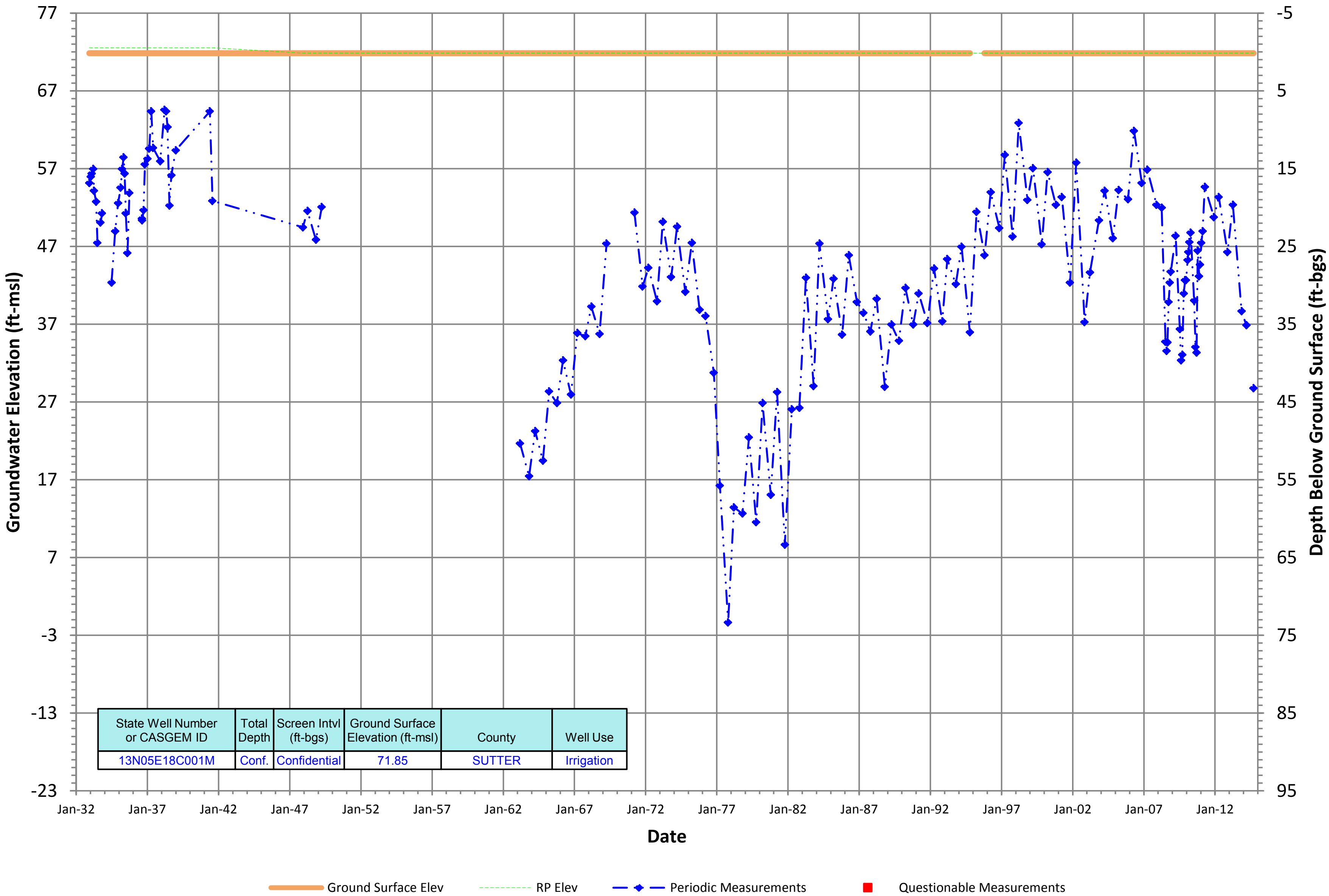
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N04E16N001M	Conf.	Confidential	45.7	SUTTER	Irrigation



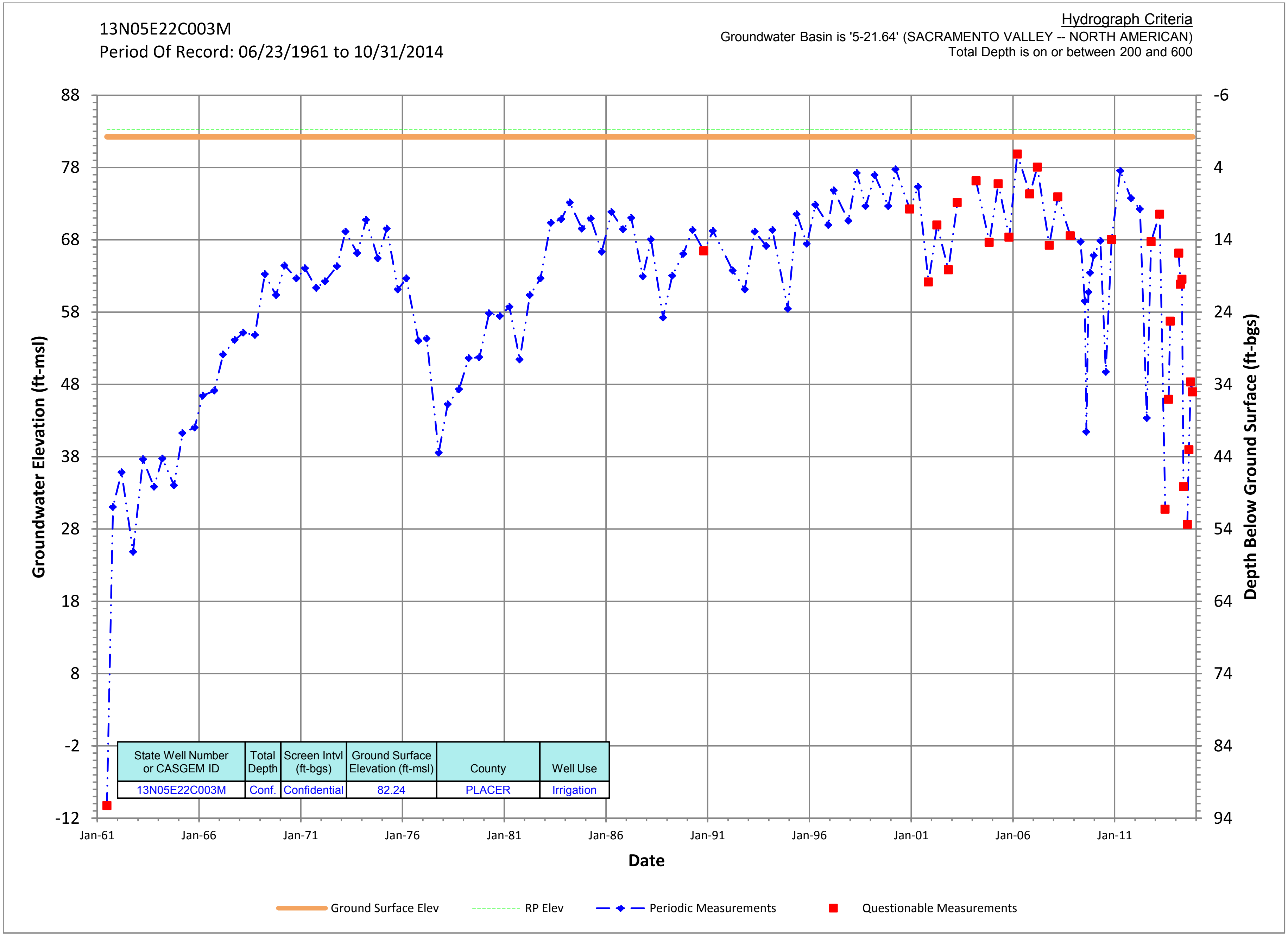
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N05E17R001M	Conf.	Confidential	72.25	SUTTER	Irrigation

13N05E18C001M
Period Of Record: 12/01/1932 to 09/15/2014

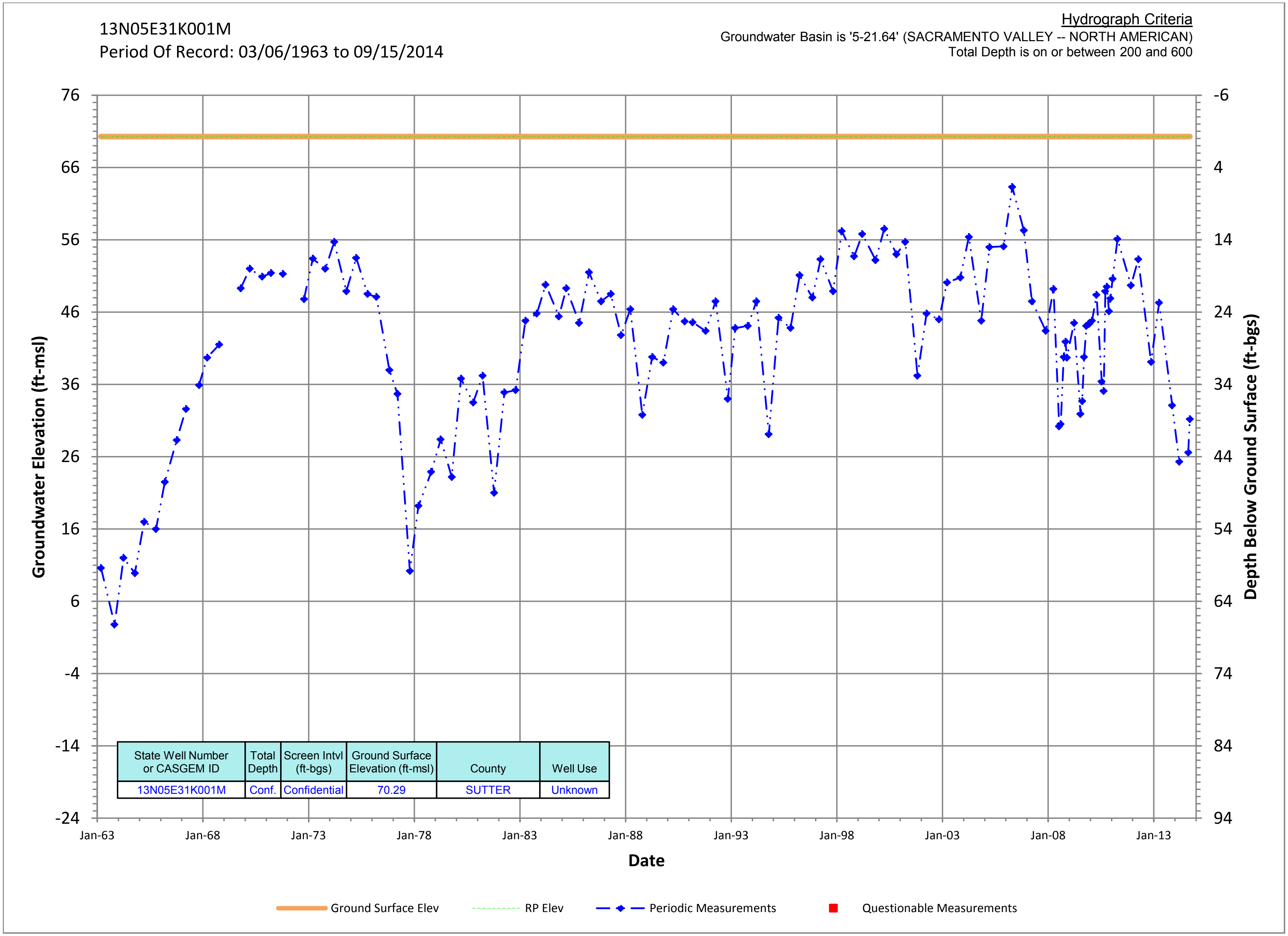
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N05E18C001M	Conf.	Confidential	71.85	SUTTER	Irrigation



13N05E22C003M
Period Of Record: 06/23/1961 to 10/31/2014
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
88
78
68
58
48
38
28
18
8
-2
-12
Depth Below Ground Surface (ft-bgs)
-6
4
14
24
34
44
54
64
74
84
94
Jan-61
Jan-66
Jan-71
Jan-76
Jan-81
Jan-86
Jan-91
Jan-96
Jan-01
Jan-06
Jan-11
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
13N05E22C003M
Conf.
Confidential
82.24
PLACER
Irrigation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N05E31K001M	Conf.	Confidential	70.29	SUTTER	Unknown

Deep Groundwater Monitoring Well Hydrographs- North American Subbasin

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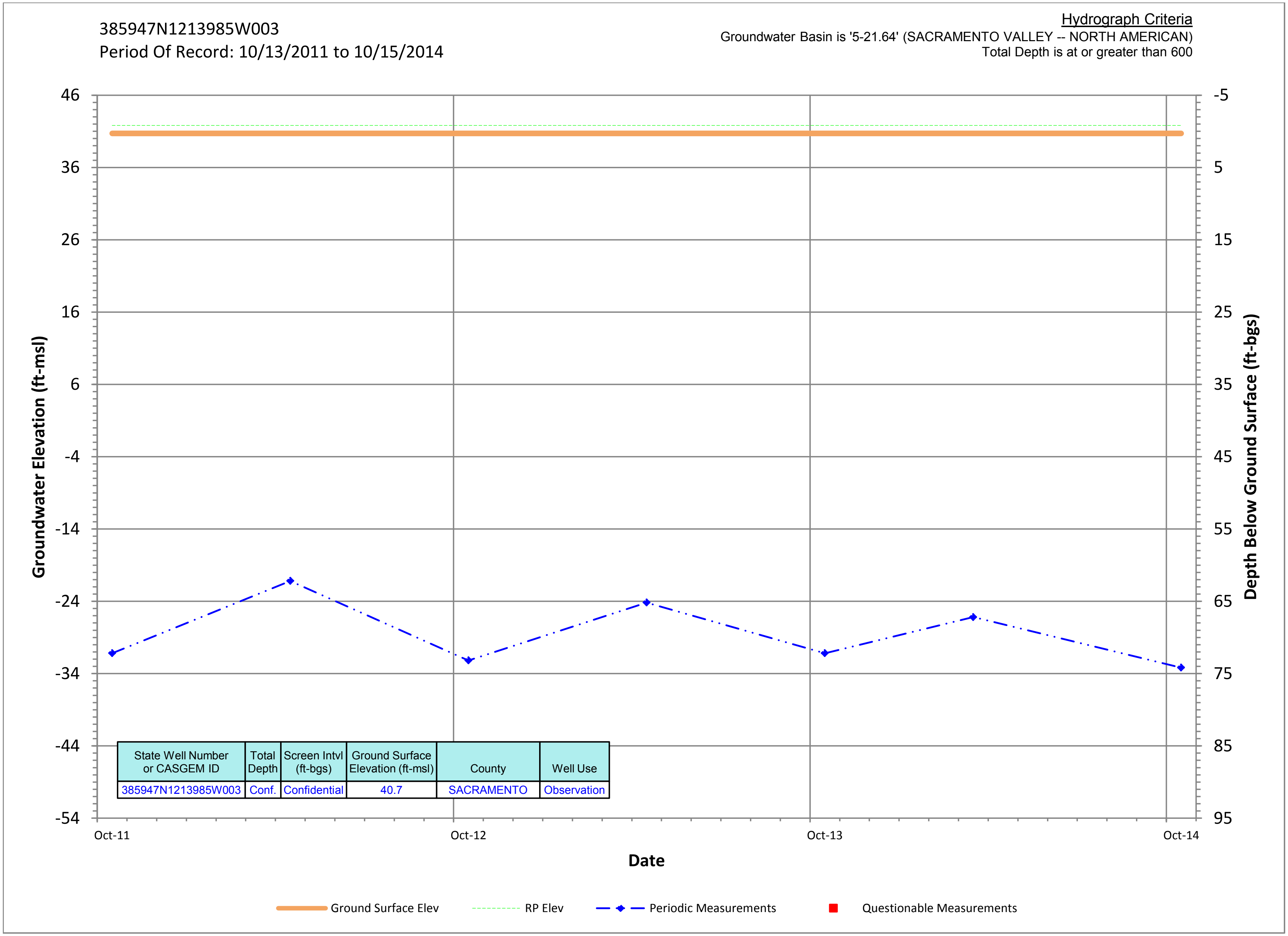
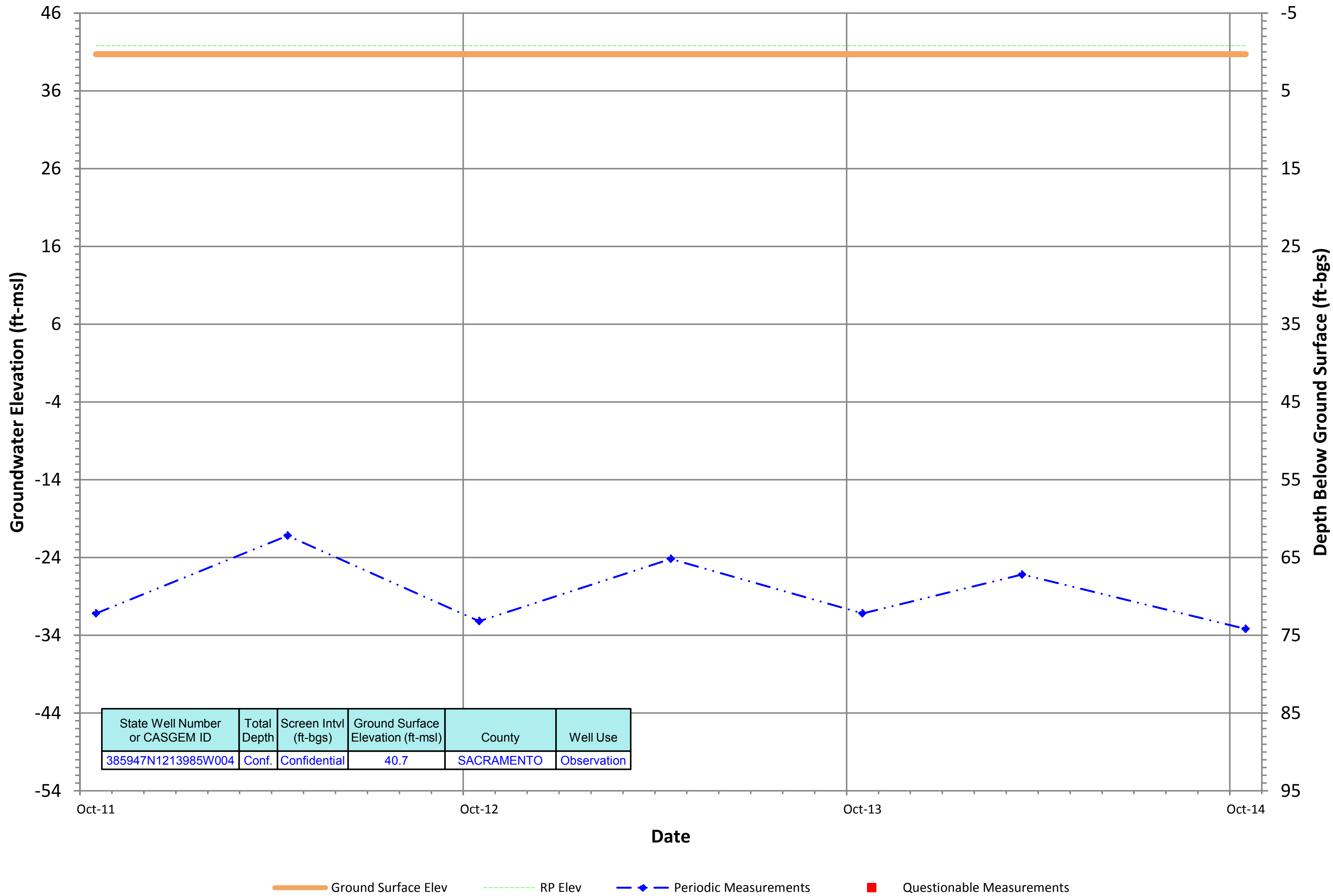


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
385947N1213985W003	Conf.	Confidential	40.7	SACRAMENTO	Observation

385947N1213985W004
Period Of Record: 10/13/2011 to 10/15/2014

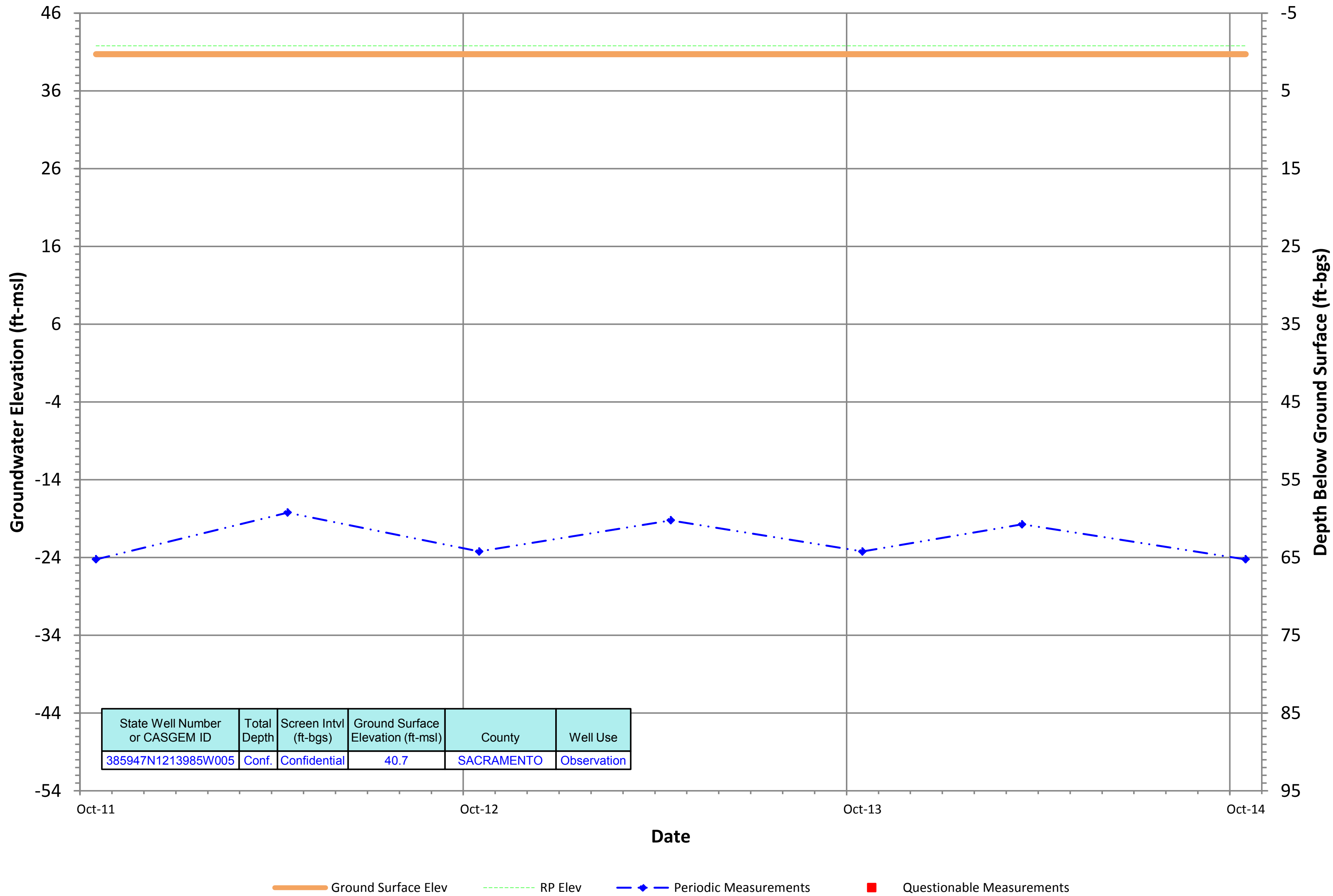
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
385947N1213985W004	Conf.	Confidential	40.7	SACRAMENTO	Observation

385947N1213985W005
Period Of Record: 10/13/2011 to 10/15/2014

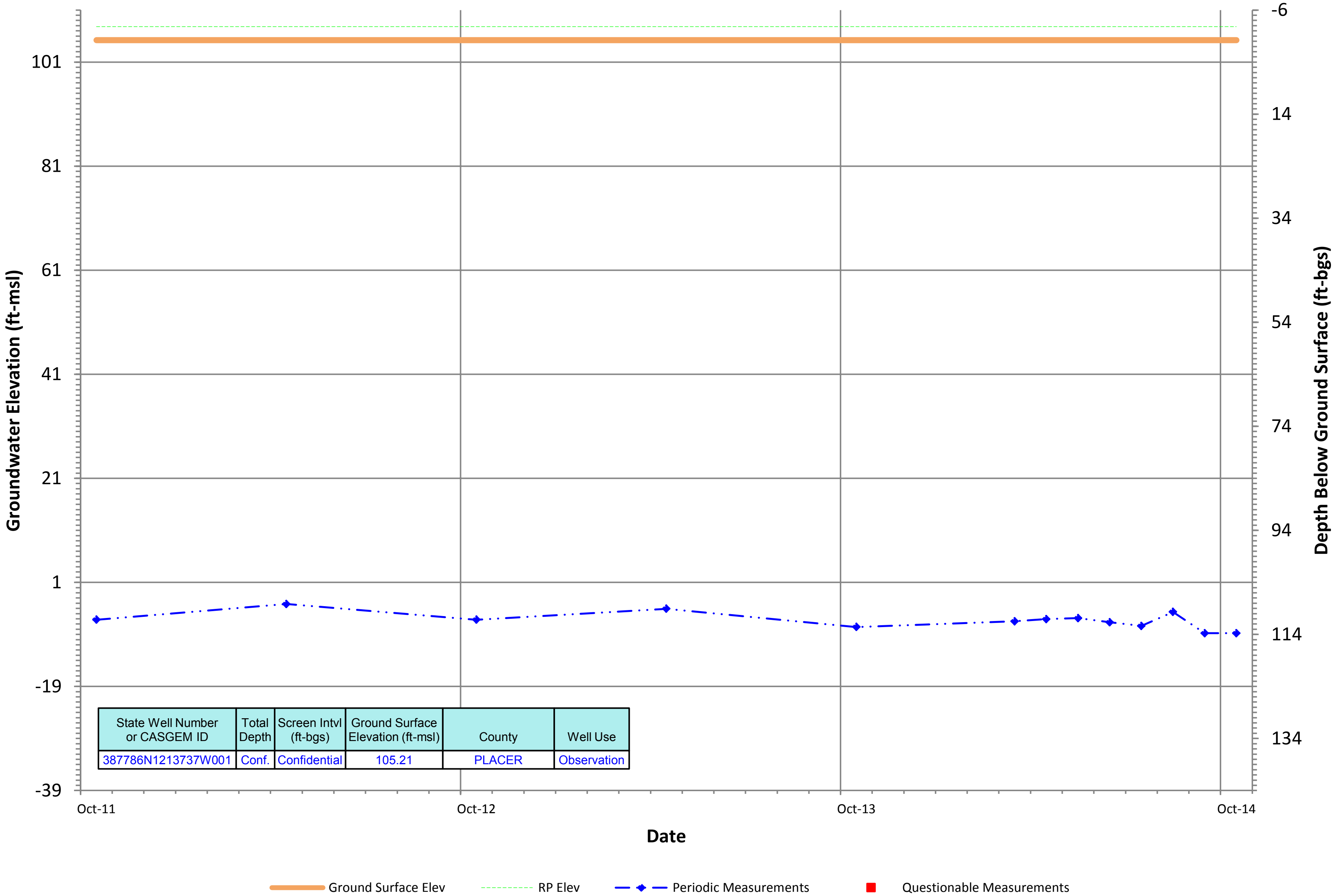
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
385947N1213985W005	Conf.	Confidential	40.7	SACRAMENTO	Observation

387786N1213737W001
Period Of Record: 10/18/2011 to 10/09/2014

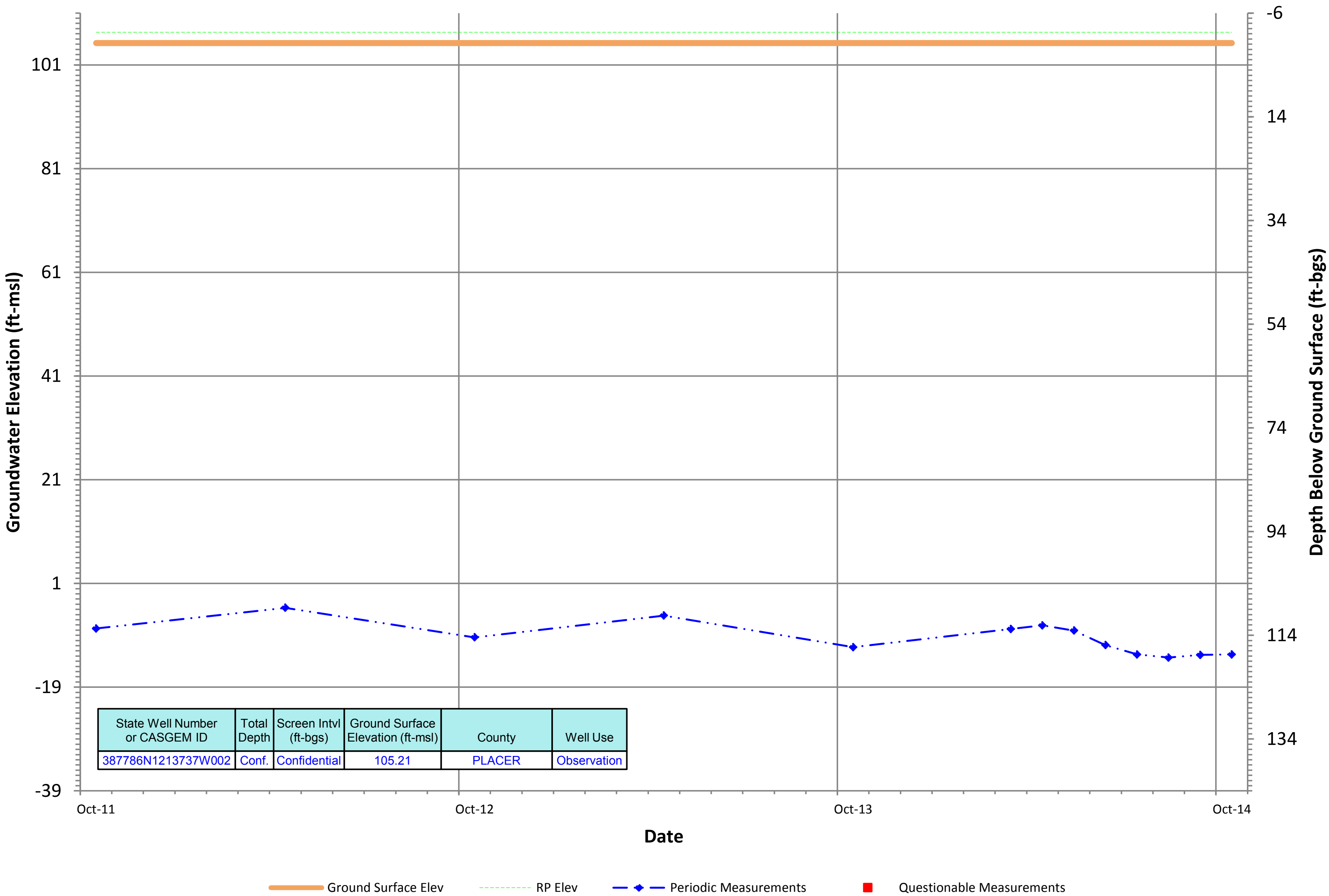
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387786N1213737W001	Conf.	Confidential	105.21	PLACER	Observation

387786N1213737W002
Period Of Record: 10/18/2011 to 10/09/2014

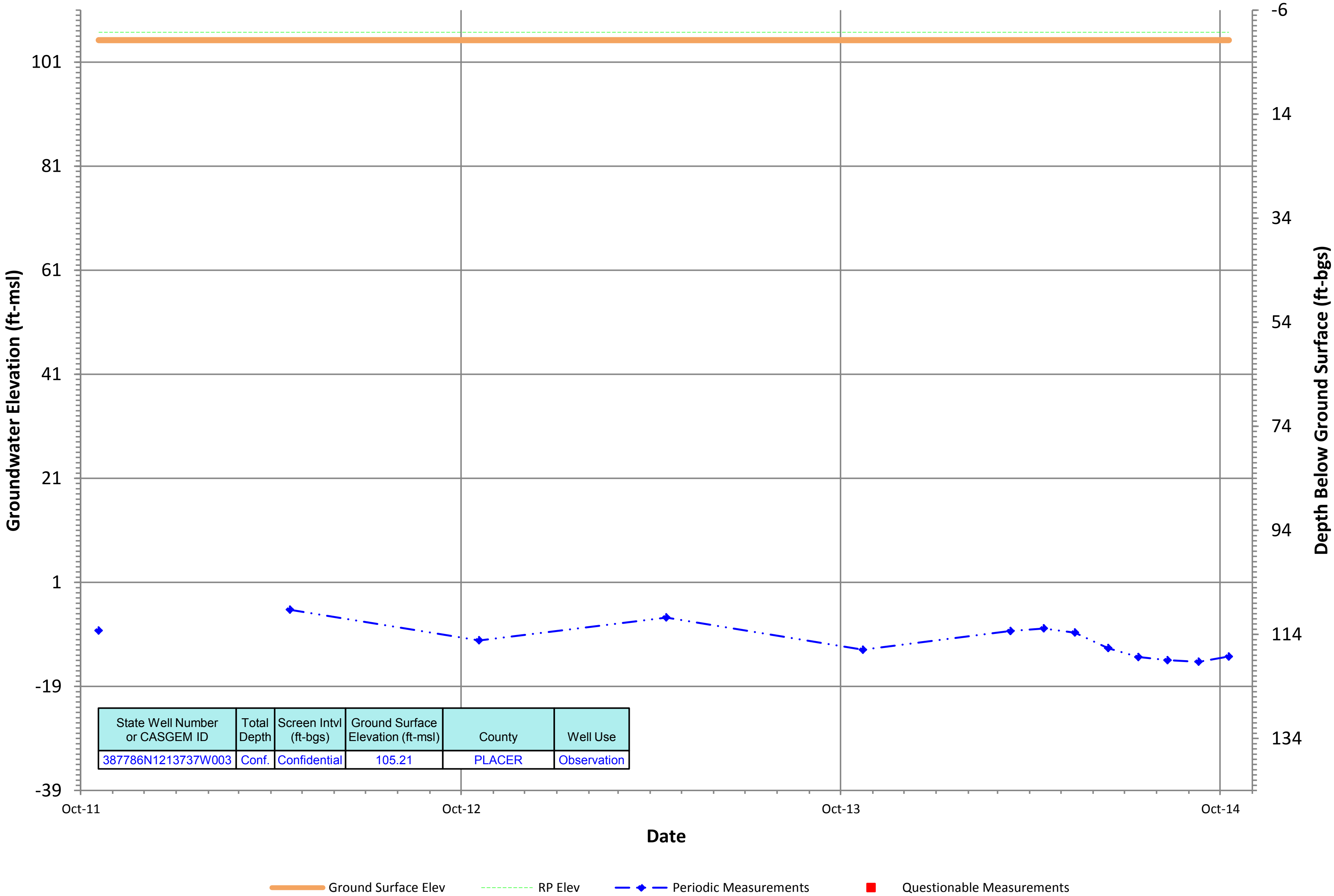
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387786N1213737W002	Conf.	Confidential	105.21	PLACER	Observation

387786N1213737W003
Period Of Record: 10/18/2011 to 10/09/2014

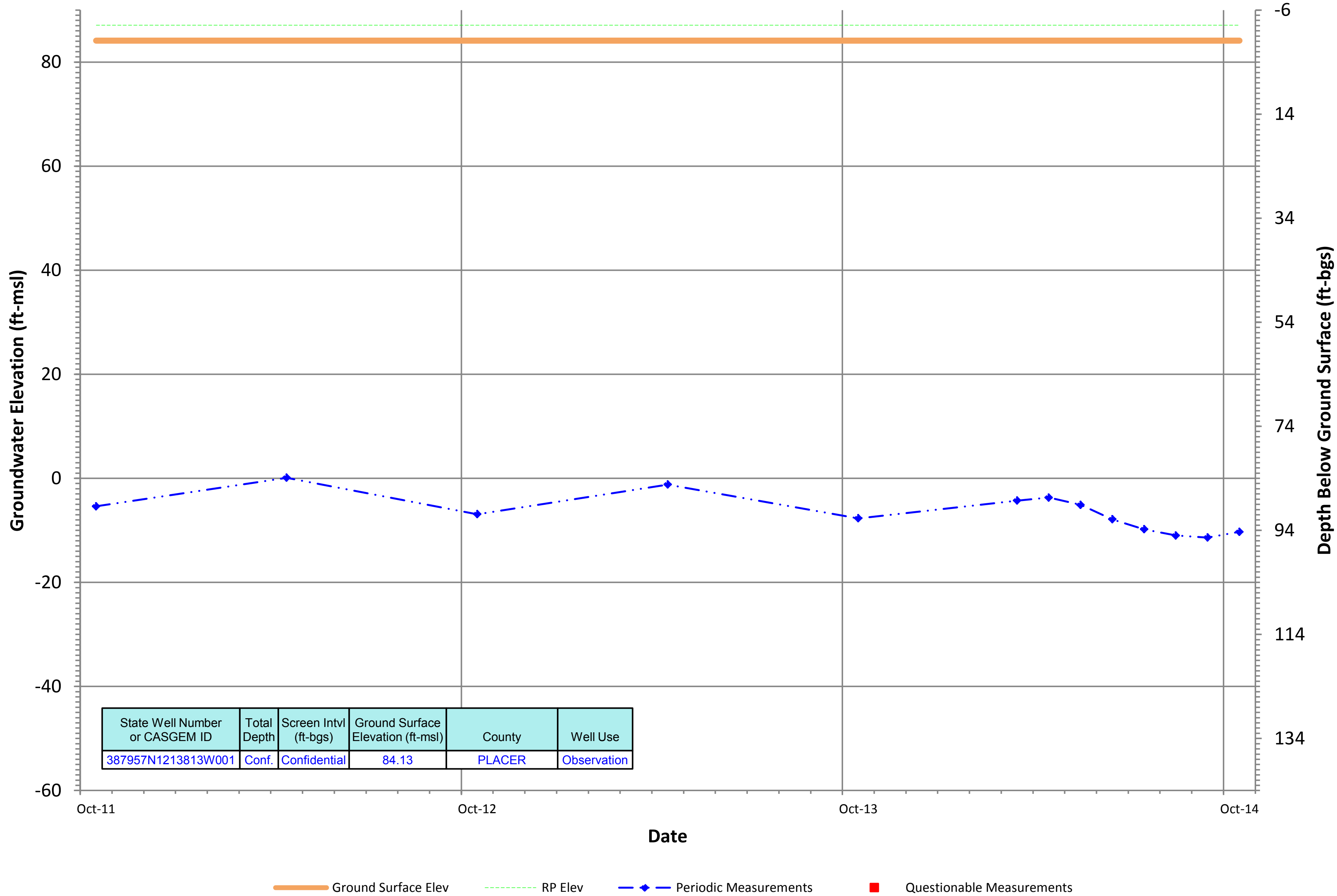
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387786N1213737W003	Conf.	Confidential	105.21	PLACER	Observation

387957N1213813W001
Period Of Record: 10/18/2011 to 10/09/2014

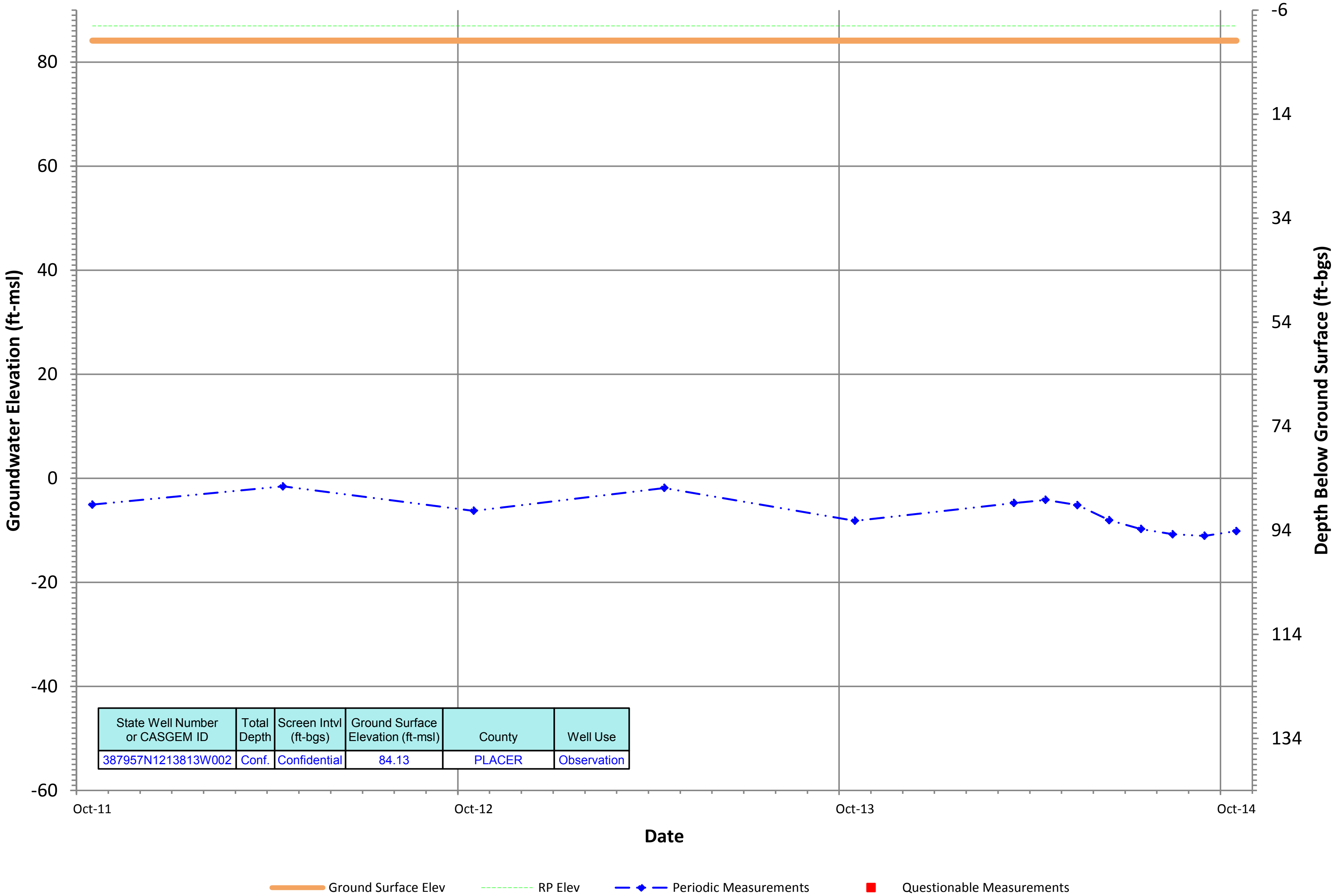
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387957N1213813W001	Conf.	Confidential	84.13	PLACER	Observation

387957N1213813W002
Period Of Record: 10/18/2011 to 10/09/2014

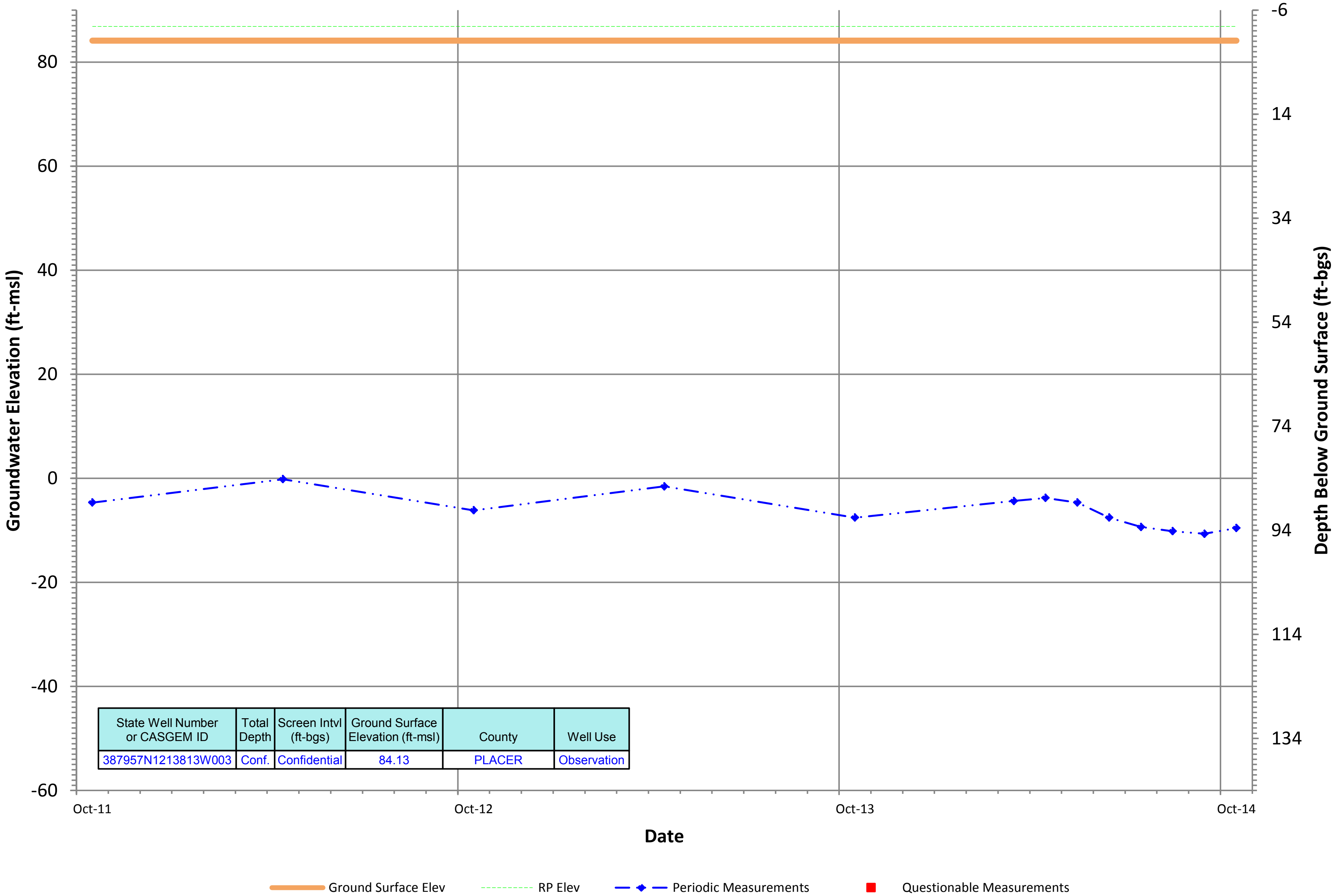
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387957N1213813W002	Conf.	Confidential	84.13	PLACER	Observation

387957N1213813W003
Period Of Record: 10/18/2011 to 10/09/2014

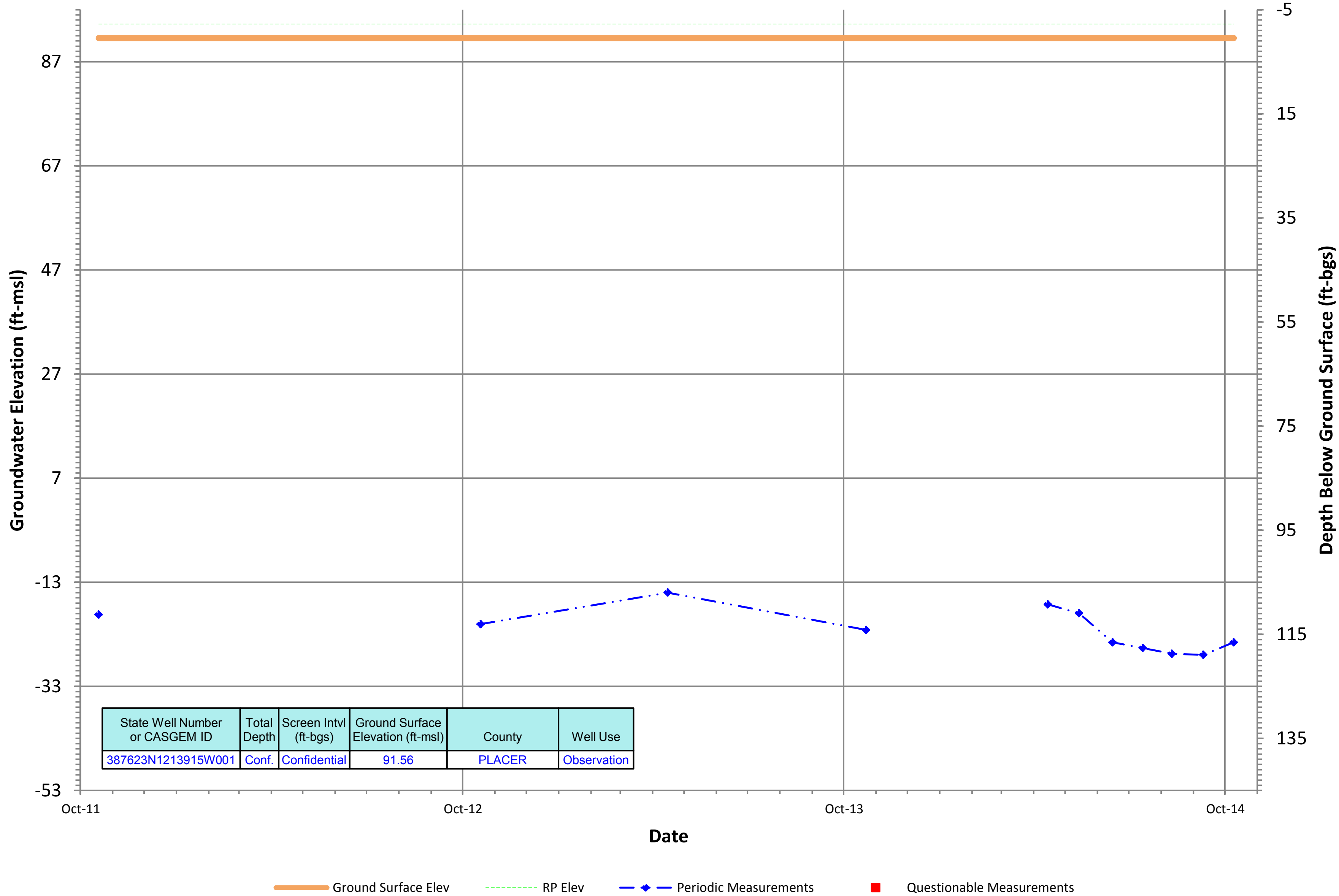
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387957N1213813W003	Conf.	Confidential	84.13	PLACER	Observation

387623N1213915W001
Period Of Record: 10/18/2011 to 10/09/2014

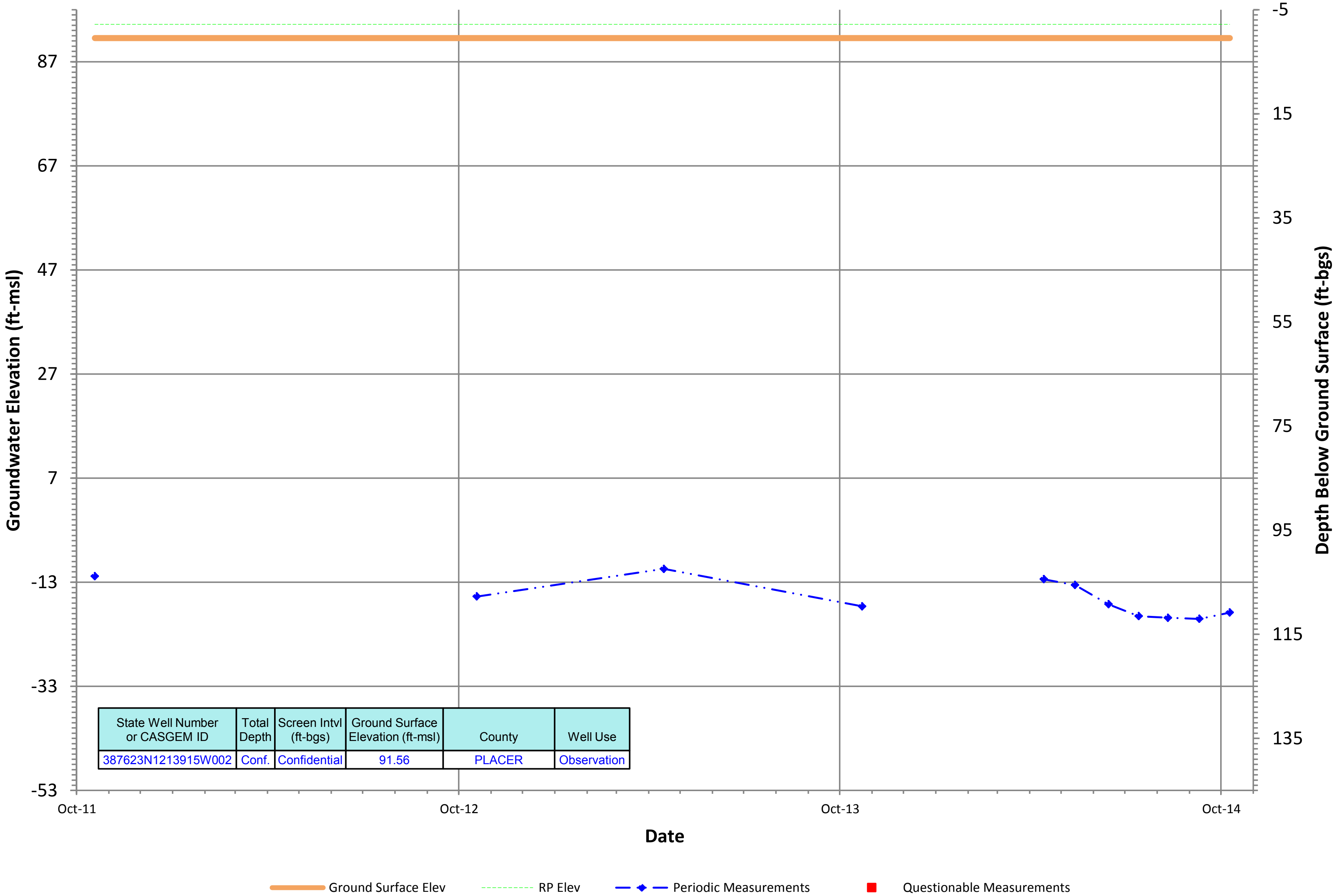
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387623N1213915W001	Conf.	Confidential	91.56	PLACER	Observation

387623N1213915W002
Period Of Record: 10/18/2011 to 10/09/2014

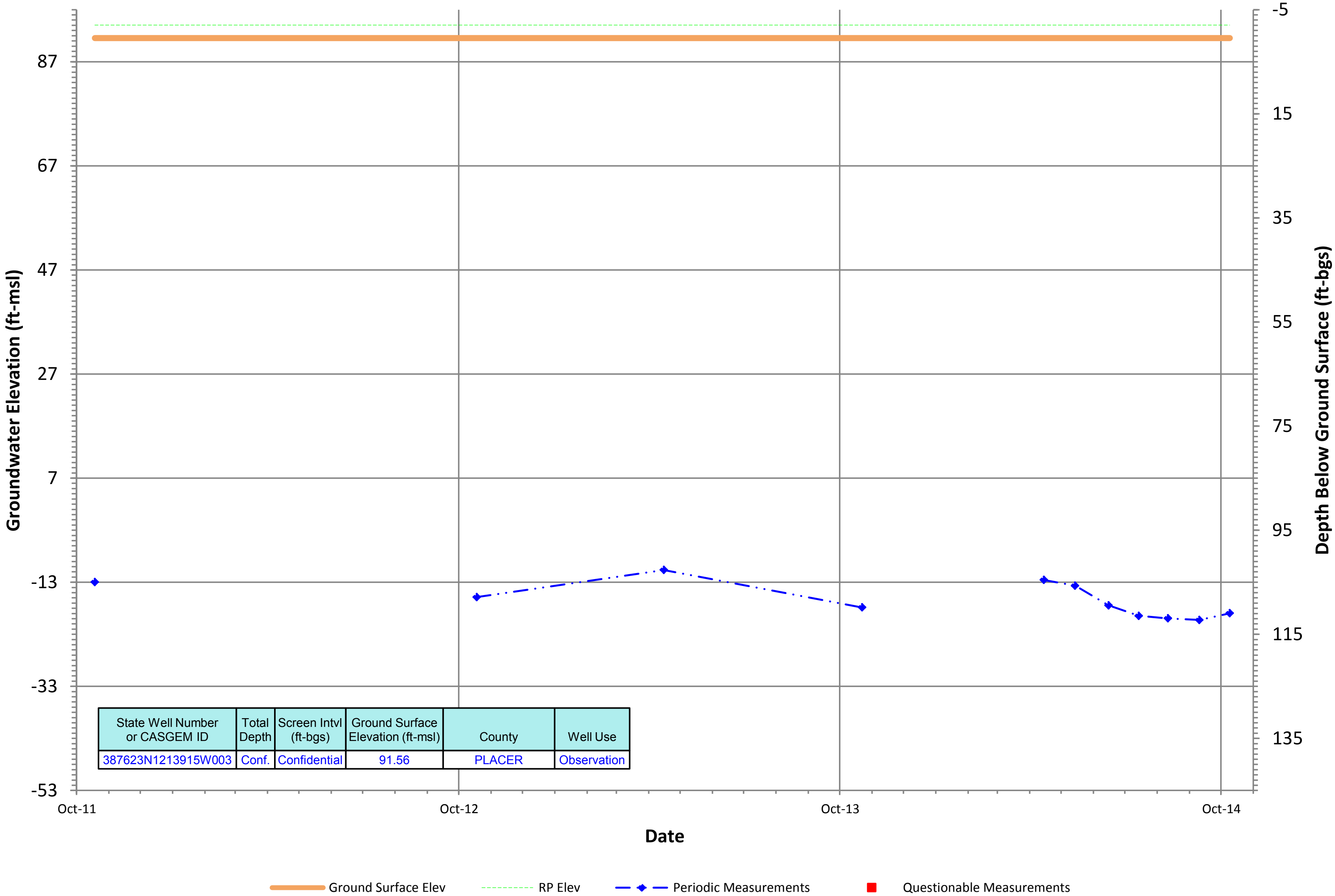
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387623N1213915W002	Conf.	Confidential	91.56	PLACER	Observation

387623N1213915W003
Period Of Record: 10/18/2011 to 10/09/2014

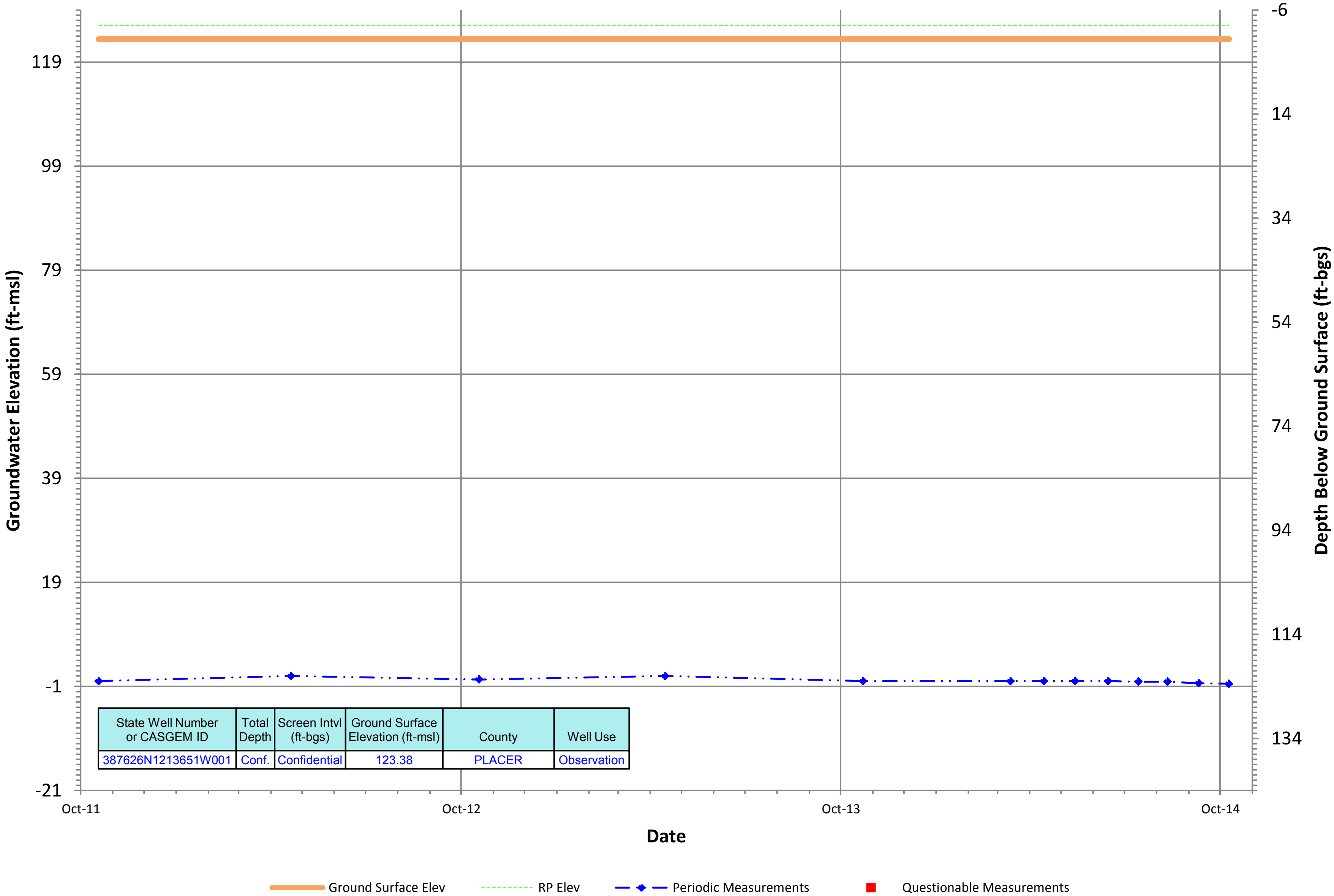
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387623N1213915W003	Conf.	Confidential	91.56	PLACER	Observation

387626N1213651W001
Period Of Record: 10/18/2011 to 10/09/2014

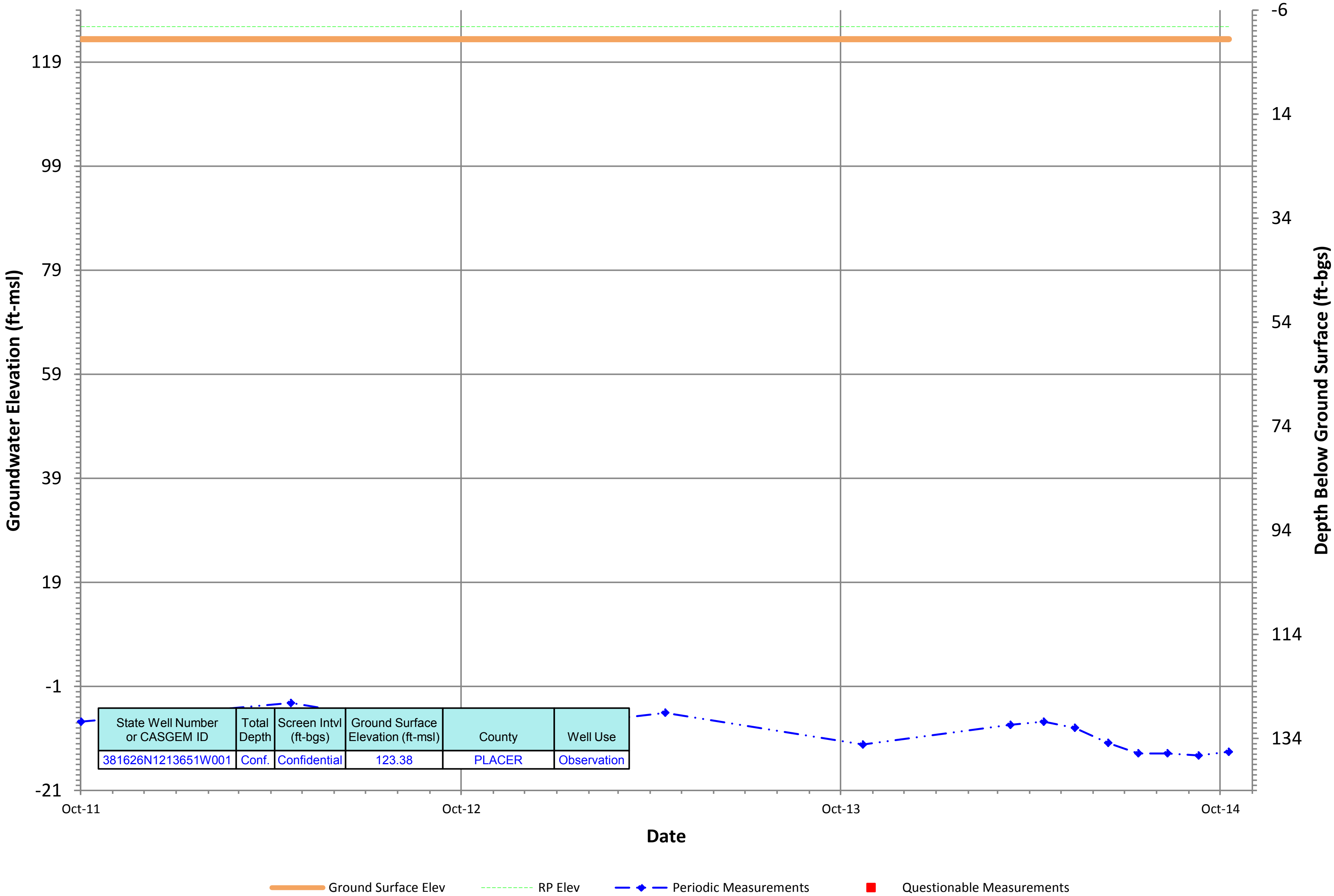
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387626N1213651W001	Conf.	Confidential	123.38	PLACER	Observation

381626N1213651W001
Period Of Record: 10/01/2011 to 10/09/2014

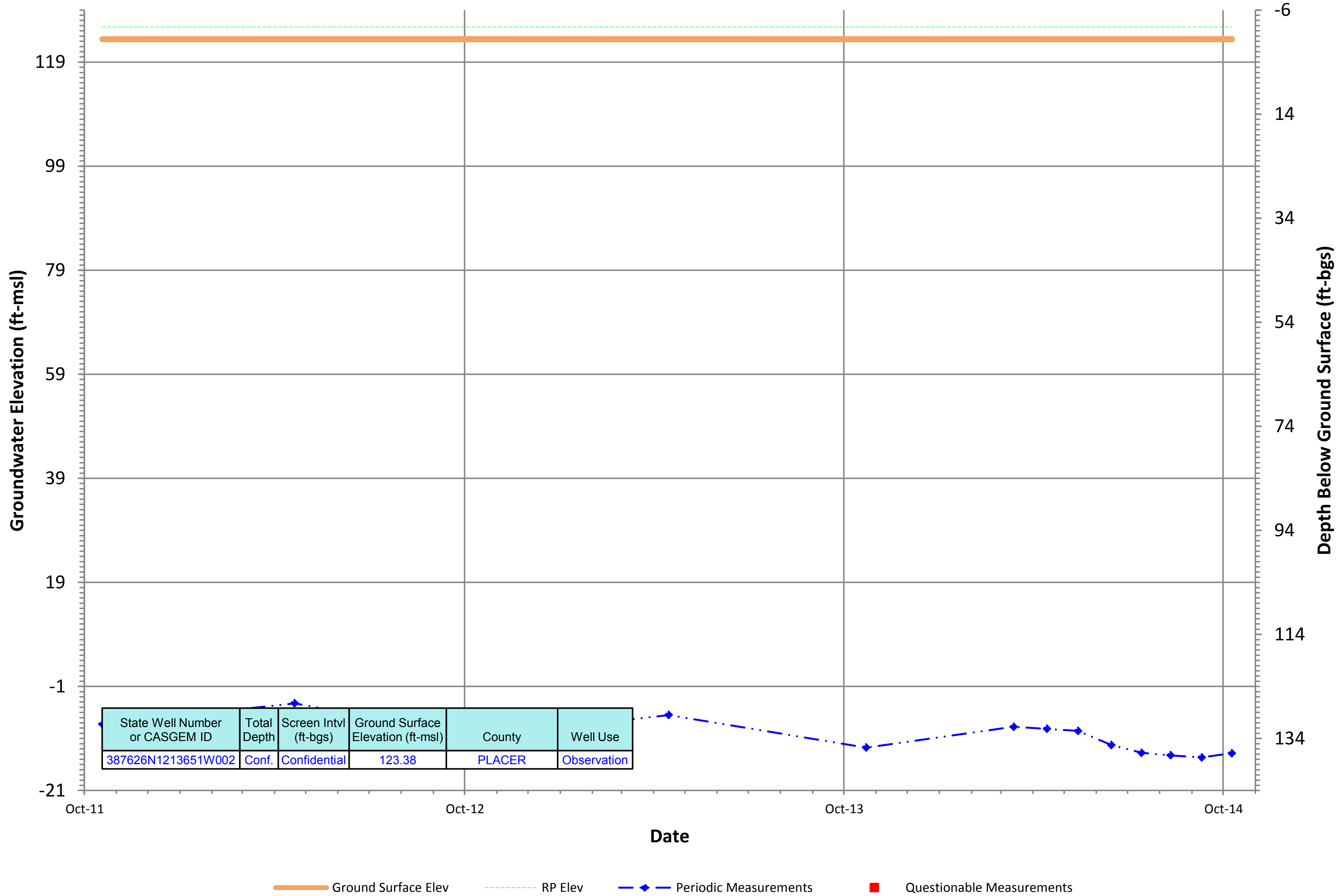
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
381626N1213651W001	Conf.	Confidential	123.38	PLACER	Observation

387626N1213651W002
Period Of Record: 10/18/2011 to 10/09/2014

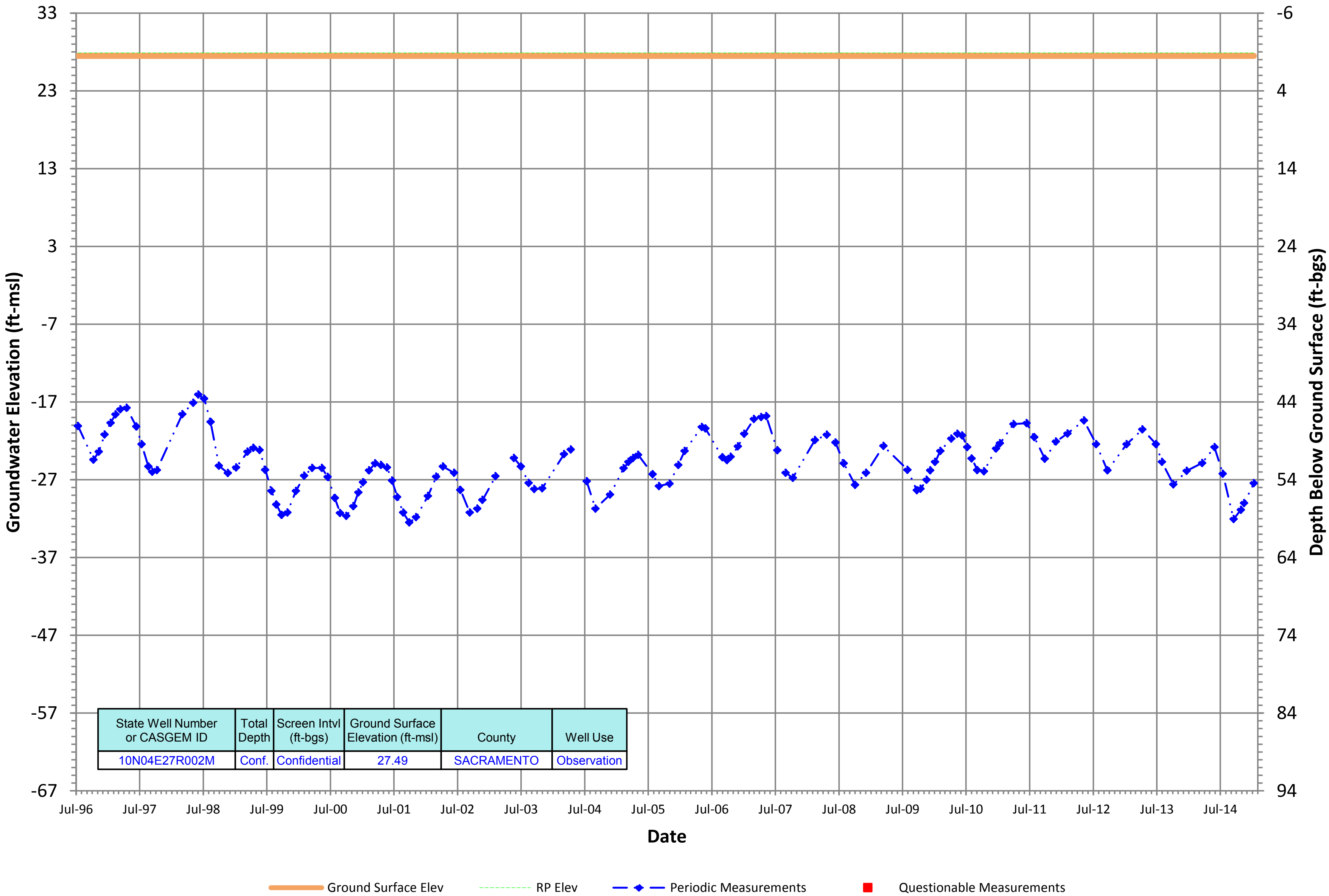
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



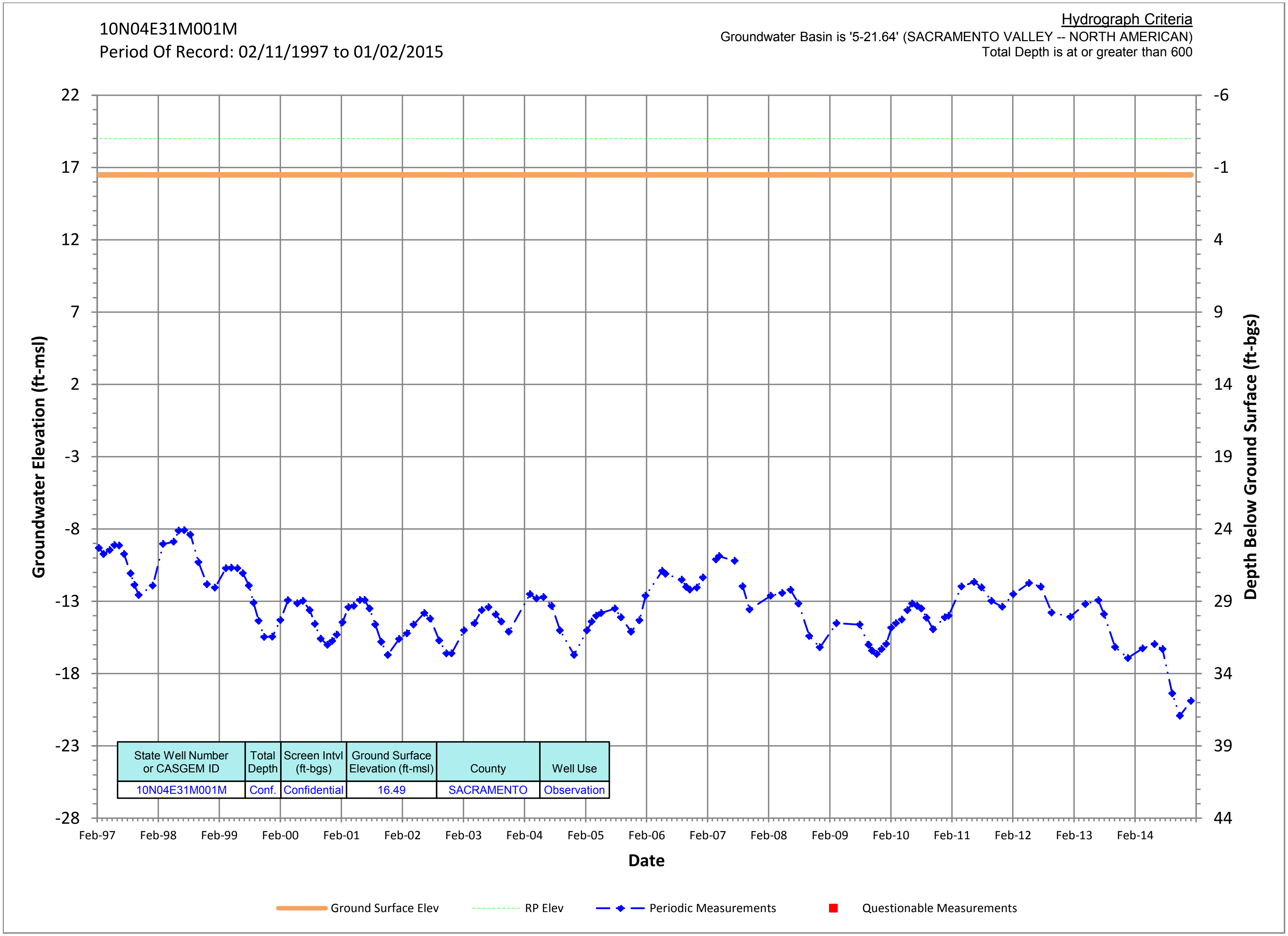
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
387626N1213651W002	Conf.	Confidential	123.38	PLACER	Observation

10N04E27R002M
Period Of Record: 07/11/1996 to 01/09/2015

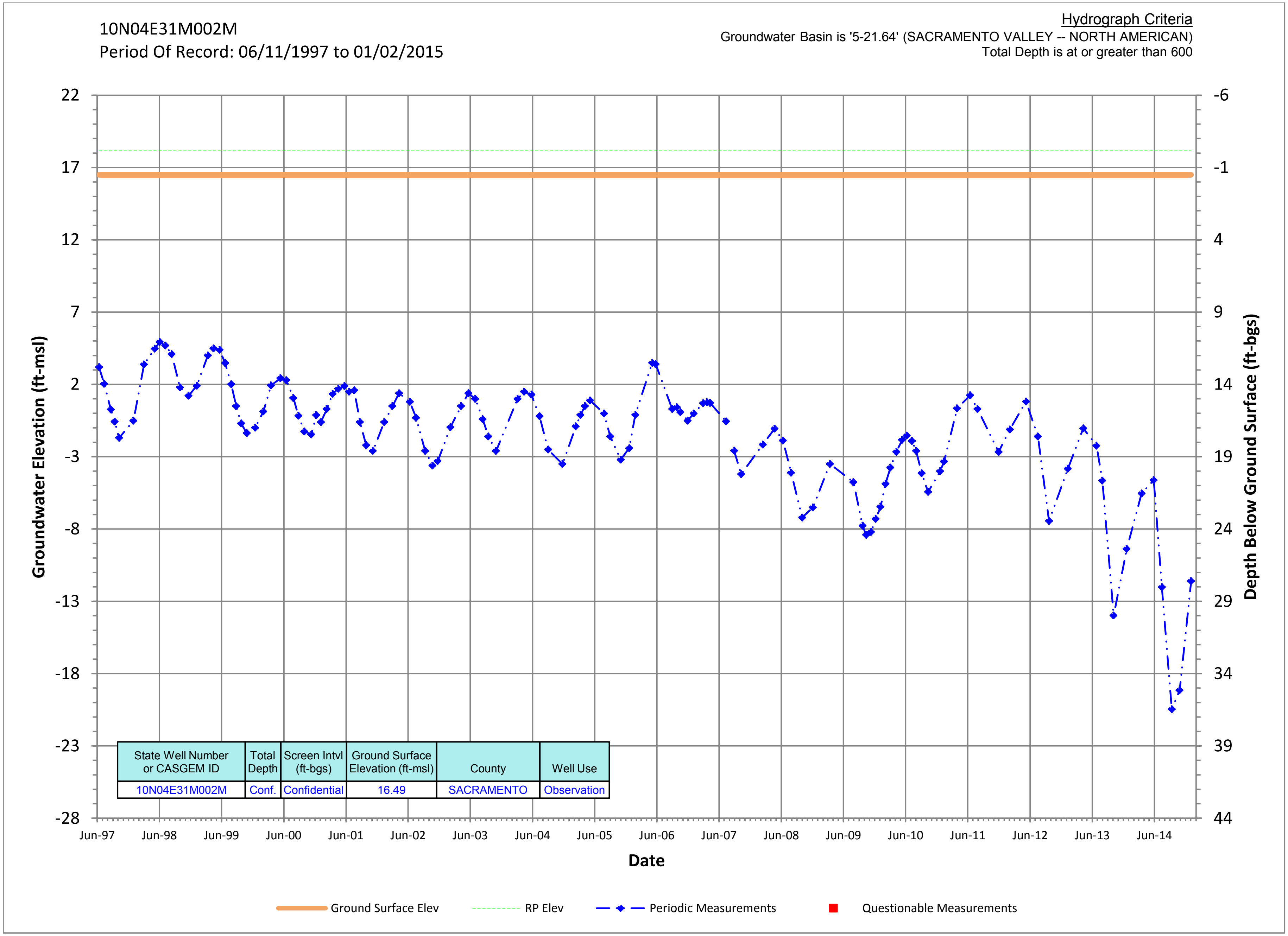
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E27R002M	Conf.	Confidential	27.49	SACRAMENTO	Observation



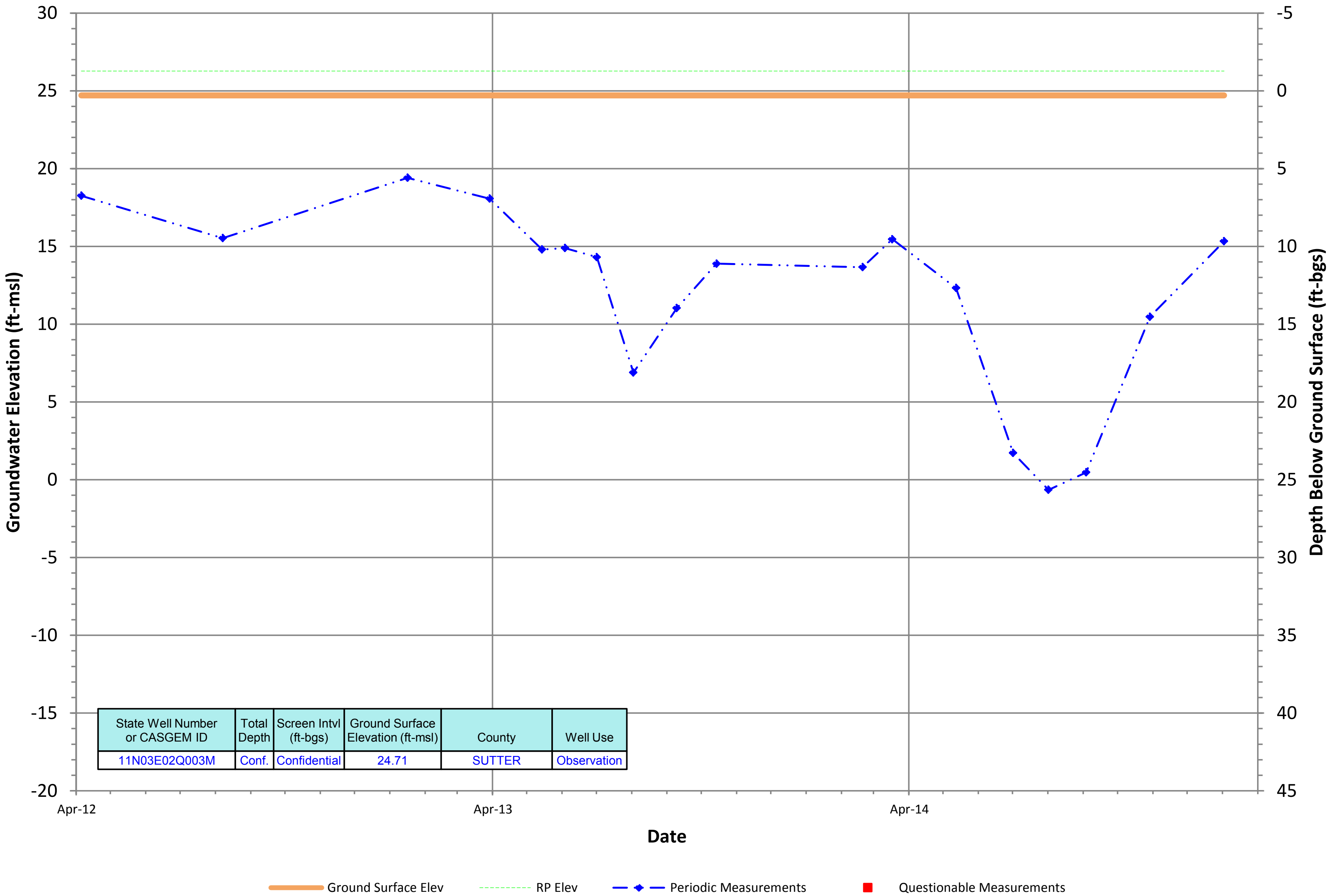
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E31M001M	Conf.	Confidential	16.49	SACRAMENTO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N04E31M002M	Conf.	Confidential	16.49	SACRAMENTO	Observation

11N03E02Q003M
Period Of Record: 04/05/2012 to 01/02/2015

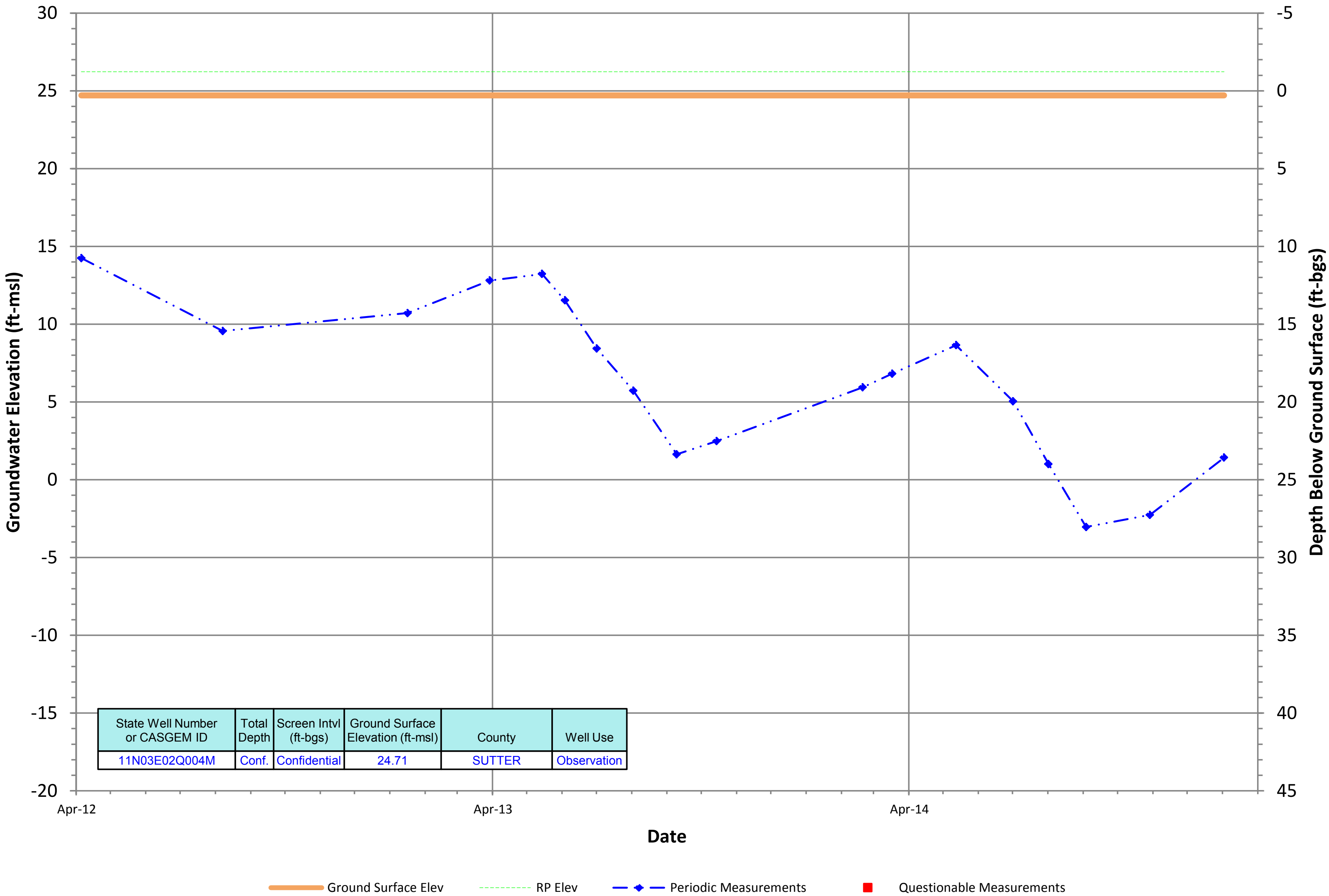
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N03E02Q003M	Conf.	Confidential	24.71	SUTTER	Observation

11N03E02Q004M
Period Of Record: 04/05/2012 to 01/02/2015

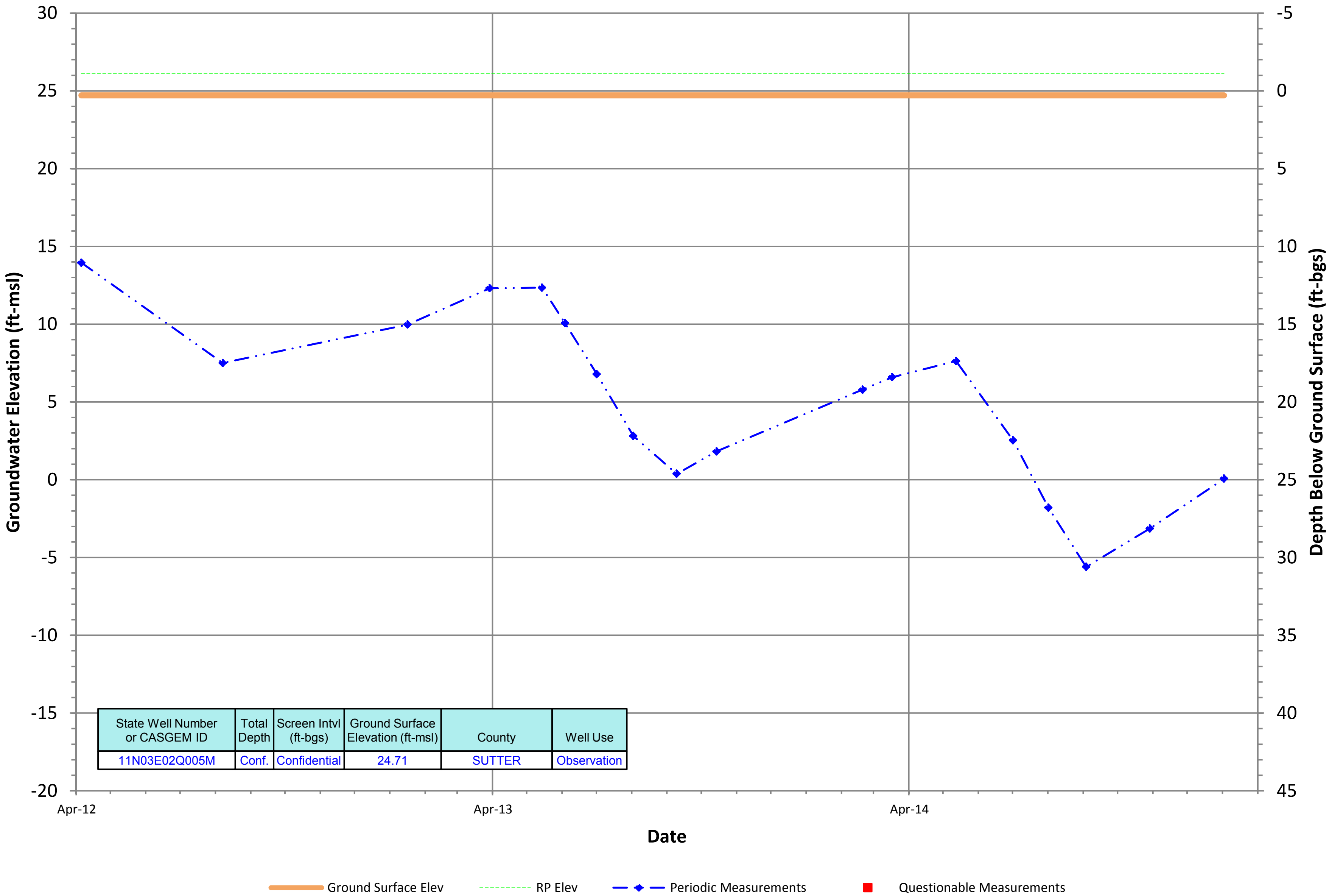
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N03E02Q004M	Conf.	Confidential	24.71	SUTTER	Observation

11N03E02Q005M
Period Of Record: 04/05/2012 to 01/02/2015

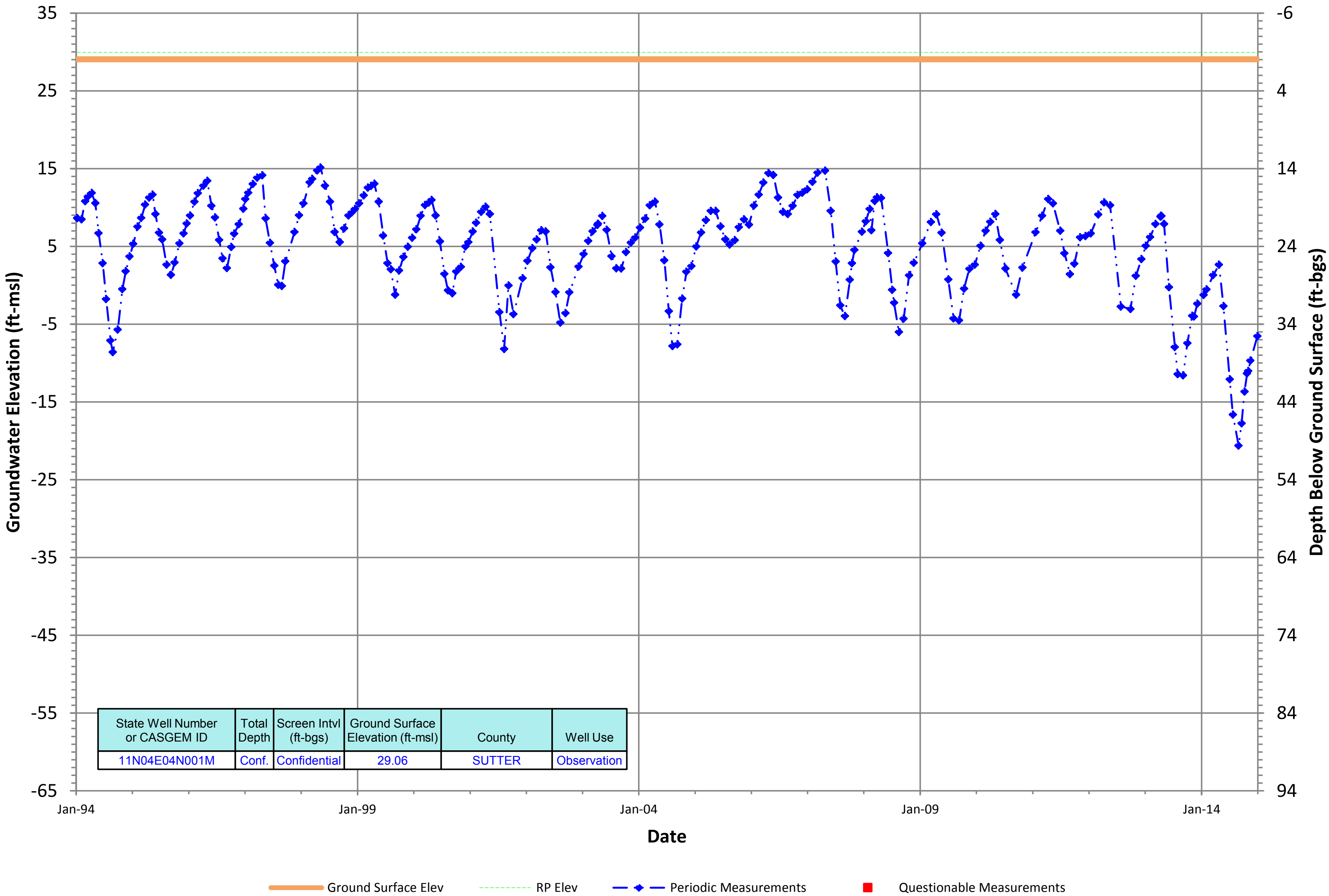
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



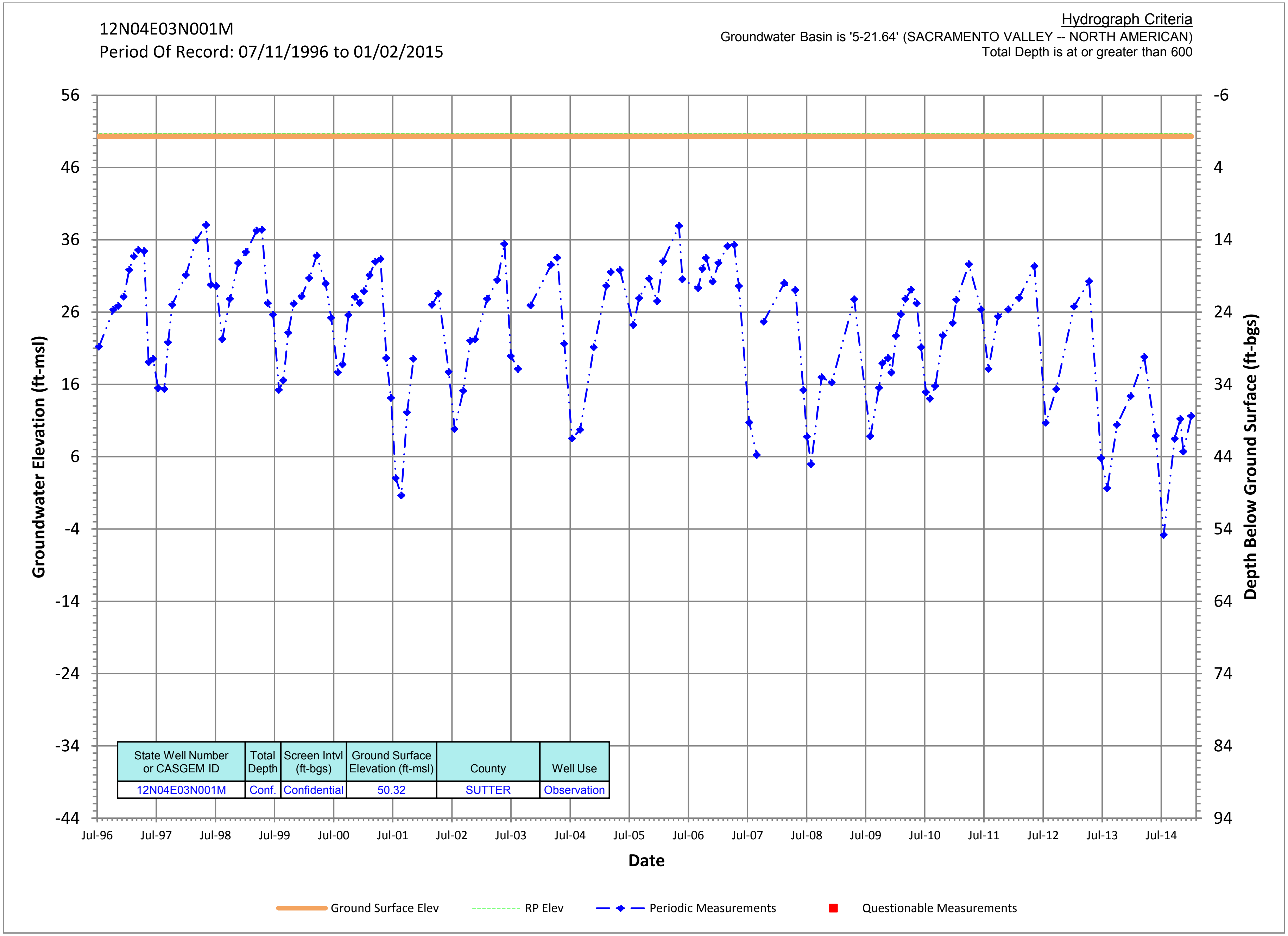
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N03E02Q005M	Conf.	Confidential	24.71	SUTTER	Observation

11N04E04N001M
Period Of Record: 01/07/1994 to 12/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



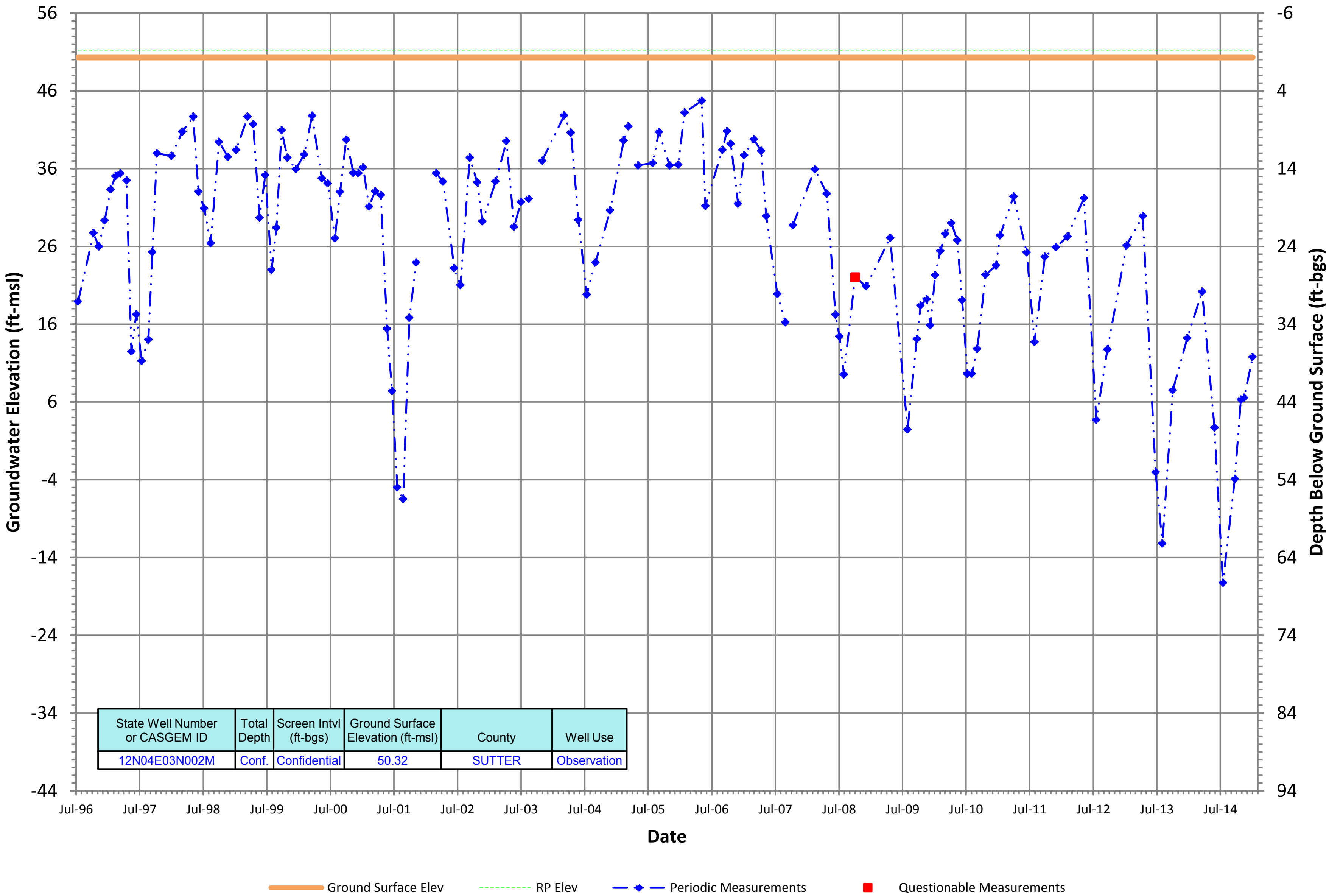
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N04E04N001M	Conf.	Confidential	29.06	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E03N001M	Conf.	Confidential	50.32	SUTTER	Observation

12N04E03N002M
Period Of Record: 07/11/1996 to 01/02/2015

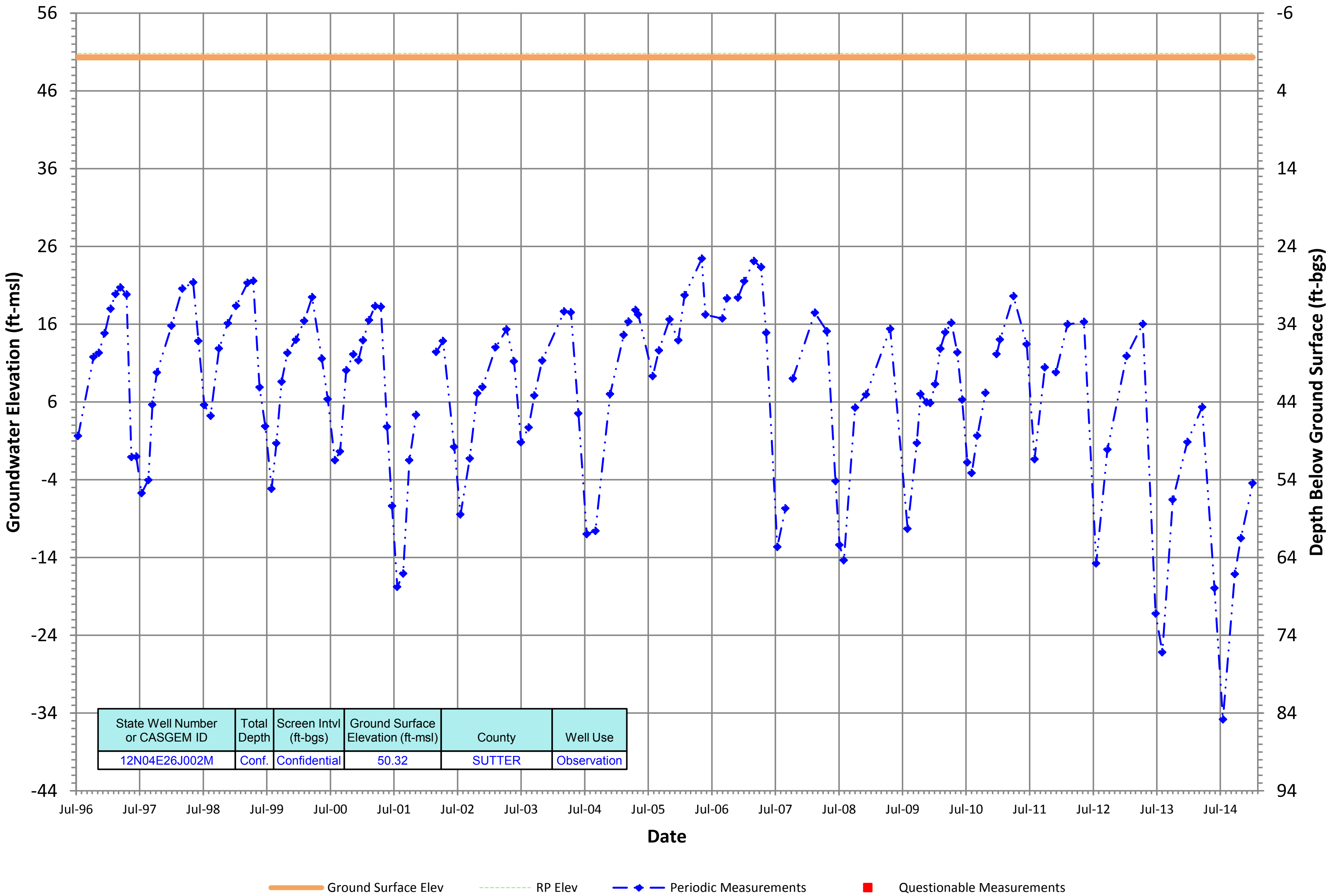
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E03N002M	Conf.	Confidential	50.32	SUTTER	Observation

12N04E26J002M
Period Of Record: 07/11/1996 to 01/02/2015

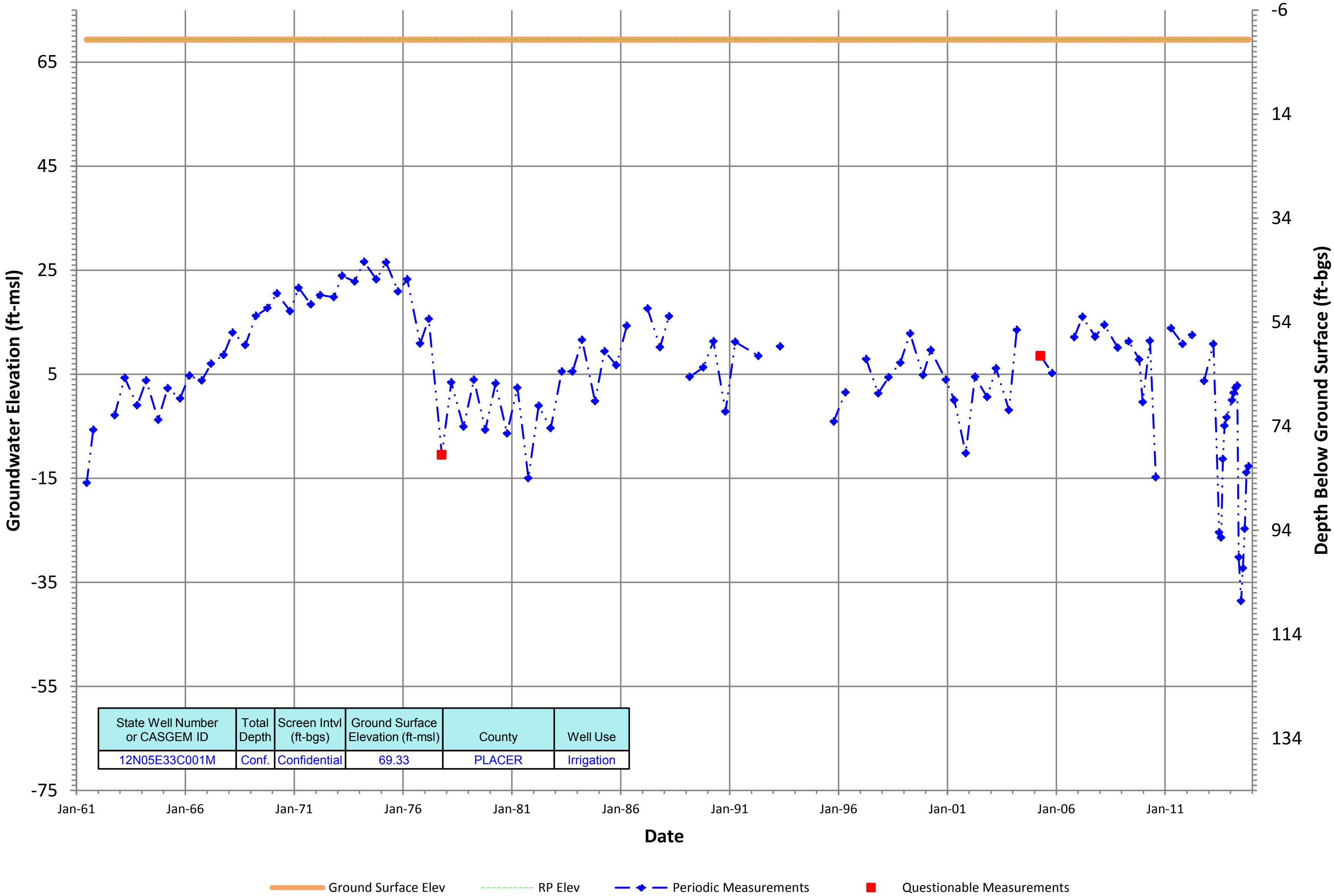
Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N04E26J002M	Conf.	Confidential	50.32	SUTTER	Observation

12N05E33C001M
Period Of Record: 06/21/1961 to 10/31/2014

Hydrograph Criteria
Groundwater Basin is '5-21.64' (SACRAMENTO VALLEY -- NORTH AMERICAN)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N05E33C001M	Conf.	Confidential	69.33	PLACER	Irrigation

Shallow Groundwater Monitoring Well Hydrographs- Solano Subbasin

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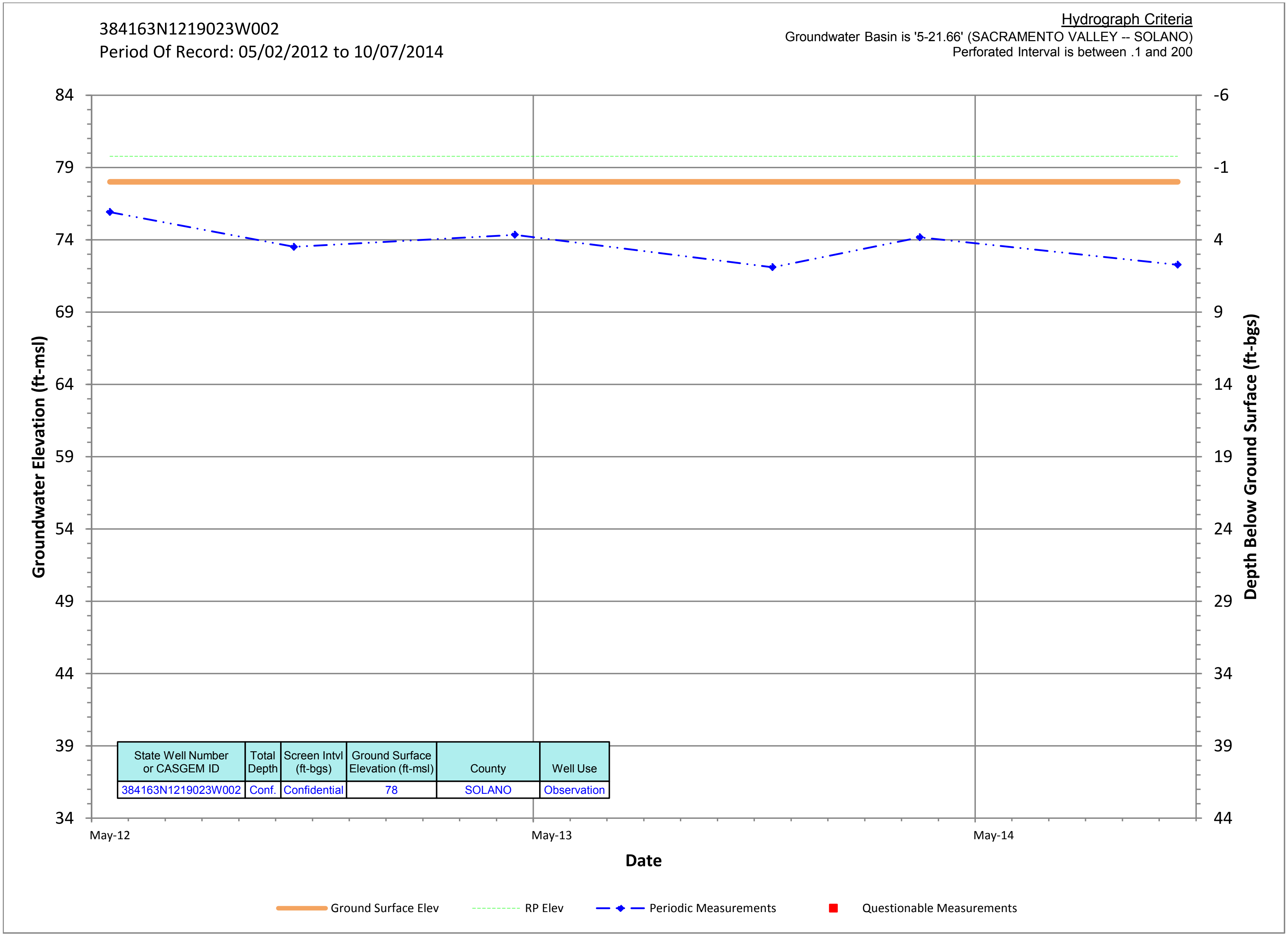
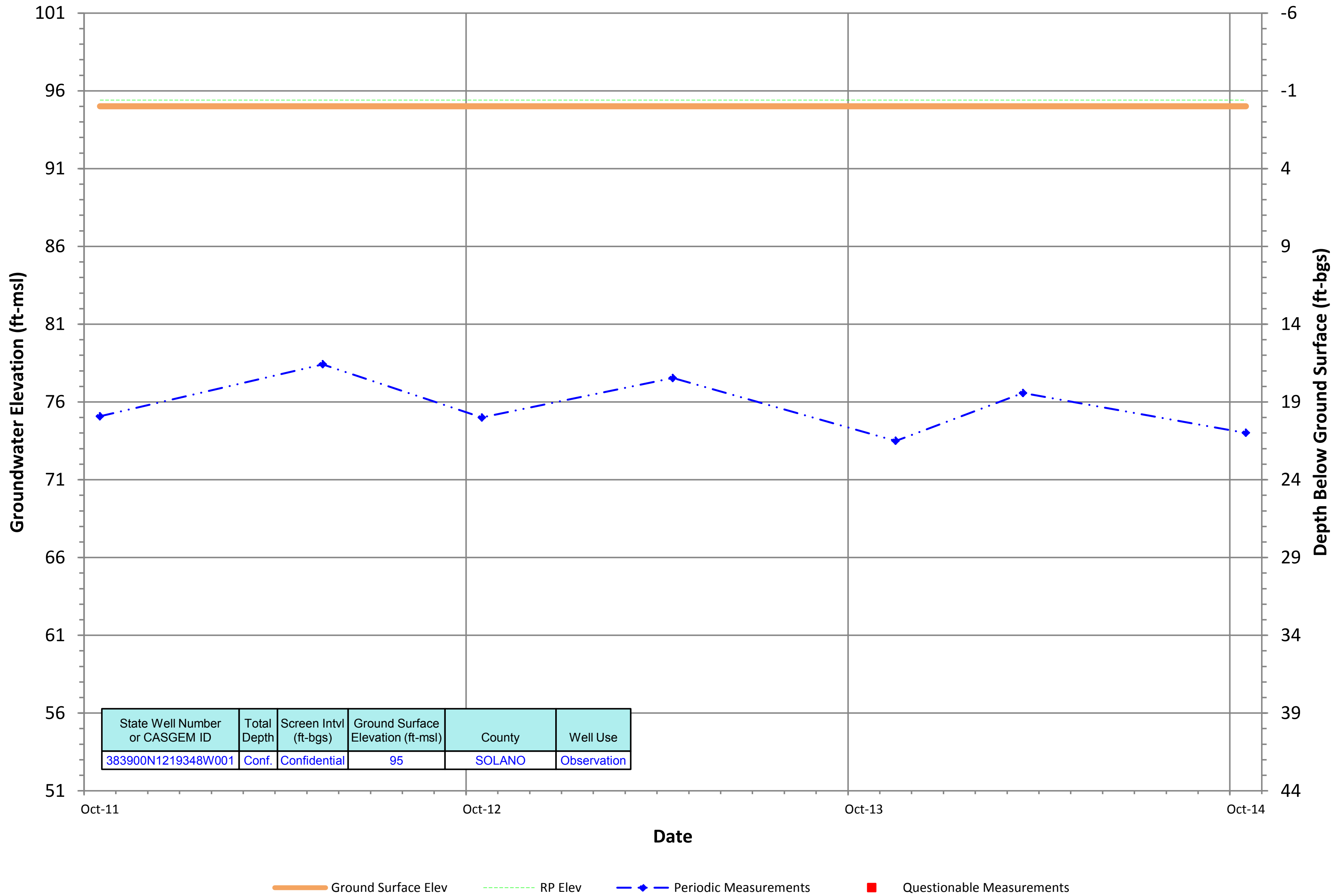


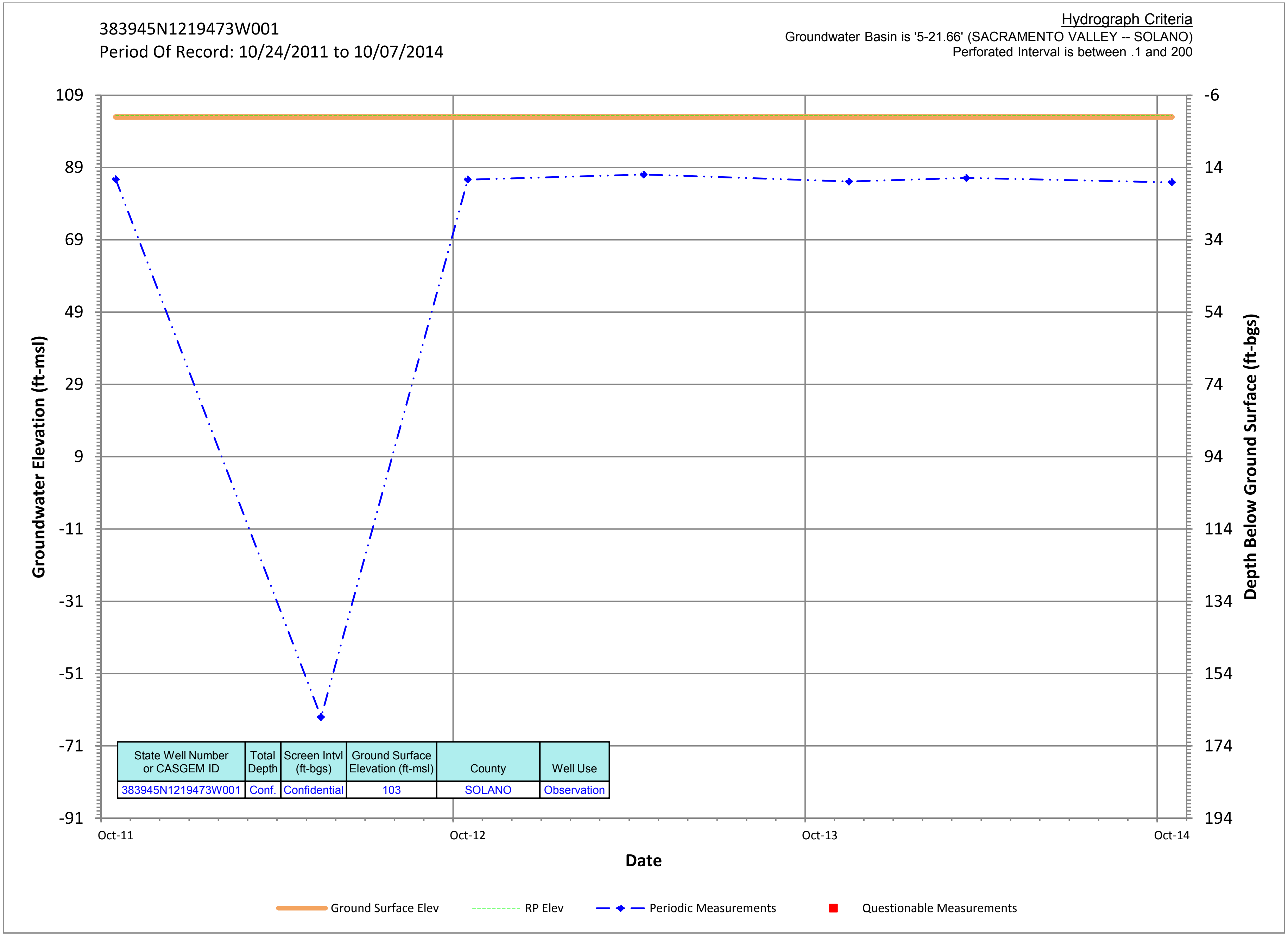
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
384163N1219023W002	Conf.	Confidential	78	SOLANO	Observation

383900N1219348W001
Period Of Record: 10/24/2011 to 10/07/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



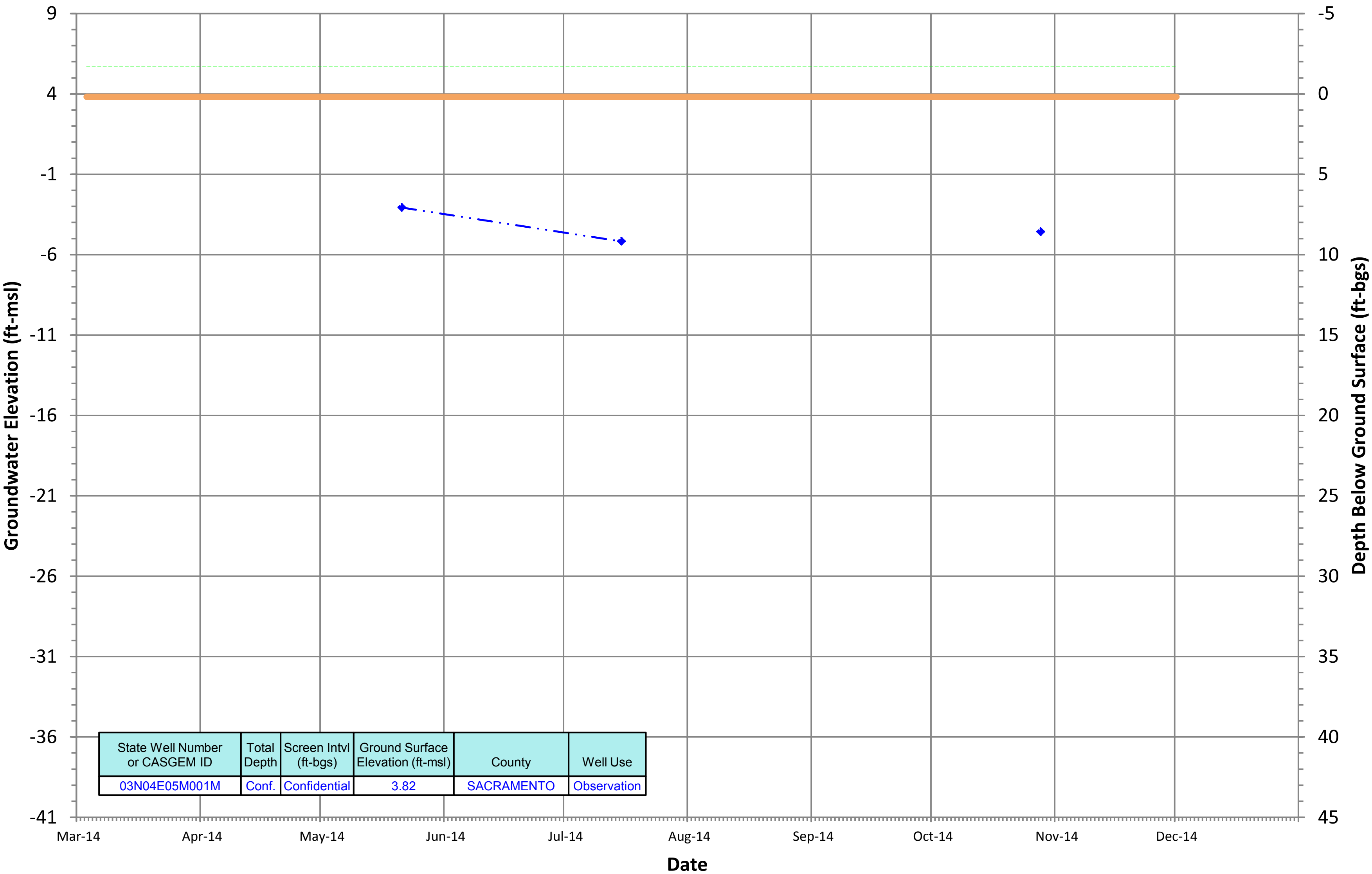
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
383900N1219348W001	Conf.	Confidential	95	SOLANO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
383945N1219473W001	Conf.	Confidential	103	SOLANO	Observation

03N04E05M001M
Period Of Record: 03/03/2014 to 12/01/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200

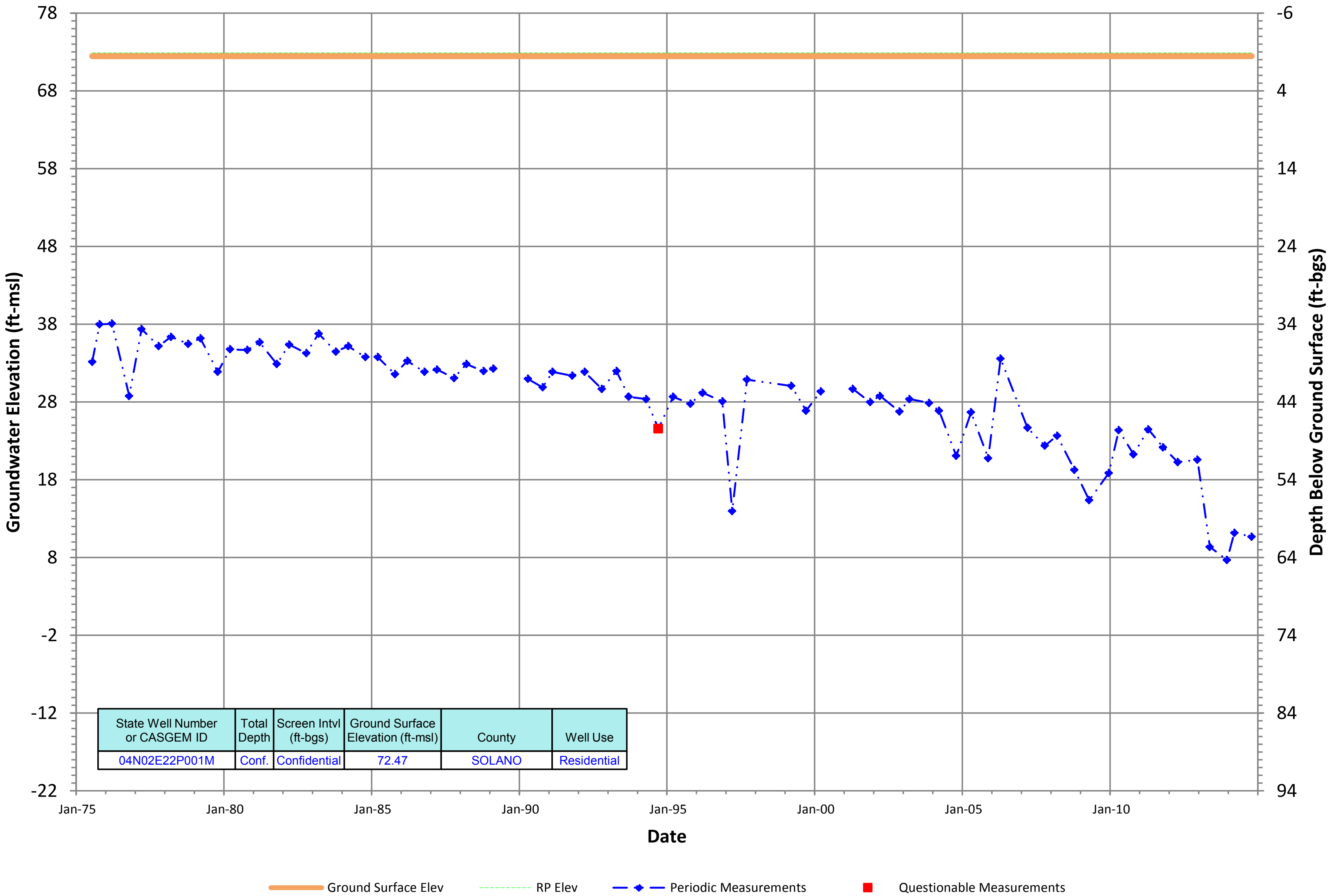


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
03N04E05M001M	Conf.	Confidential	3.82	SACRAMENTO	Observation

Ground Surface Elev — RP Elev — Periodic Measurements — Questionable Measurements

04N02E22P001M
Period Of Record: 07/16/1975 to 10/28/2014

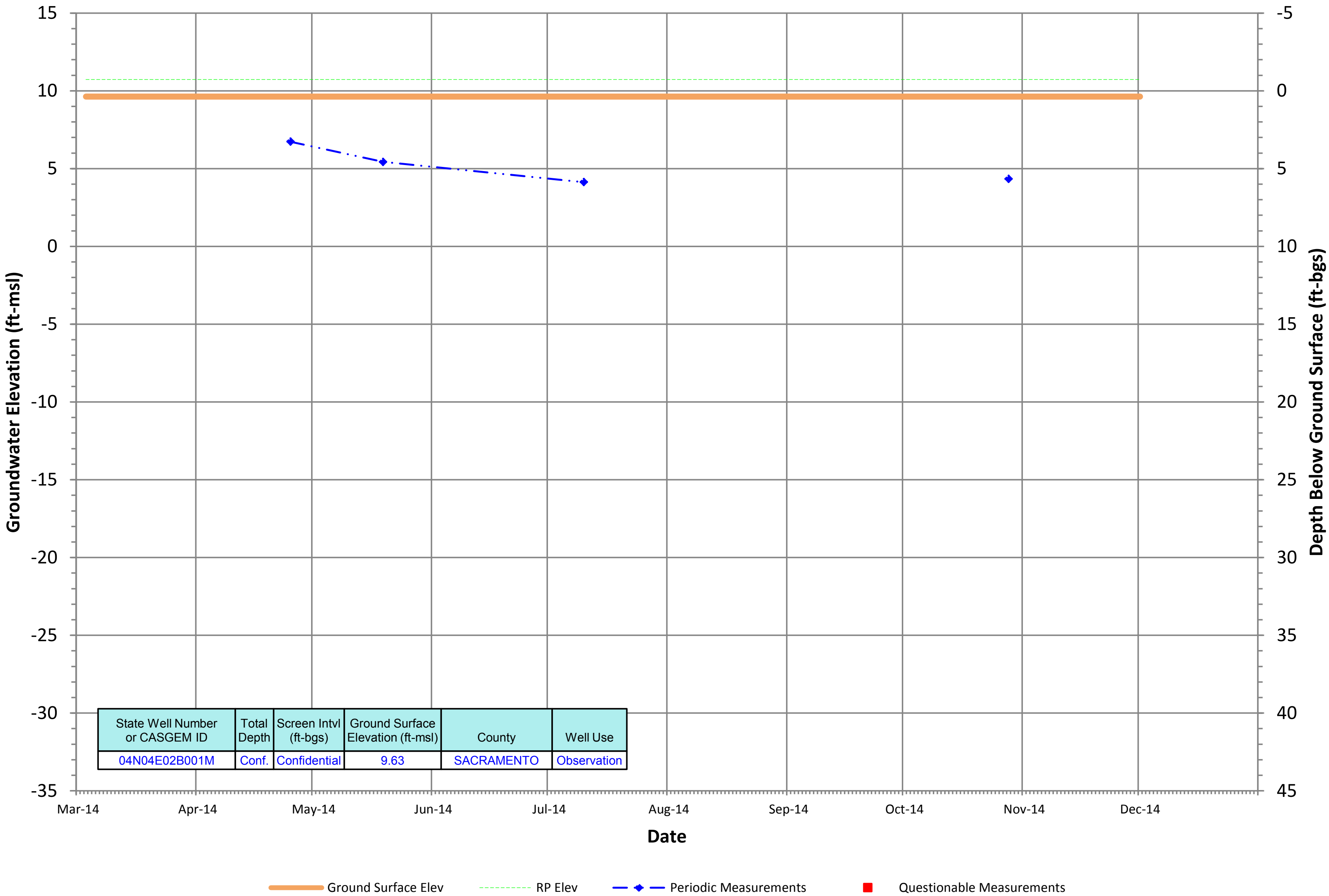
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
04N02E22P001M	Conf.	Confidential	72.47	SOLANO	Residential

04N04E02B001M
Period Of Record: 03/03/2014 to 12/01/2014

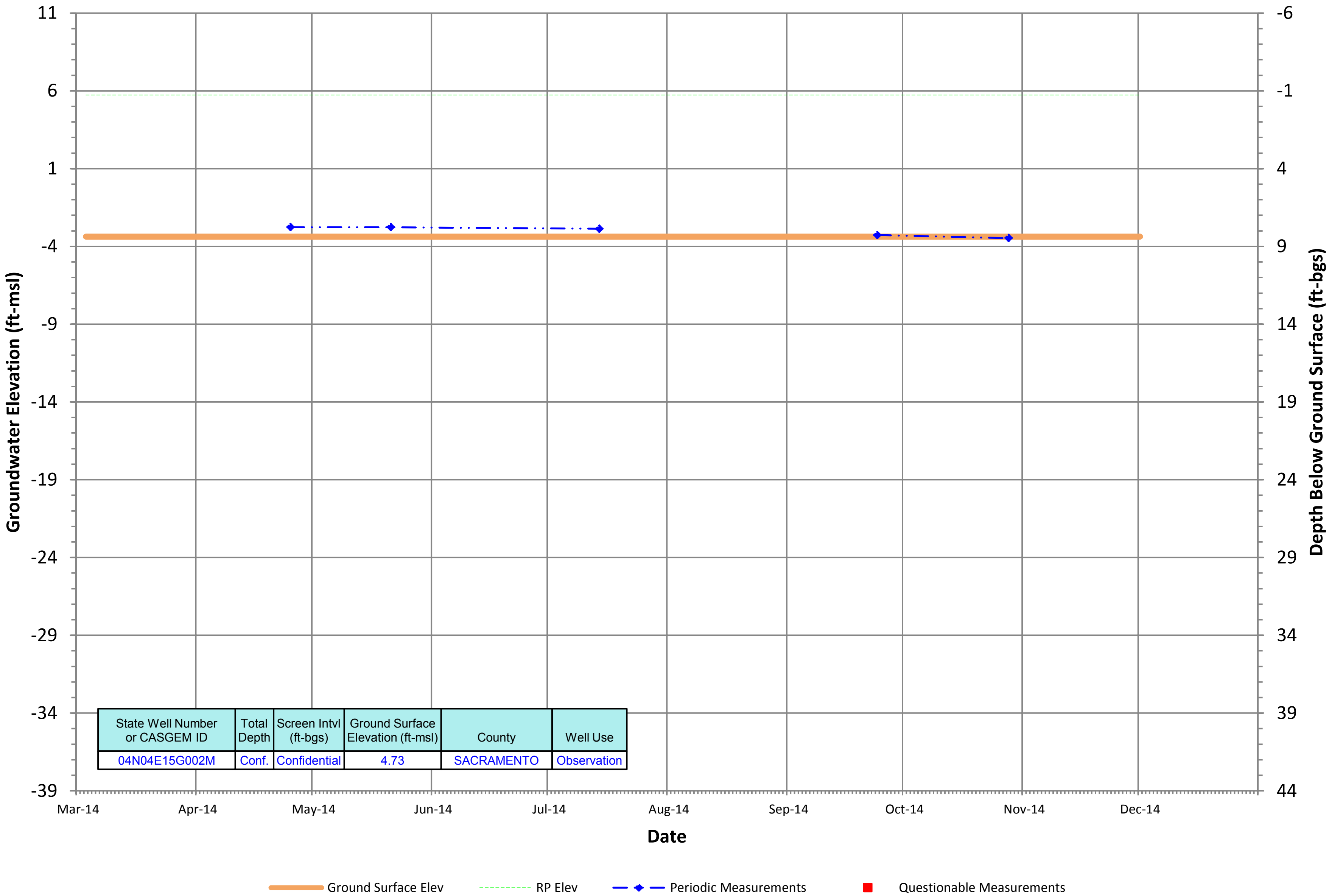
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
04N04E02B001M	Conf.	Confidential	9.63	SACRAMENTO	Observation

04N04E15G002M
Period Of Record: 03/03/2014 to 12/01/2014

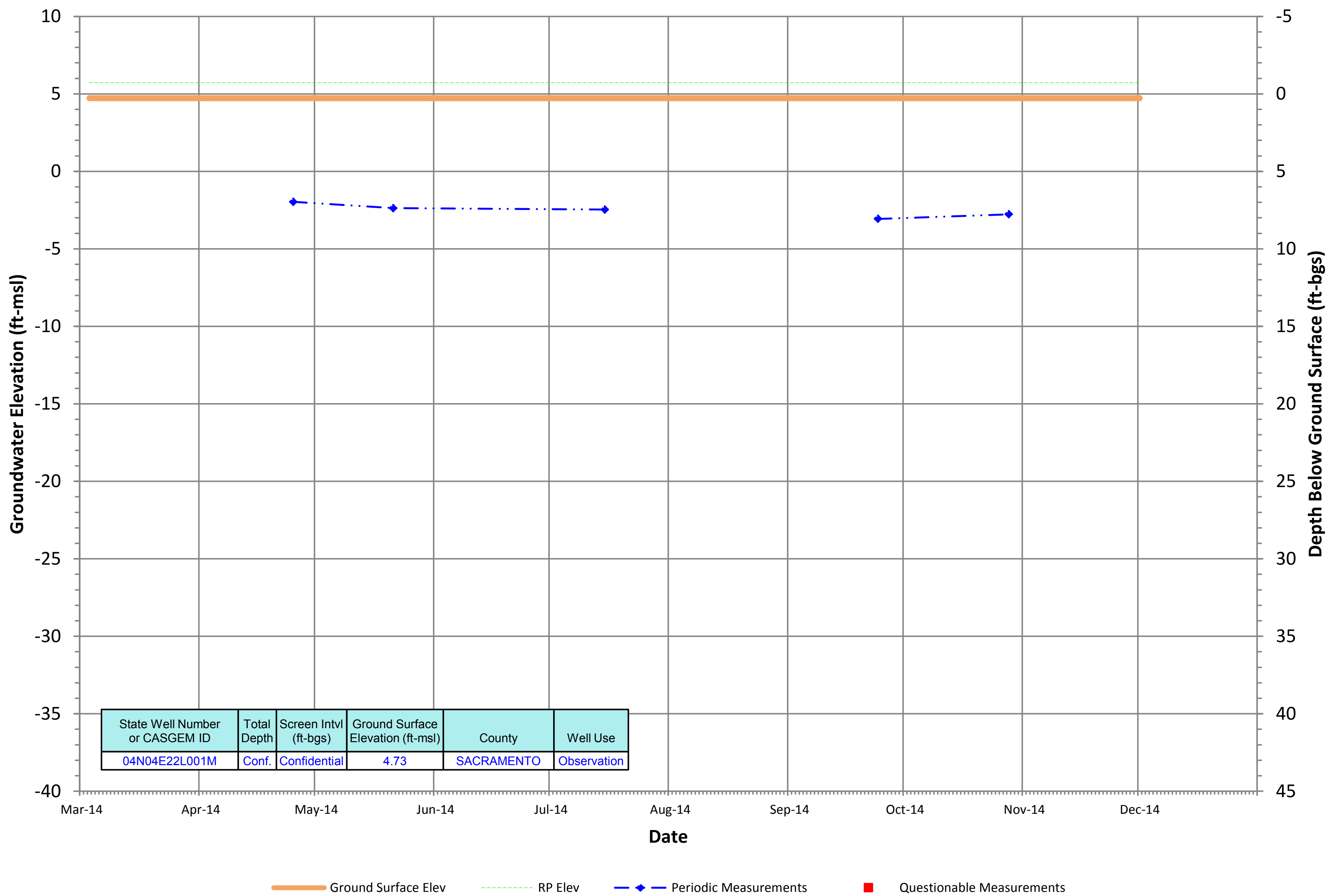
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
04N04E15G002M	Conf.	Confidential	4.73	SACRAMENTO	Observation

04N04E22L001M
Period Of Record: 03/03/2014 to 12/01/2014

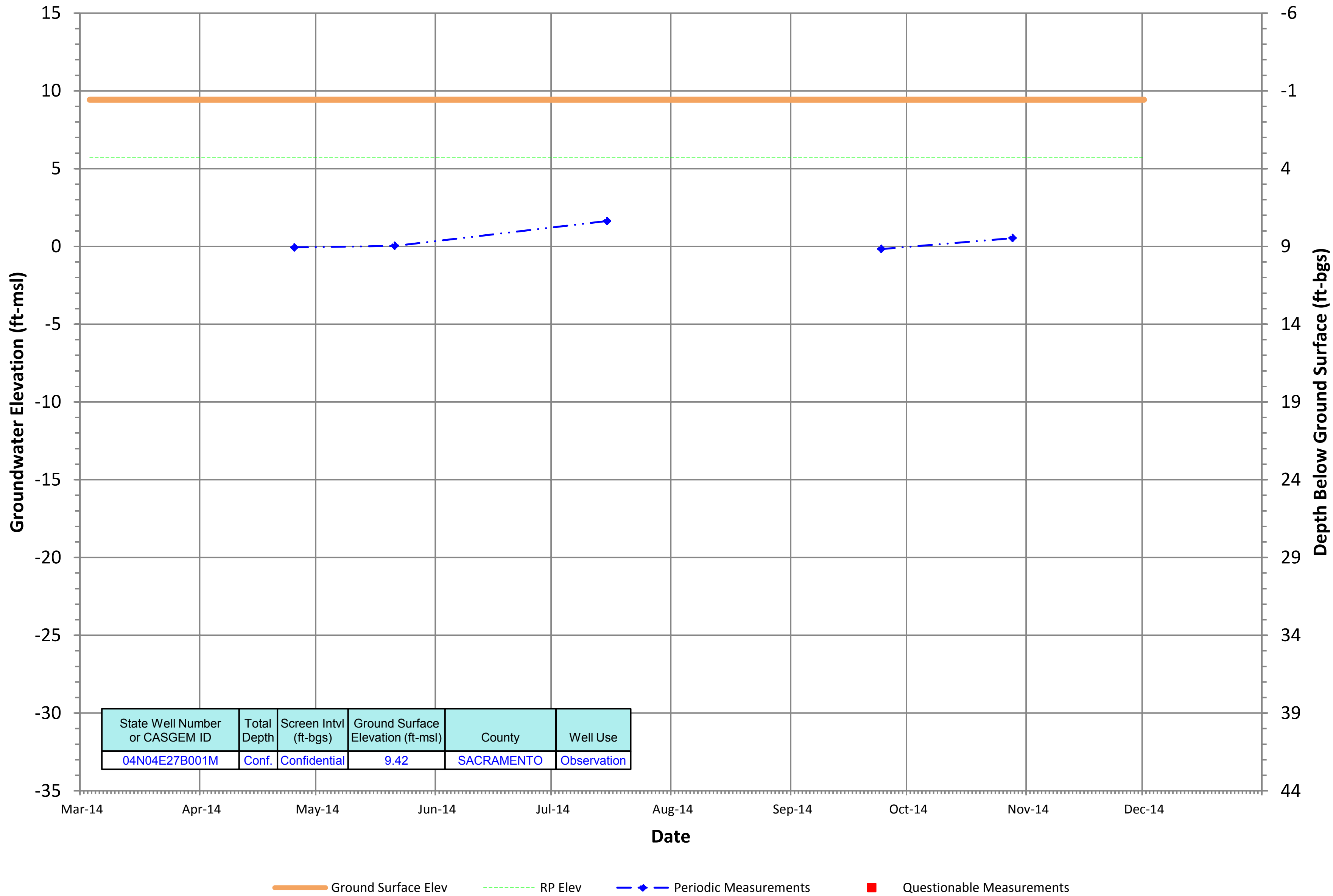
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
04N04E22L001M	Conf.	Confidential	4.73	SACRAMENTO	Observation

04N04E27B001M
Period Of Record: 03/03/2014 to 12/01/2014

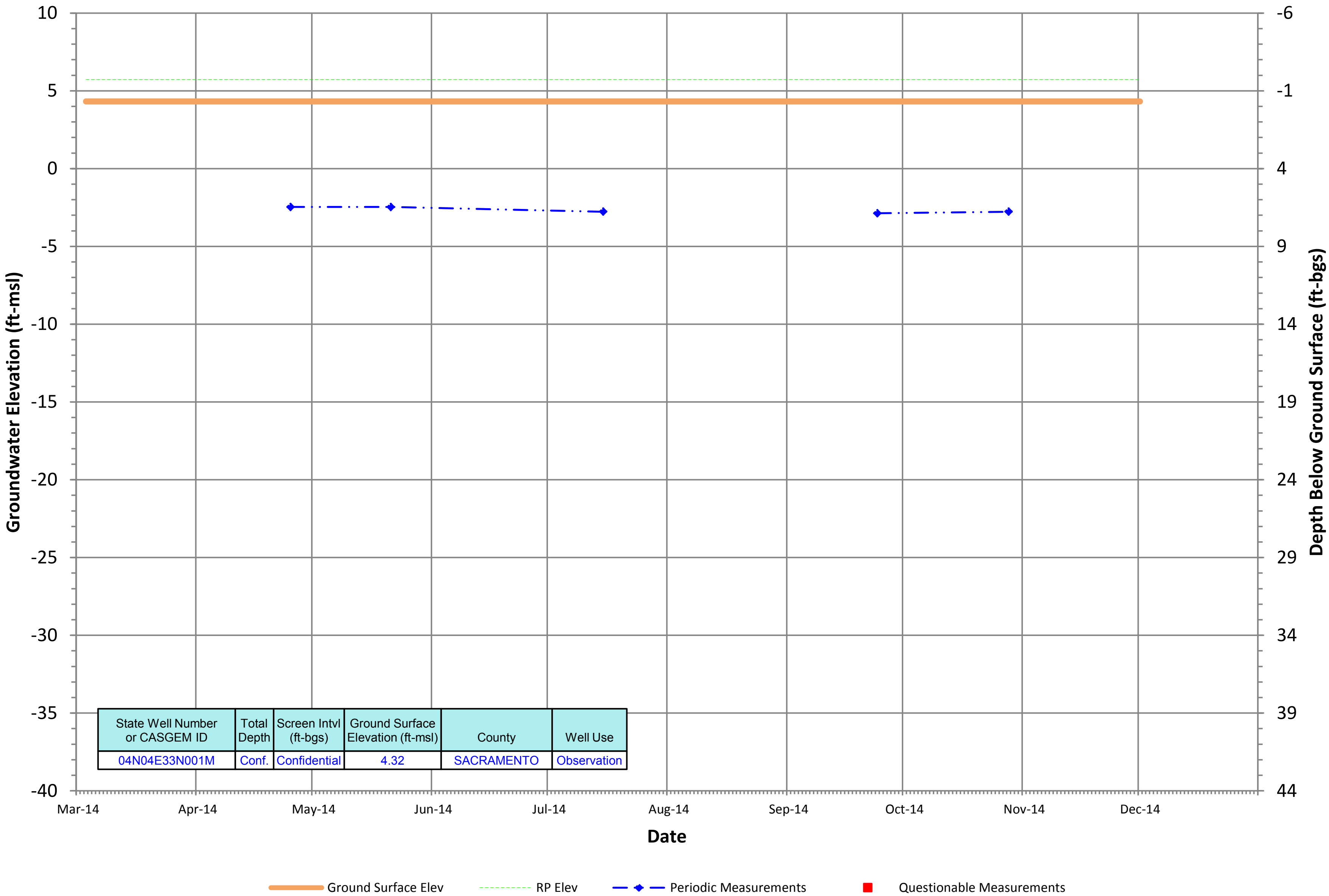
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
04N04E27B001M	Conf.	Confidential	9.42	SACRAMENTO	Observation

04N04E33N001M
Period Of Record: 03/03/2014 to 12/01/2014

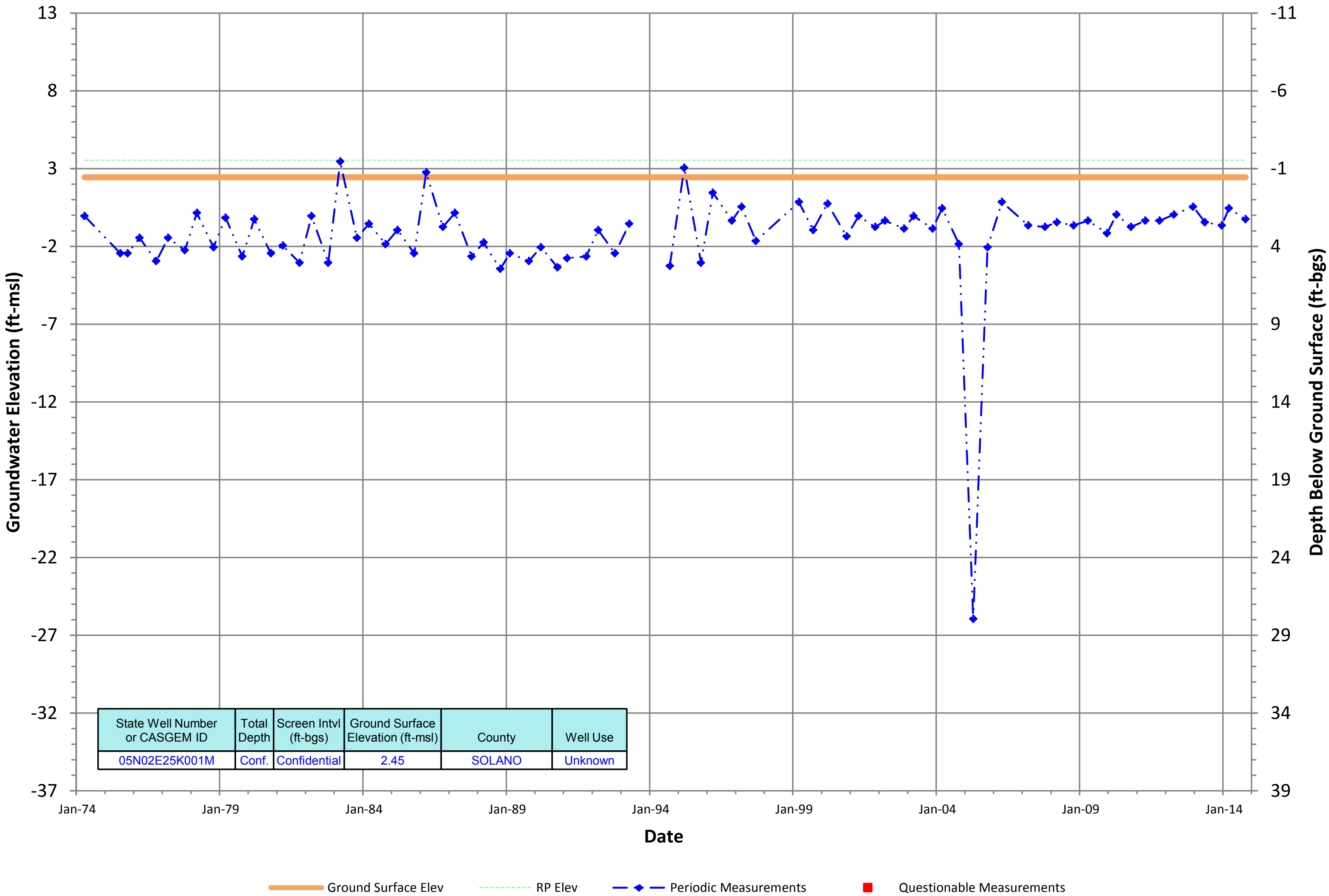
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
04N04E33N001M	Conf.	Confidential	4.32	SACRAMENTO	Observation

05N02E25K001M
Period Of Record: 04/04/1974 to 10/28/2014

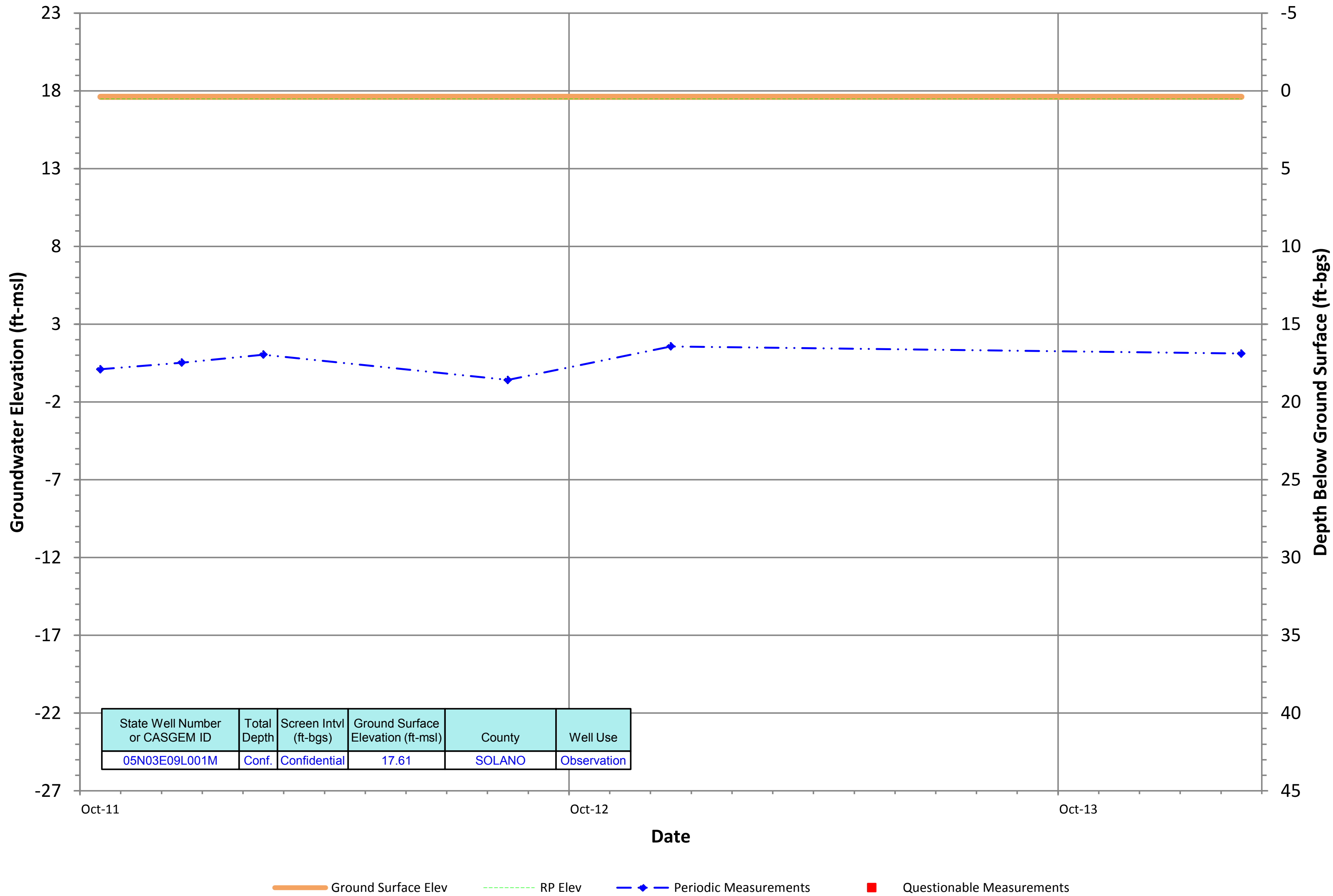
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



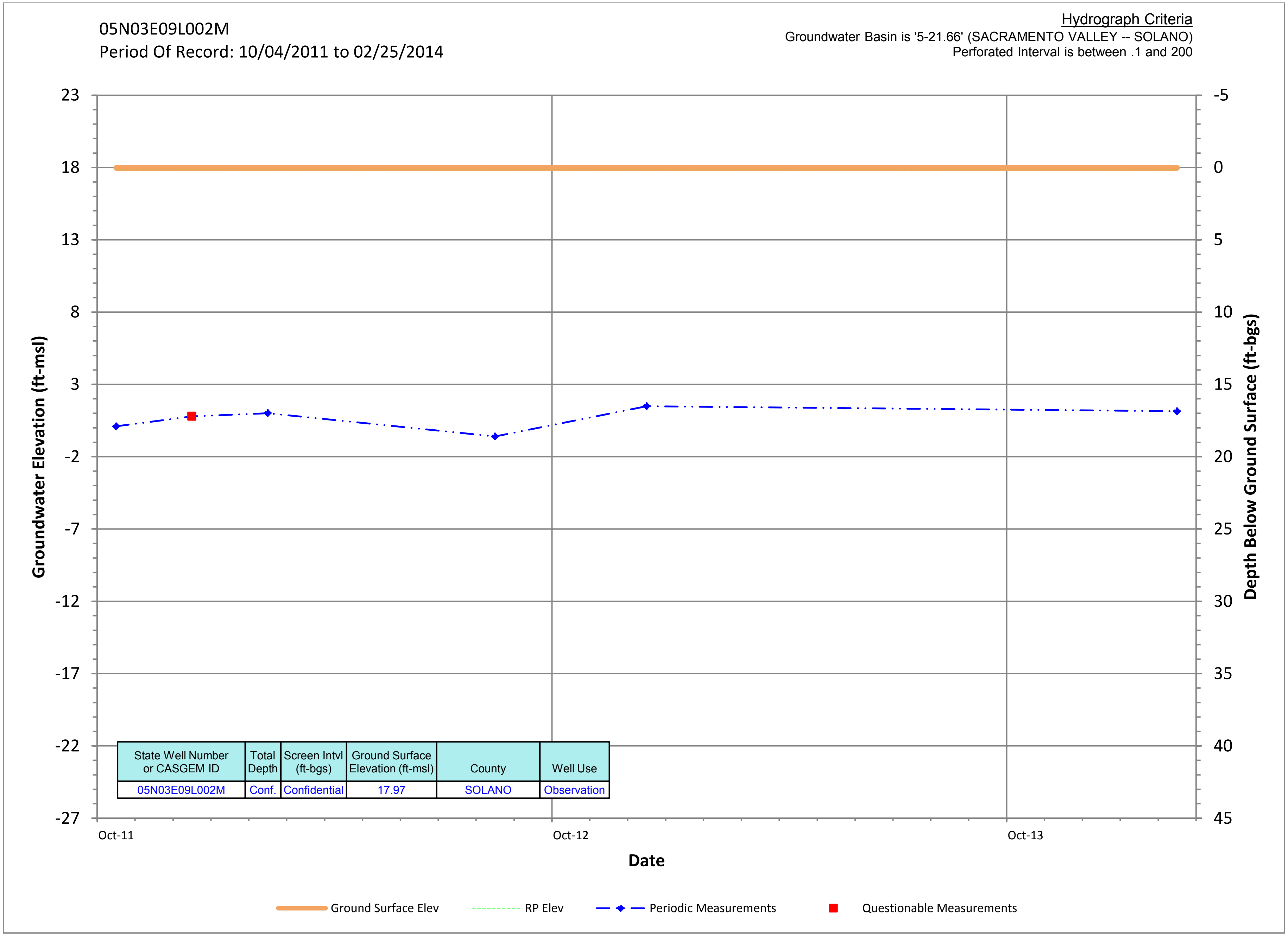
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N02E25K001M	Conf.	Confidential	2.45	SOLANO	Unknown

05N03E09L001M
Period Of Record: 10/04/2011 to 02/25/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E09L001M	Conf.	Confidential	17.61	SOLANO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E09L002M	Conf.	Confidential	17.97	SOLANO	Observation

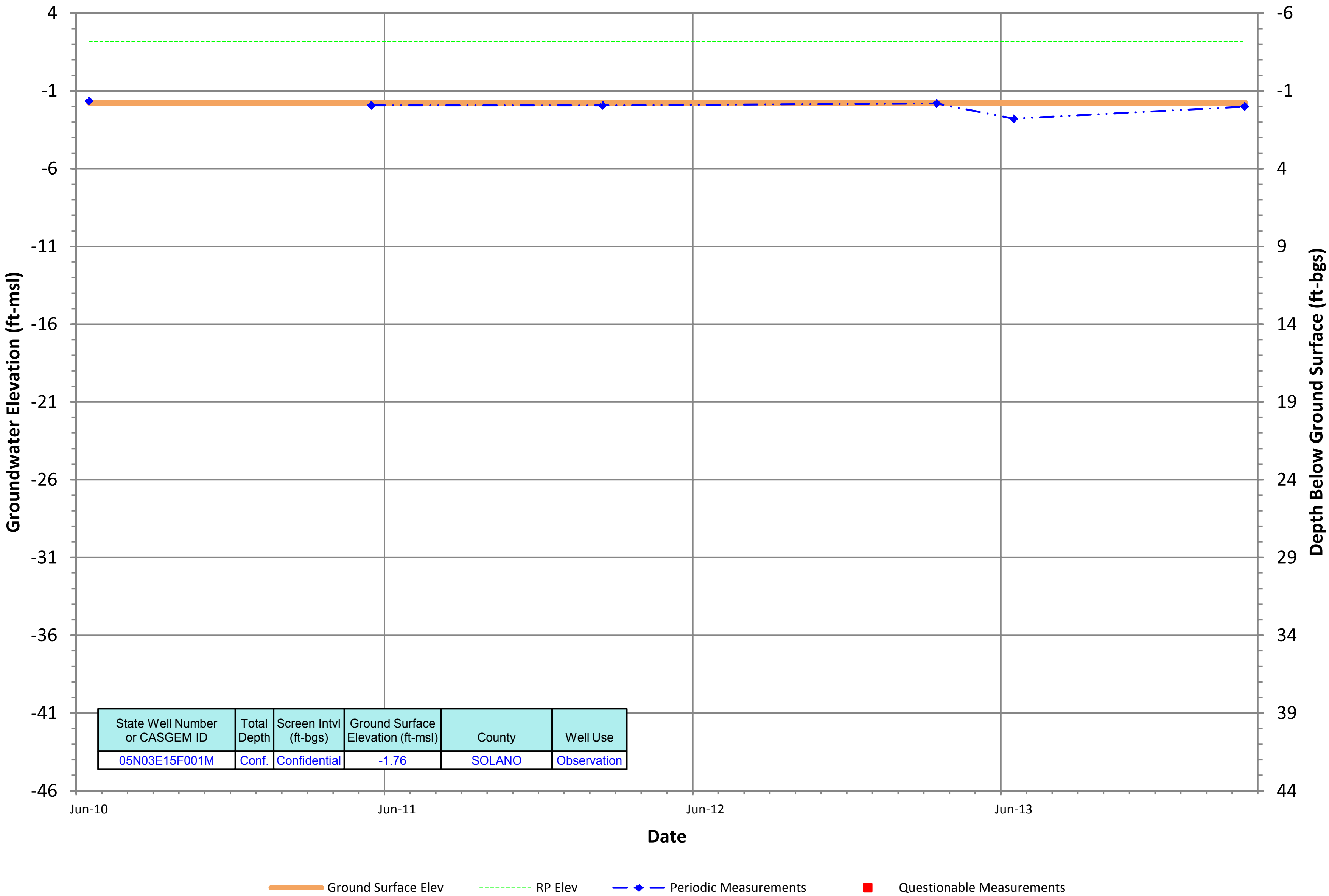
05N03E15F001M

Period Of Record: 06/03/2010 to 03/19/2014

Hydrograph Criteria

Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)

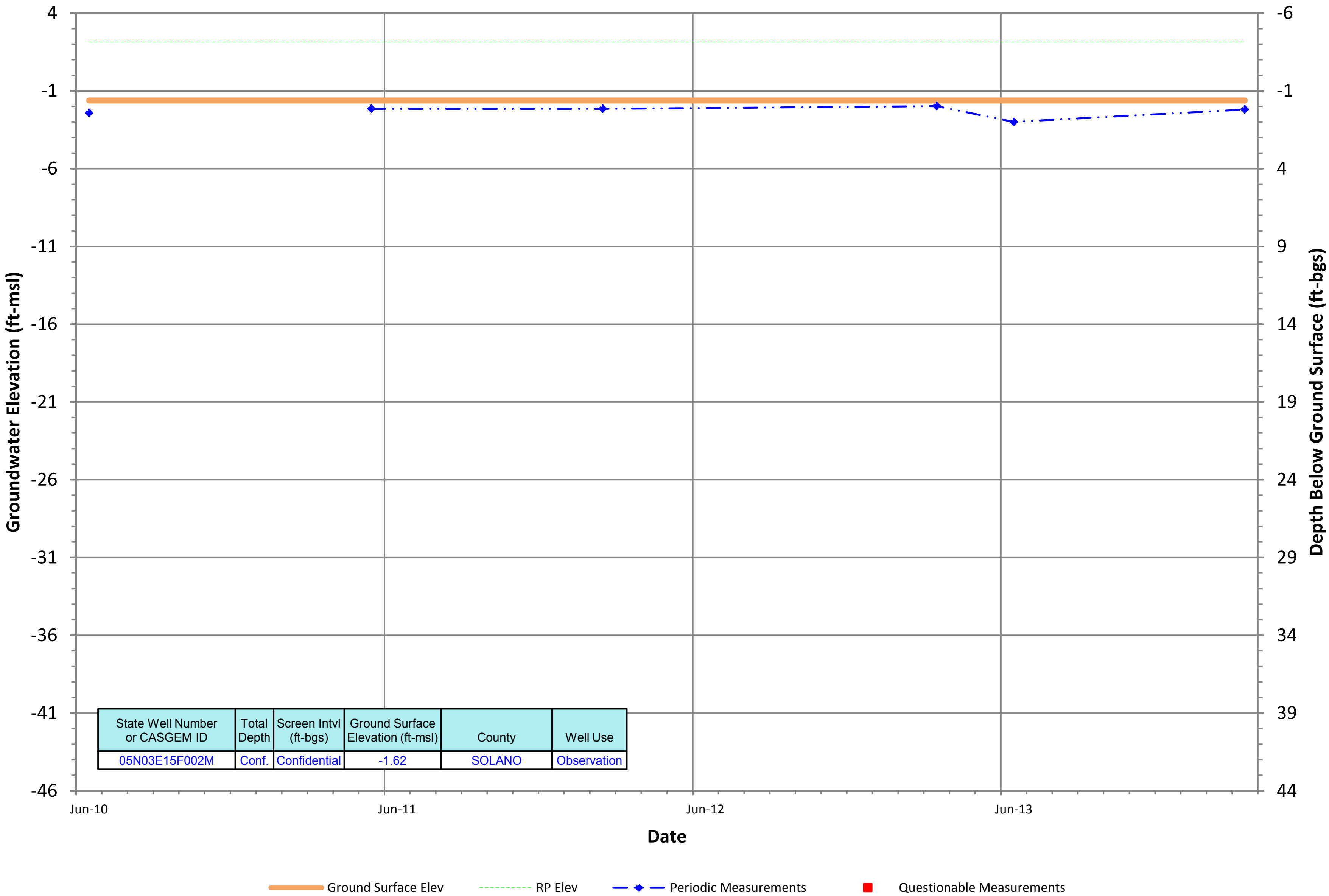
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E15F001M	Conf.	Confidential	-1.76	SOLANO	Observation

05N03E15F002M
Period Of Record: 06/03/2010 to 03/19/2014

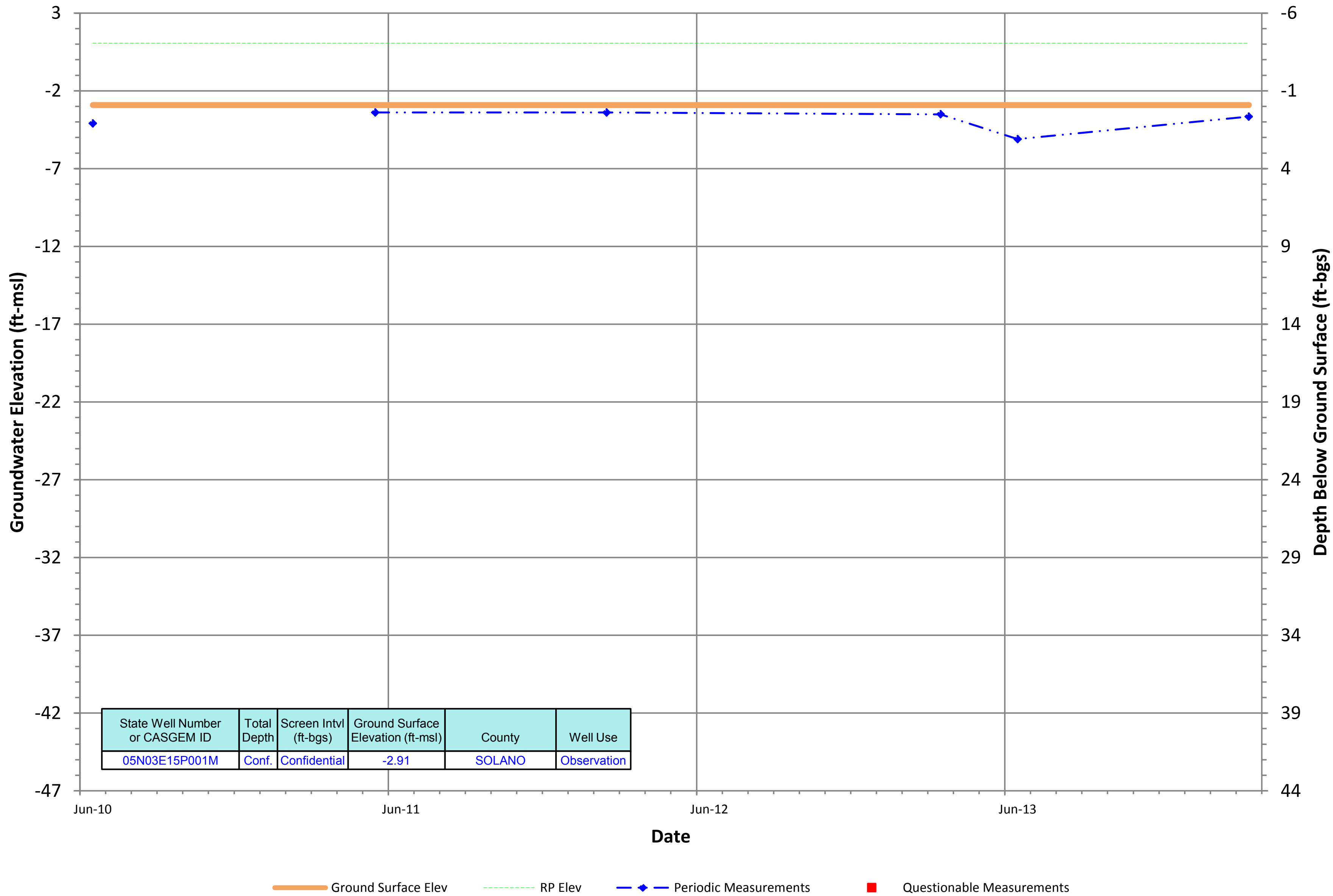
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E15F002M	Conf.	Confidential	-1.62	SOLANO	Observation

05N03E15P001M
Period Of Record: 06/03/2010 to 03/19/2014

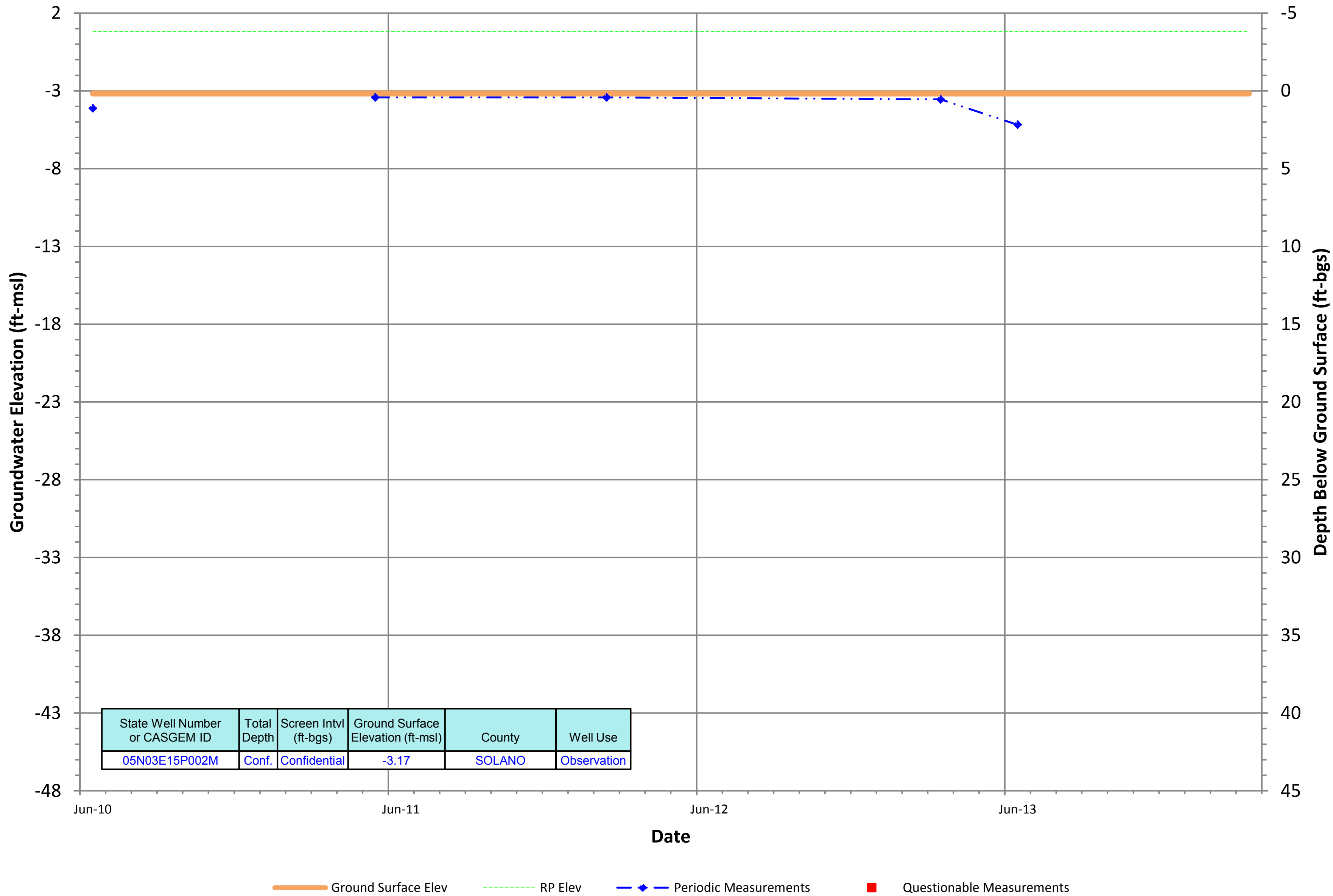
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E15P001M	Conf.	Confidential	-2.91	SOLANO	Observation

05N03E15P002M
Period Of Record: 06/03/2010 to 03/19/2014

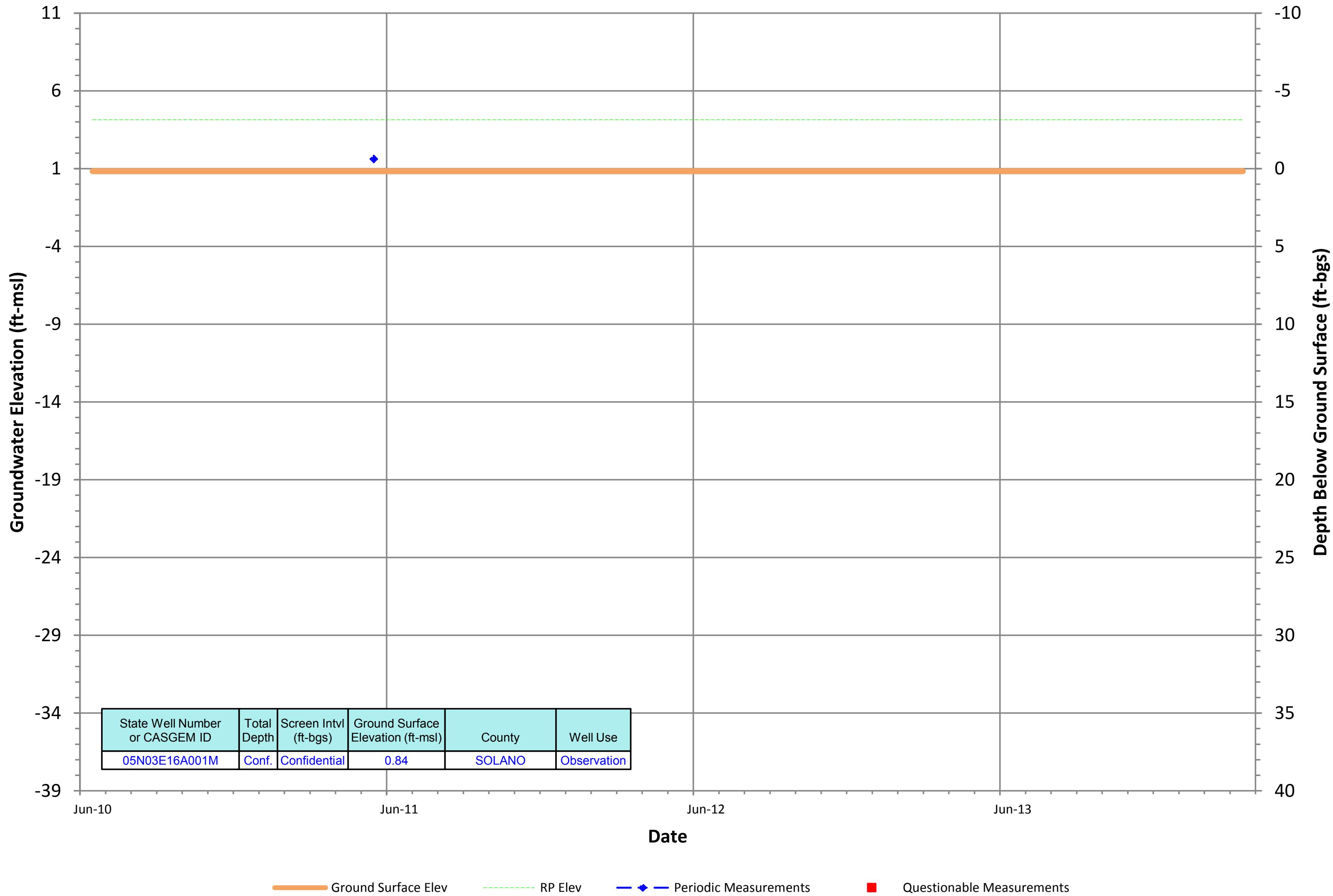
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E15P002M	Conf.	Confidential	-3.17	SOLANO	Observation

05N03E16A001M
Period Of Record: 06/03/2010 to 03/19/2014

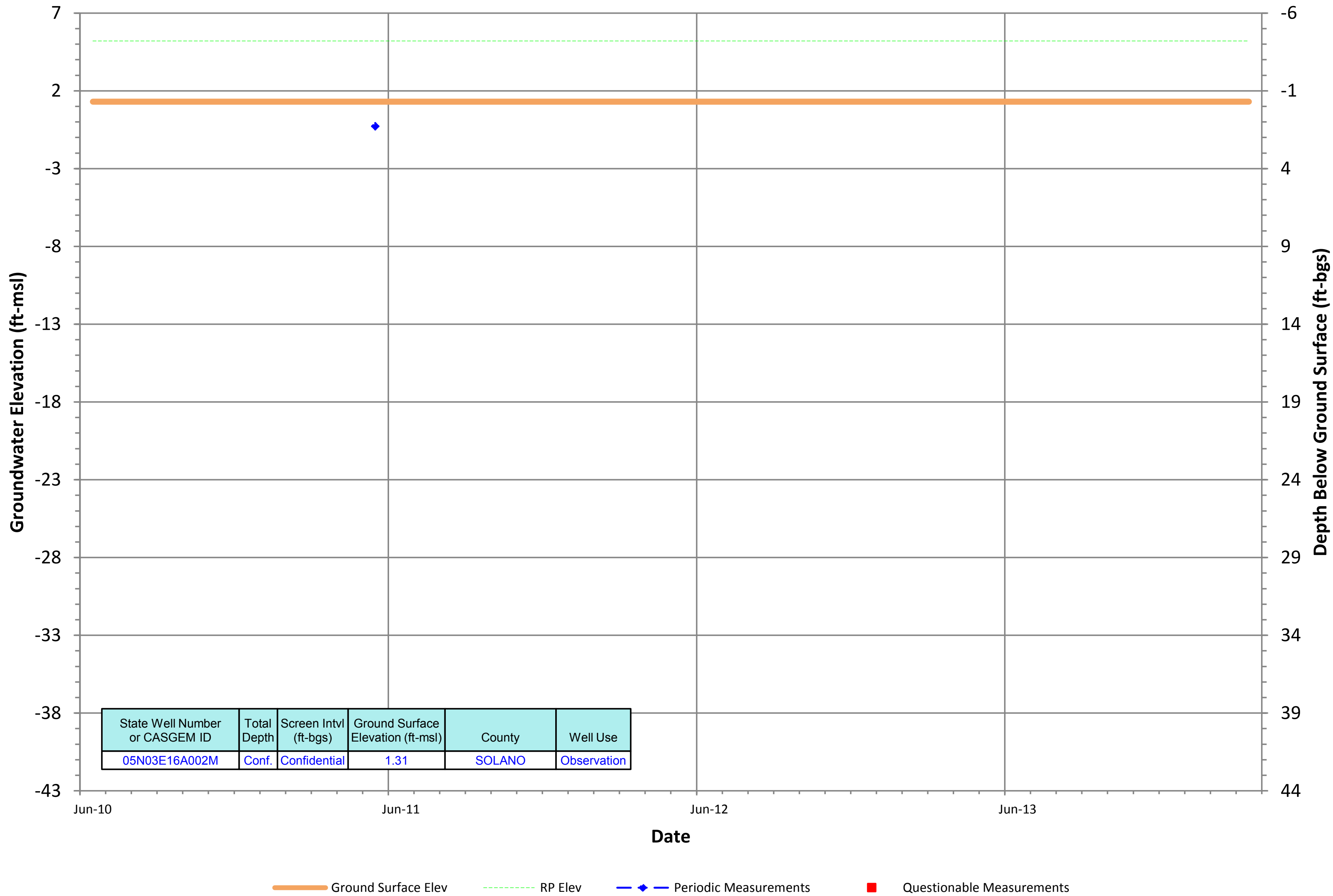
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16A001M	Conf.	Confidential	0.84	SOLANO	Observation

05N03E16A002M
Period Of Record: 06/03/2010 to 03/19/2014

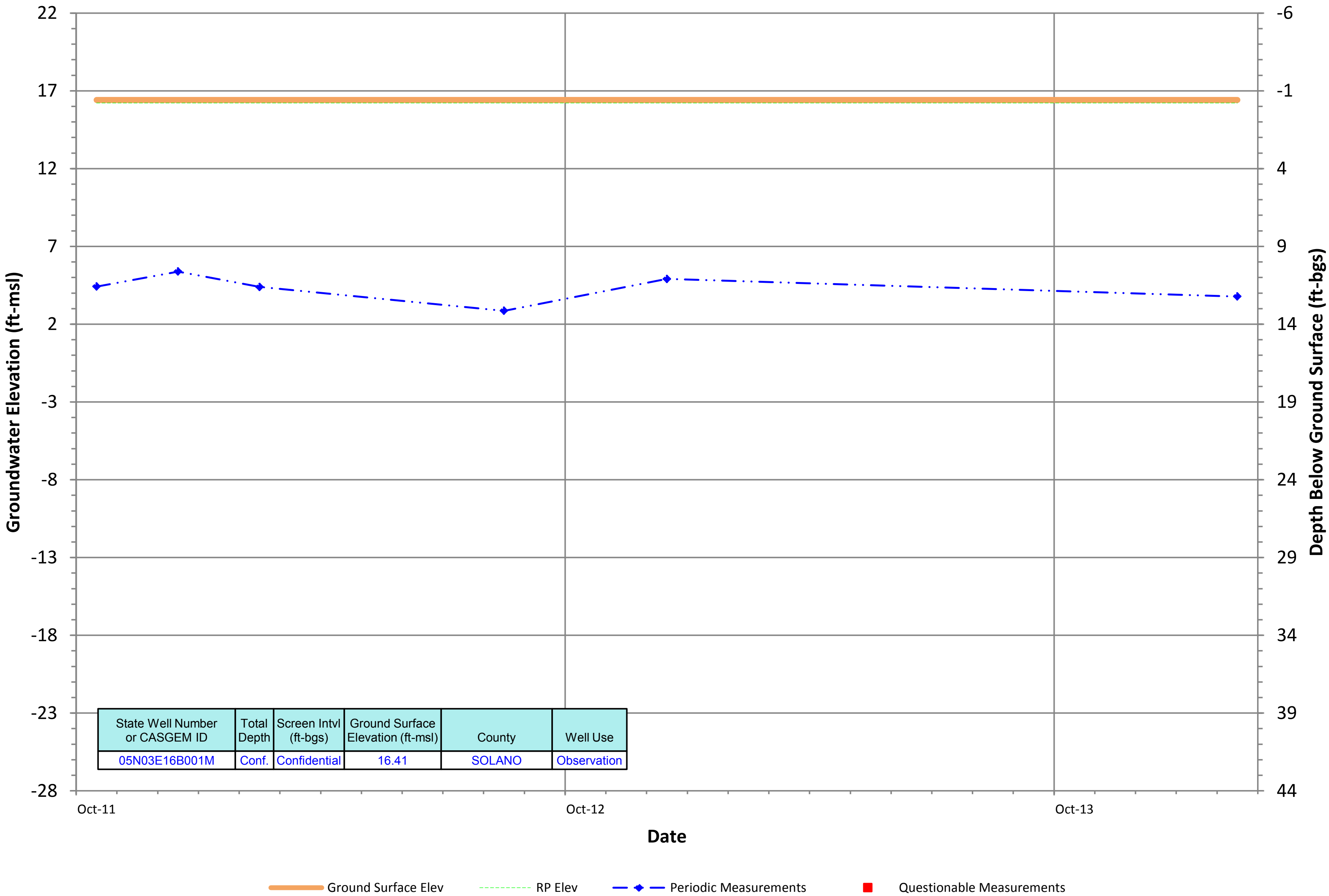
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16A002M	Conf.	Confidential	1.31	SOLANO	Observation

05N03E16B001M
Period Of Record: 10/04/2011 to 02/25/2014

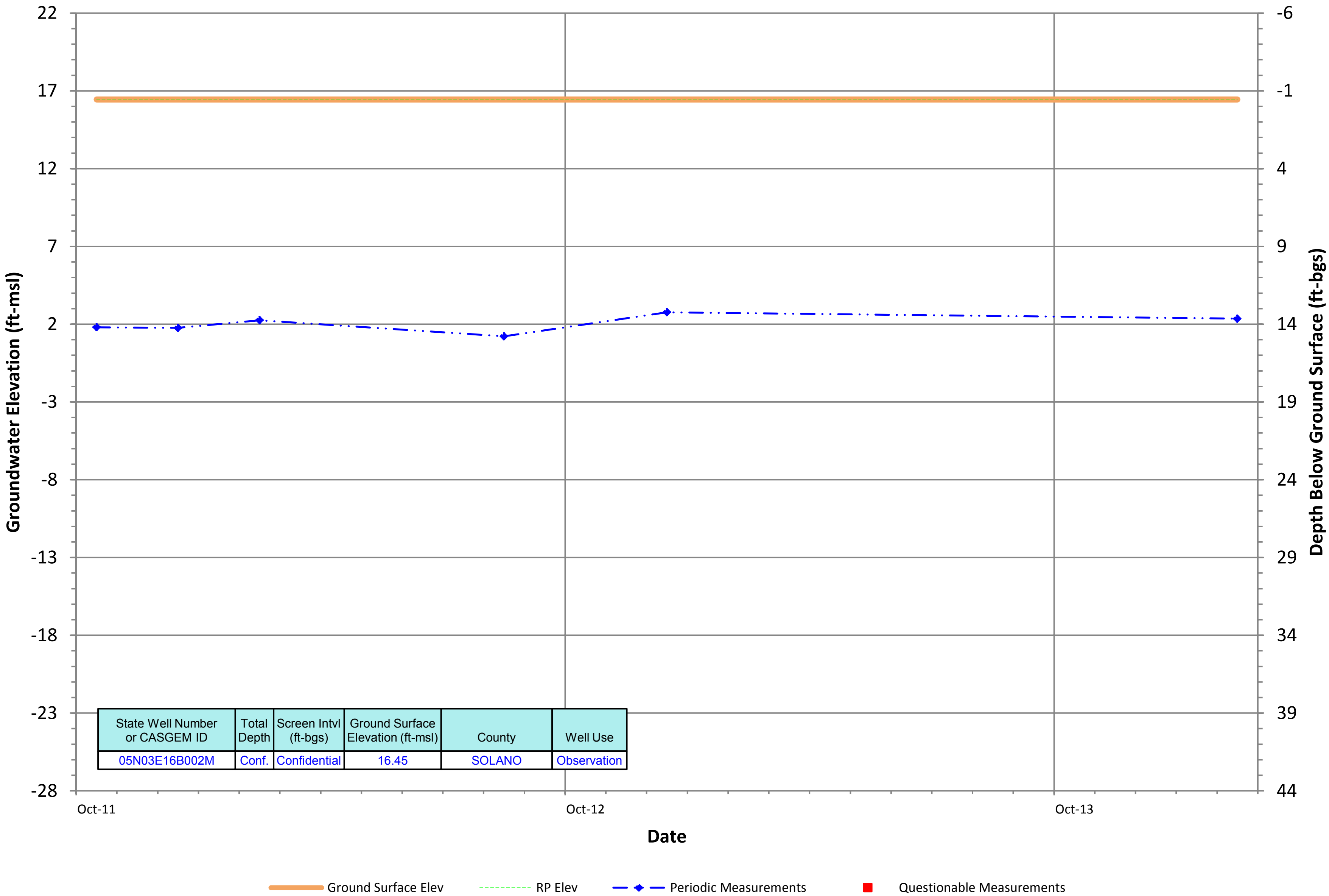
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16B001M	Conf.	Confidential	16.41	SOLANO	Observation

05N03E16B002M
Period Of Record: 10/04/2011 to 02/25/2014

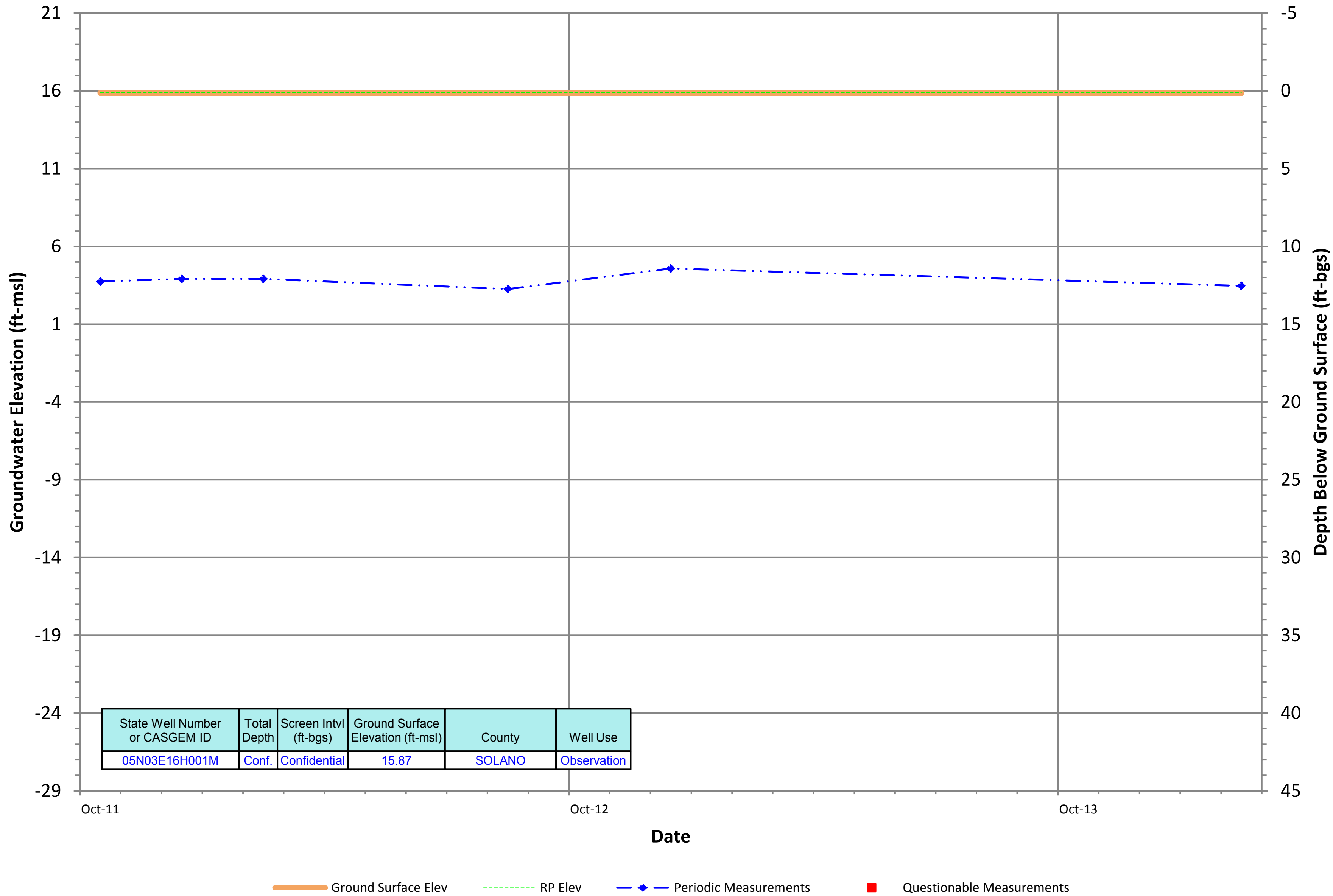
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16B002M	Conf.	Confidential	16.45	SOLANO	Observation

05N03E16H001M
Period Of Record: 10/04/2011 to 02/25/2014

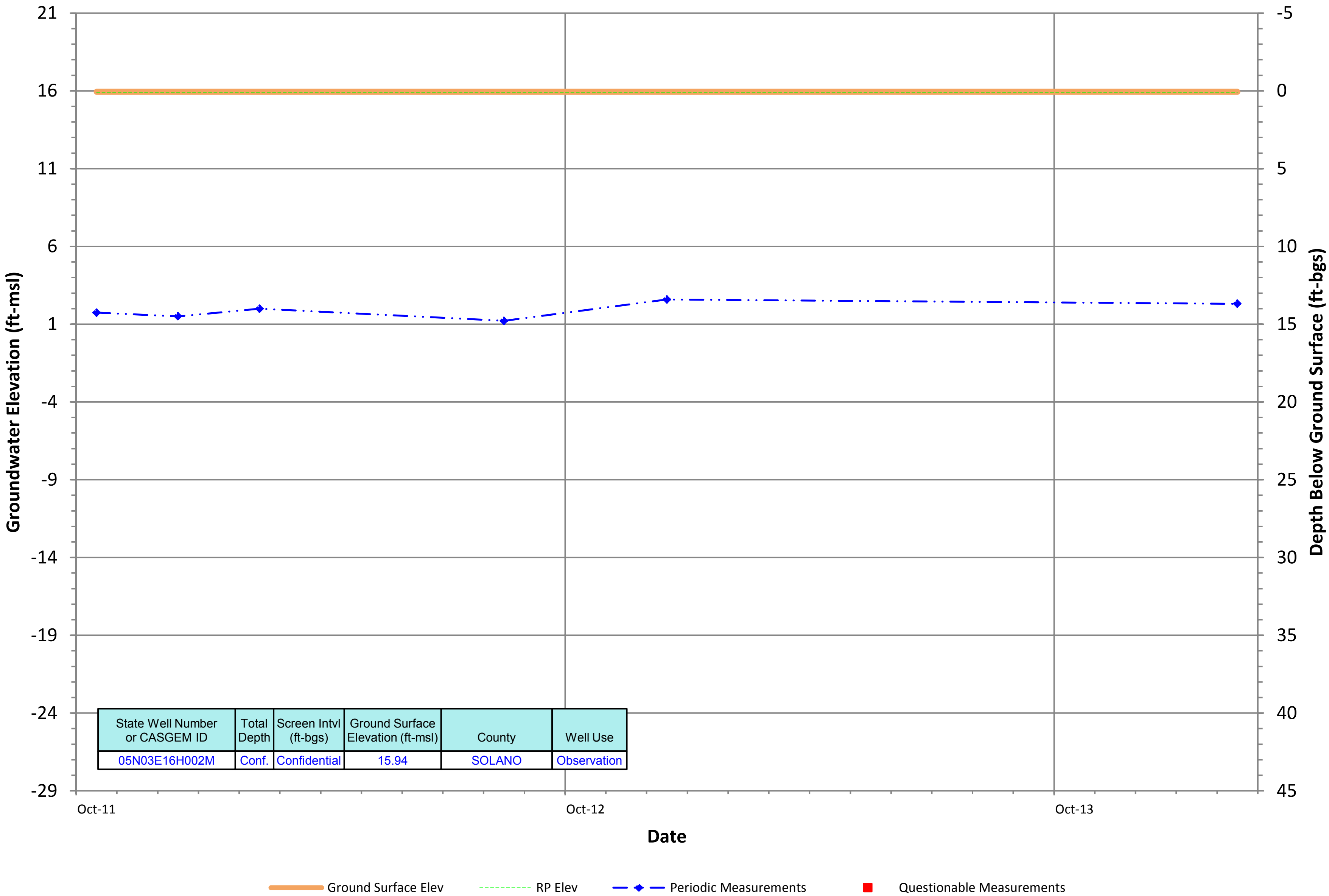
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16H001M	Conf.	Confidential	15.87	SOLANO	Observation

05N03E16H002M
Period Of Record: 10/04/2011 to 02/25/2014

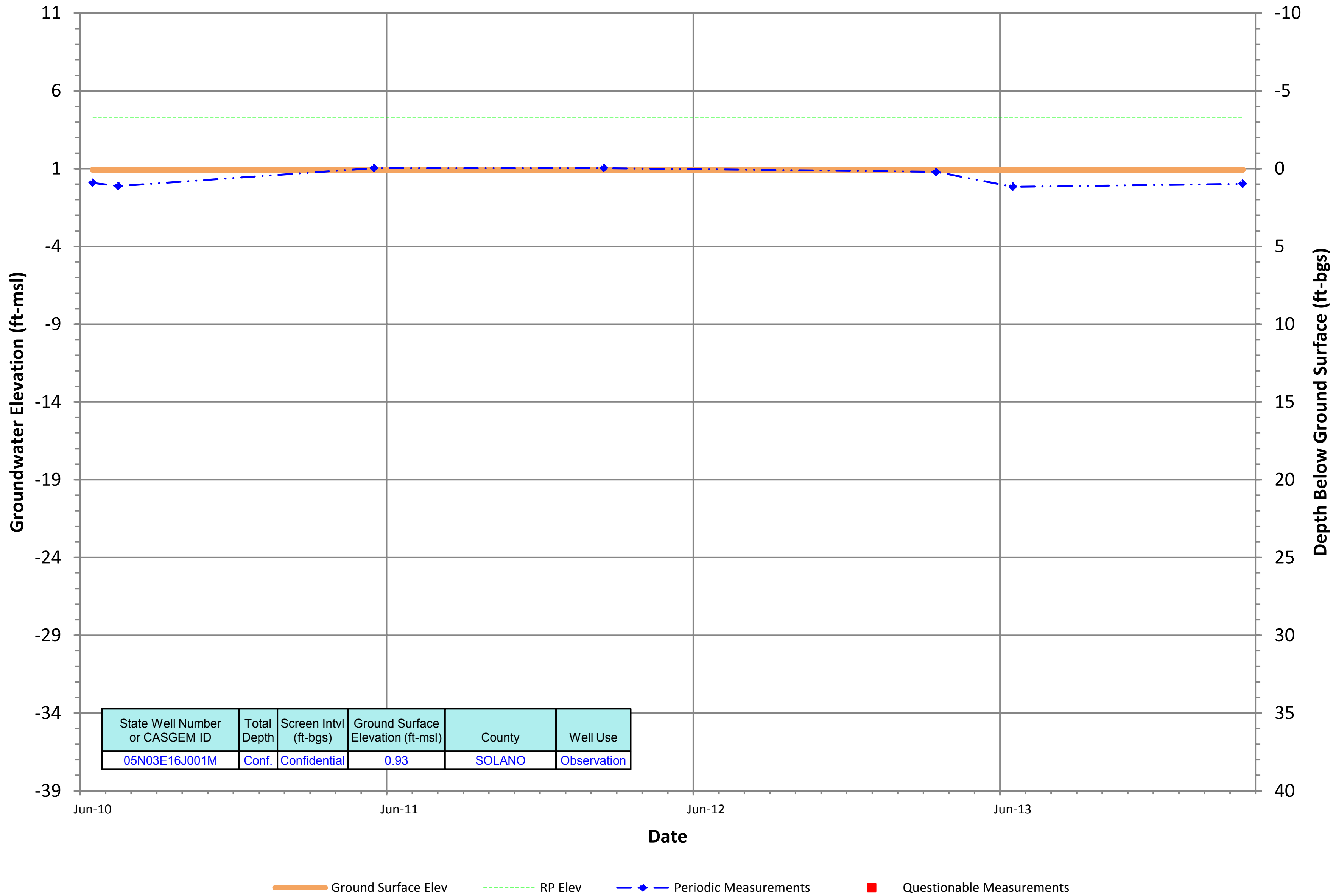
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16H002M	Conf.	Confidential	15.94	SOLANO	Observation

05N03E16J001M
Period Of Record: 06/03/2010 to 03/19/2014

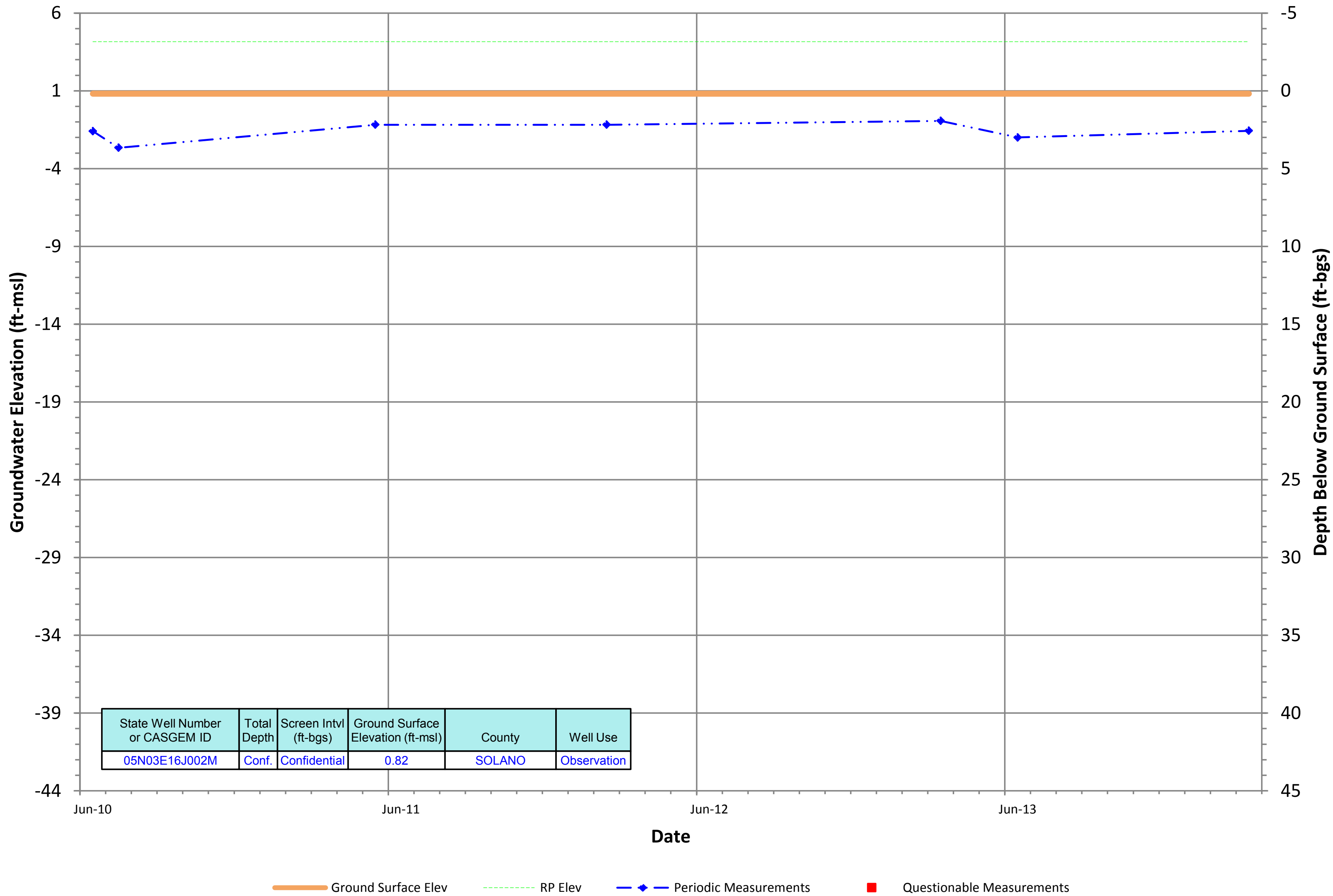
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16J001M	Conf.	Confidential	0.93	SOLANO	Observation

05N03E16J002M
Period Of Record: 06/03/2010 to 03/19/2014

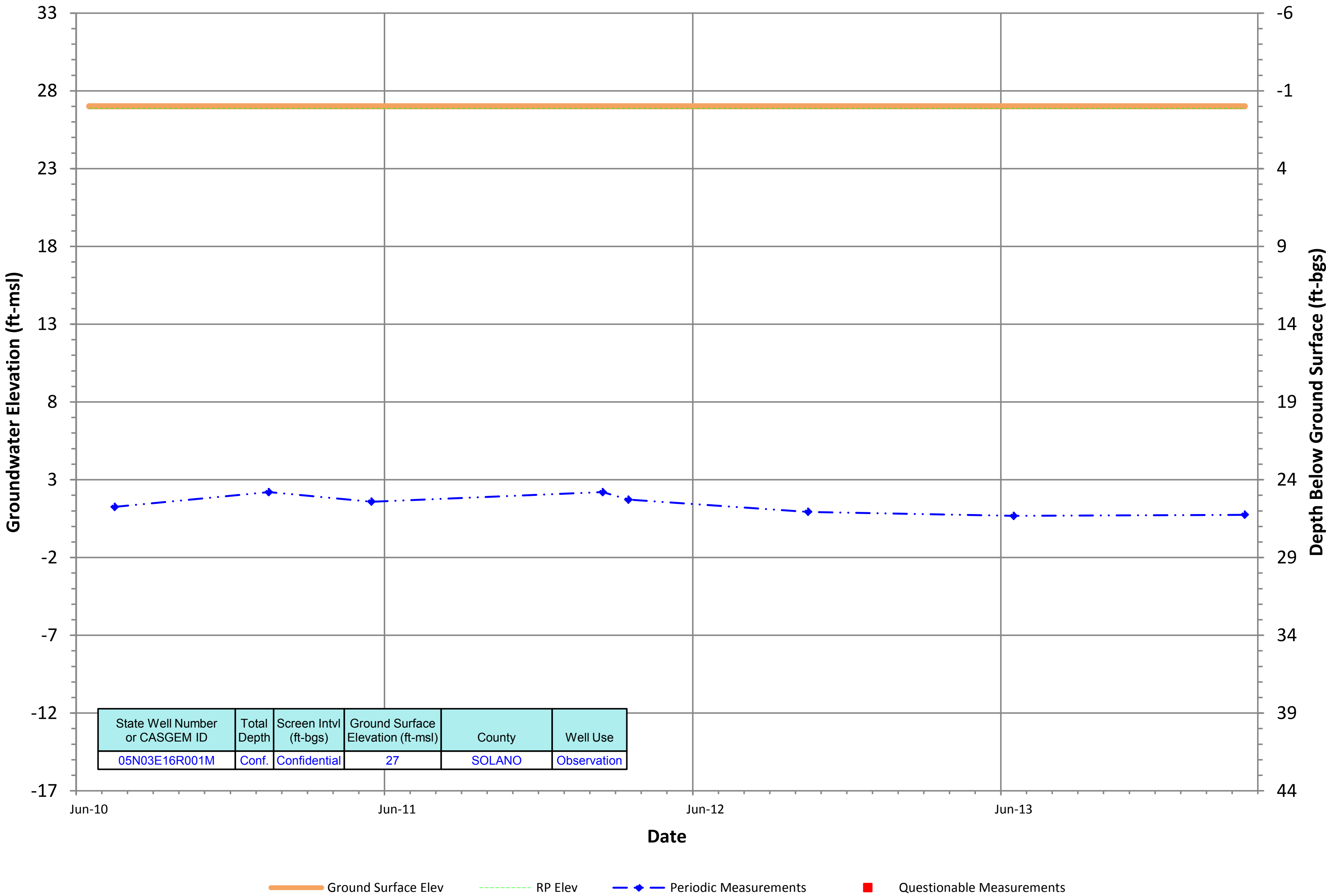
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16J002M	Conf.	Confidential	0.82	SOLANO	Observation

05N03E16R001M
Period Of Record: 06/03/2010 to 03/19/2014

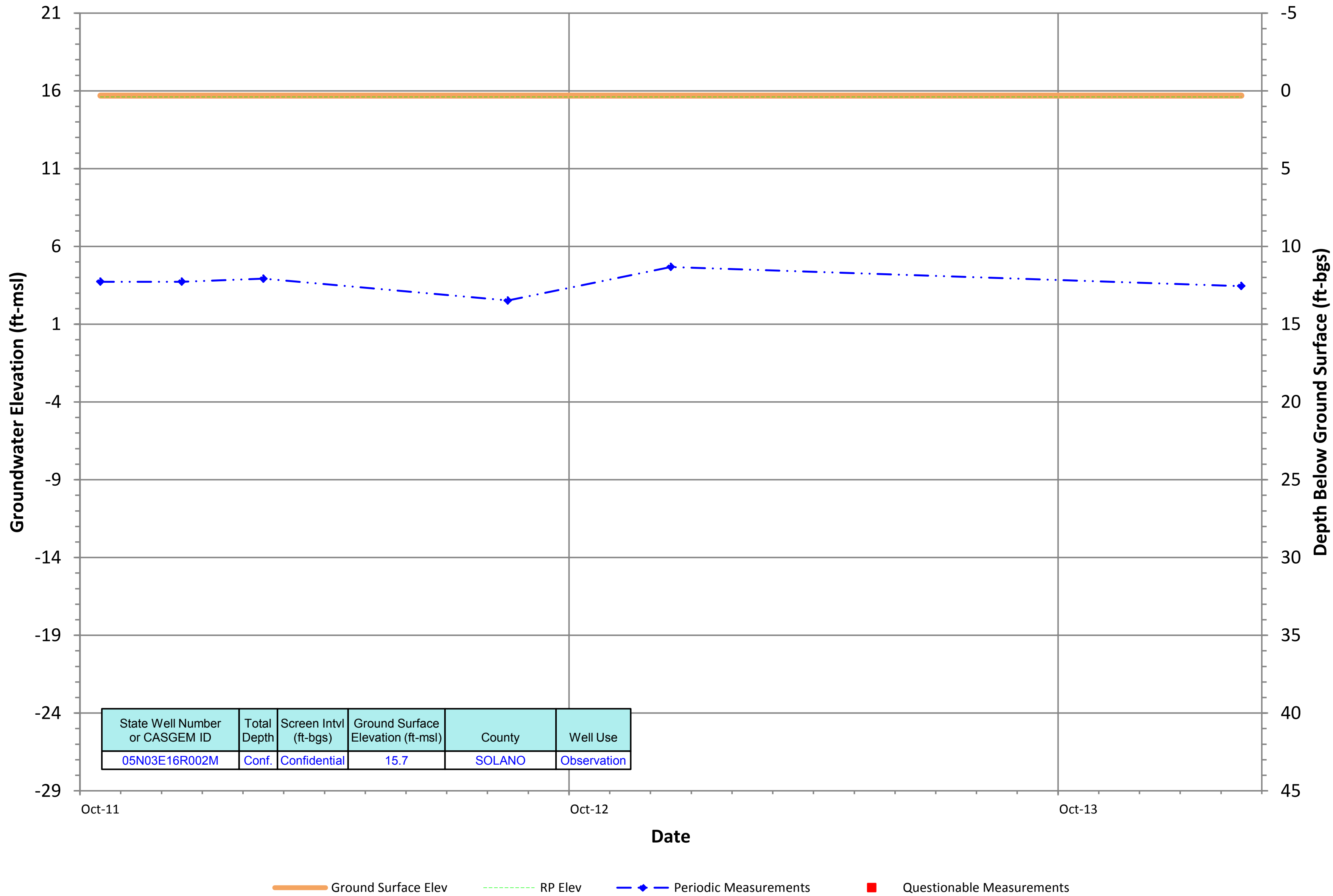
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16R001M	Conf.	Confidential	27	SOLANO	Observation

05N03E16R002M
Period Of Record: 10/07/2011 to 02/25/2014

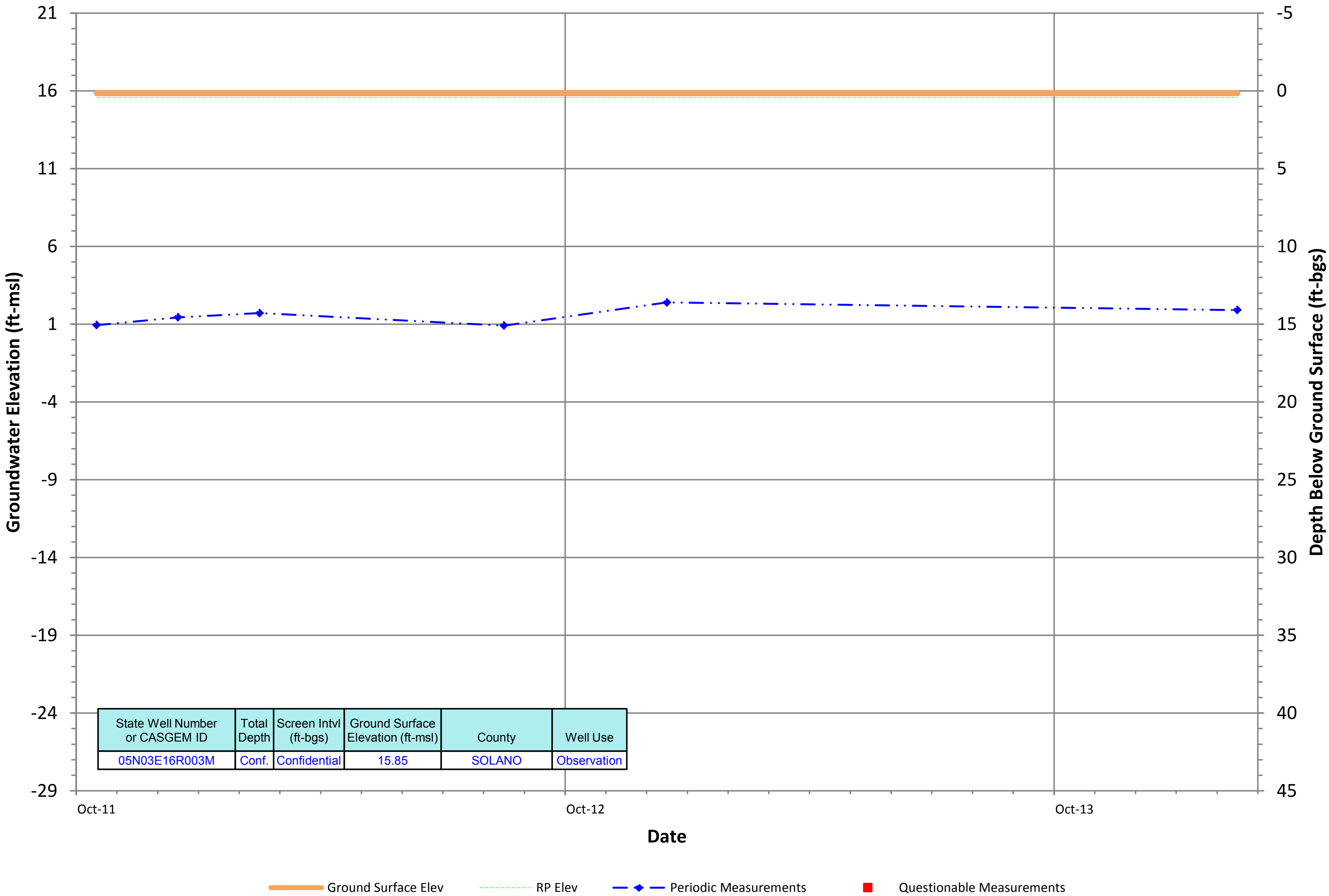
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16R002M	Conf.	Confidential	15.7	SOLANO	Observation

05N03E16R003M
Period Of Record: 10/07/2011 to 02/25/2014

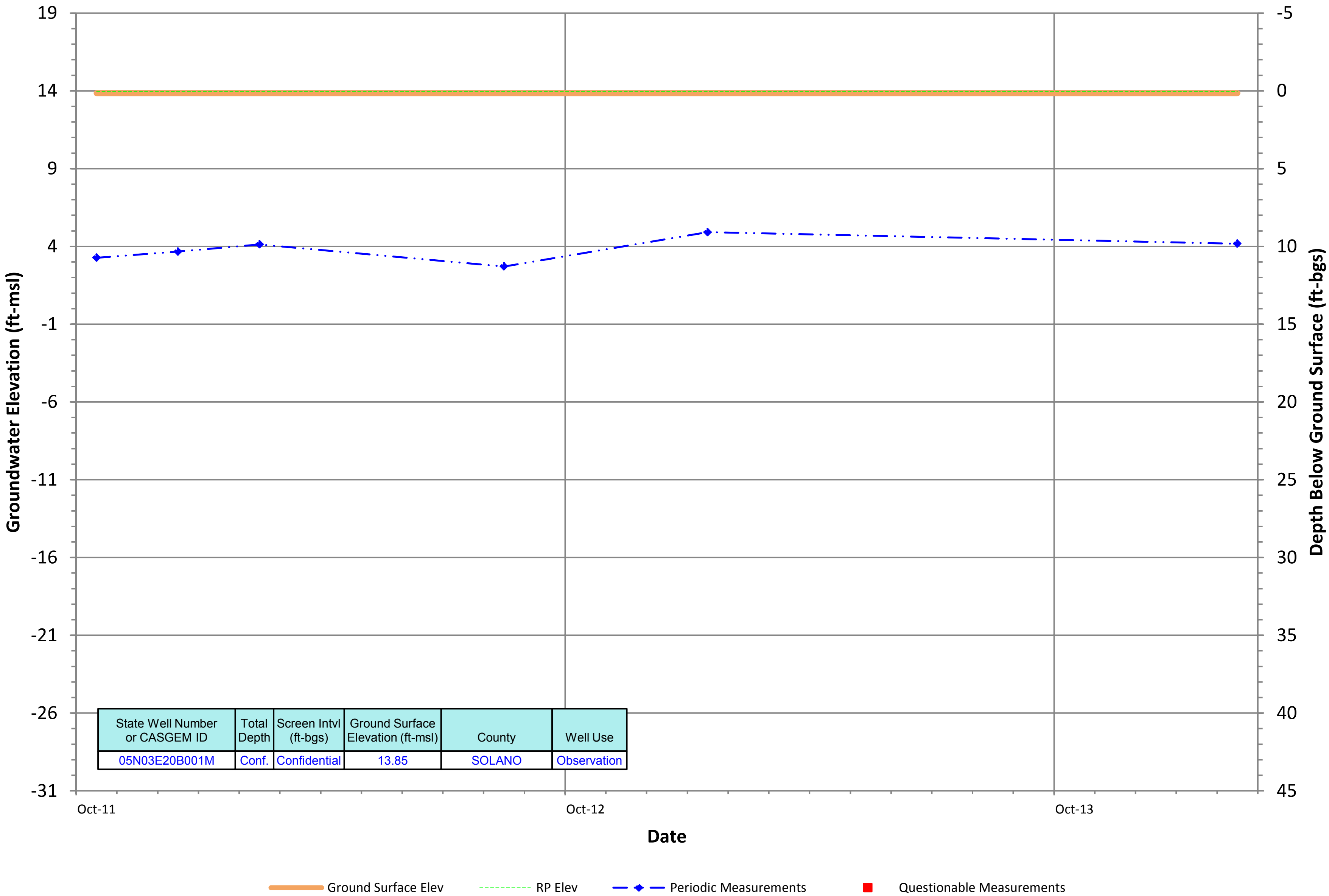
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E16R003M	Conf.	Confidential	15.85	SOLANO	Observation

05N03E20B001M
Period Of Record: 10/04/2011 to 02/25/2014

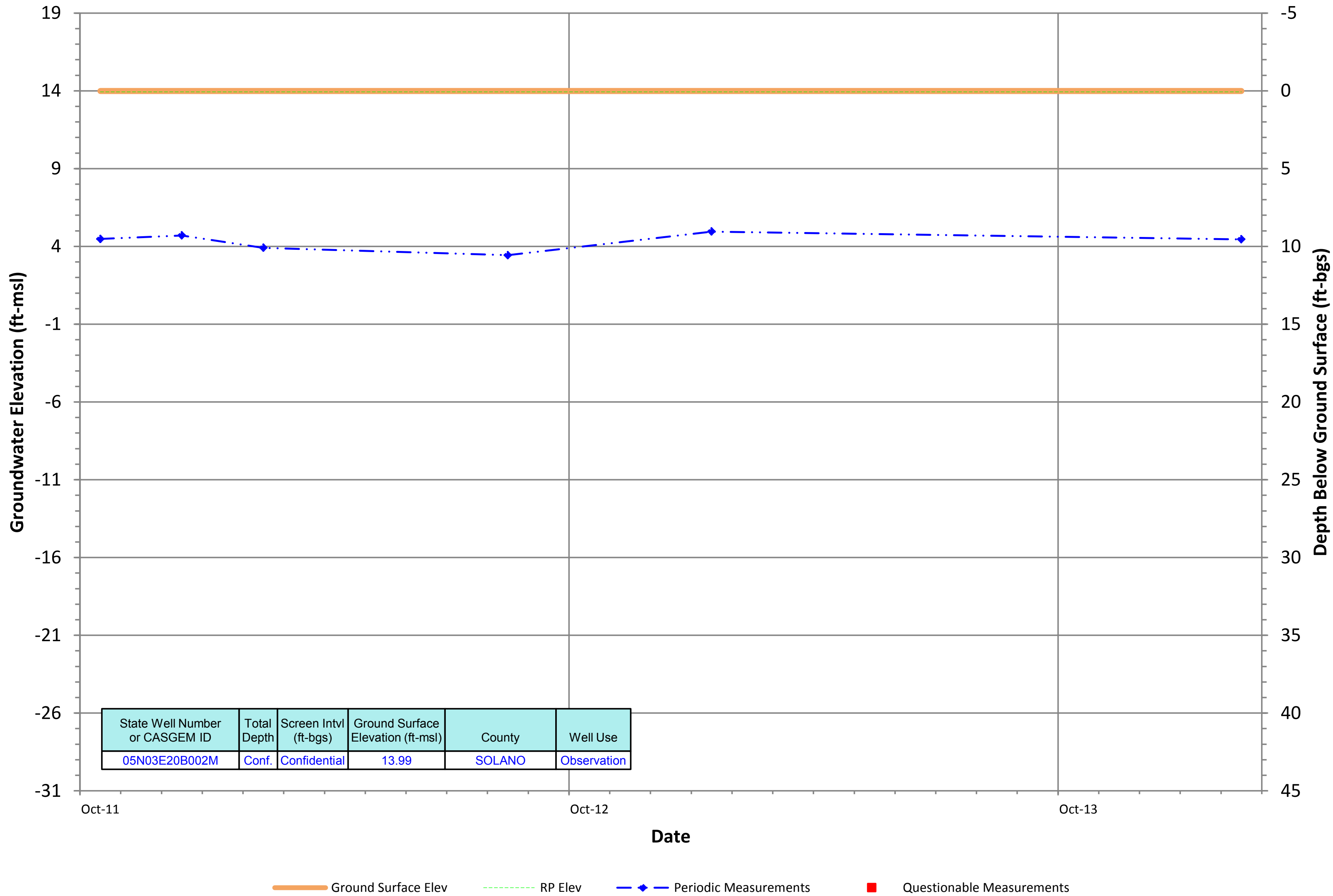
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



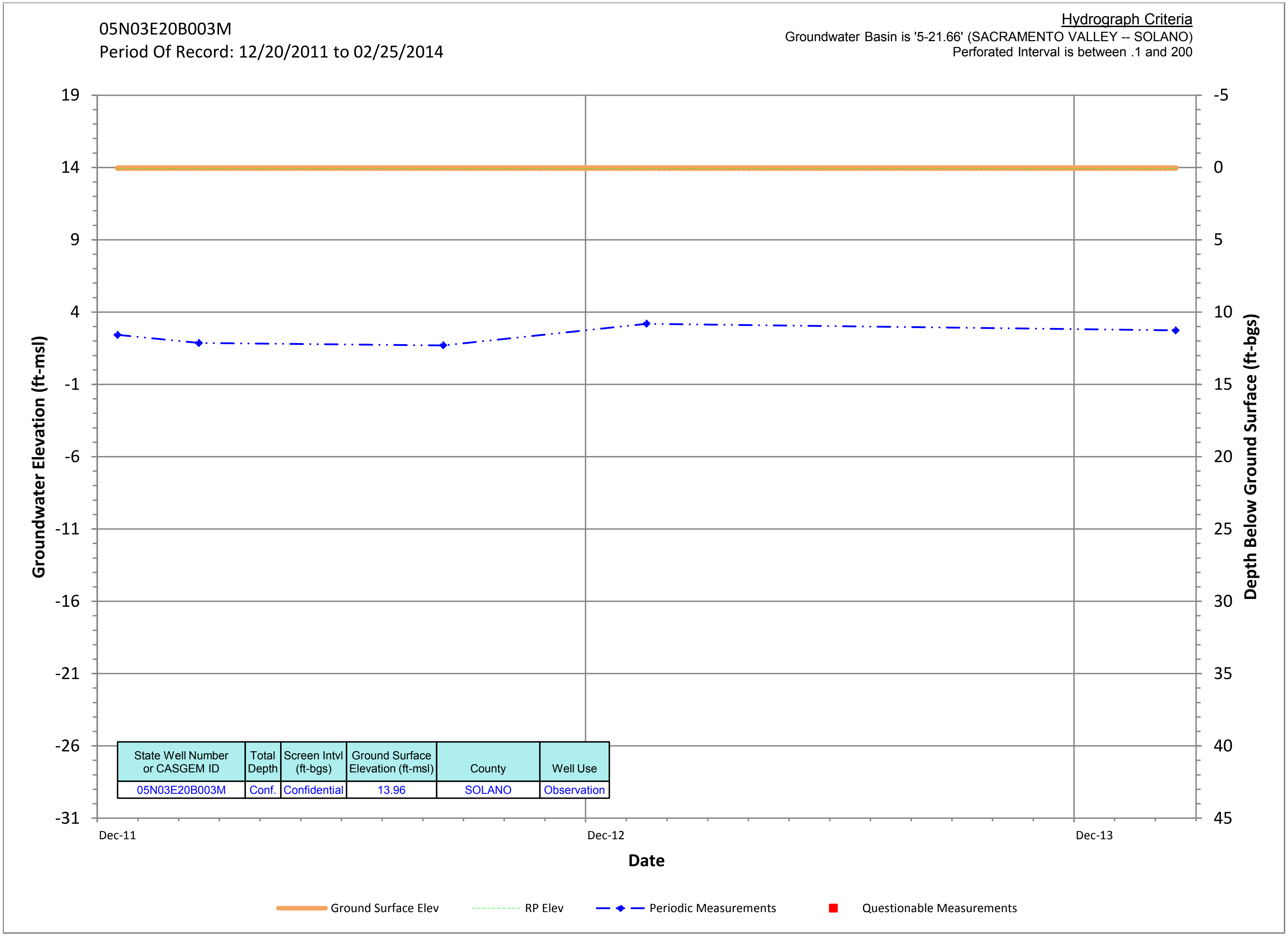
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E20B001M	Conf.	Confidential	13.85	SOLANO	Observation

05N03E20B002M
Period Of Record: 10/04/2011 to 02/25/2014

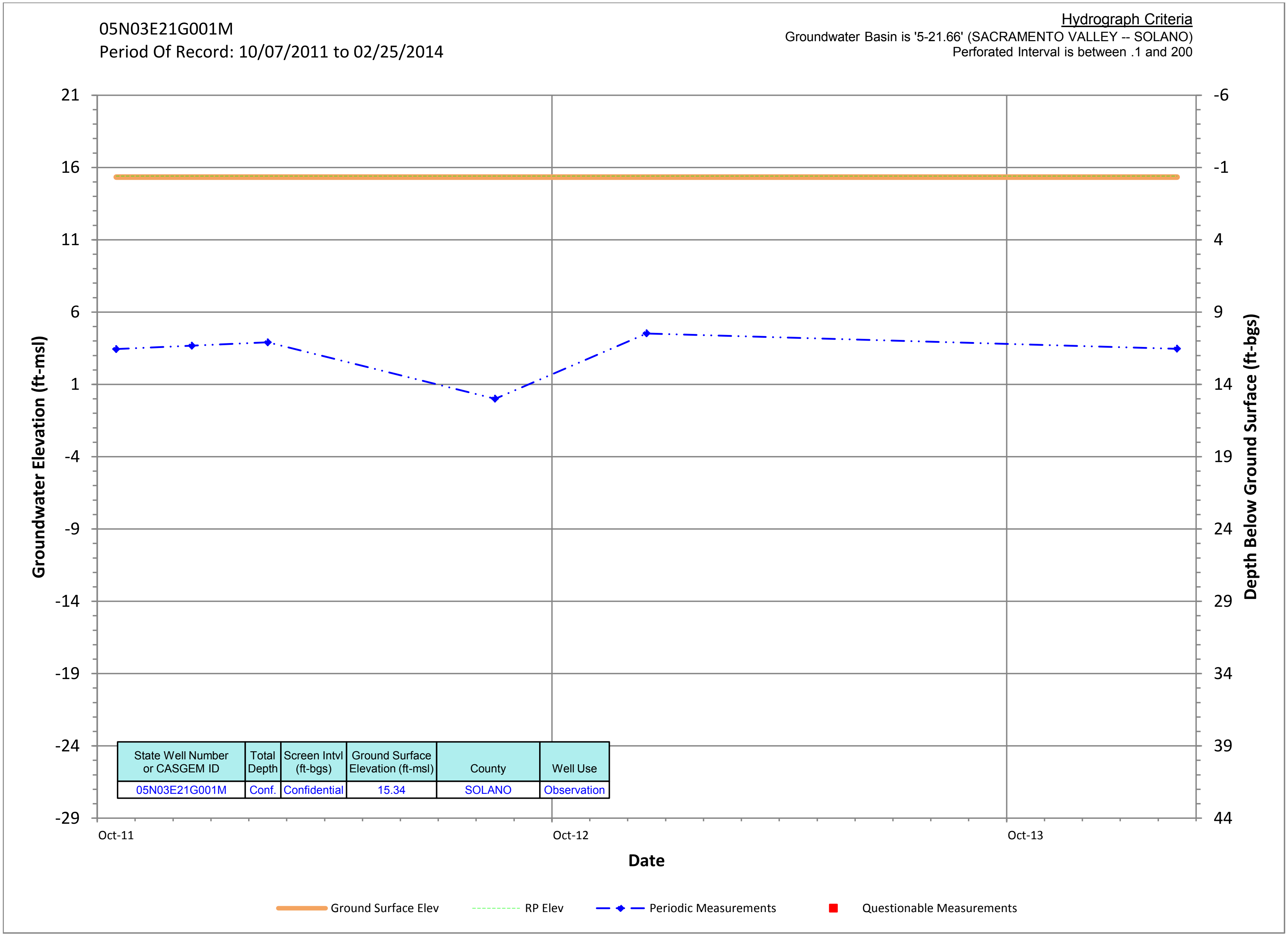
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E20B002M	Conf.	Confidential	13.99	SOLANO	Observation



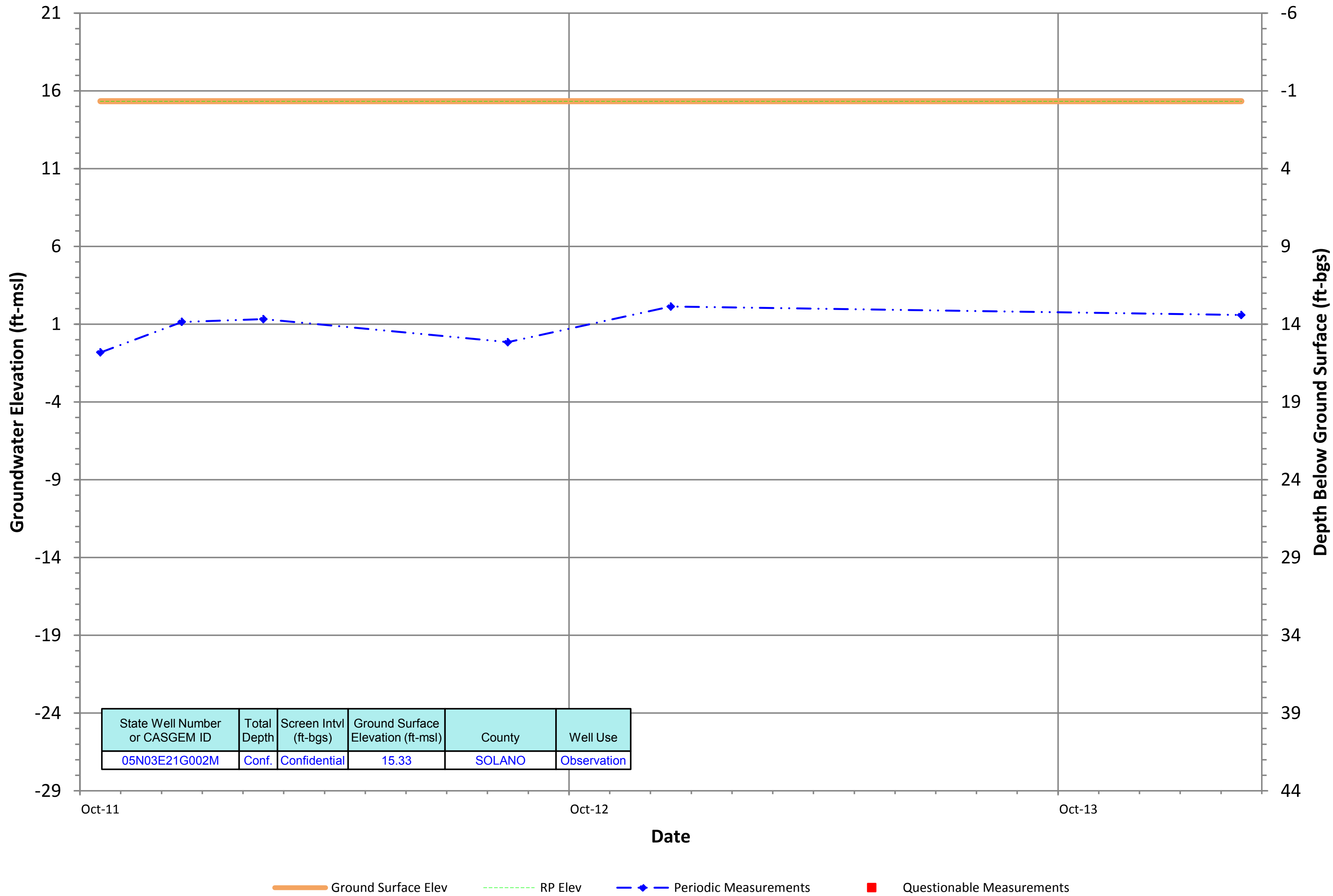
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E20B003M	Conf.	Confidential	13.96	SOLANO	Observation



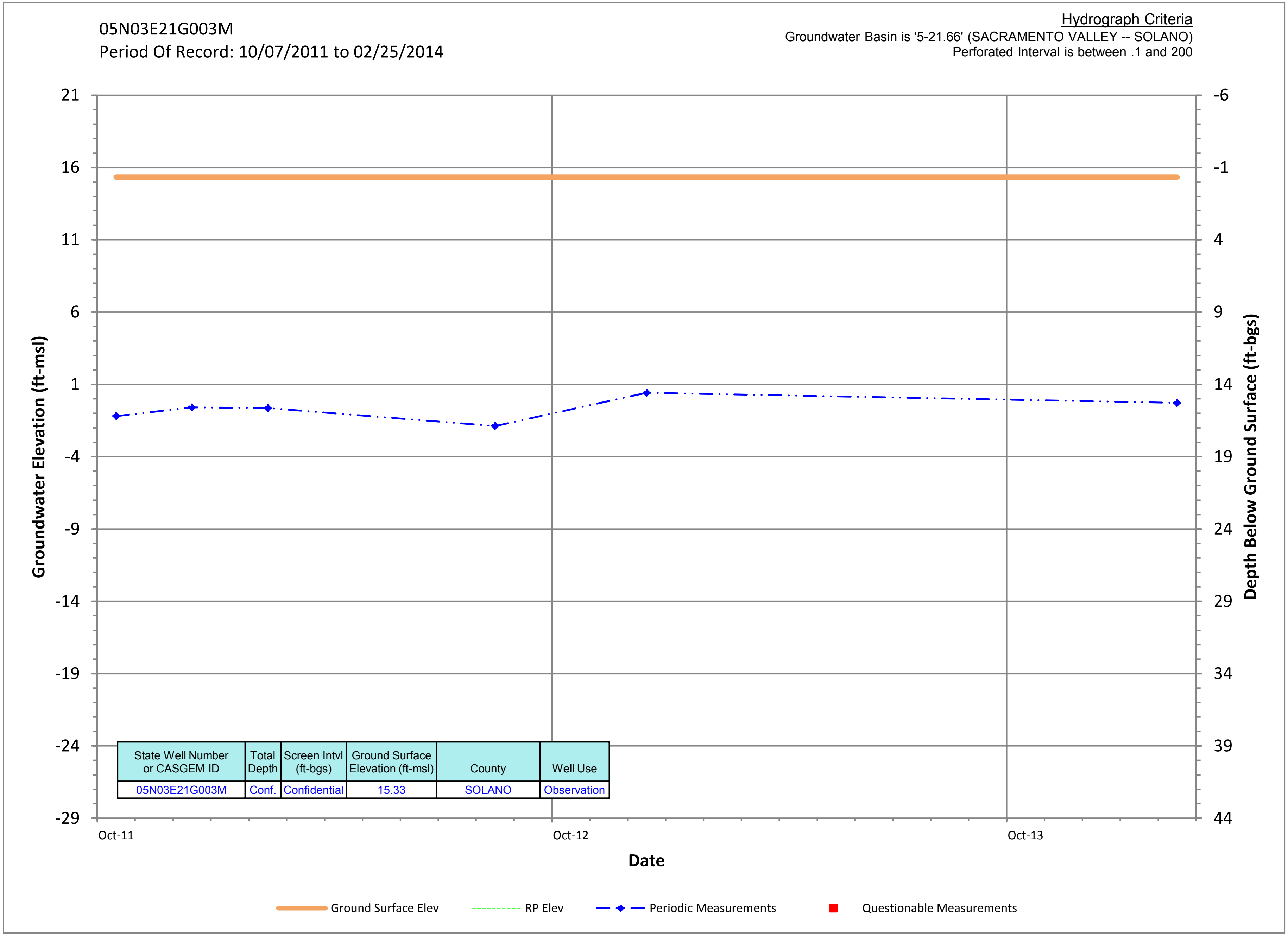
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E21G001M	Conf.	Confidential	15.34	SOLANO	Observation

05N03E21G002M
Period Of Record: 10/07/2011 to 02/25/2014

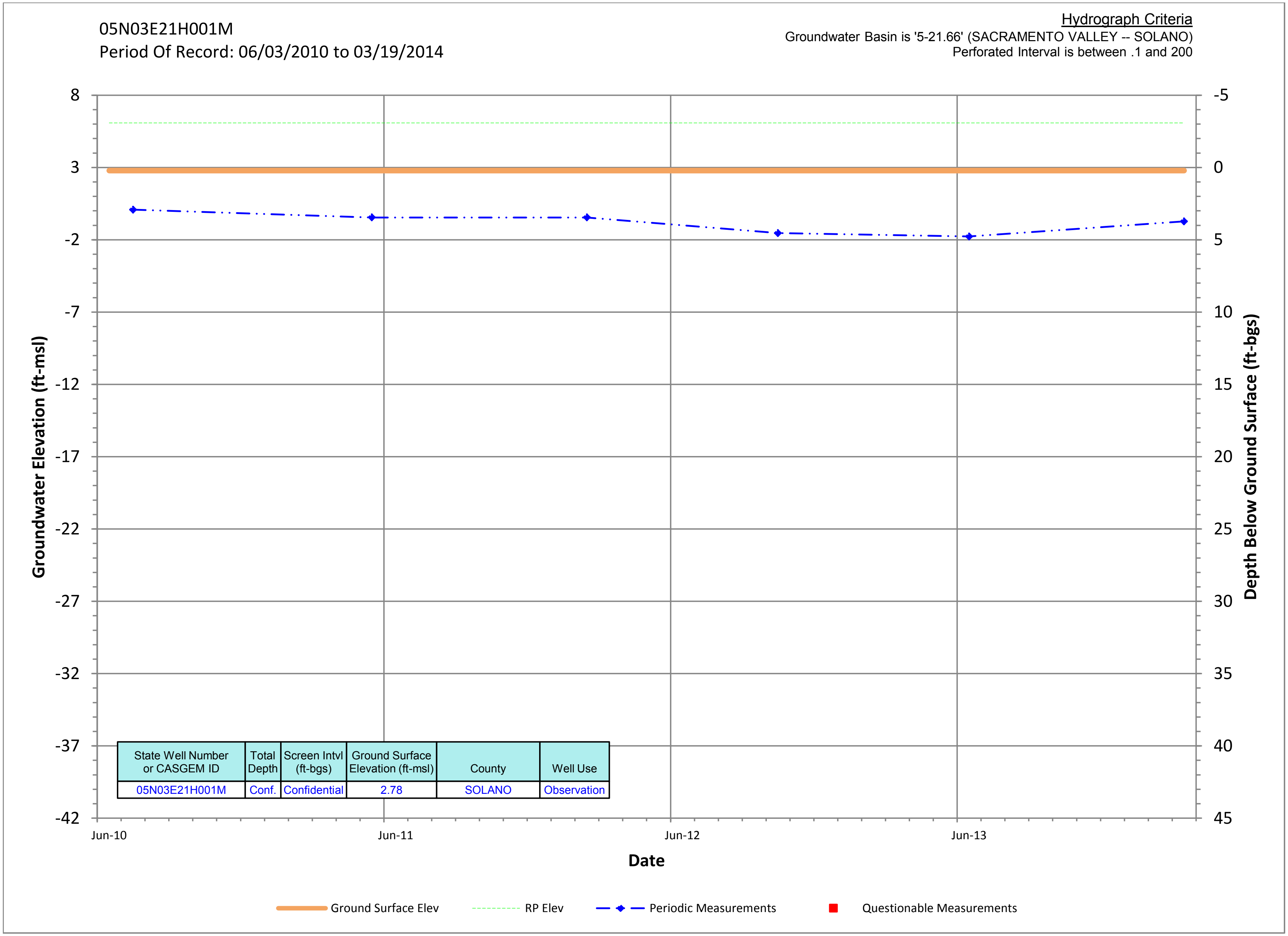
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E21G002M	Conf.	Confidential	15.33	SOLANO	Observation



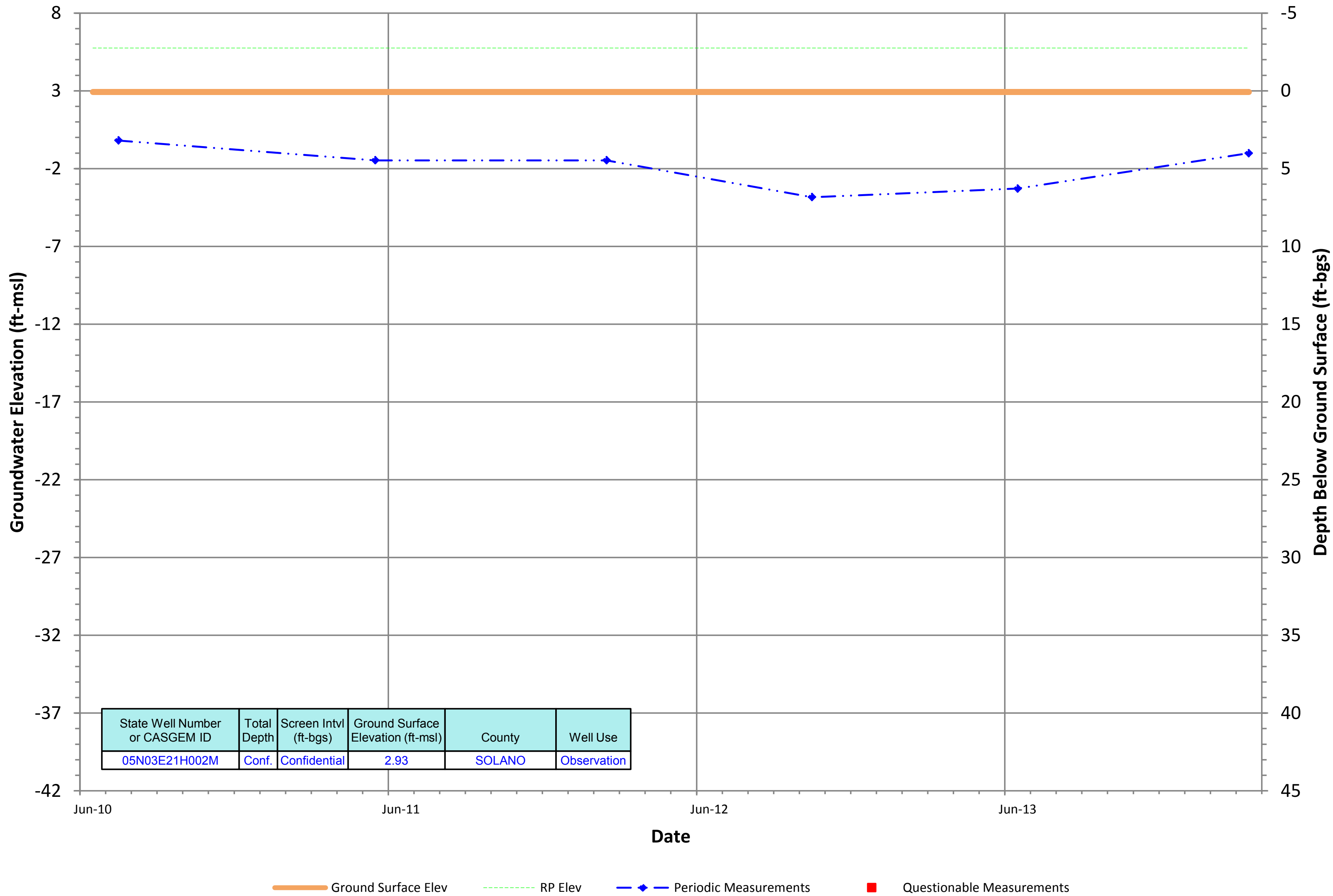
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E21G003M	Conf.	Confidential	15.33	SOLANO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E21H001M	Conf.	Confidential	2.78	SOLANO	Observation

05N03E21H002M
Period Of Record: 06/03/2010 to 03/19/2014

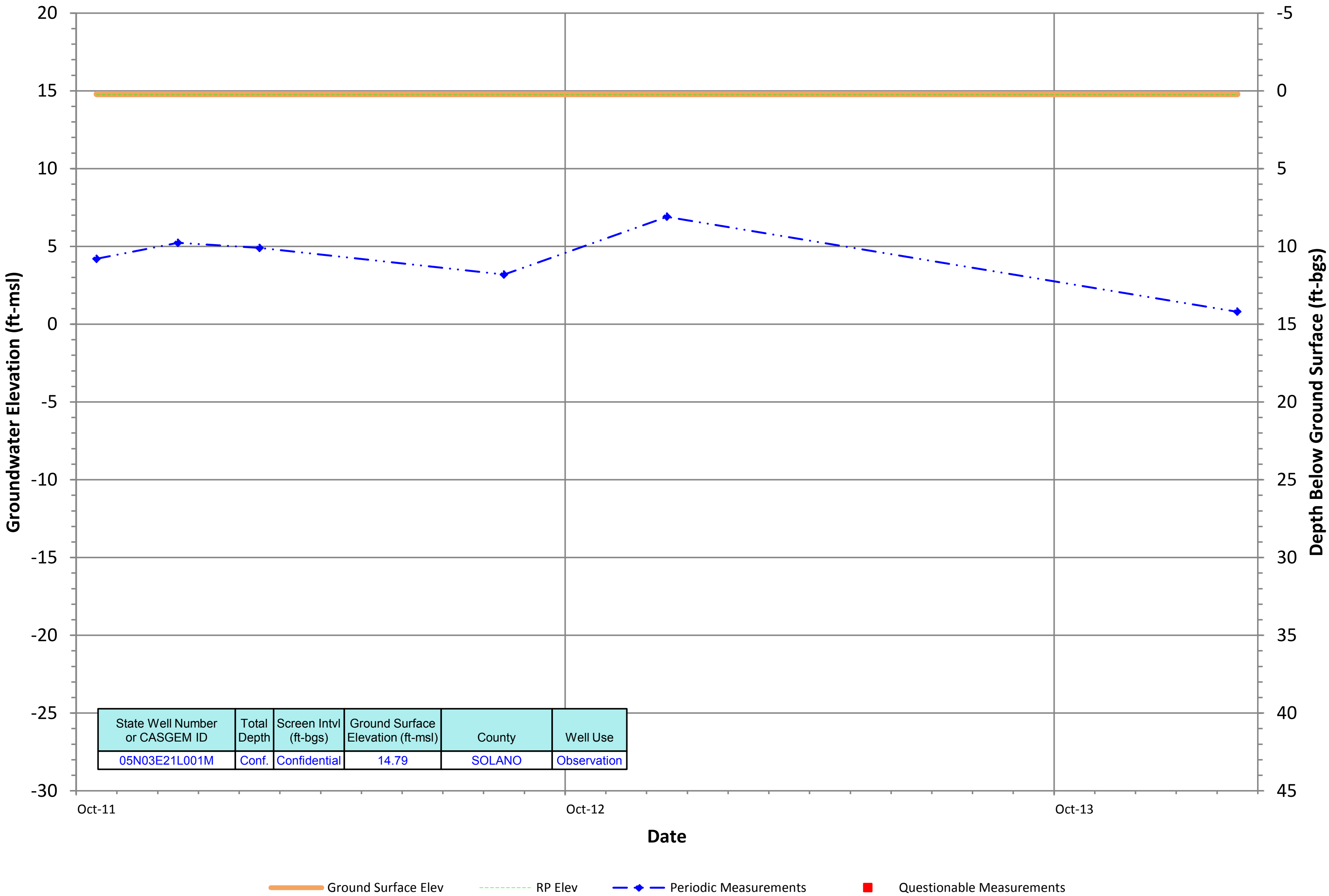
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E21H002M	Conf.	Confidential	2.93	SOLANO	Observation

05N03E21L001M
Period Of Record: 10/07/2011 to 02/25/2014

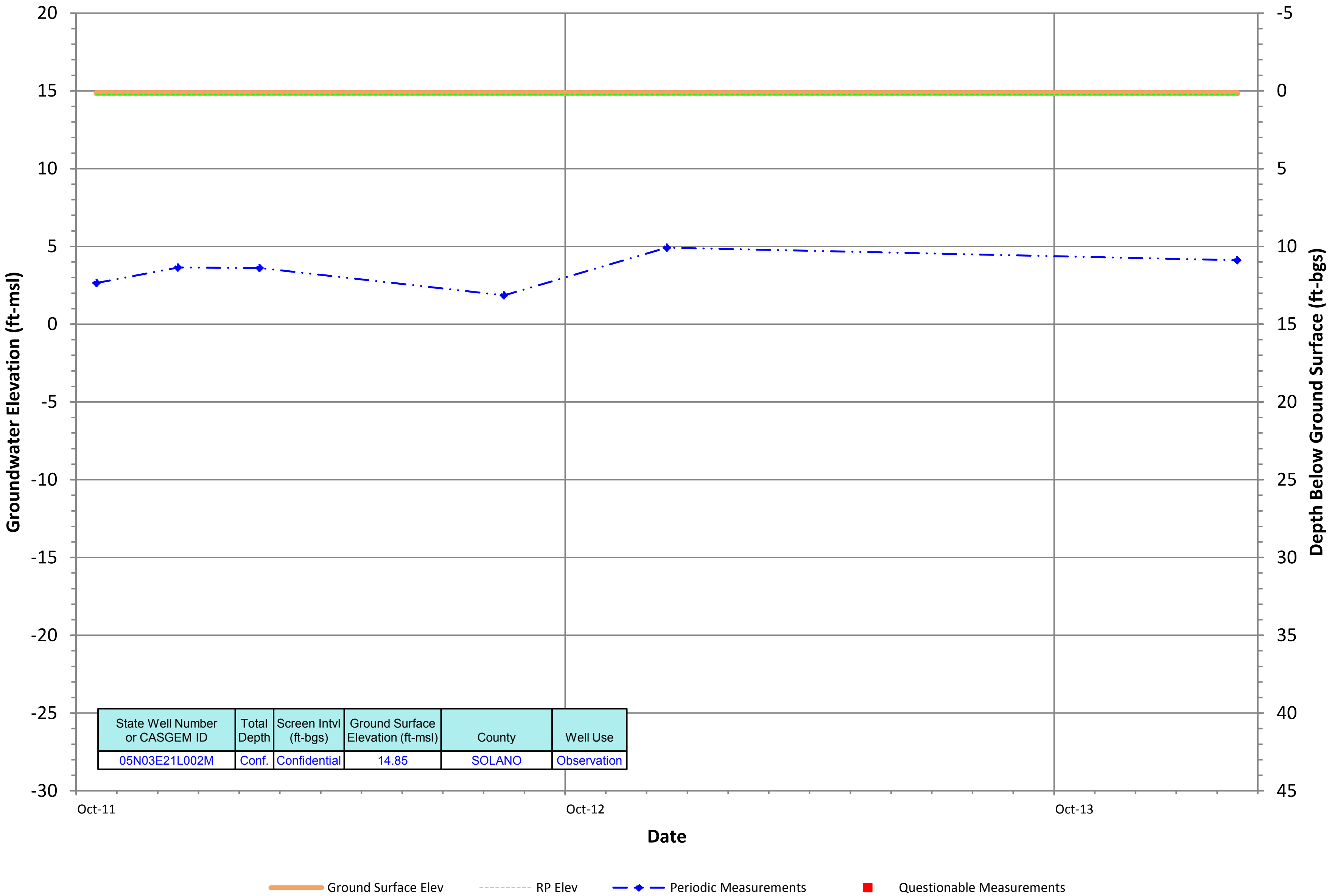
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E21L001M	Conf.	Confidential	14.79	SOLANO	Observation

05N03E21L002M
Period Of Record: 10/07/2011 to 02/25/2014

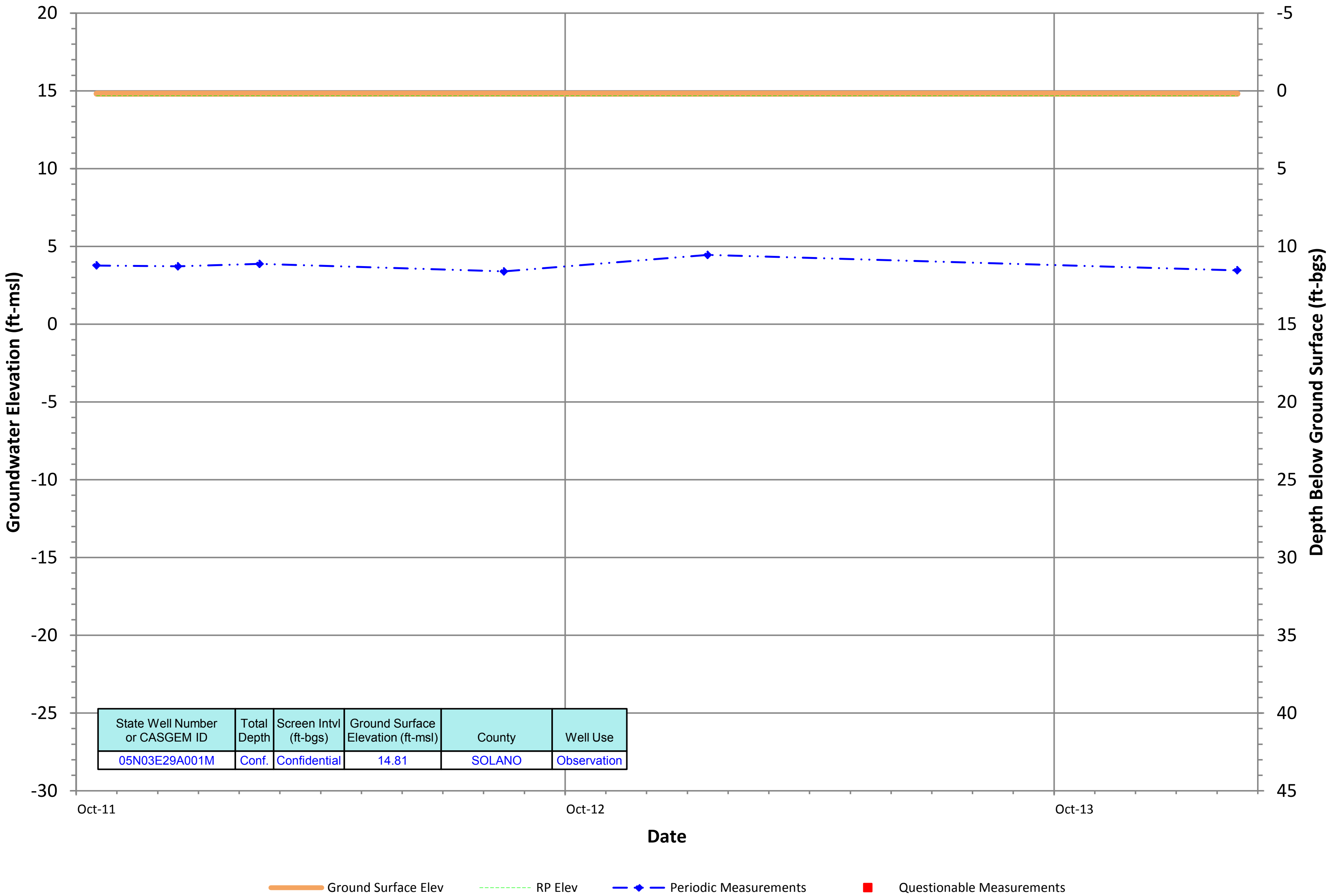
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E21L002M	Conf.	Confidential	14.85	SOLANO	Observation

05N03E29A001M
Period Of Record: 10/07/2011 to 02/25/2014

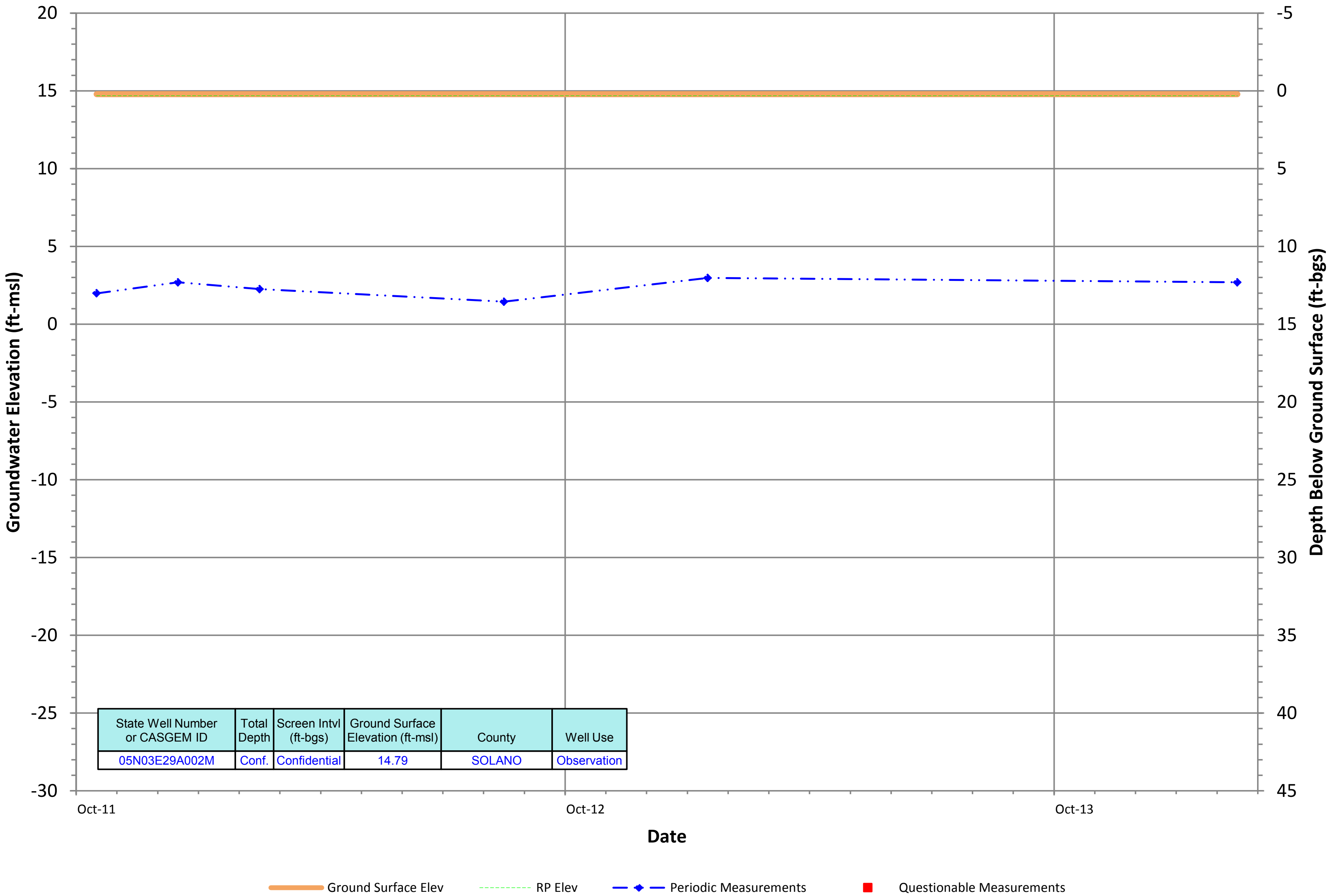
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E29A001M	Conf.	Confidential	14.81	SOLANO	Observation

05N03E29A002M
Period Of Record: 10/07/2011 to 02/25/2014

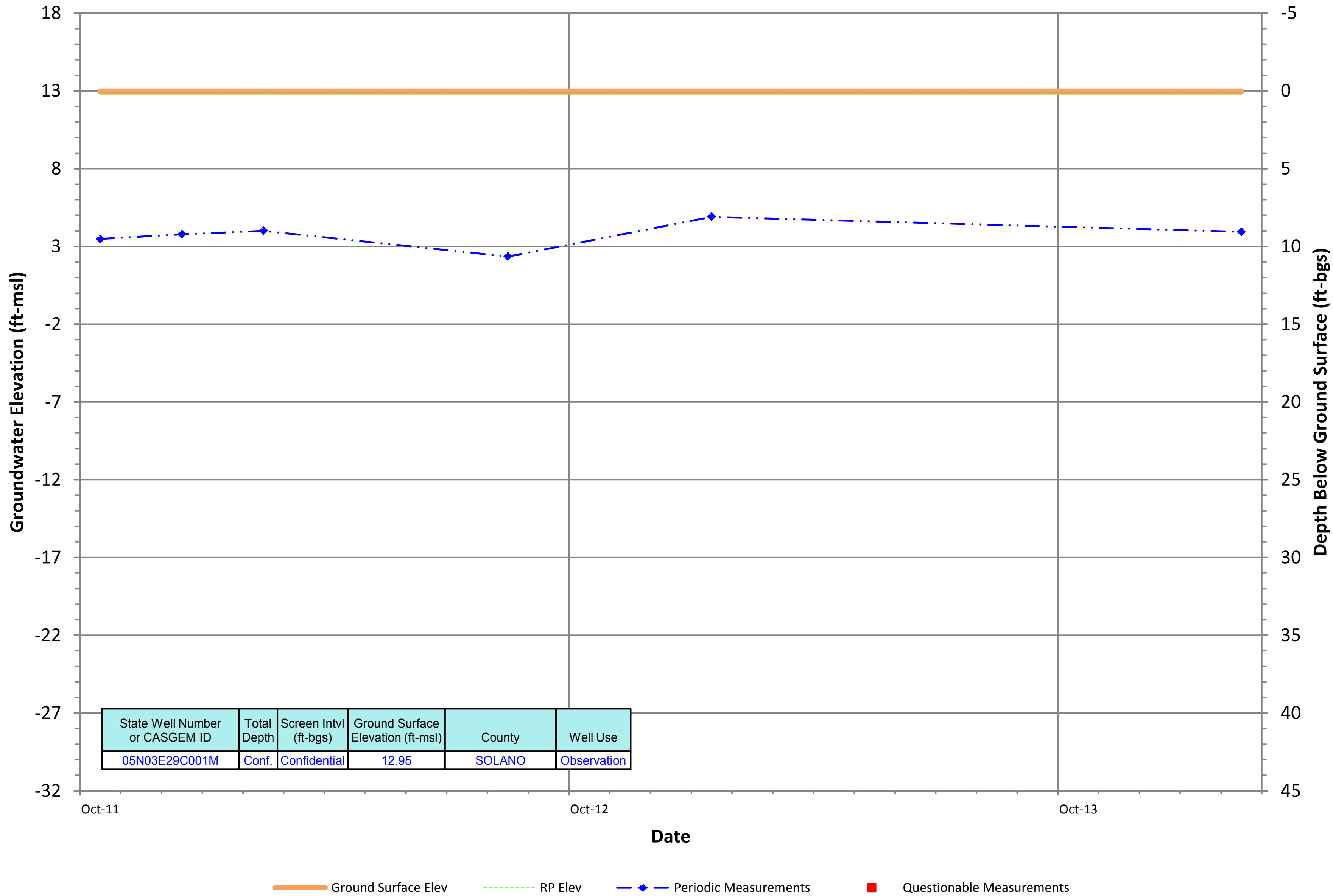
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E29A002M	Conf.	Confidential	14.79	SOLANO	Observation

05N03E29C001M
Period Of Record: 10/07/2011 to 02/25/2014

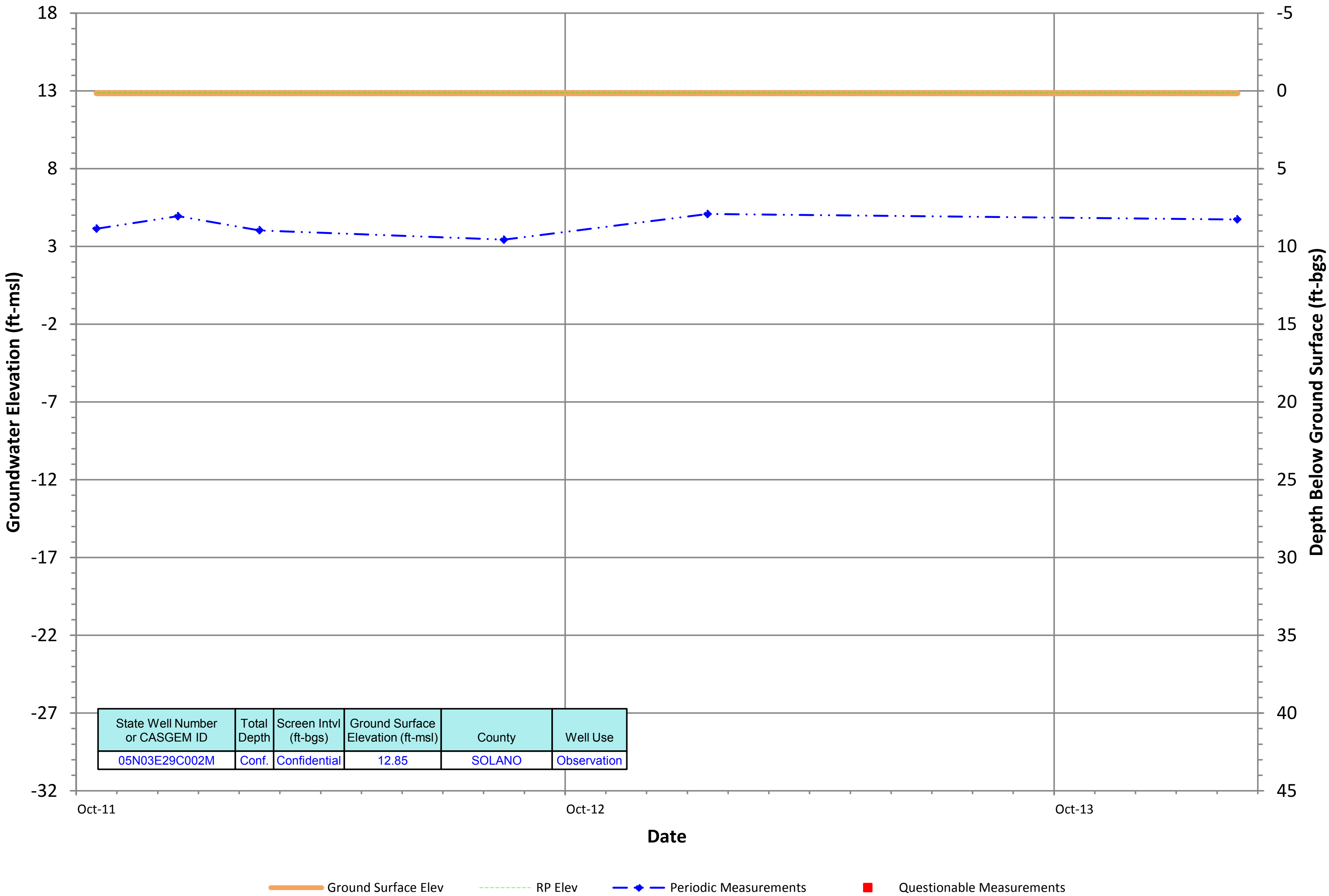
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E29C001M	Conf.	Confidential	12.95	SOLANO	Observation

05N03E29C002M
Period Of Record: 10/07/2011 to 02/25/2014

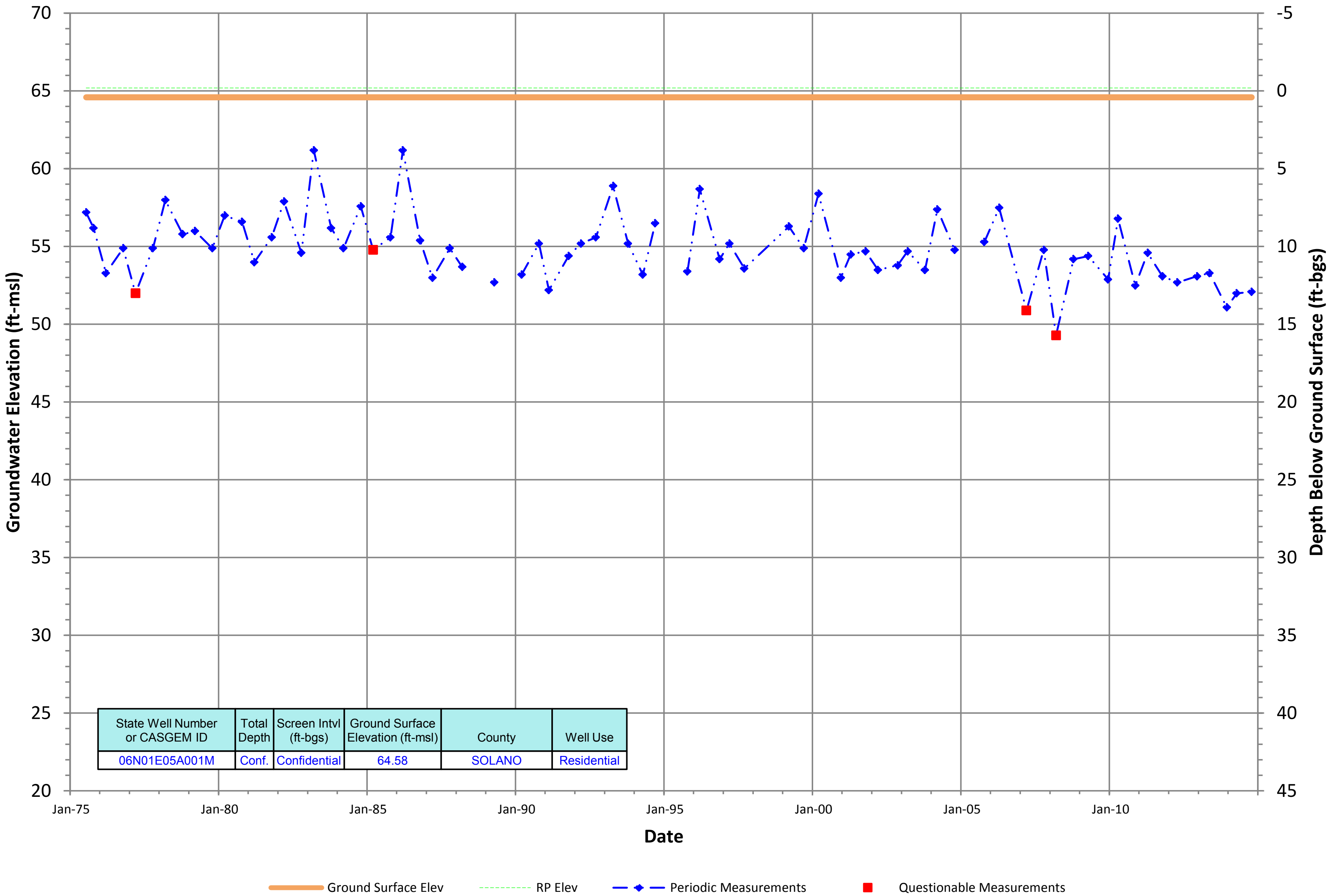
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N03E29C002M	Conf.	Confidential	12.85	SOLANO	Observation

06N01E05A001M
Period Of Record: 07/24/1975 to 10/29/2014

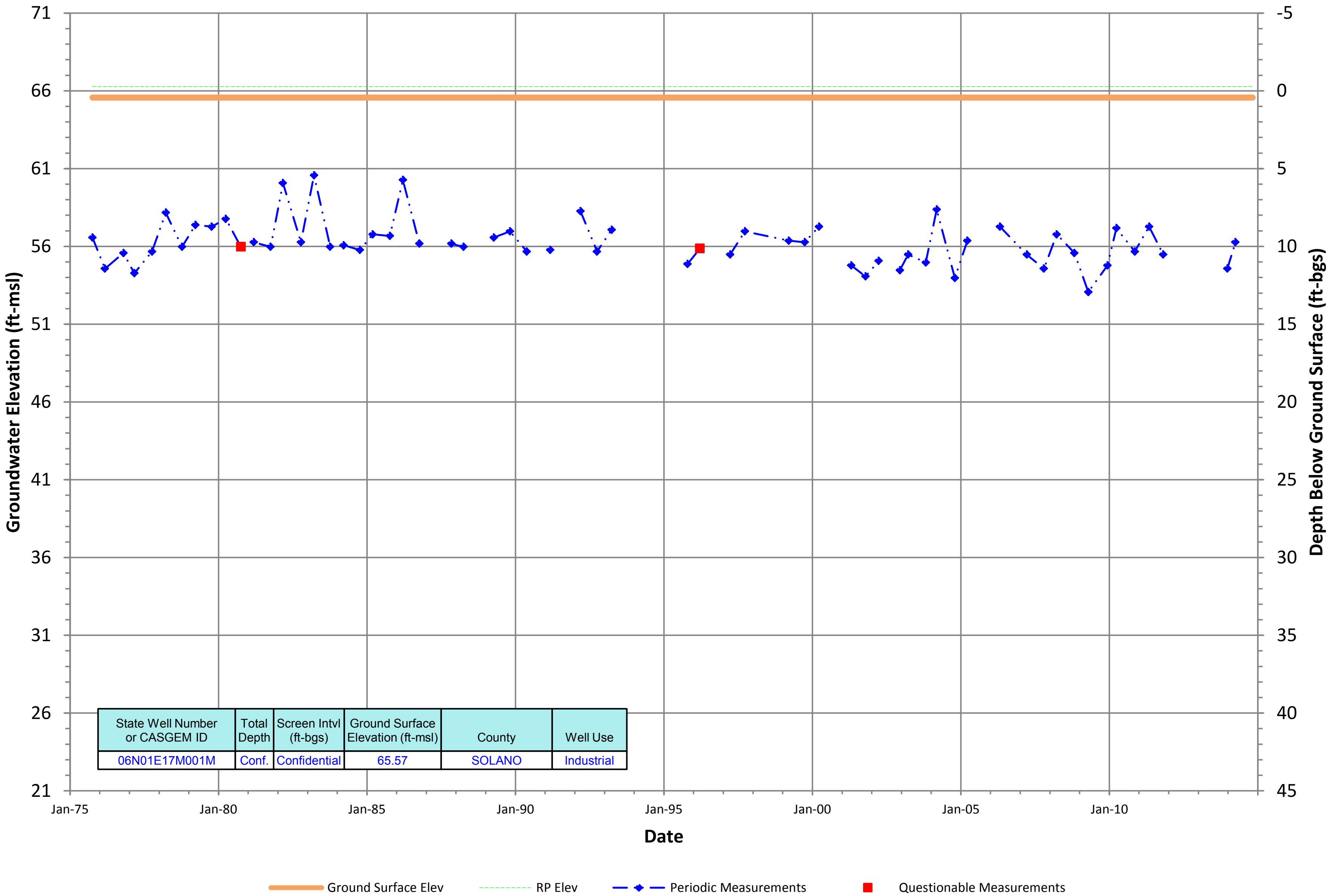
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E05A001M	Conf.	Confidential	64.58	SOLANO	Residential

06N01E17M001M
Period Of Record: 10/03/1975 to 10/29/2014

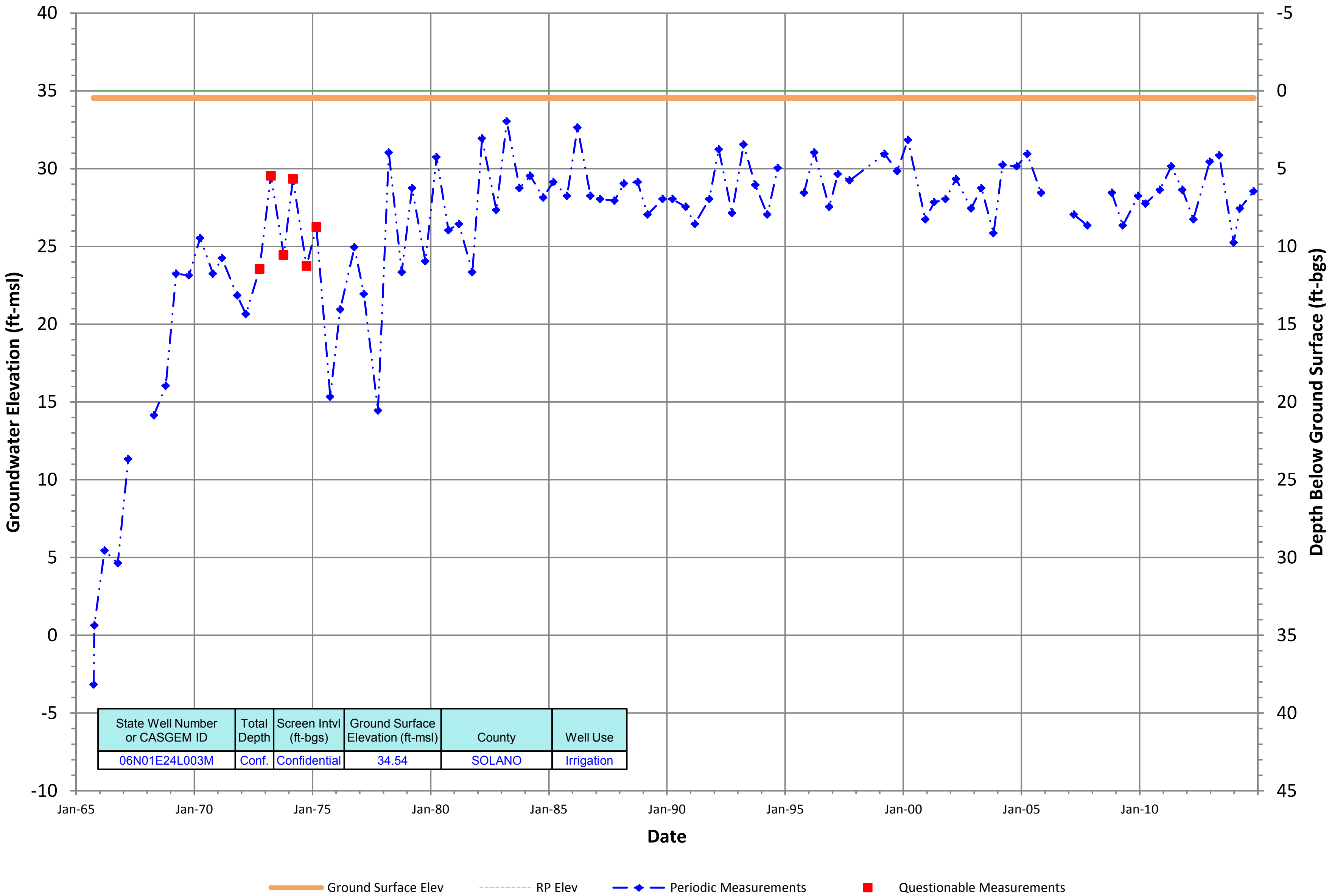
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E17M001M	Conf.	Confidential	65.57	SOLANO	Industrial

06N01E24L003M
Period Of Record: 09/28/1965 to 10/29/2014

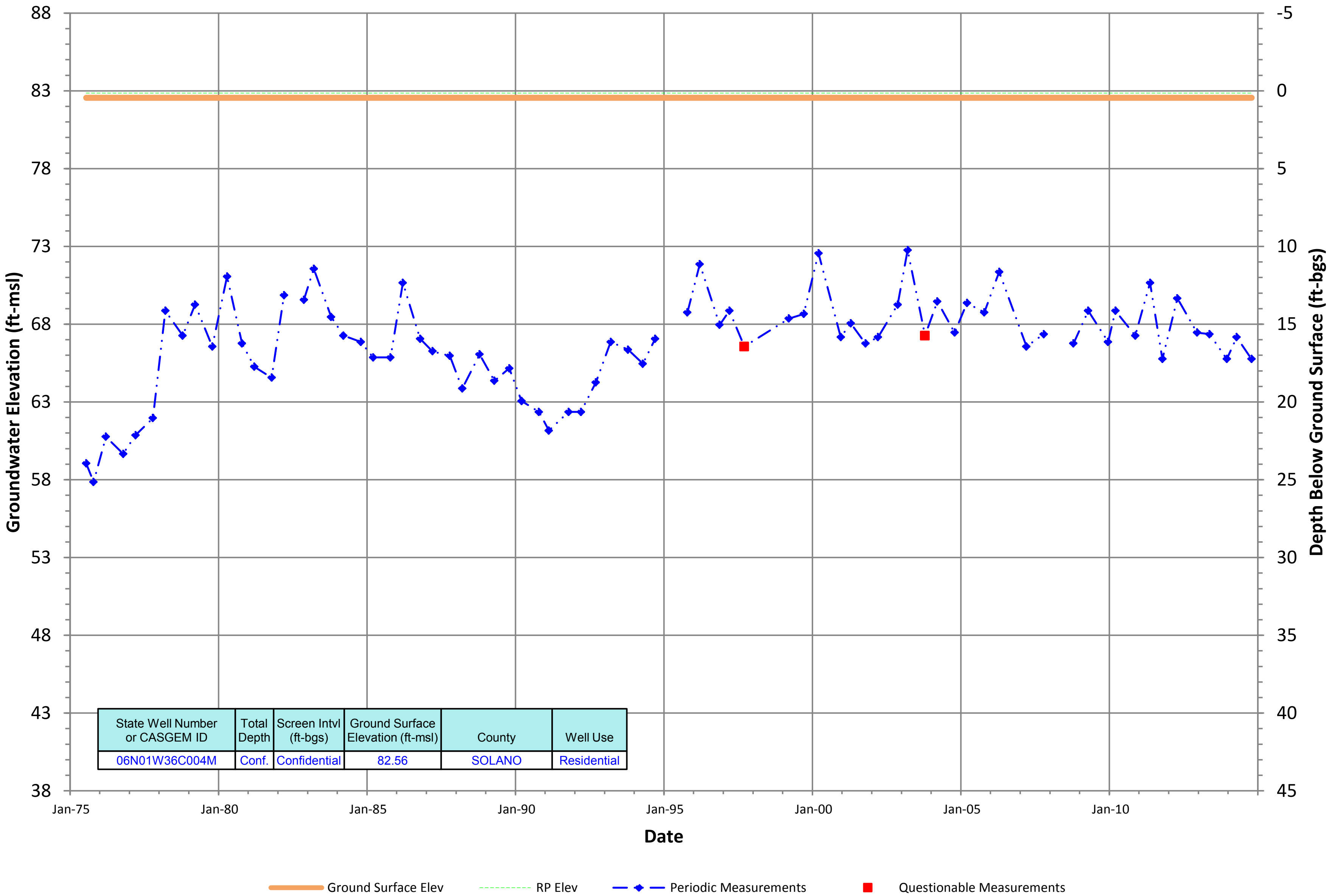
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



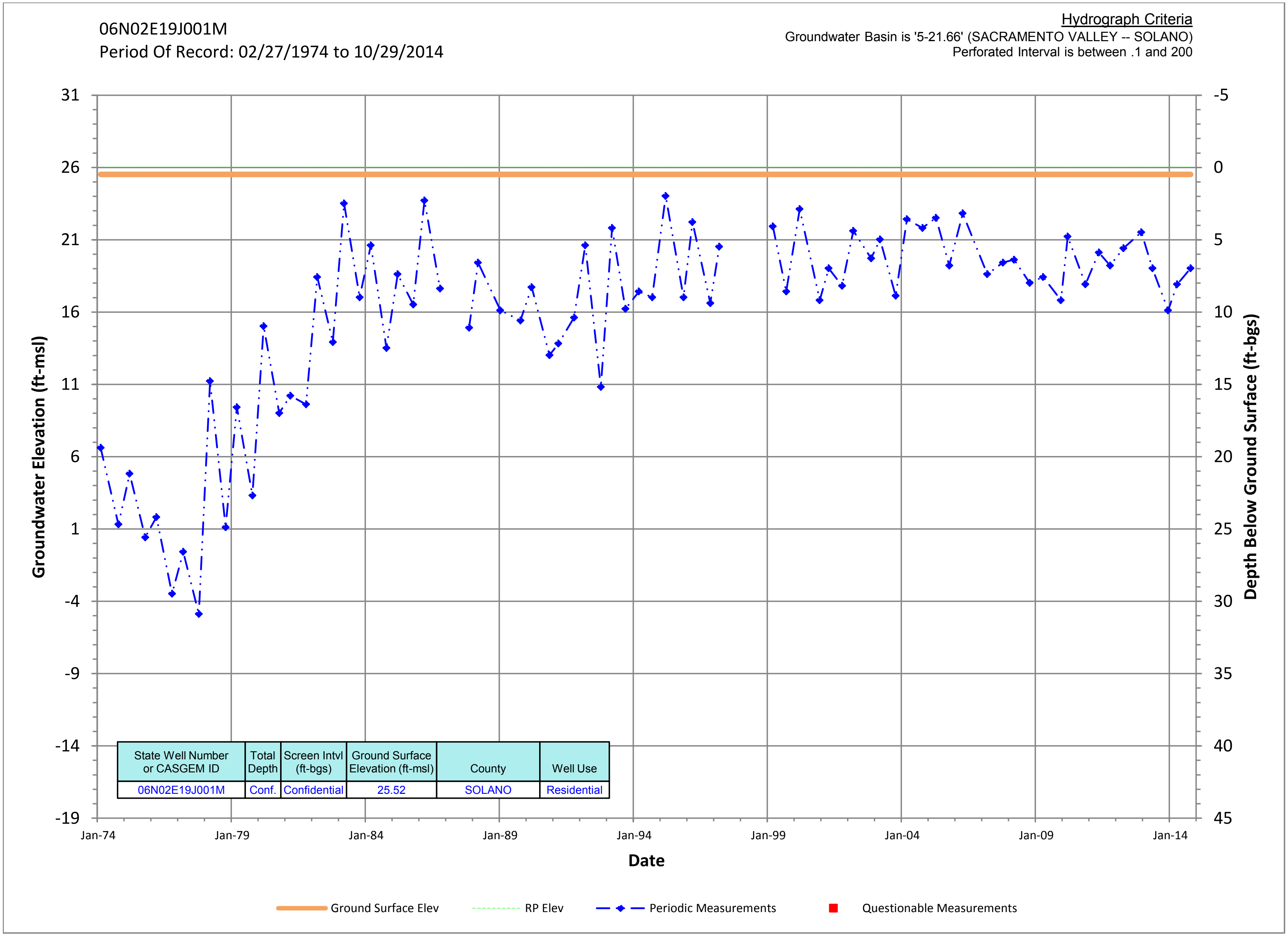
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E24L003M	Conf.	Confidential	34.54	SOLANO	Irrigation

06N01W36C004M
Period Of Record: 07/30/1975 to 10/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



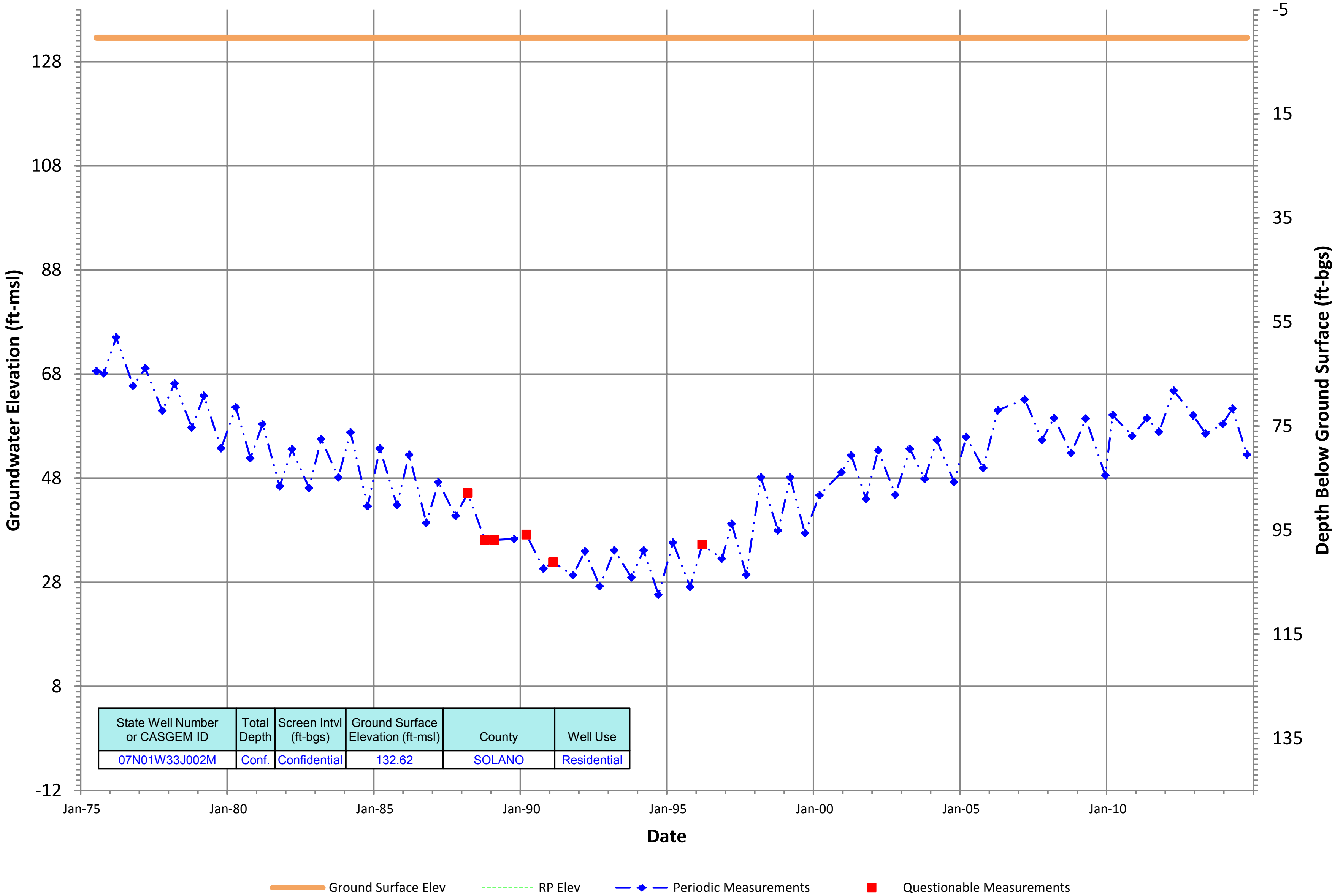
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01W36C004M	Conf.	Confidential	82.56	SOLANO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N02E19J001M	Conf.	Confidential	25.52	SOLANO	Residential

07N01W33J002M
Period Of Record: 07/17/1975 to 10/29/2014

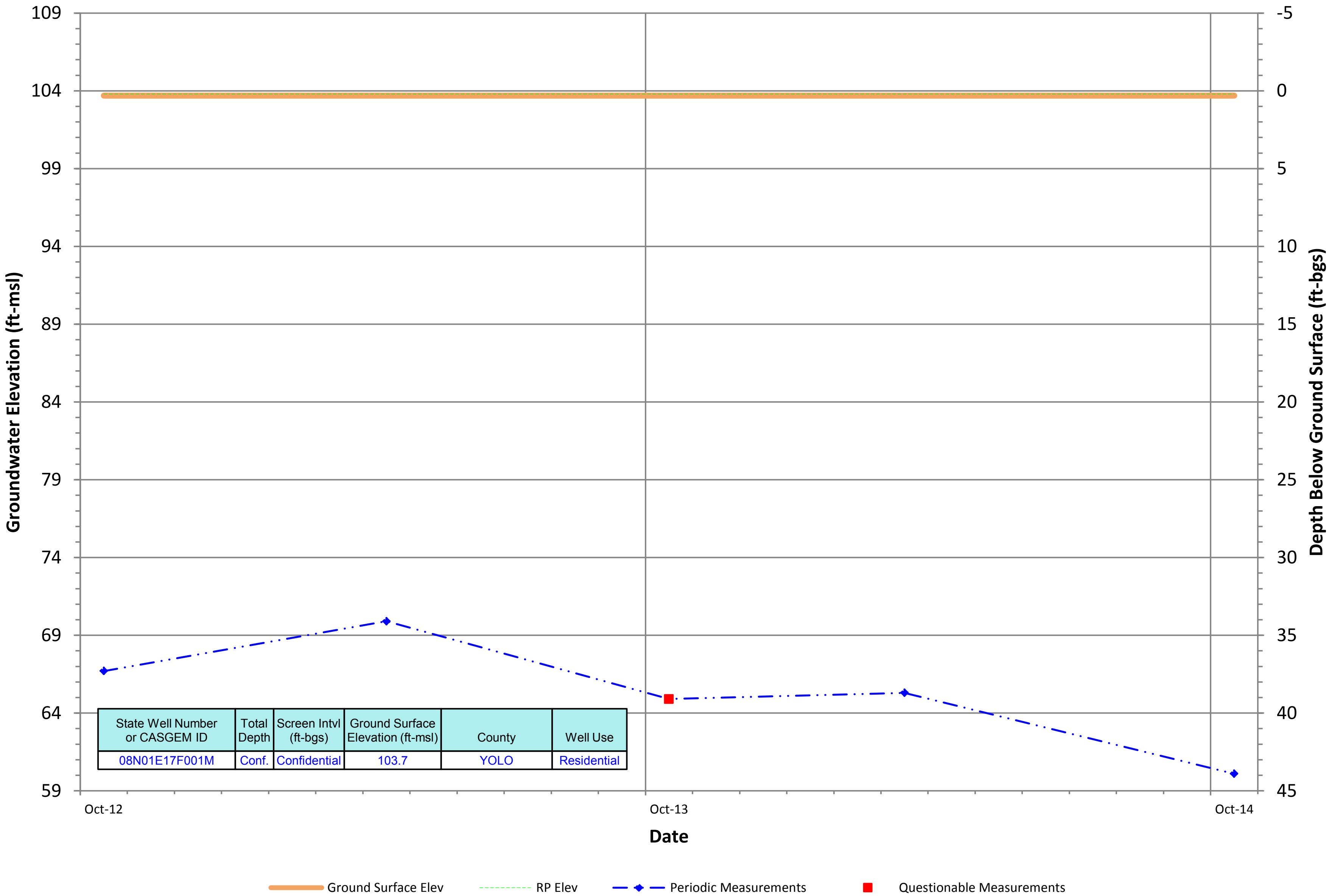
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01W33J002M	Conf.	Confidential	132.62	SOLANO	Residential

08N01E17F001M
Period Of Record: 10/25/2012 to 10/08/2014

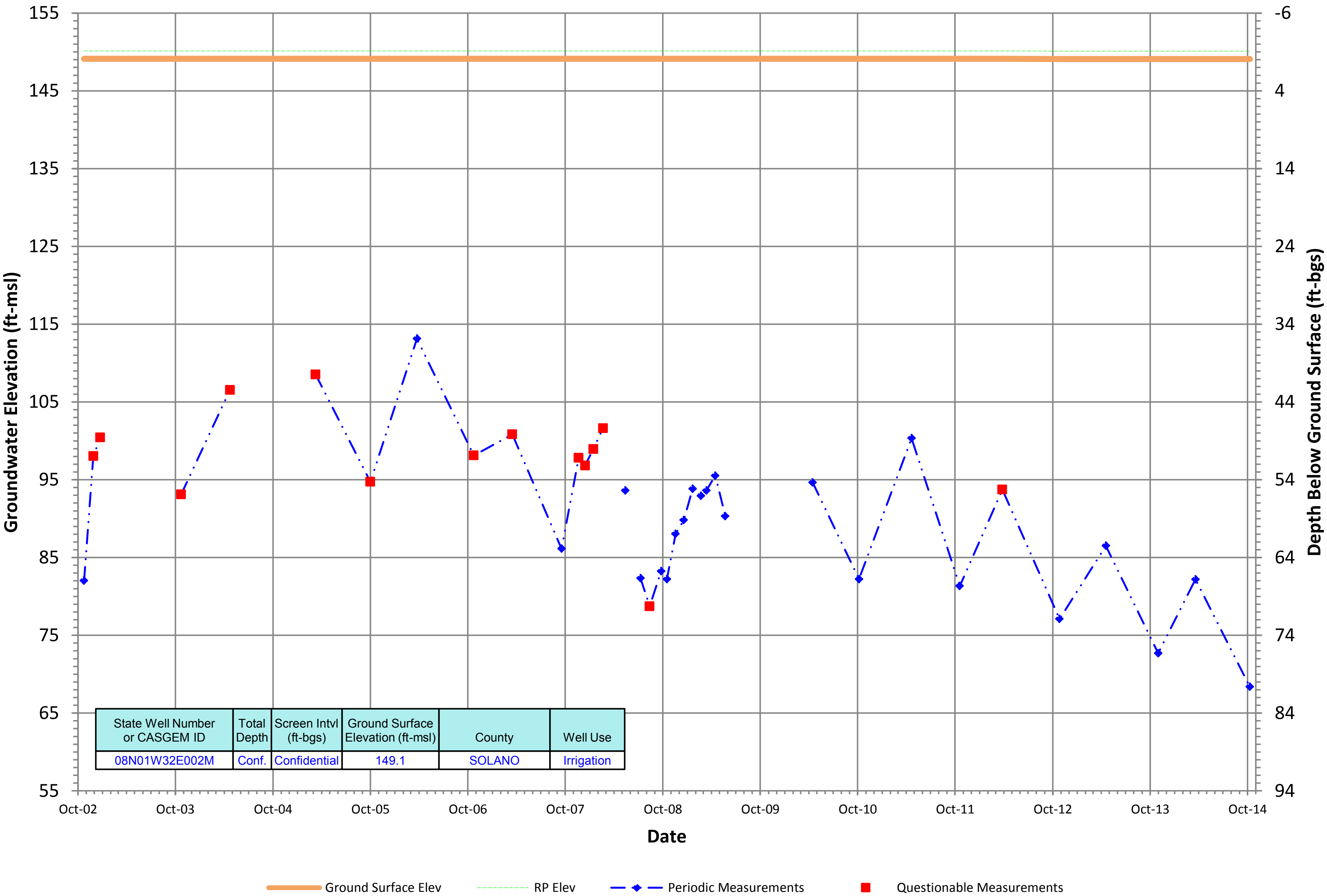
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E17F001M	Conf.	Confidential	103.7	YOLO	Residential

08N01W32E002M
Period Of Record: 10/23/2002 to 10/09/2014

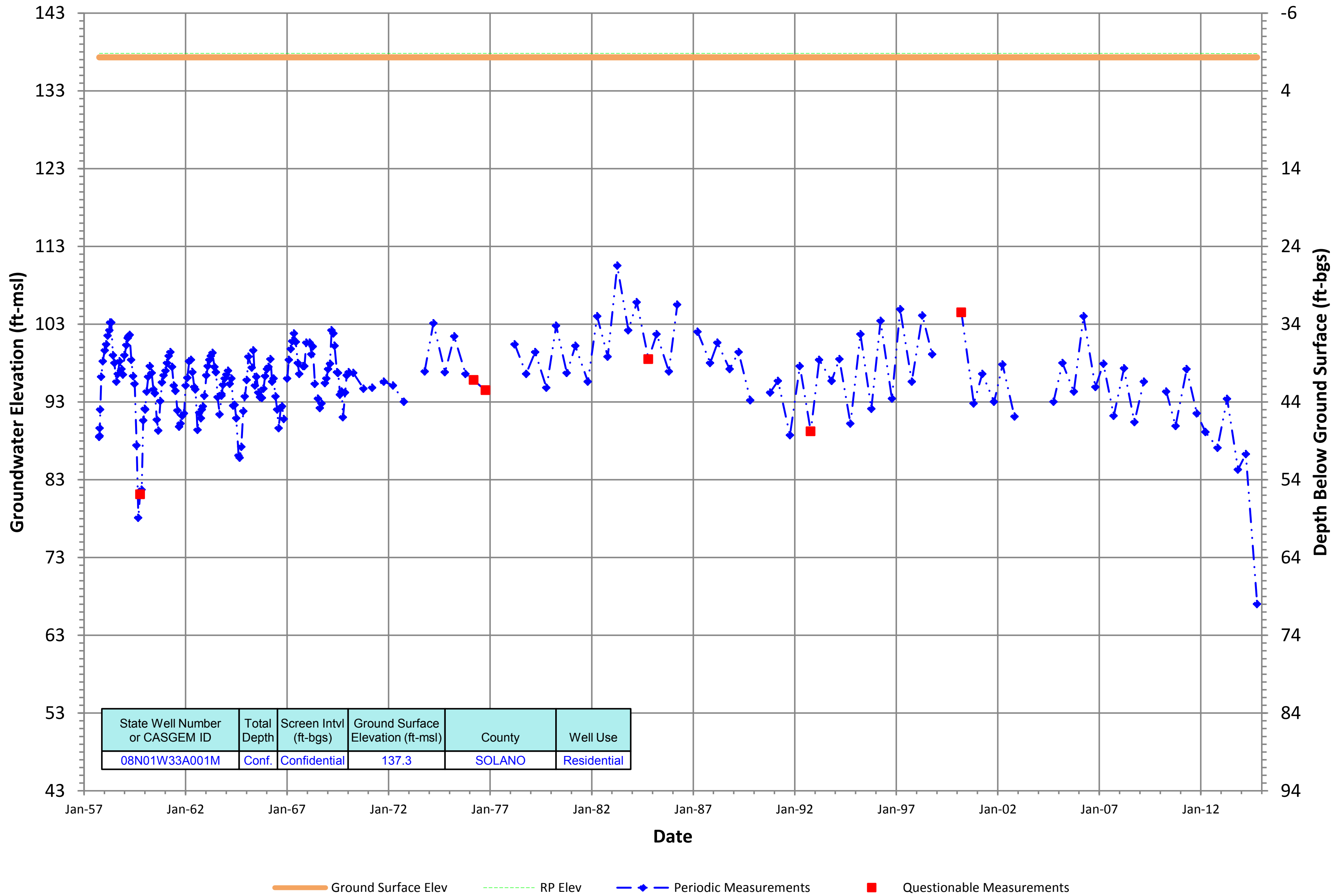
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W32E002M	Conf.	Confidential	149.1	SOLANO	Irrigation

08N01W33A001M
Period Of Record: 10/02/1957 to 10/09/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Perforated Interval is between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W33A001M	Conf.	Confidential	137.3	SOLANO	Residential

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Intermediate Depth Groundwater Monitoring Well Hydrographs- Solano Subbasin

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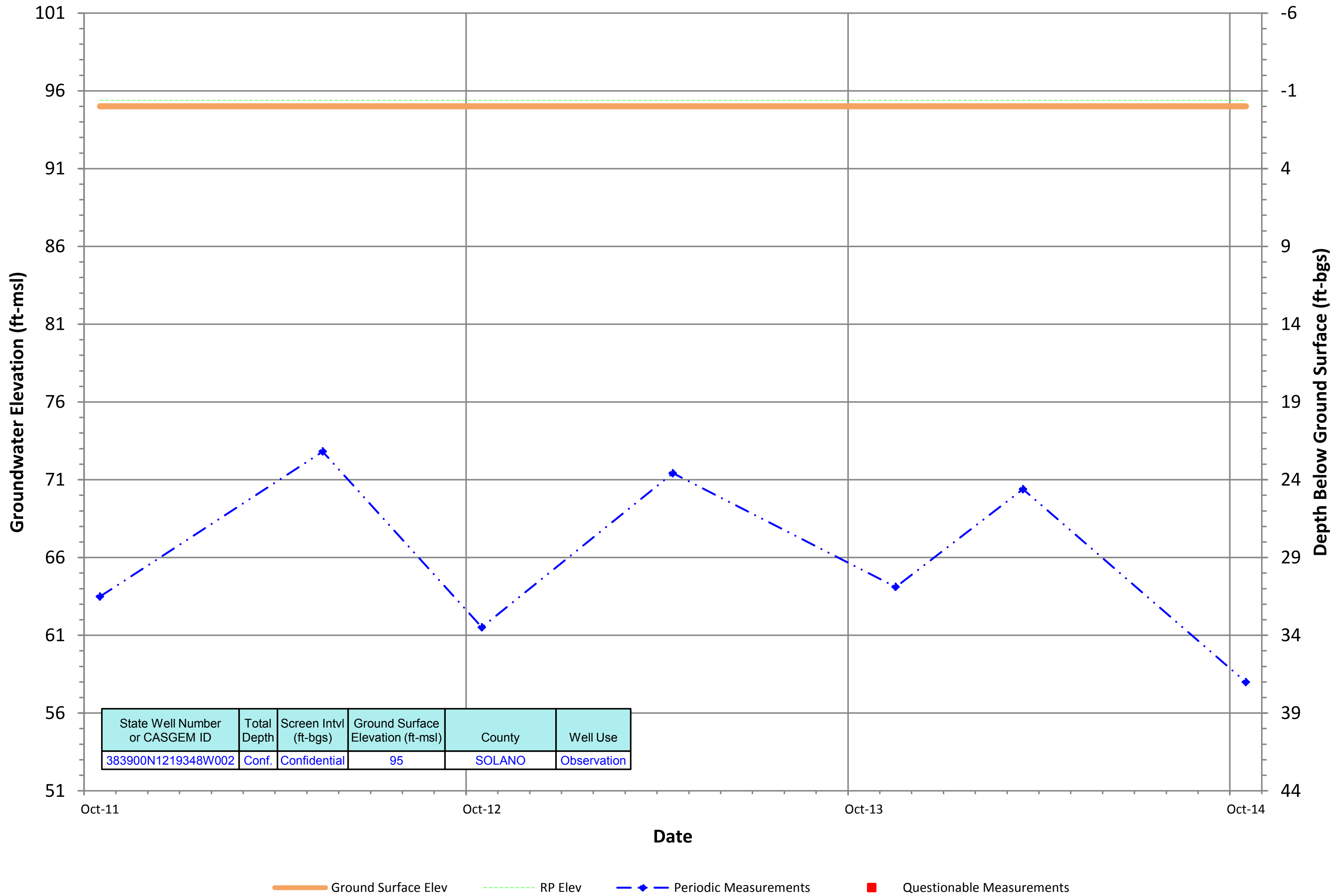
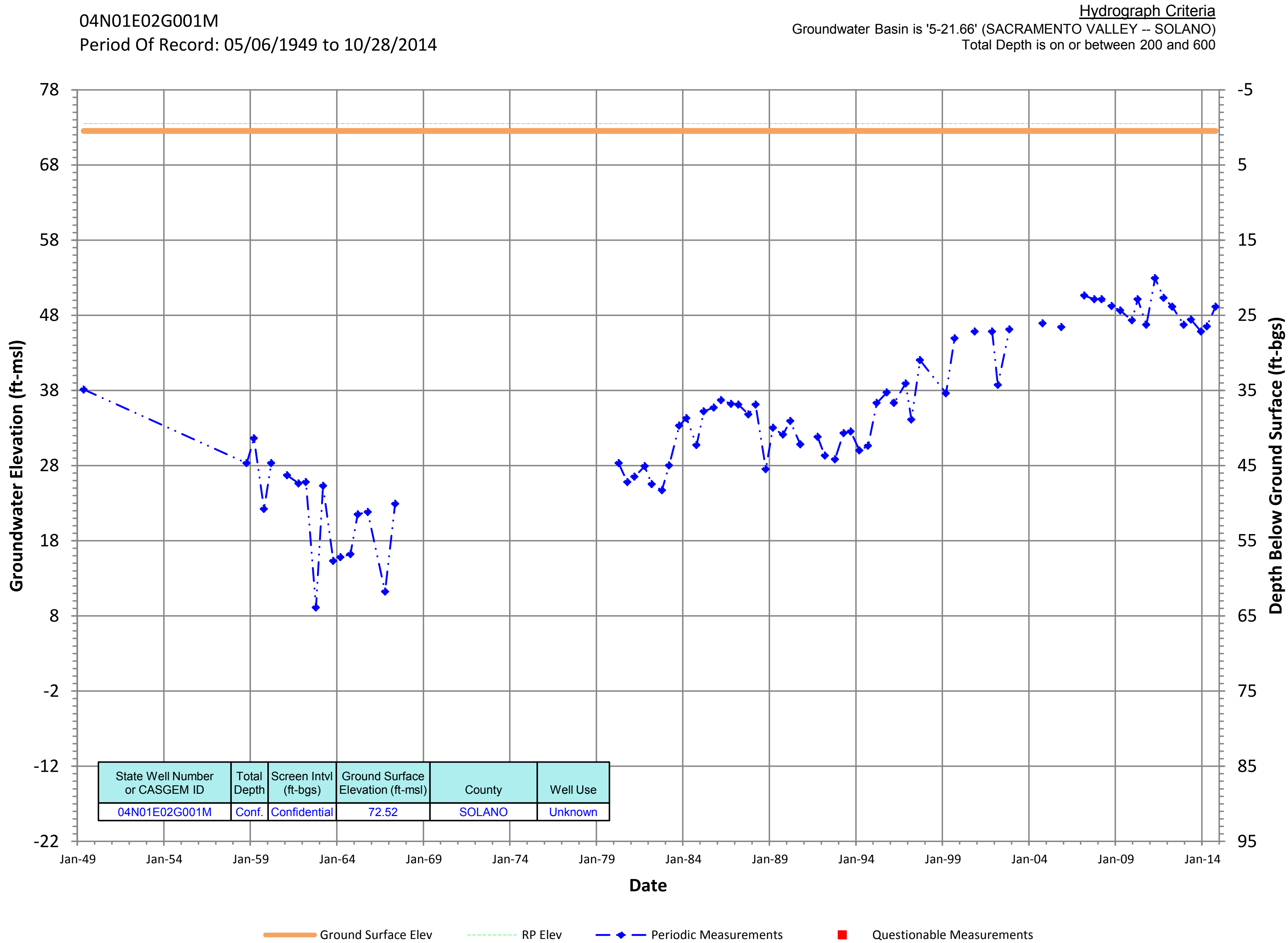
383900N1219348W002
Period Of Record: 10/24/2011 to 10/07/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600

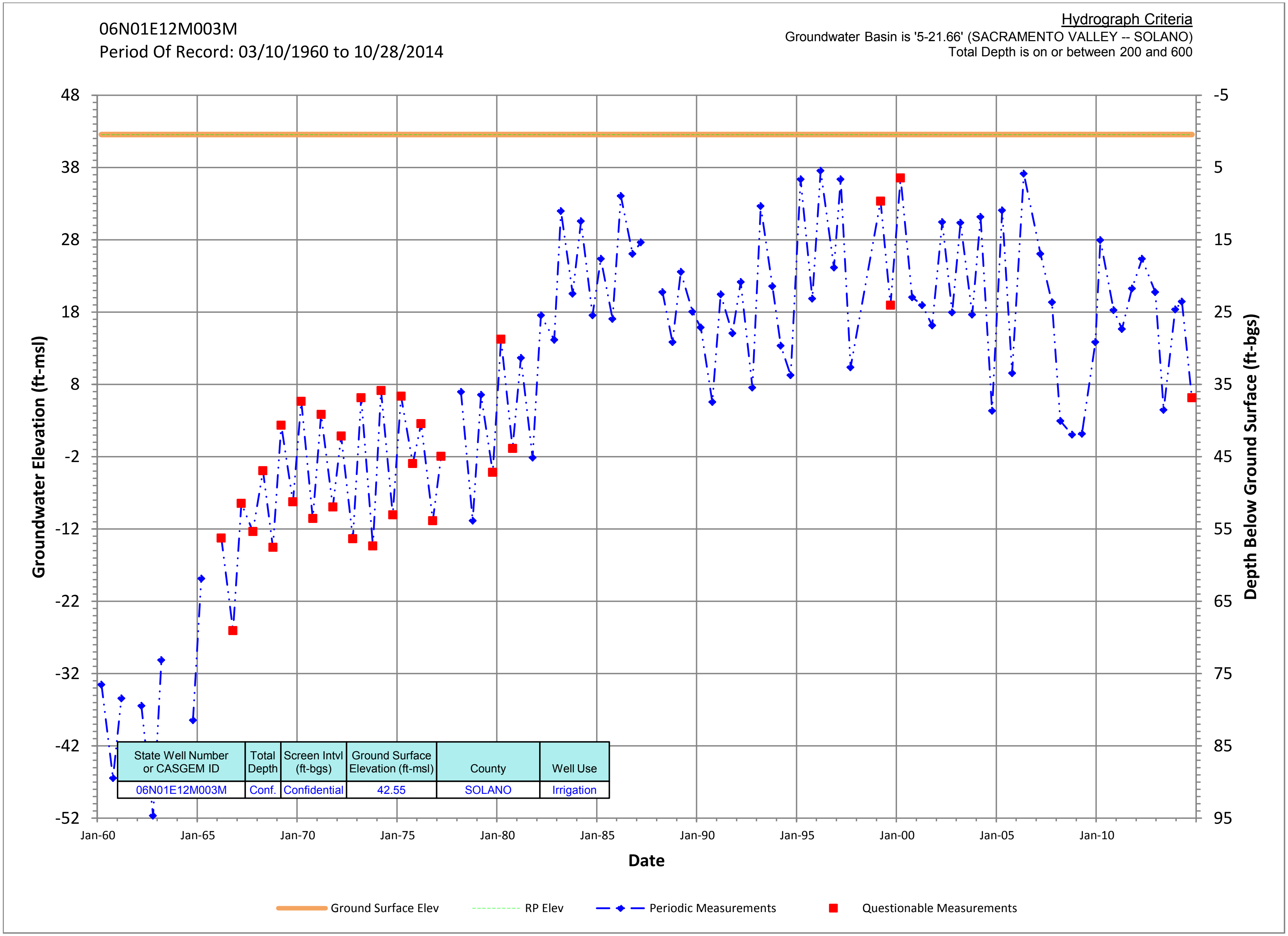


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
383900N1219348W002	Conf.	Confidential	95	SOLANO	Observation

04N01E02G001M
Period Of Record: 05/06/1949 to 10/28/2014



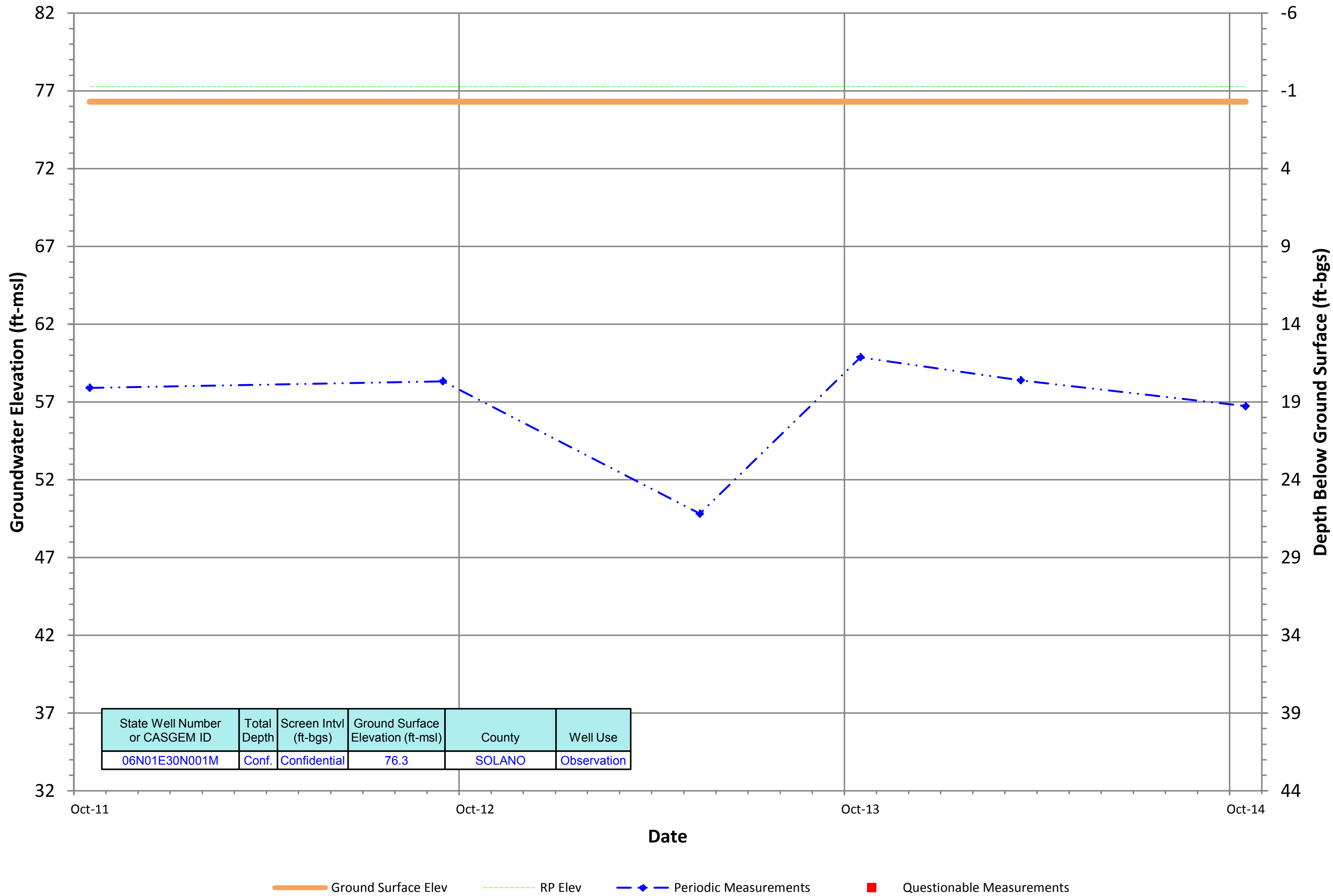
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
04N01E02G001M	Conf.	Confidential	72.52	SOLANO	Unknown



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E12M003M	Conf.	Confidential	42.55	SOLANO	Irrigation

06N01E30N001M
Period Of Record: 10/24/2011 to 10/14/2014

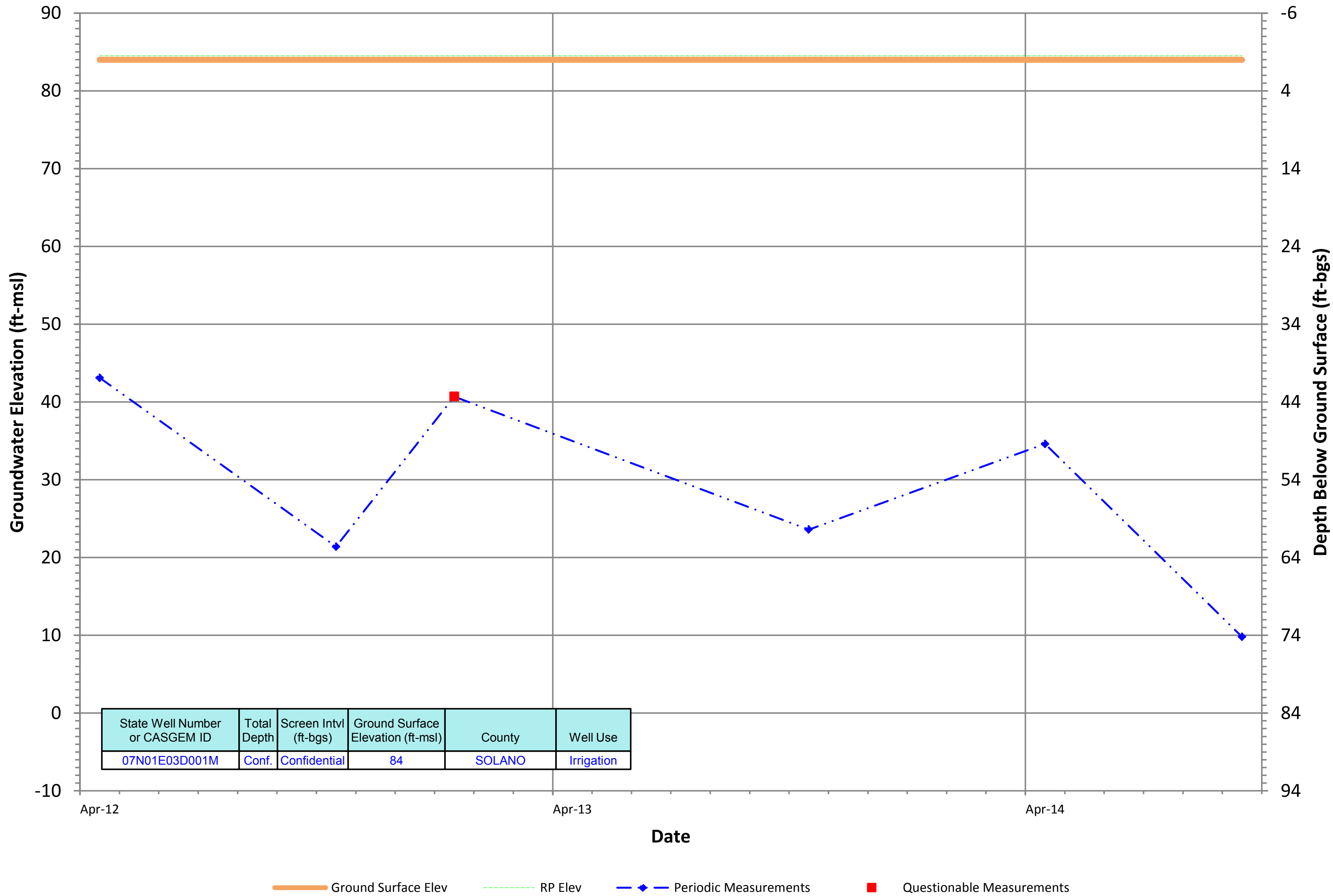
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E30N001M	Conf.	Confidential	76.3	SOLANO	Observation

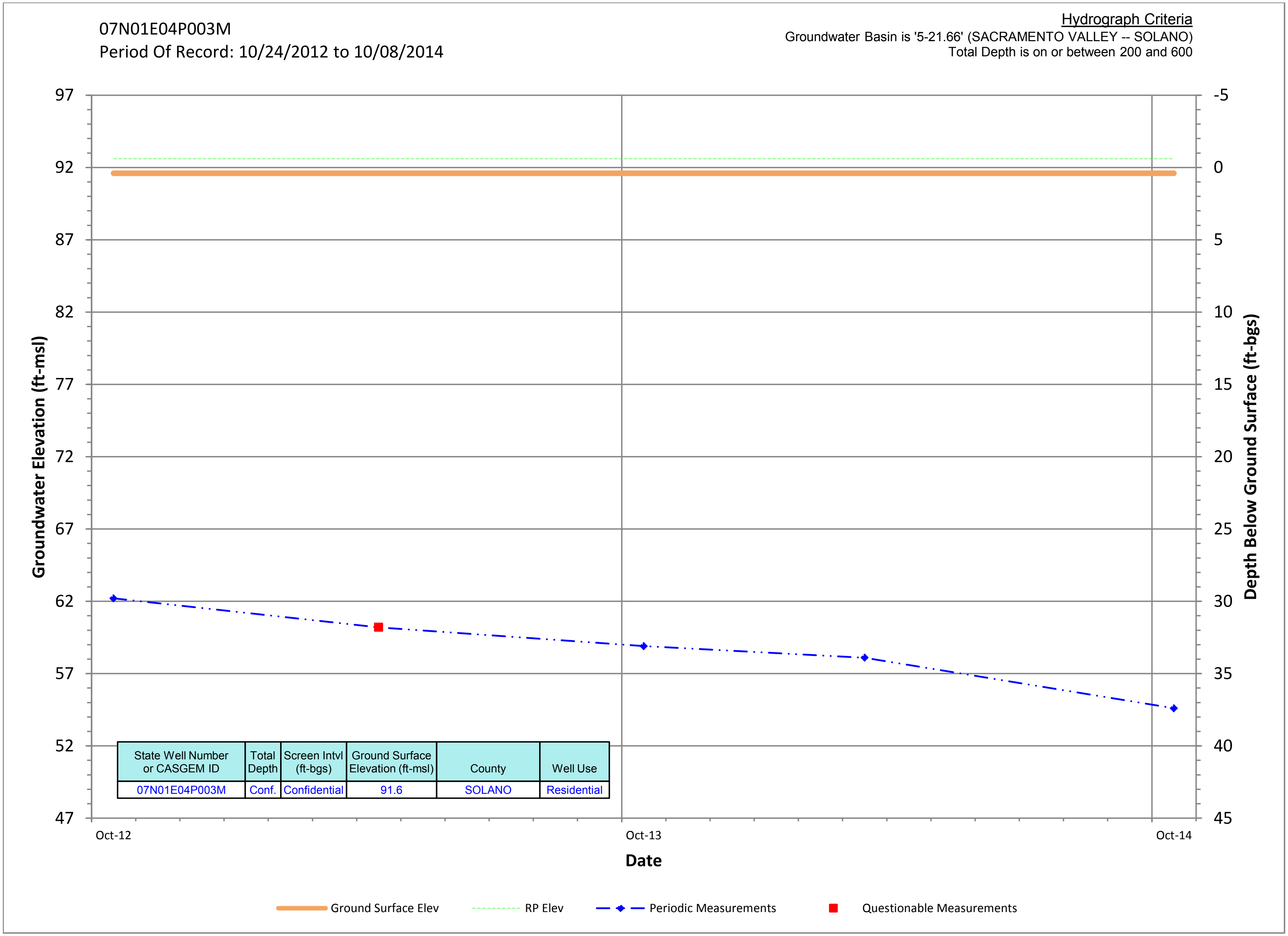
07N01E03D001M
Period Of Record: 04/02/2012 to 09/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E03D001M	Conf.	Confidential	84	SOLANO	Irrigation

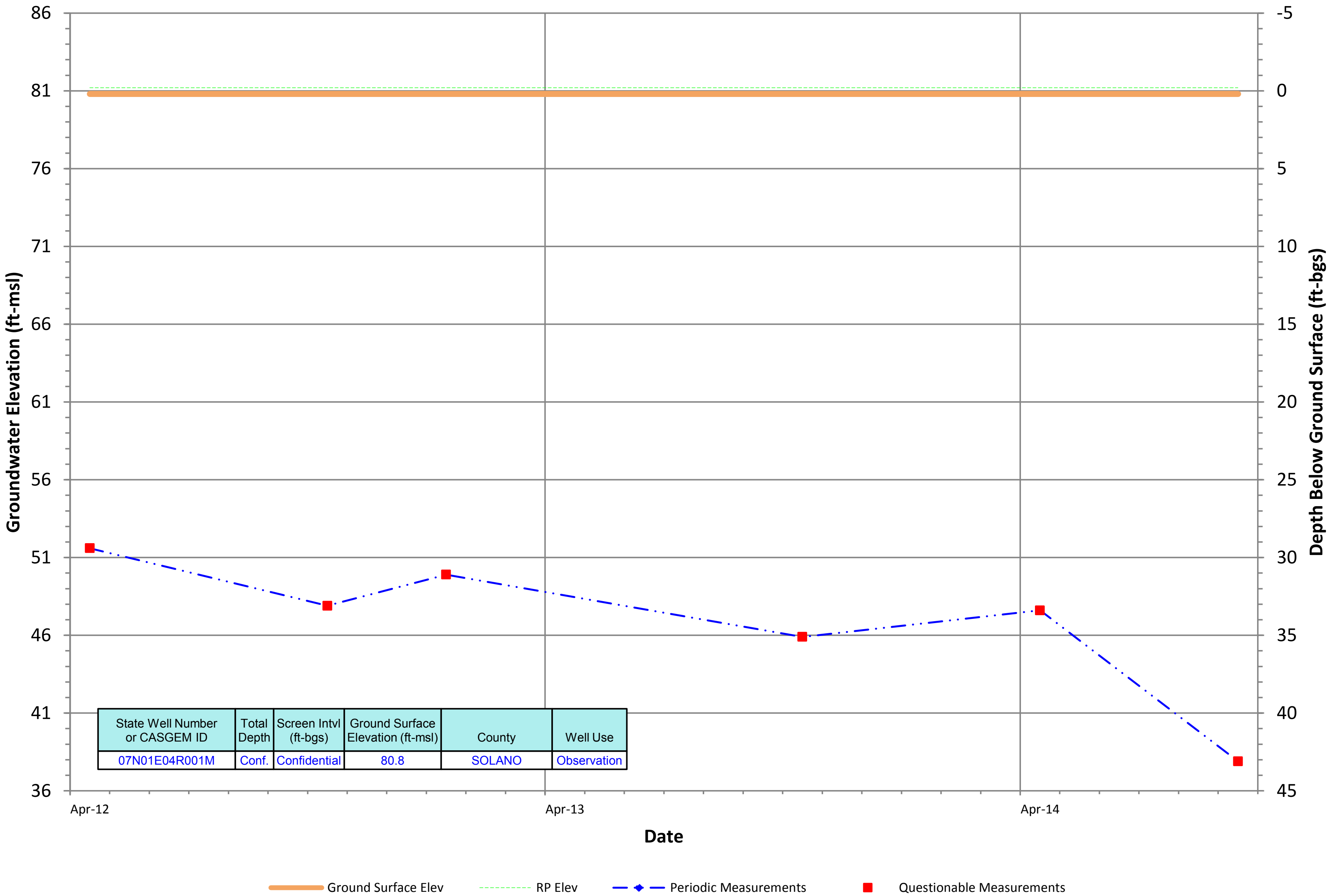
07N01E04P003M
Period Of Record: 10/24/2012 to 10/08/2014



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E04P003M	Conf.	Confidential	91.6	SOLANO	Residential

07N01E04R001M
Period Of Record: 04/02/2012 to 09/29/2014

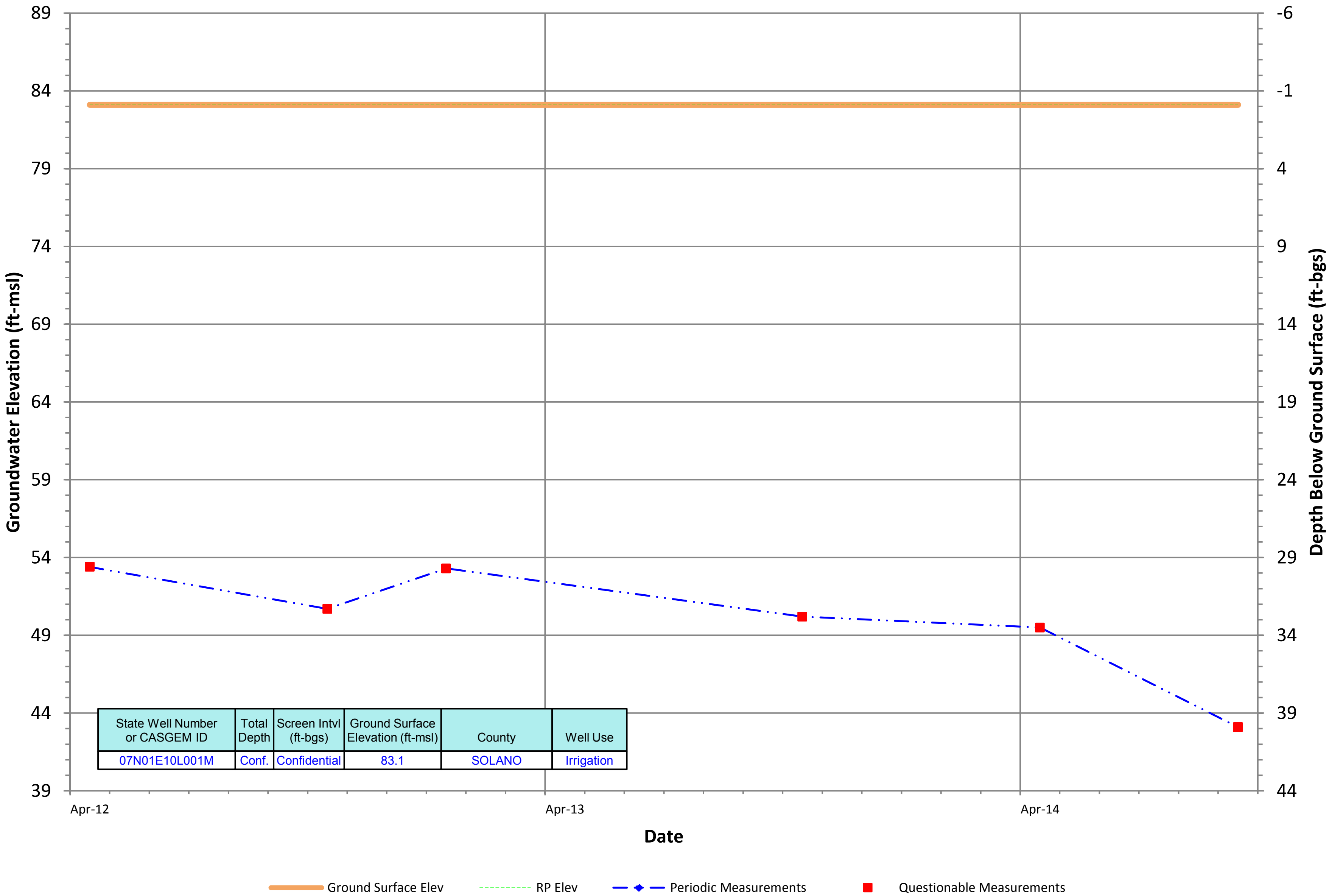
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



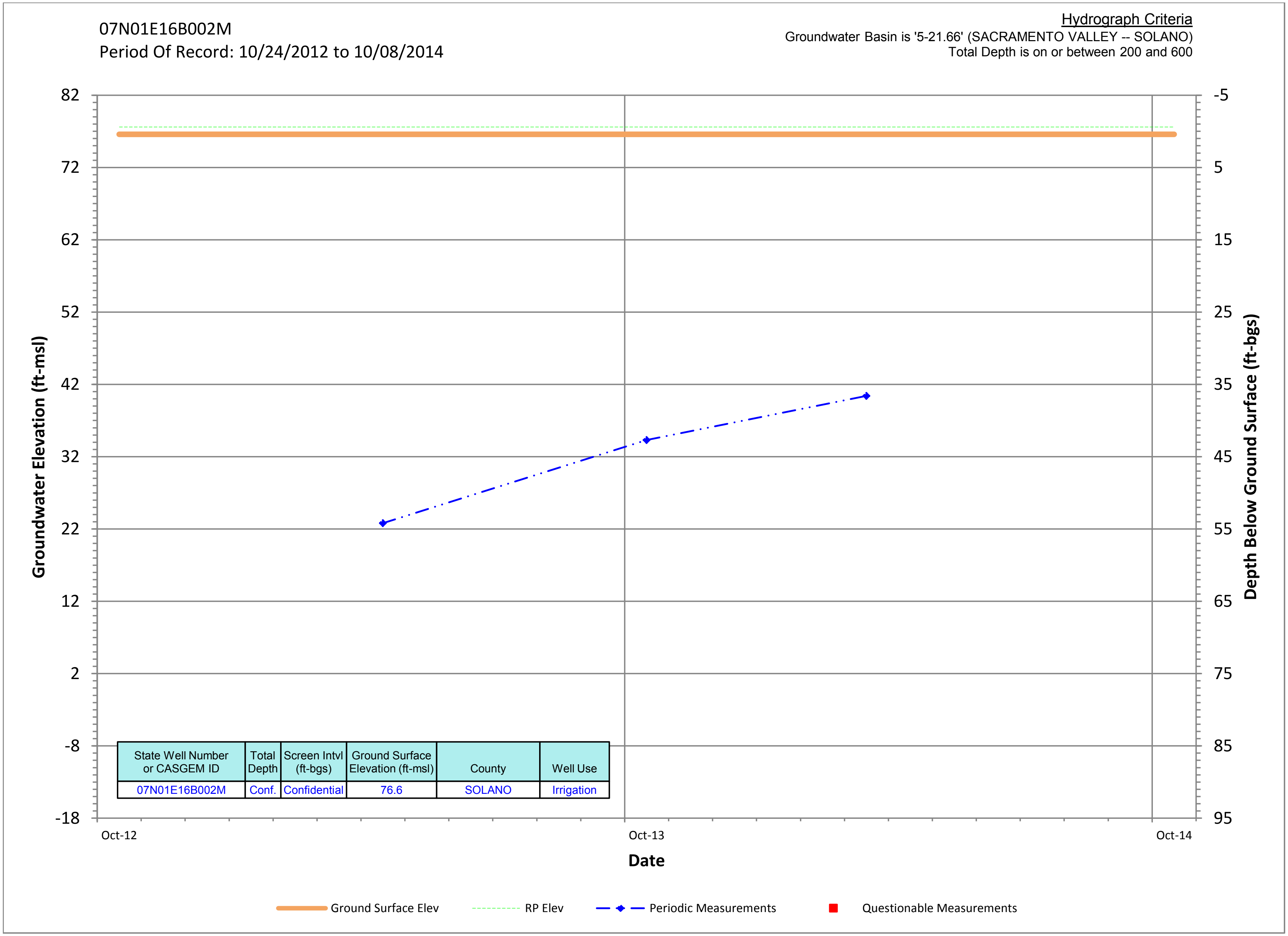
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E04R001M	Conf.	Confidential	80.8	SOLANO	Observation

07N01E10L001M
Period Of Record: 04/02/2012 to 09/30/2014

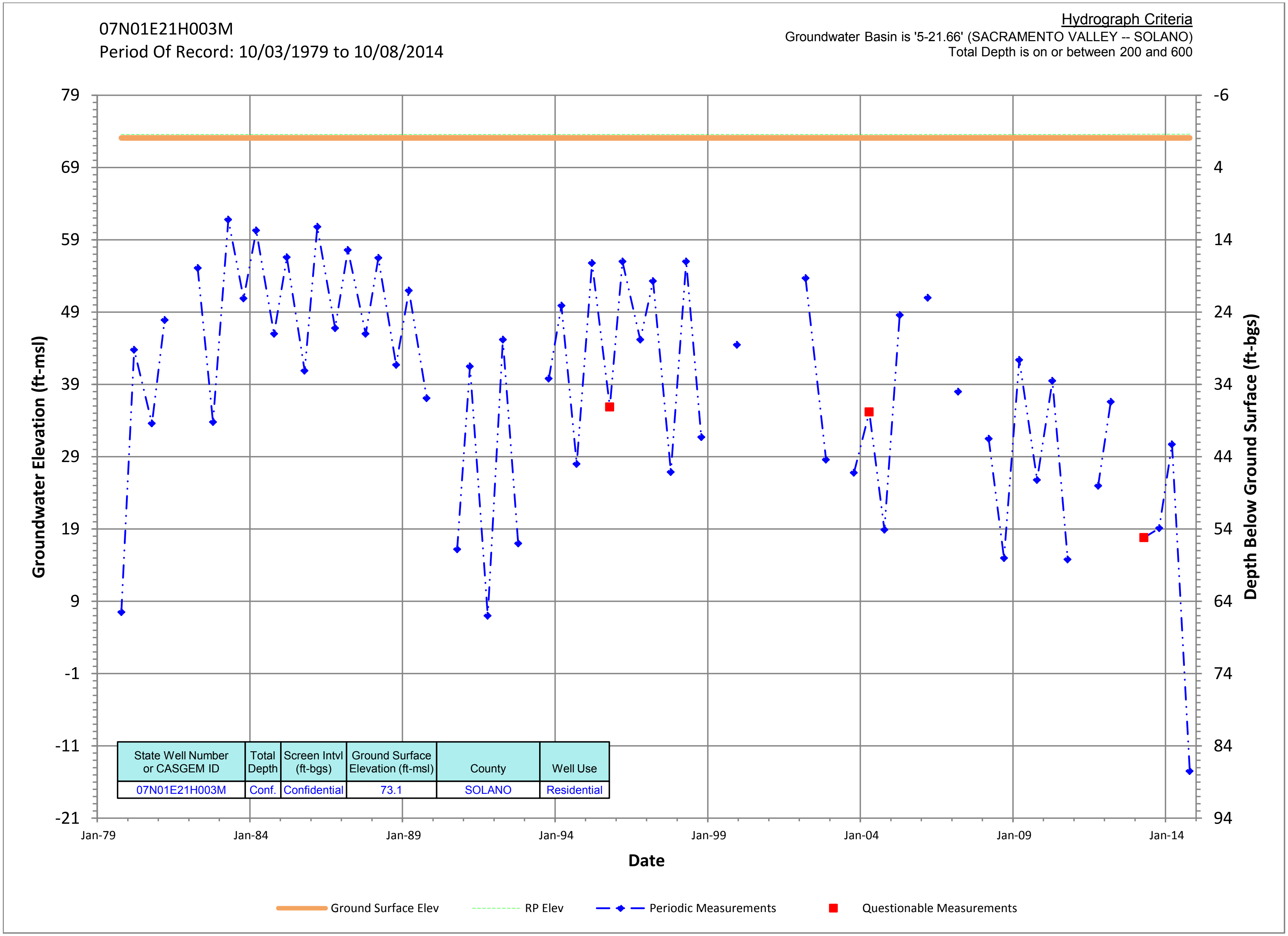
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E10L001M	Conf.	Confidential	83.1	SOLANO	Irrigation



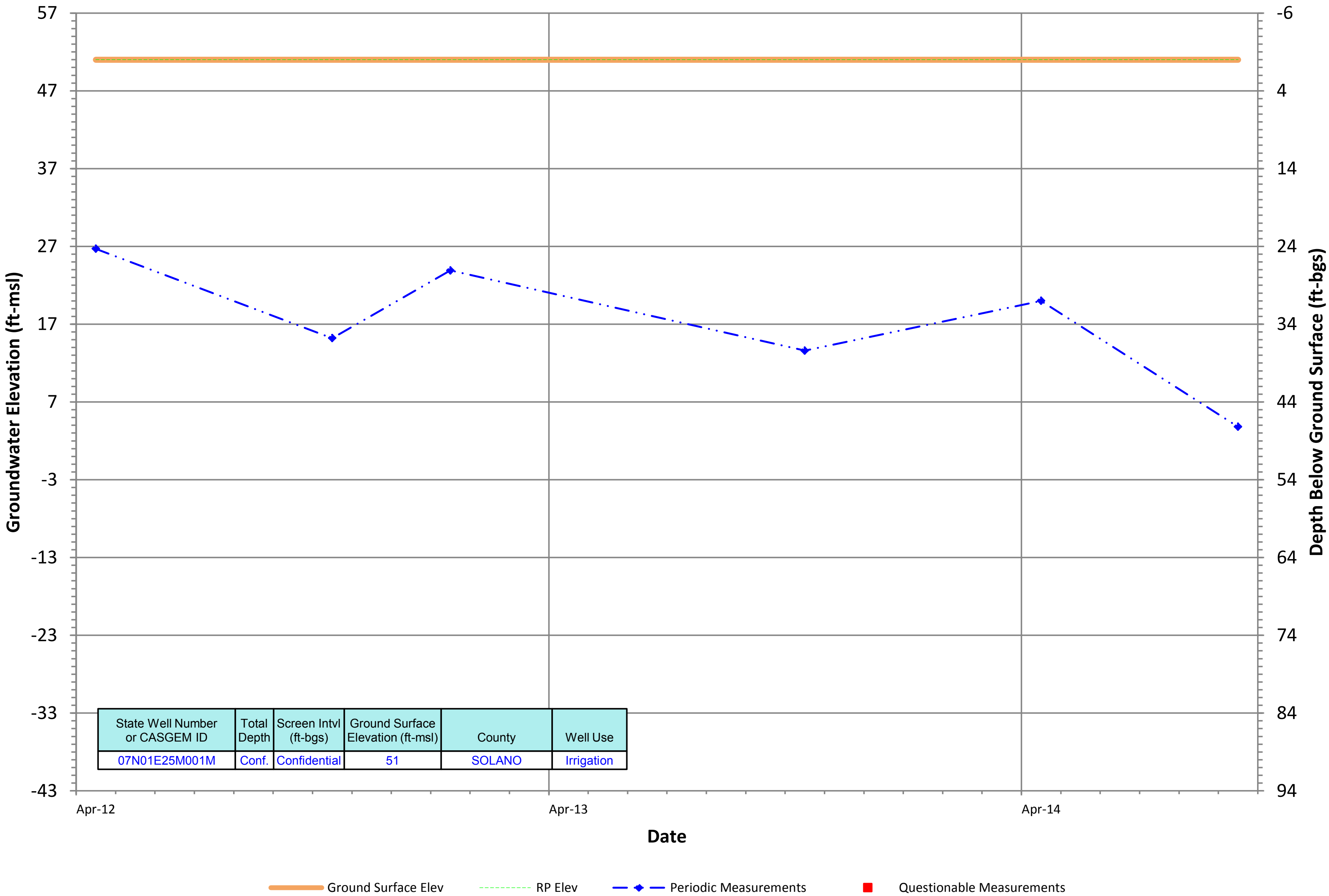
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E16B002M	Conf.	Confidential	76.6	SOLANO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E21H003M	Conf.	Confidential	73.1	SOLANO	Residential

07N01E25M001M
Period Of Record: 04/02/2012 to 09/29/2014

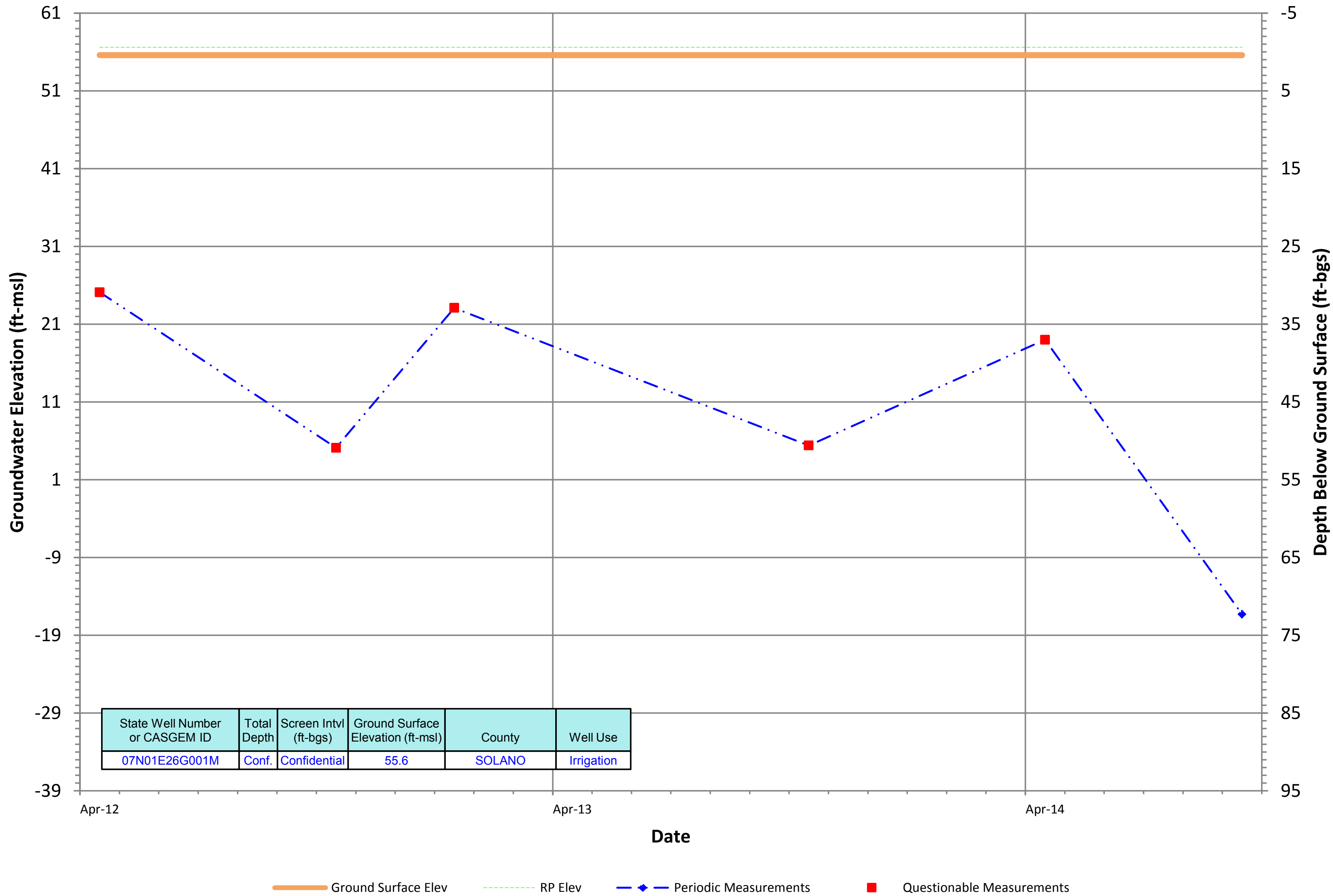
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E25M001M	Conf.	Confidential	51	SOLANO	Irrigation

07N01E26G001M
Period Of Record: 04/02/2012 to 09/29/2014

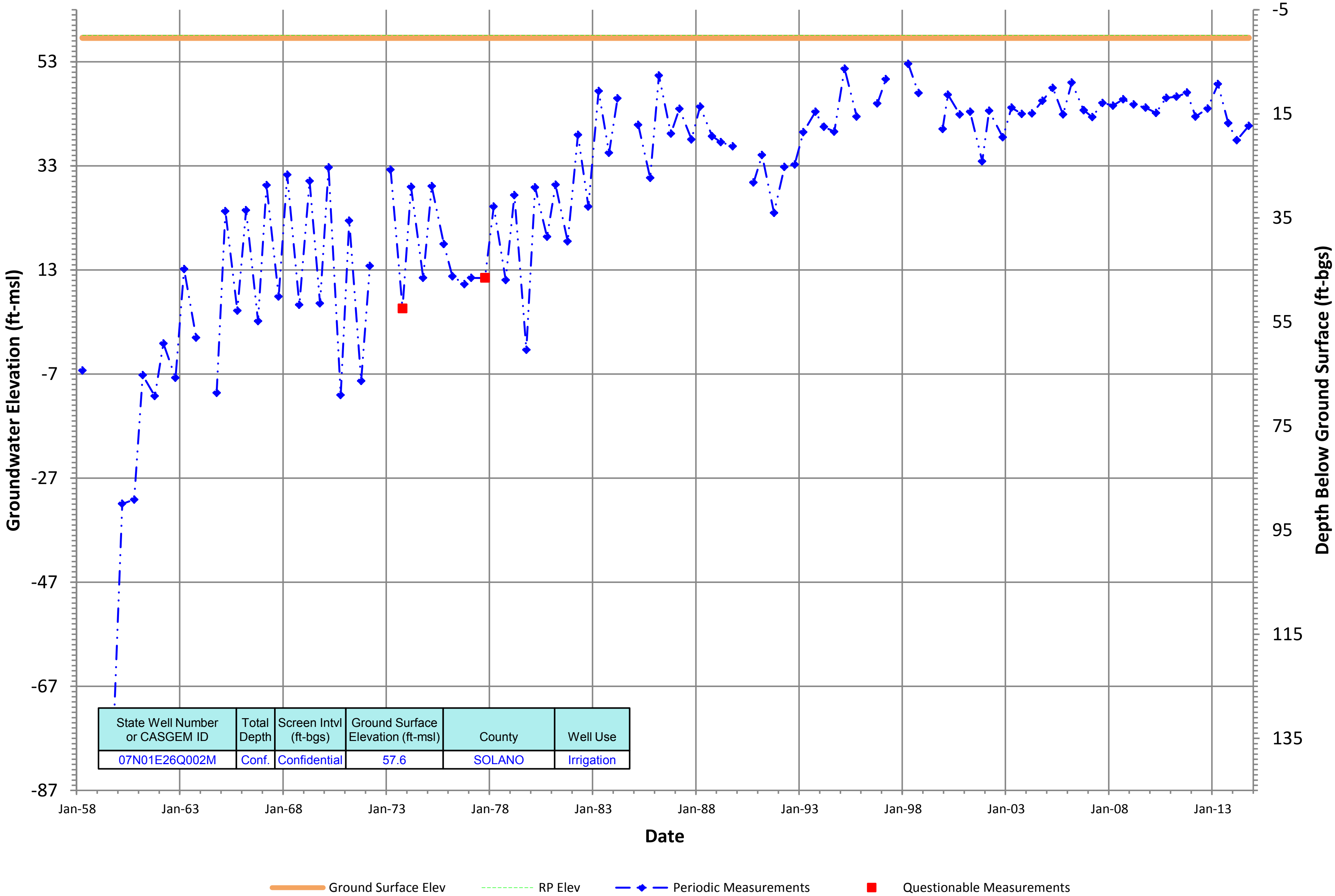
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E26G001M	Conf.	Confidential	55.6	SOLANO	Irrigation

07N01E26Q002M
Period Of Record: 04/22/1958 to 10/07/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E26Q002M	Conf.	Confidential	57.6	SOLANO	Irrigation

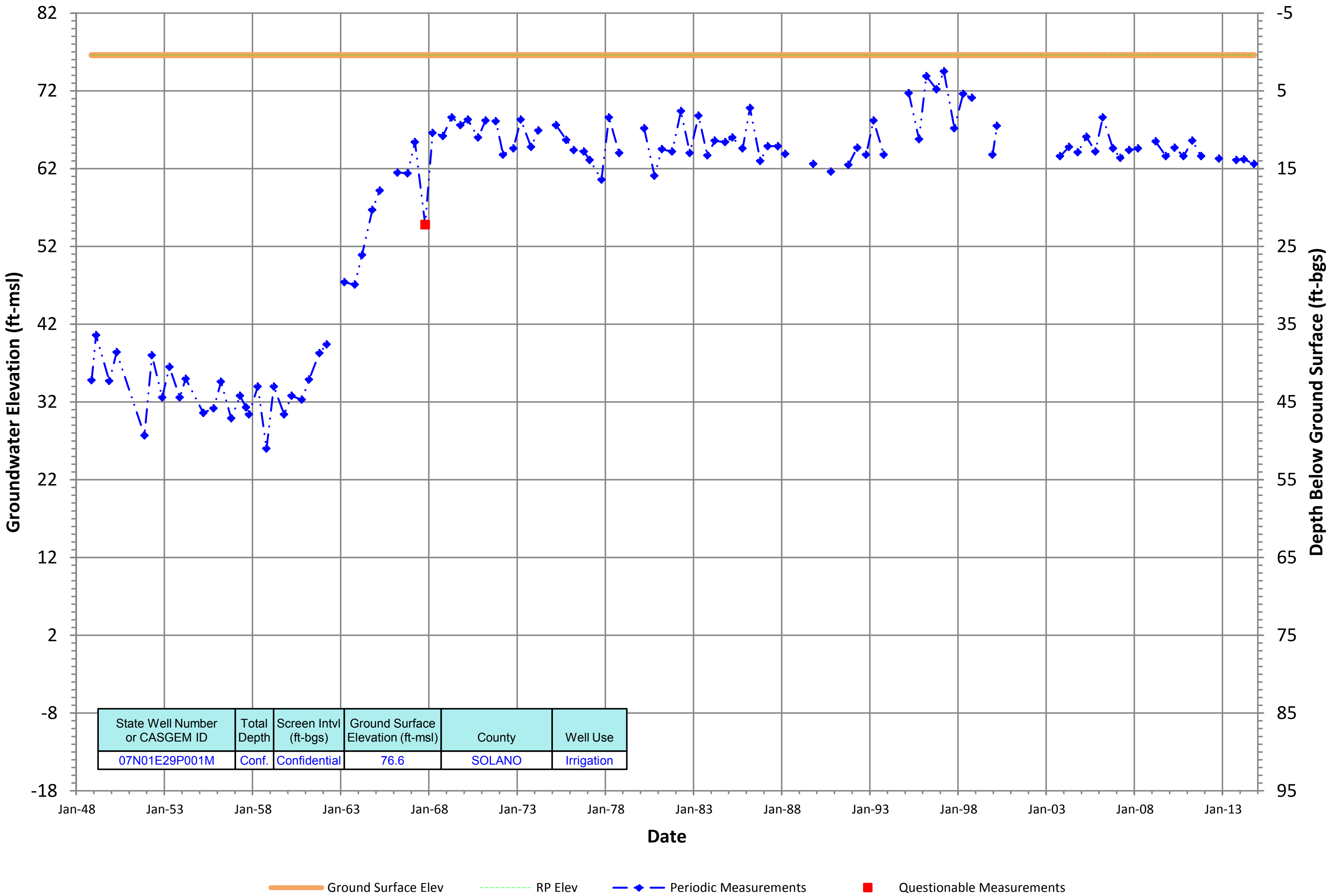
07N01E29P001M

Period Of Record: 11/12/1948 to 10/08/2014

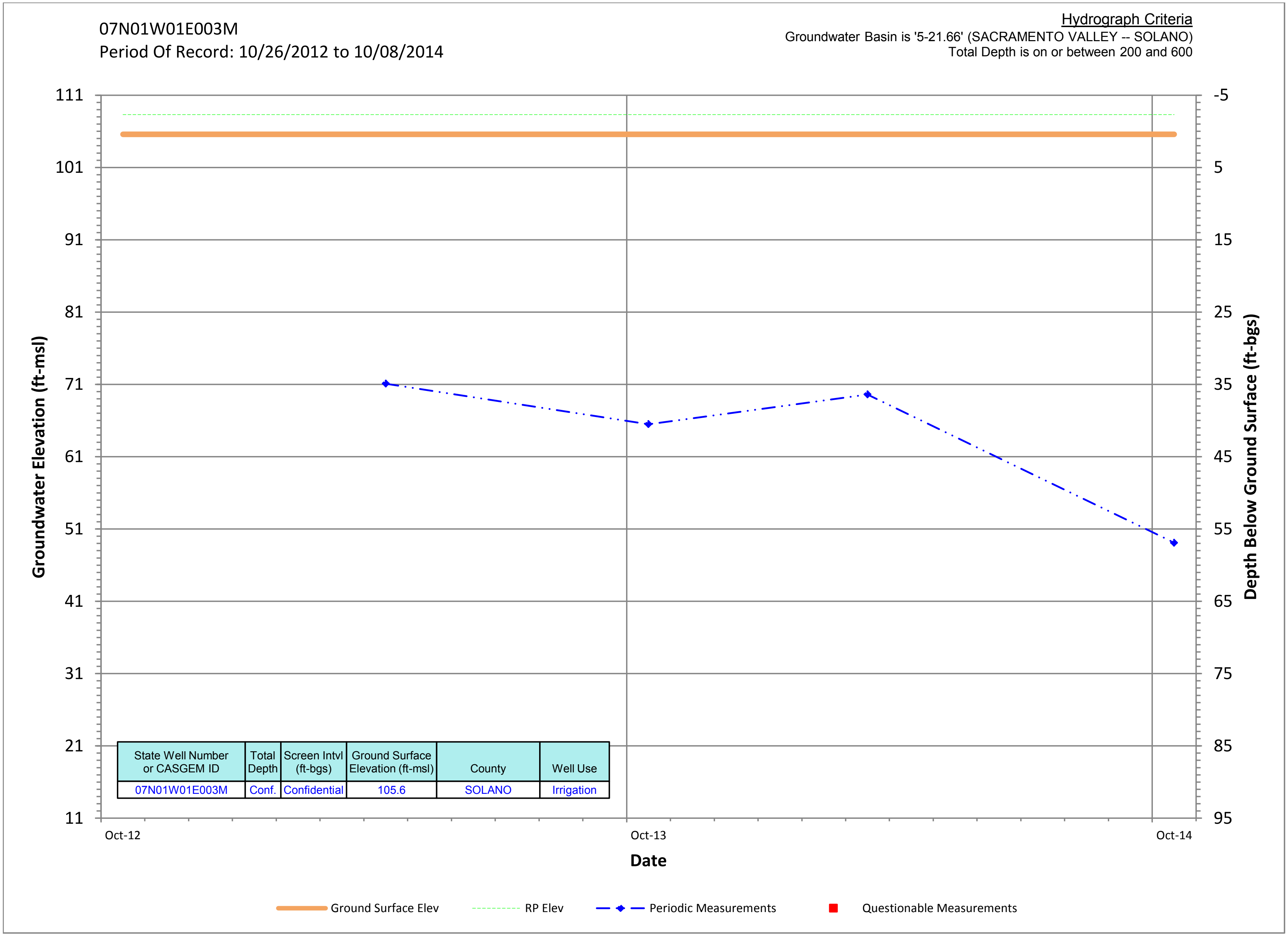
Hydrograph Criteria

Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)

Total Depth is on or between 200 and 600



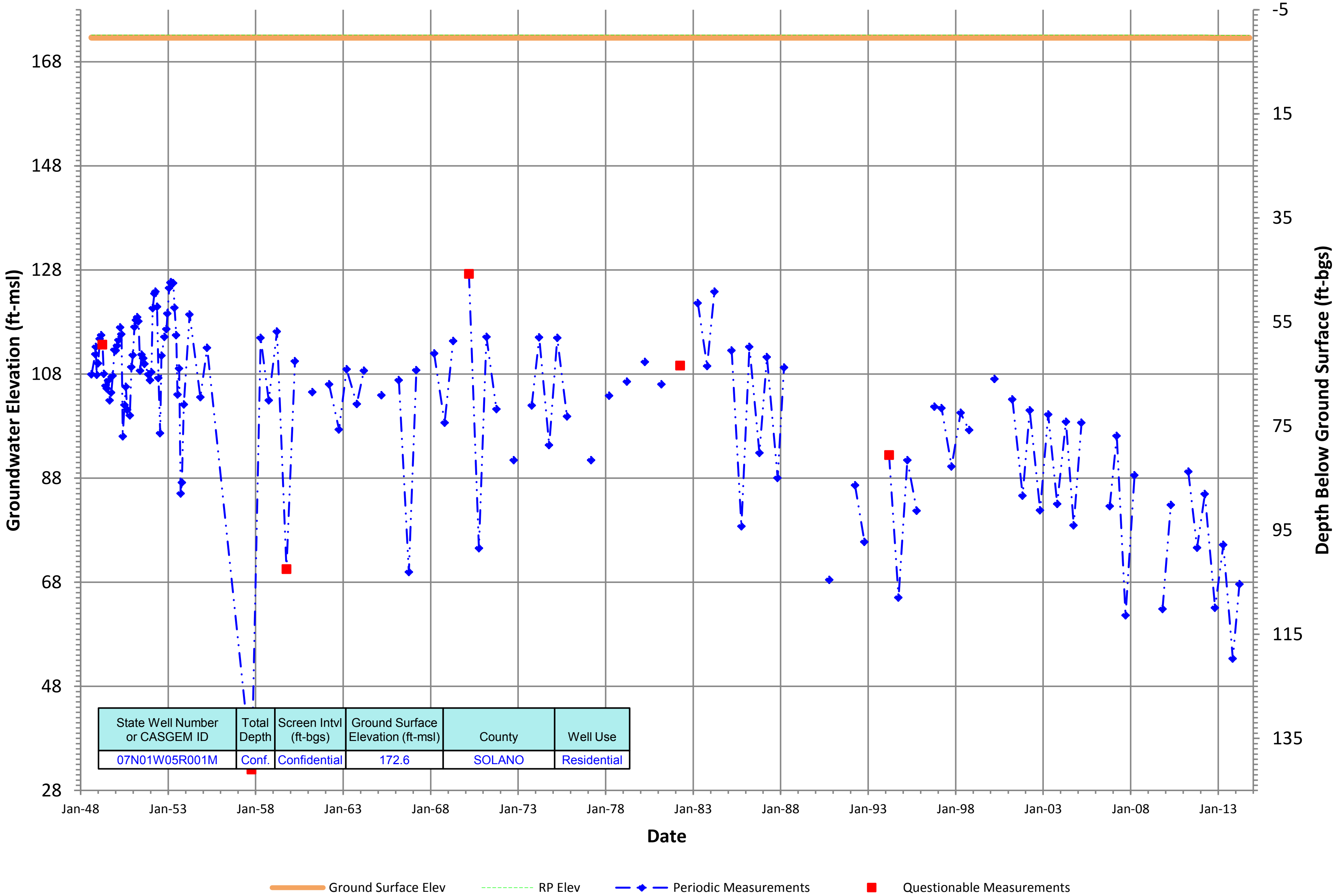
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E29P001M	Conf.	Confidential	76.6	SOLANO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01W01E003M	Conf.	Confidential	105.6	SOLANO	Irrigation

07N01W05R001M
Period Of Record: 08/16/1948 to 10/09/2014

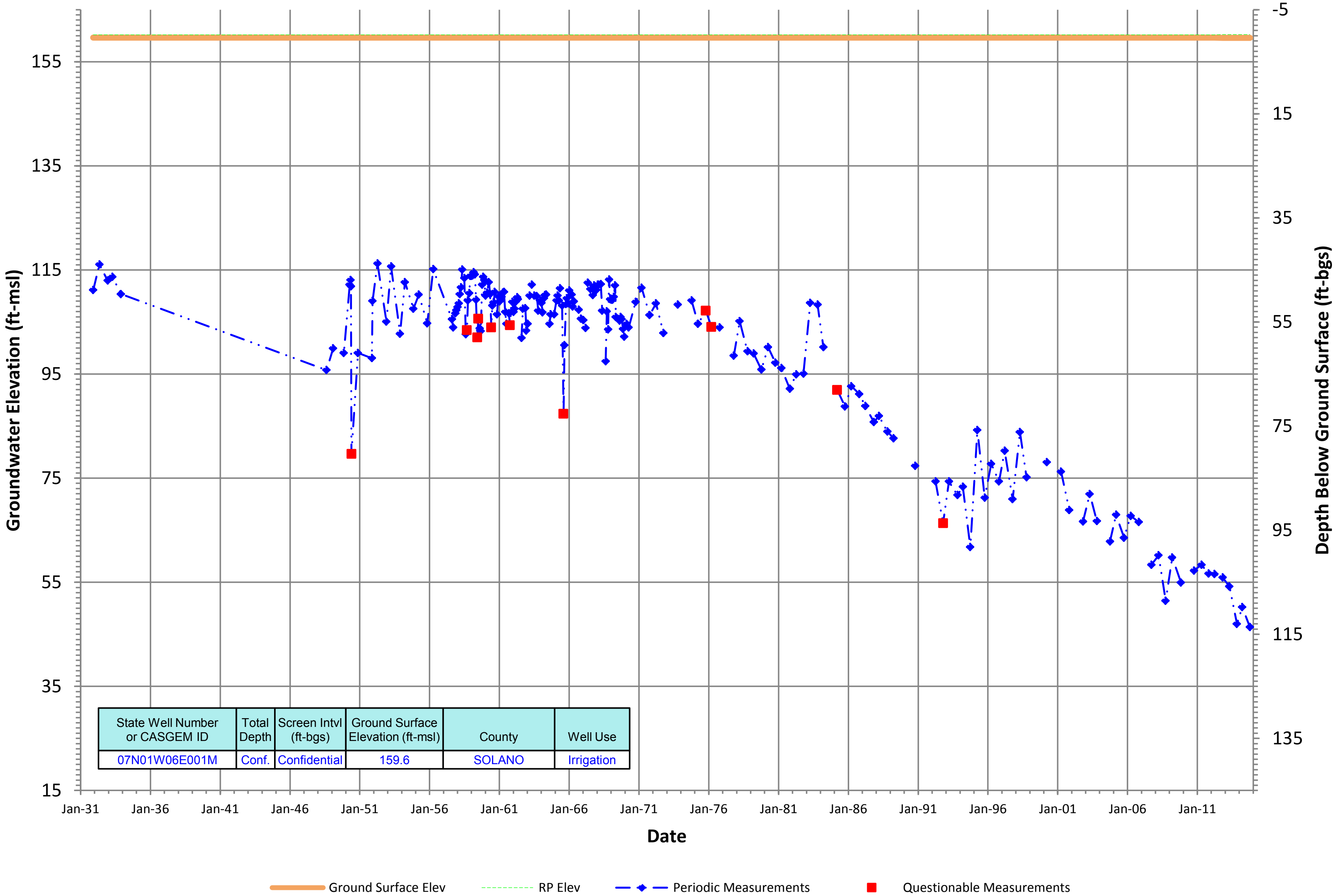
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



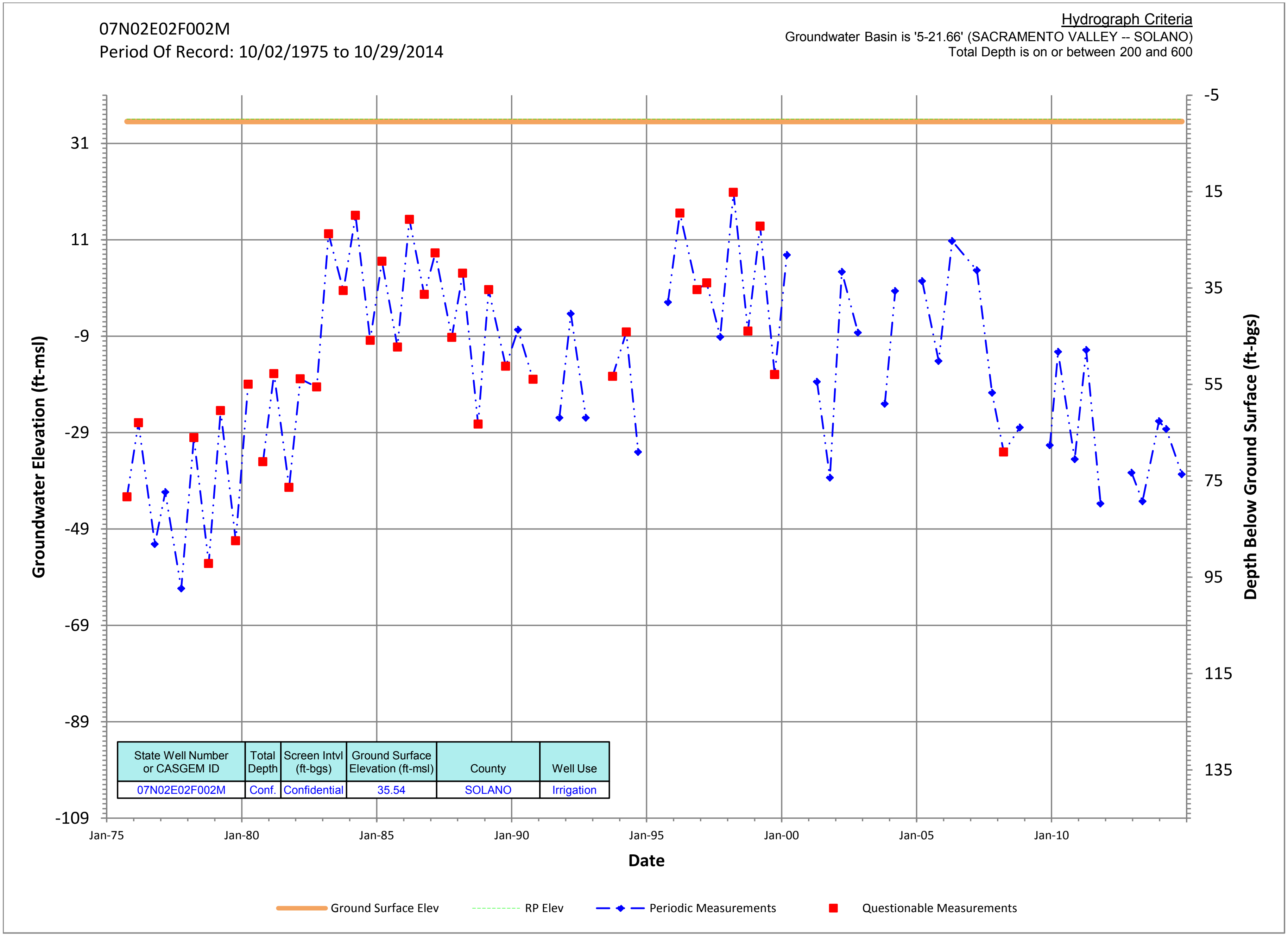
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01W05R001M	Conf.	Confidential	172.6	SOLANO	Residential

07N01W06E001M
Period Of Record: 11/27/1931 to 10/09/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



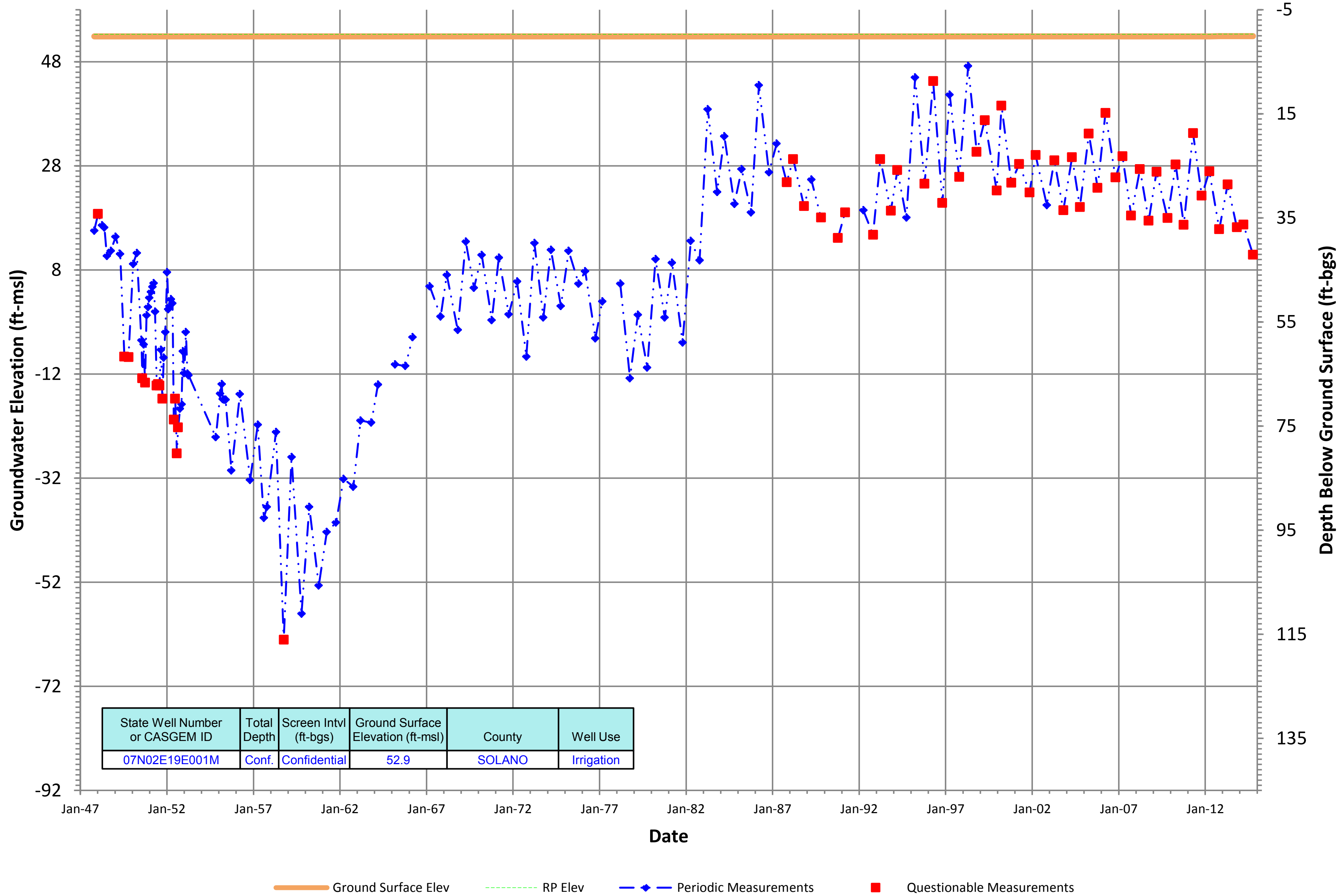
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01W06E001M	Conf.	Confidential	159.6	SOLANO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N02E02F002M	Conf.	Confidential	35.54	SOLANO	Irrigation

07N02E19E001M
Period Of Record: 10/20/1947 to 10/07/2014

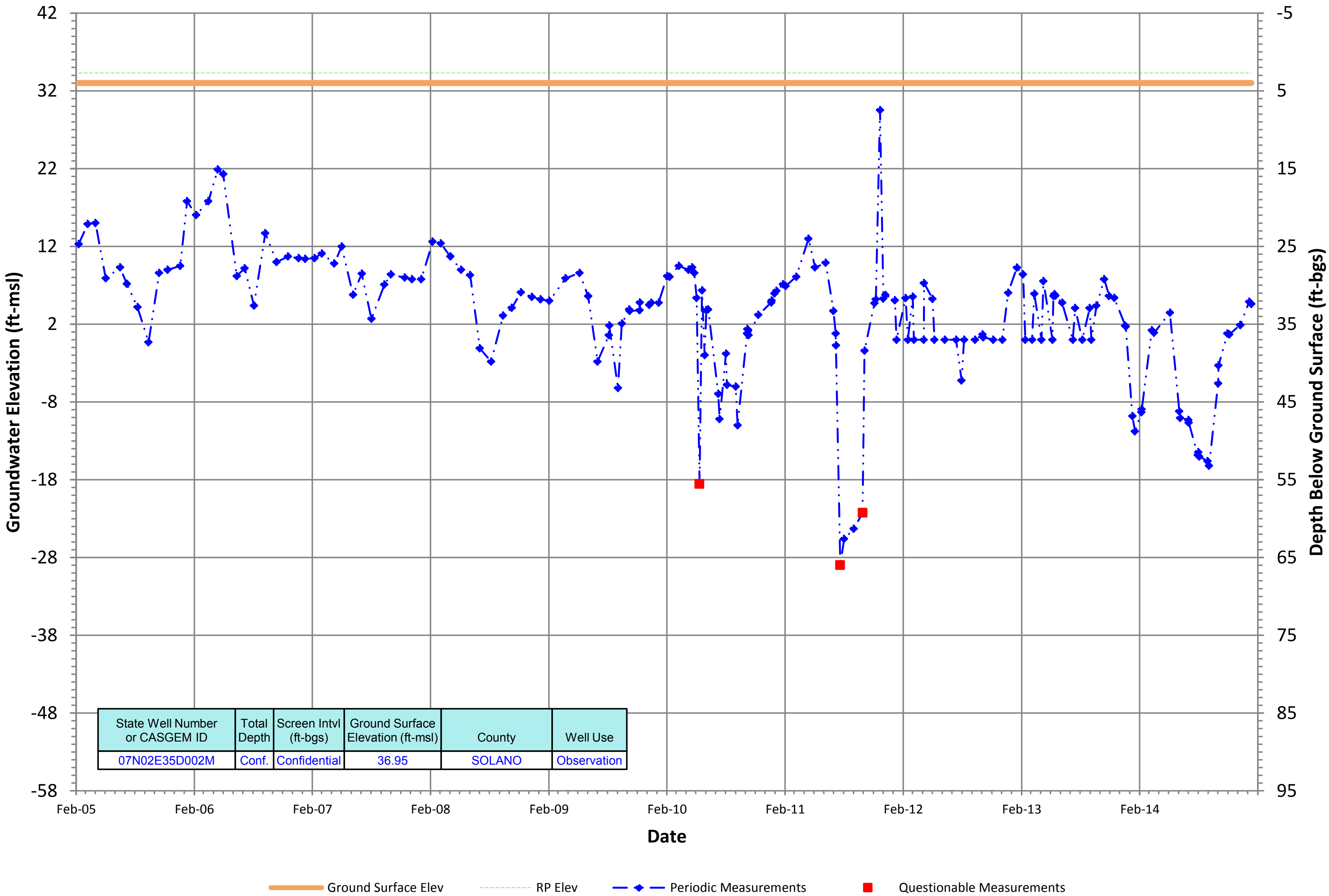
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N02E19E001M	Conf.	Confidential	52.9	SOLANO	Irrigation

07N02E35D002M
Period Of Record: 02/08/2005 to 01/12/2015

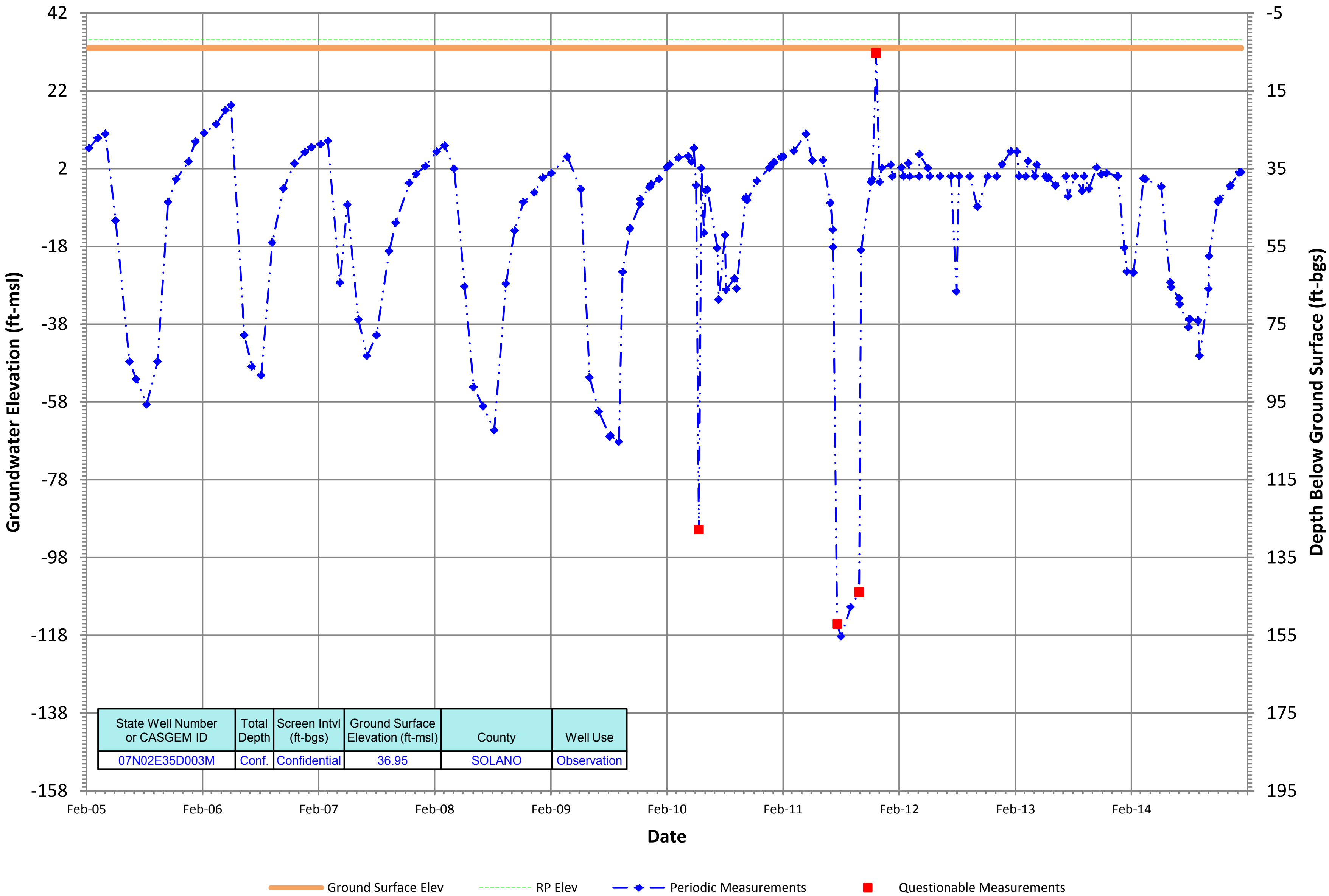
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N02E35D002M	Conf.	Confidential	36.95	SOLANO	Observation

07N02E35D003M
Period Of Record: 02/08/2005 to 01/12/2015

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N02E35D003M	Conf.	Confidential	36.95	SOLANO	Observation

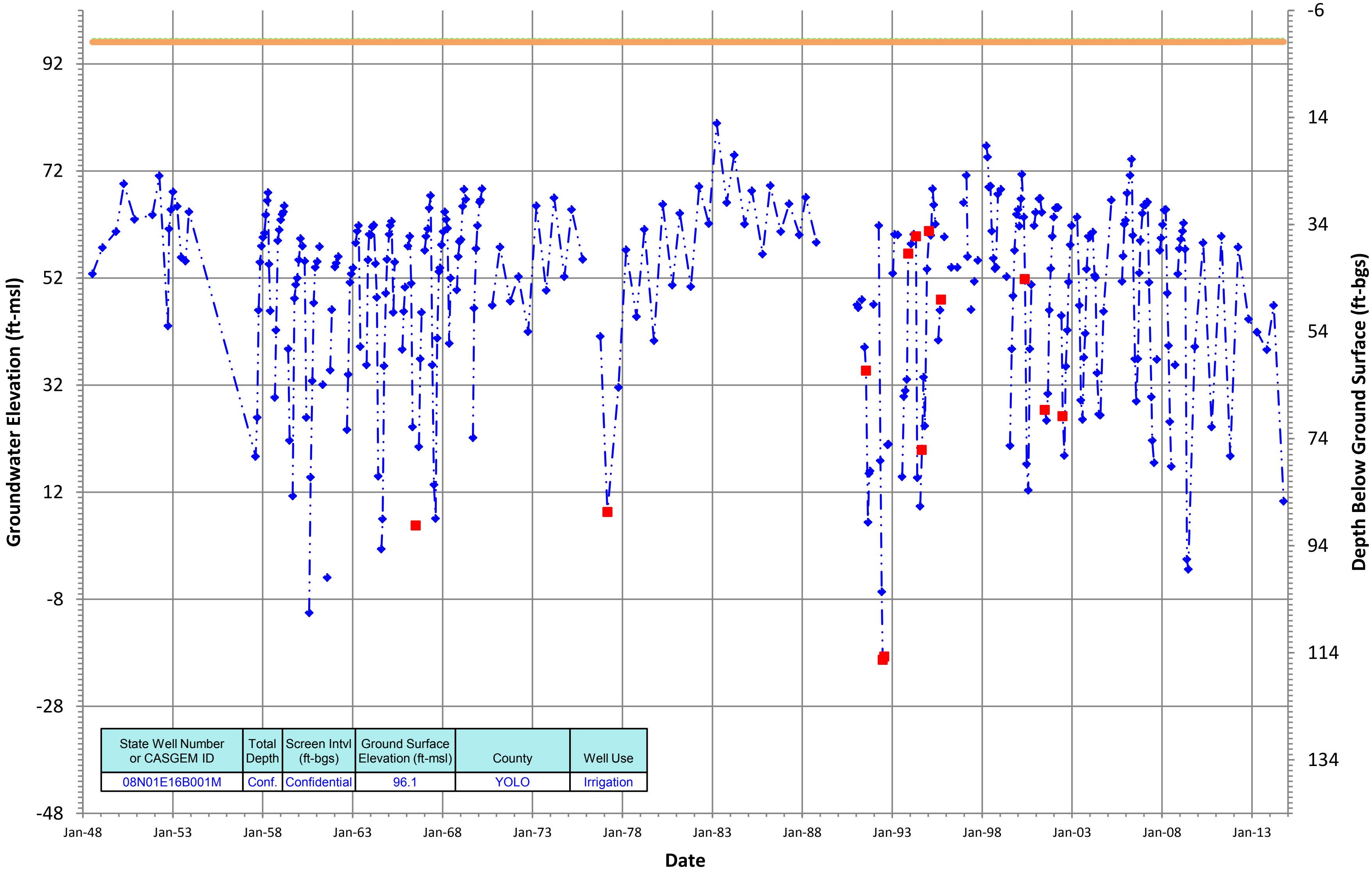
08N01E16B001M

Period Of Record: 07/13/1948 to 10/08/2014

Hydrograph Criteria

Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)

Total Depth is on or between 200 and 600

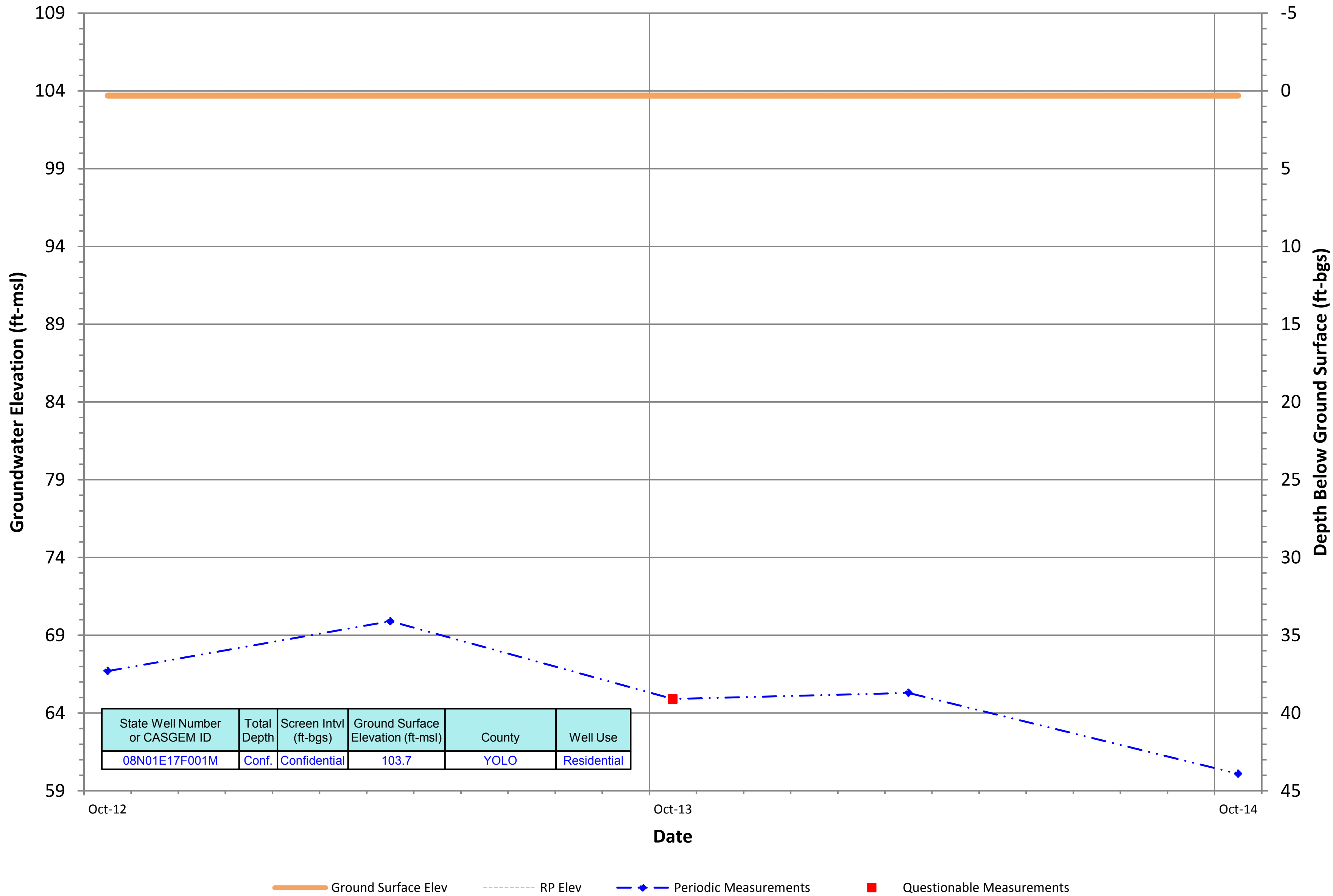


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E16B001M	Conf.	Confidential	96.1	YOLO	Irrigation

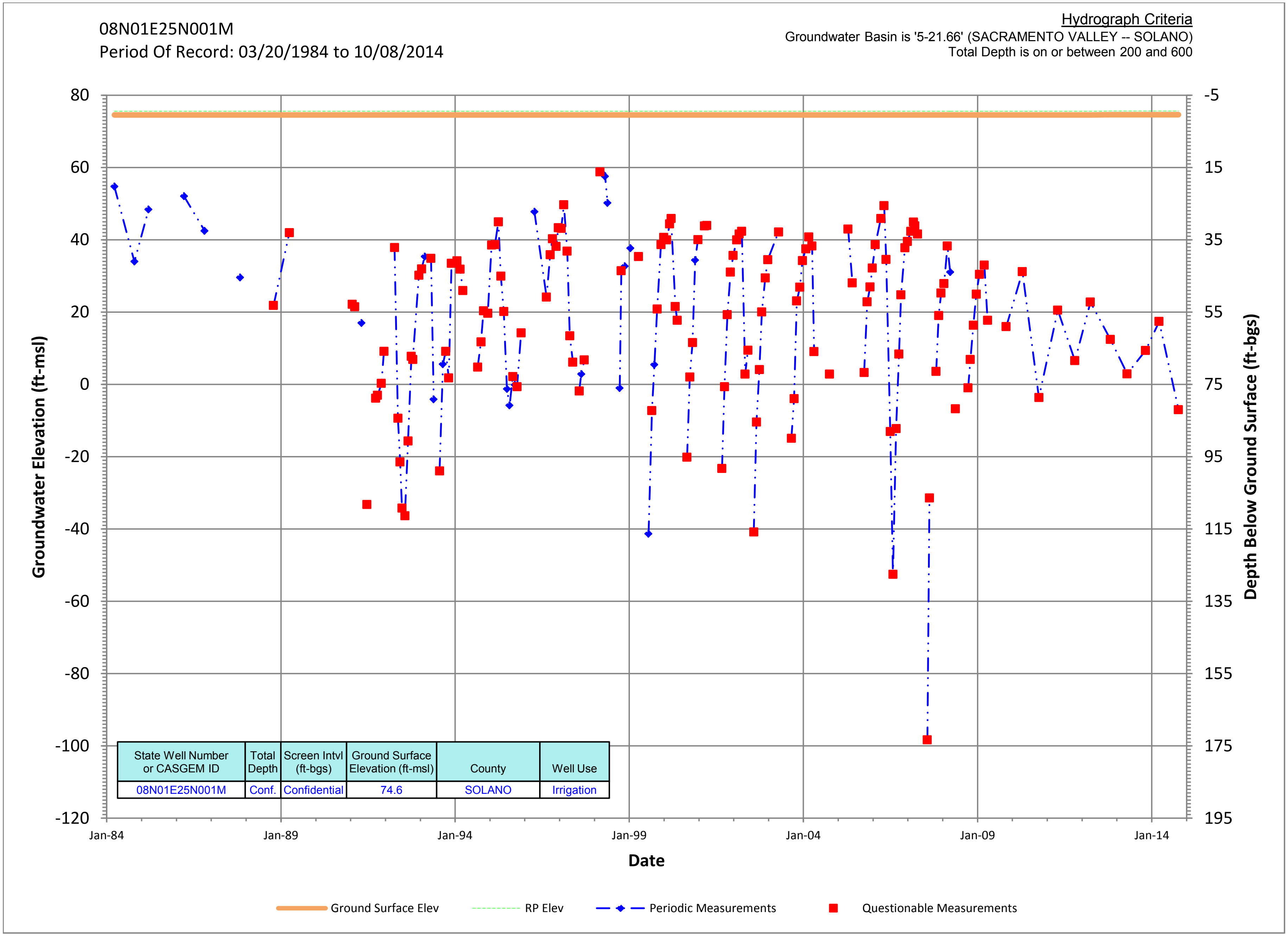
Ground Surface Elev — RP Elev — Periodic Measurements — Questionable Measurements

08N01E17F001M
Period Of Record: 10/25/2012 to 10/08/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



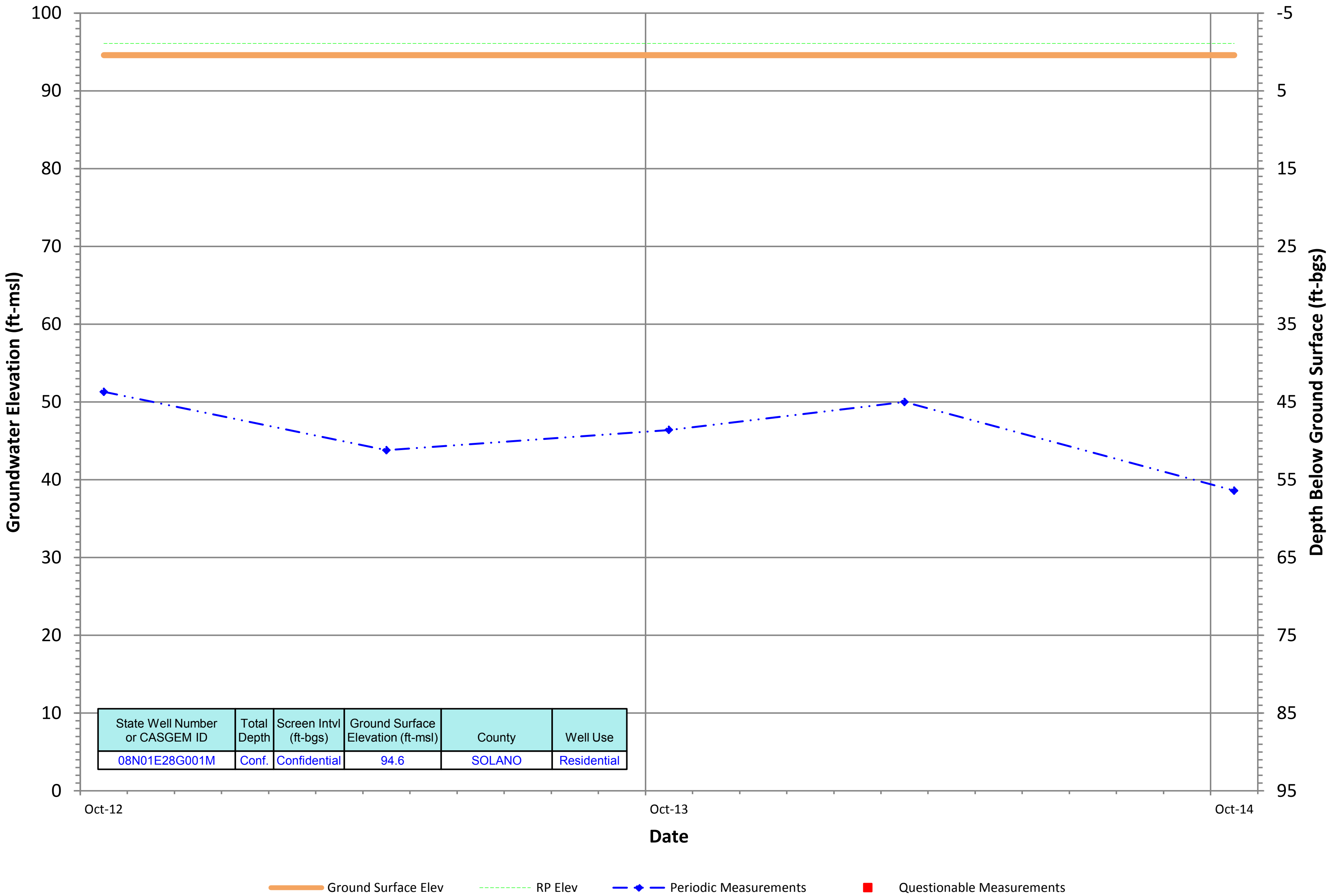
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E17F001M	Conf.	Confidential	103.7	YOLO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E25N001M	Conf.	Confidential	74.6	SOLANO	Irrigation

08N01E28G001M
Period Of Record: 10/24/2012 to 10/08/2014

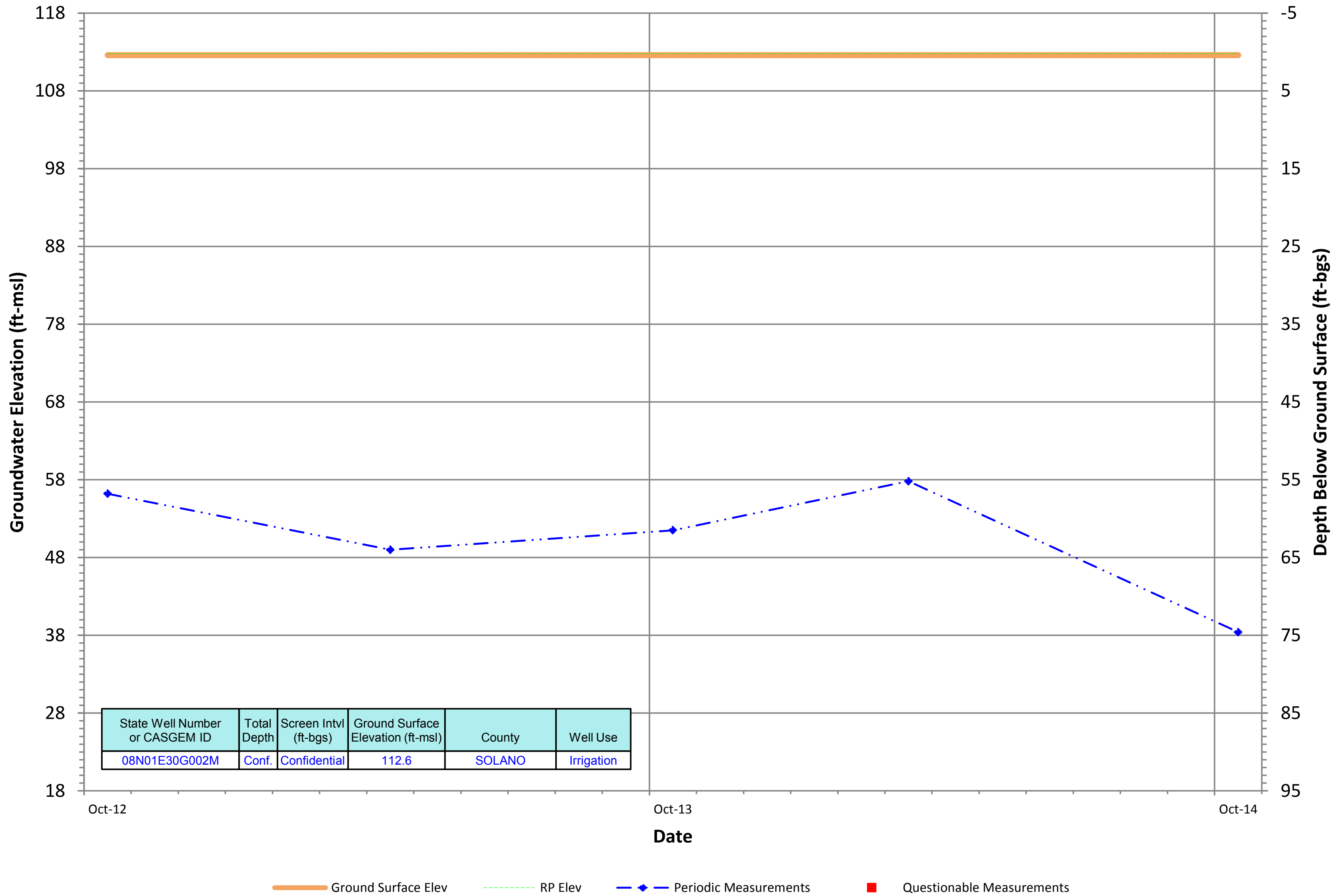
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E28G001M	Conf.	Confidential	94.6	SOLANO	Residential

08N01E30G002M
Period Of Record: 10/25/2012 to 10/08/2014

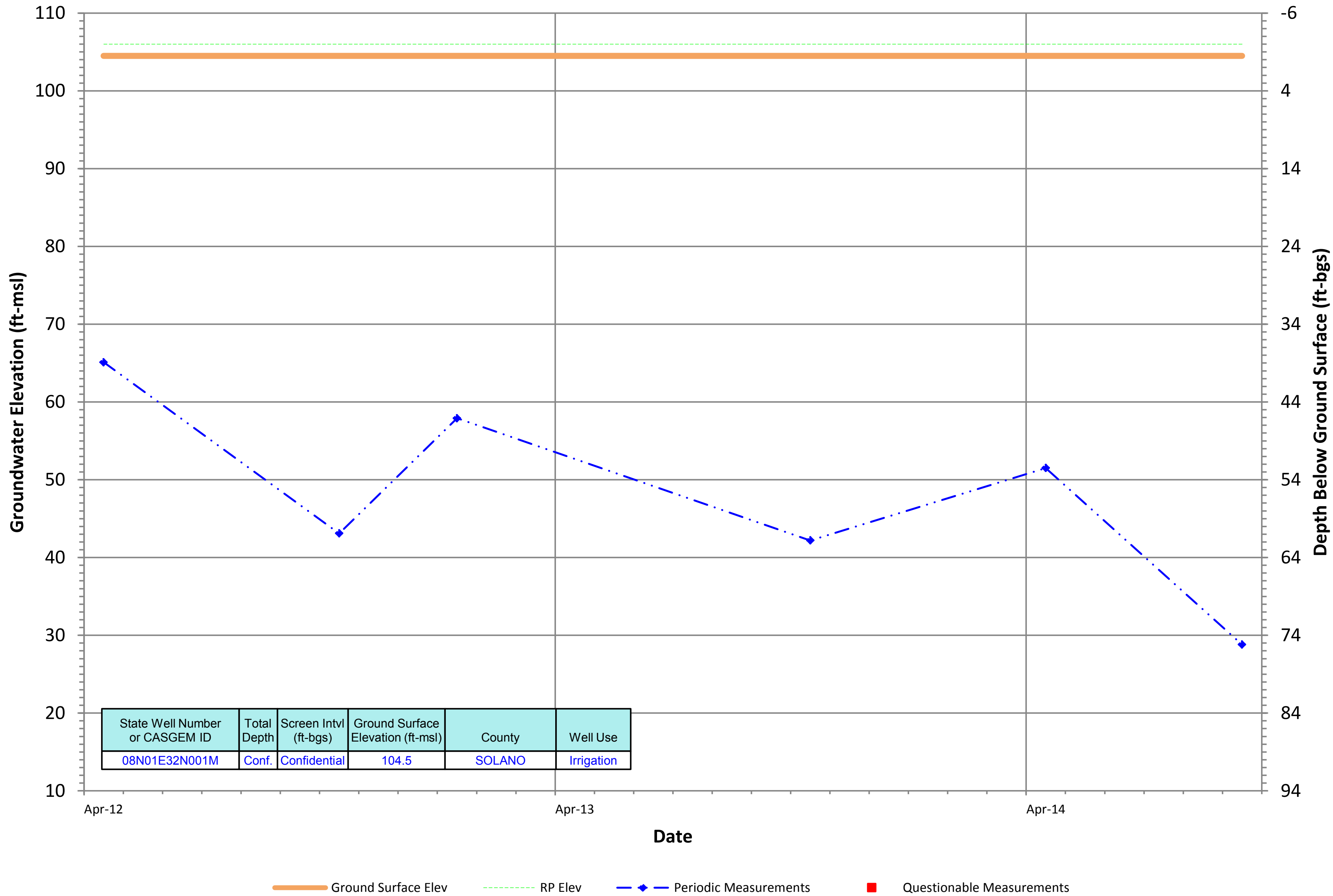
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E30G002M	Conf.	Confidential	112.6	SOLANO	Irrigation

08N01E32N001M
Period Of Record: 04/02/2012 to 09/30/2014

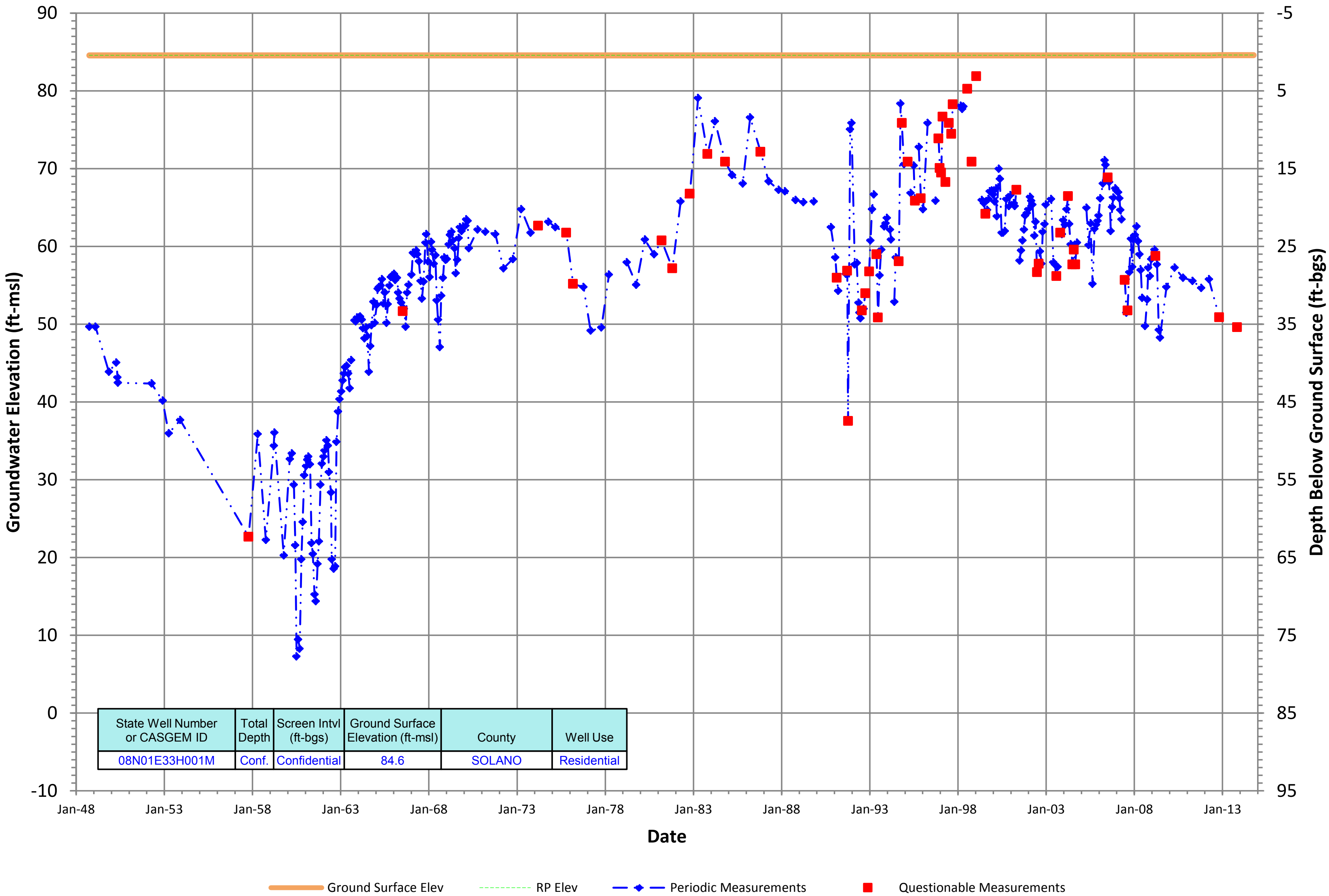
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



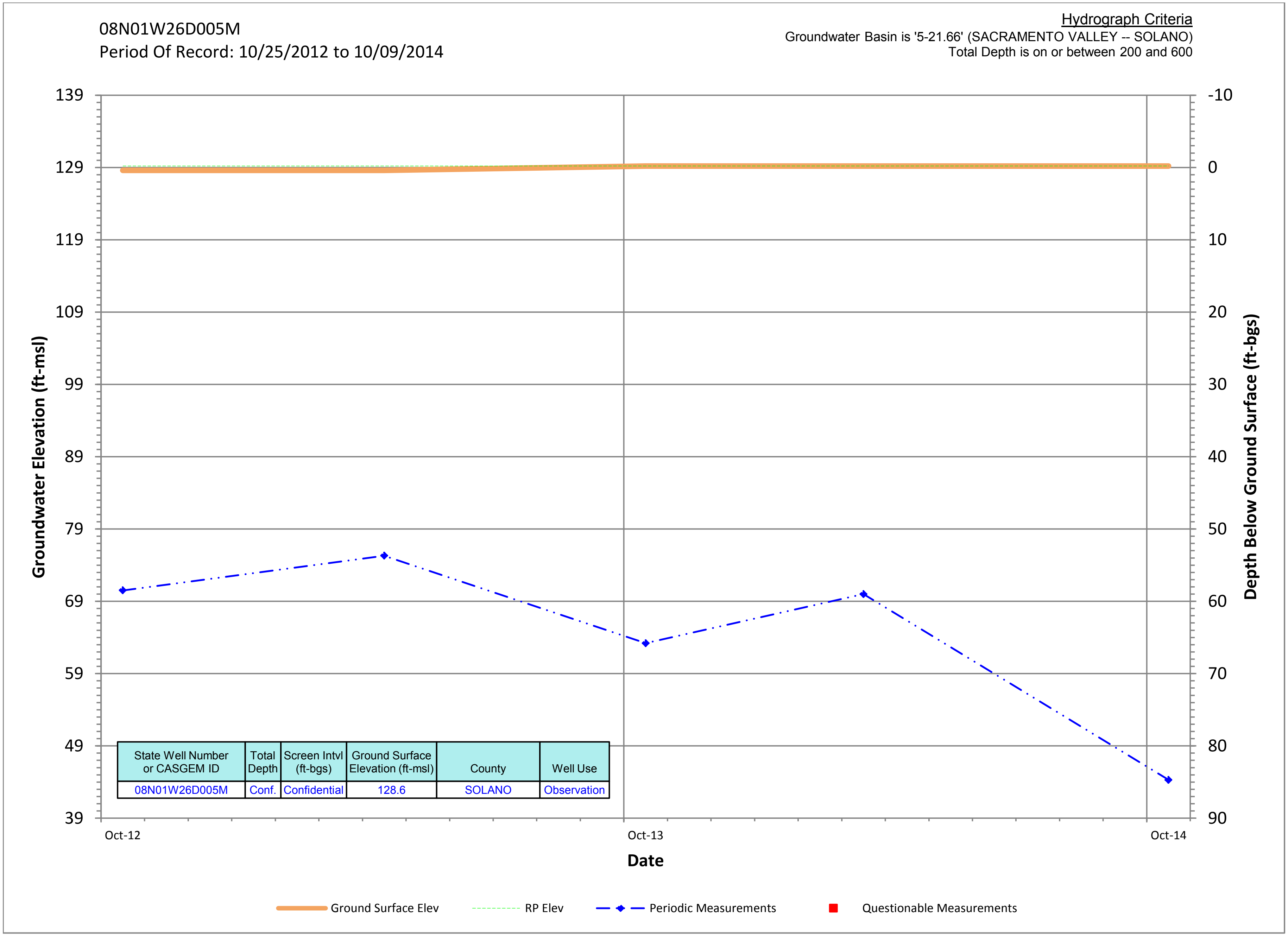
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E32N001M	Conf.	Confidential	104.5	SOLANO	Irrigation

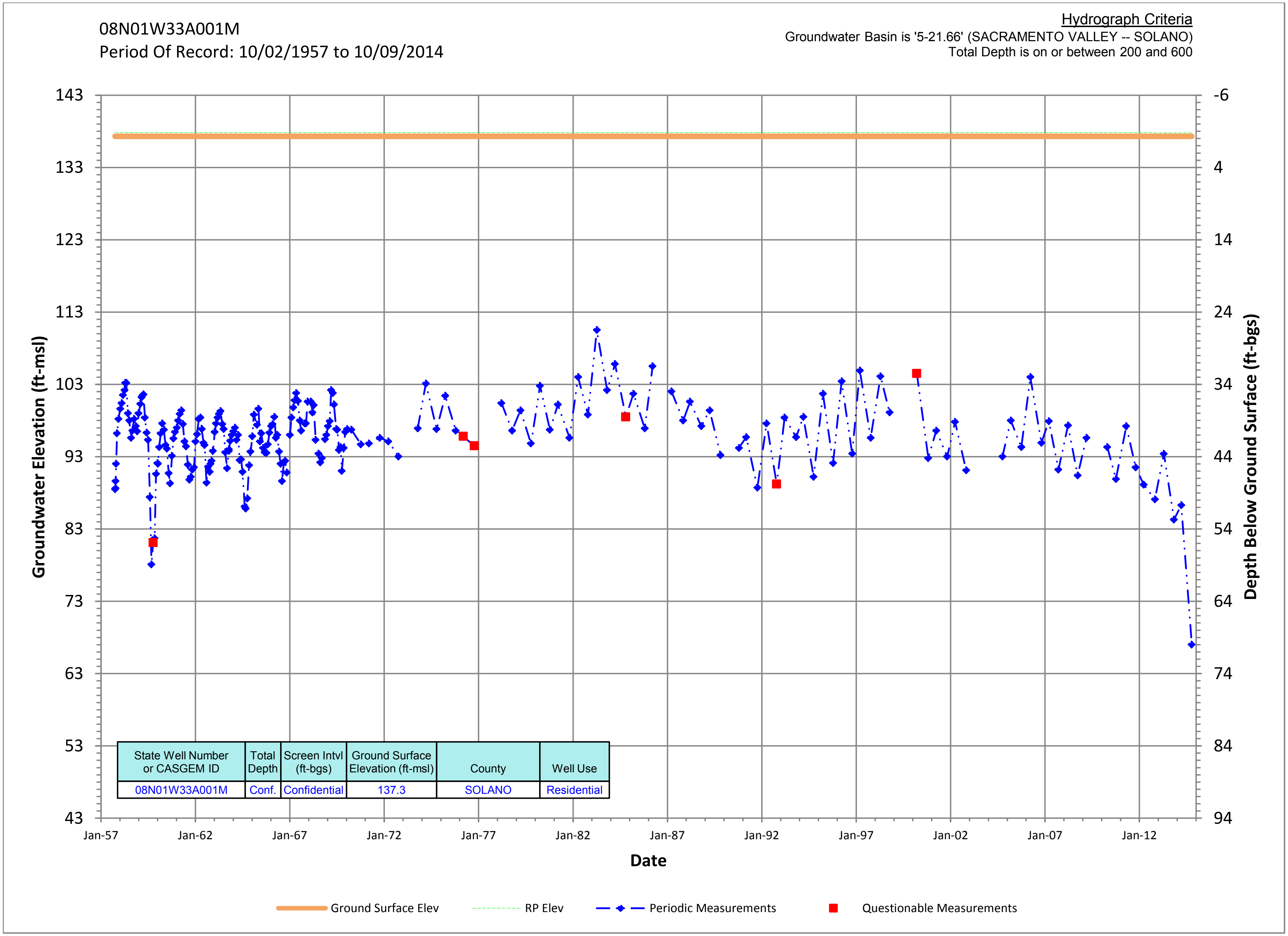
08N01E33H001M
Period Of Record: 09/27/1948 to 10/08/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E33H001M	Conf.	Confidential	84.6	SOLANO	Residential

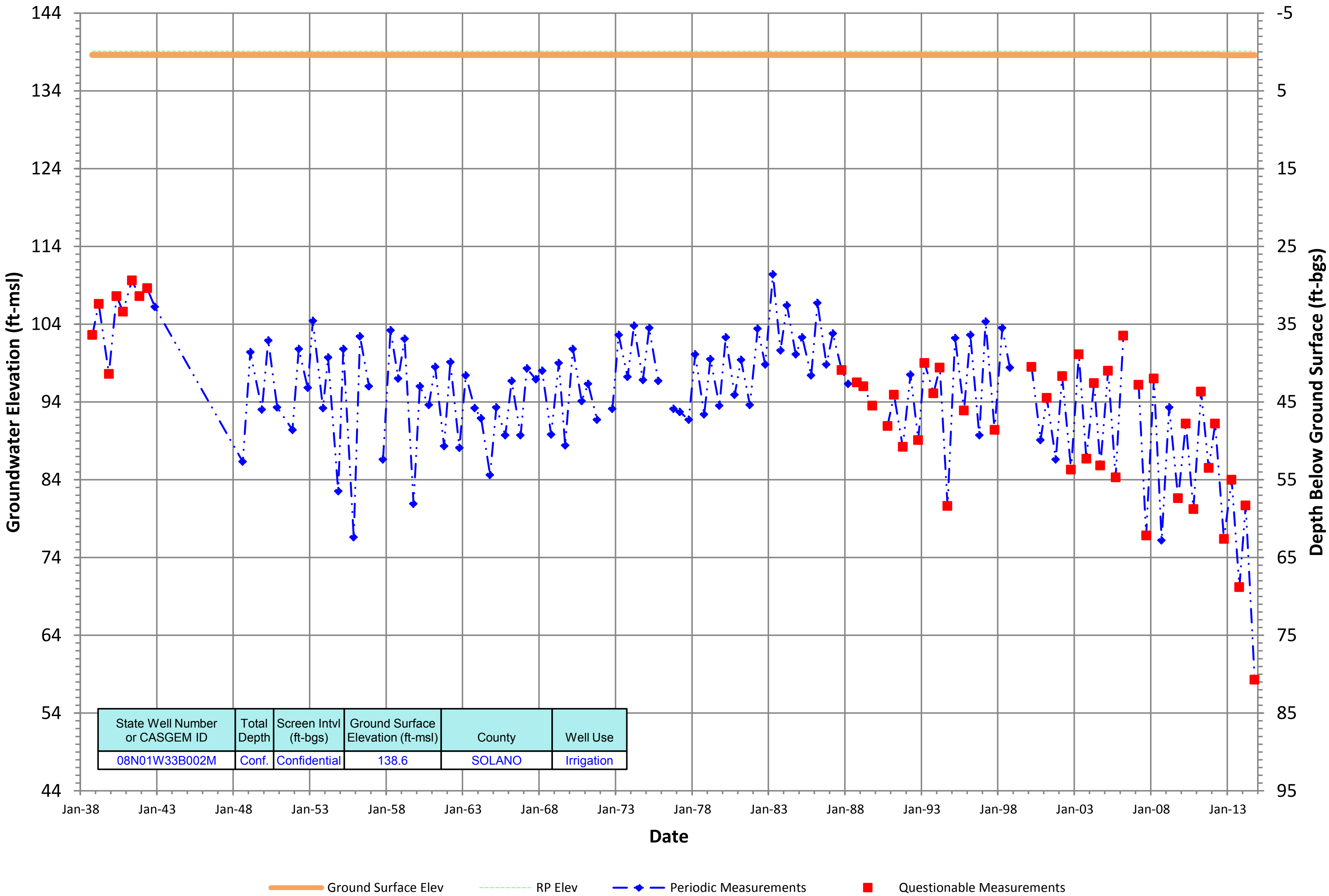

08N01W26D005M
Period Of Record: 10/25/2012 to 10/09/2014
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
139
129
119
109
99
89
79
69
59
49
39
Depth Below Ground Surface (ft-bgs)
-10
0
10
20
30
40
50
60
70
80
90
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
08N01W26D005M
Conf.
Confidential
128.6
SOLANO
Observation
Oct-12
Oct-13
Oct-14
Date
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W33A001M	Conf.	Confidential	137.3	SOLANO	Residential

08N01W33B002M
Period Of Record: 10/20/1938 to 10/09/2014

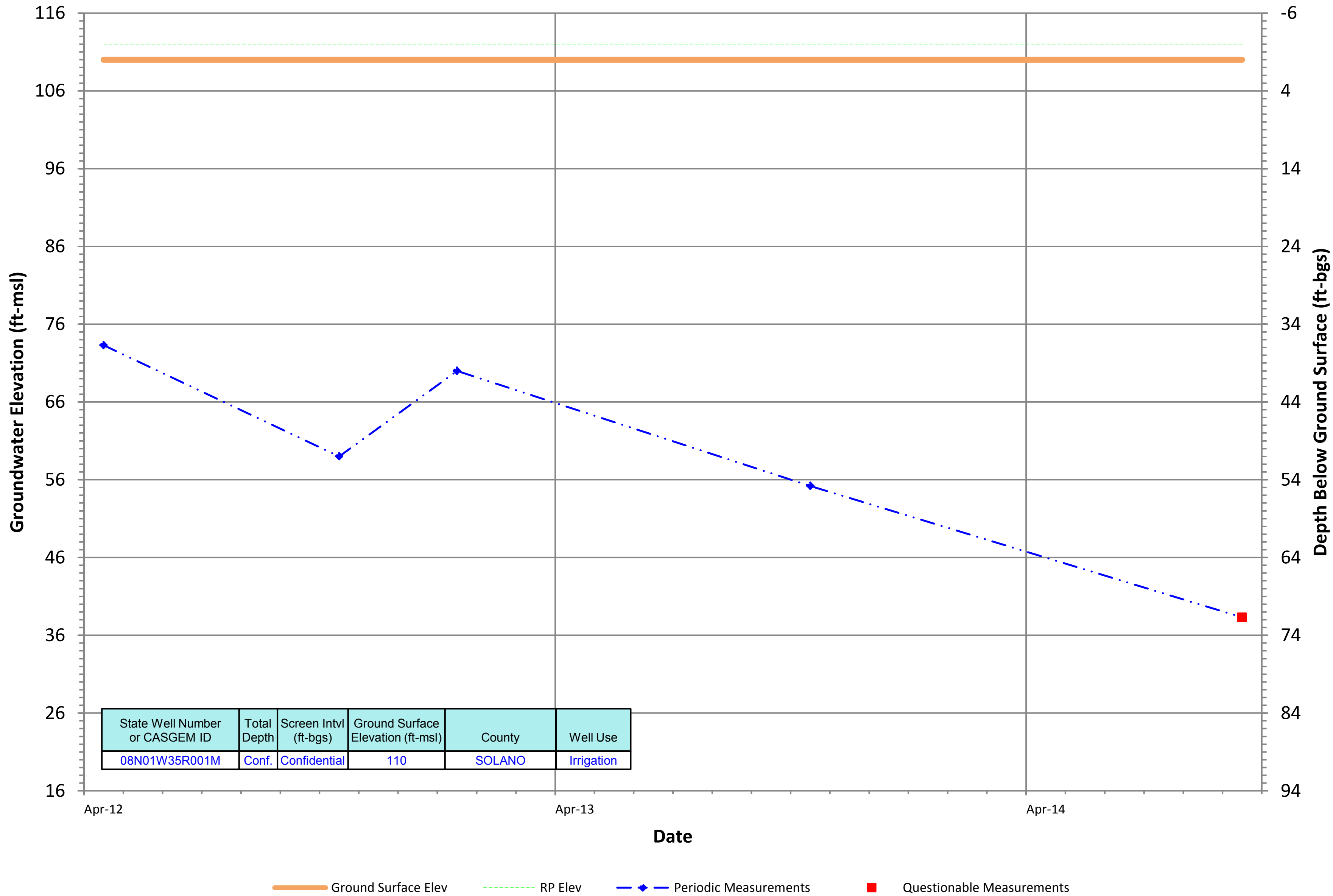
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W33B002M	Conf.	Confidential	138.6	SOLANO	Irrigation

08N01W35R001M
Period Of Record: 04/02/2012 to 09/30/2014

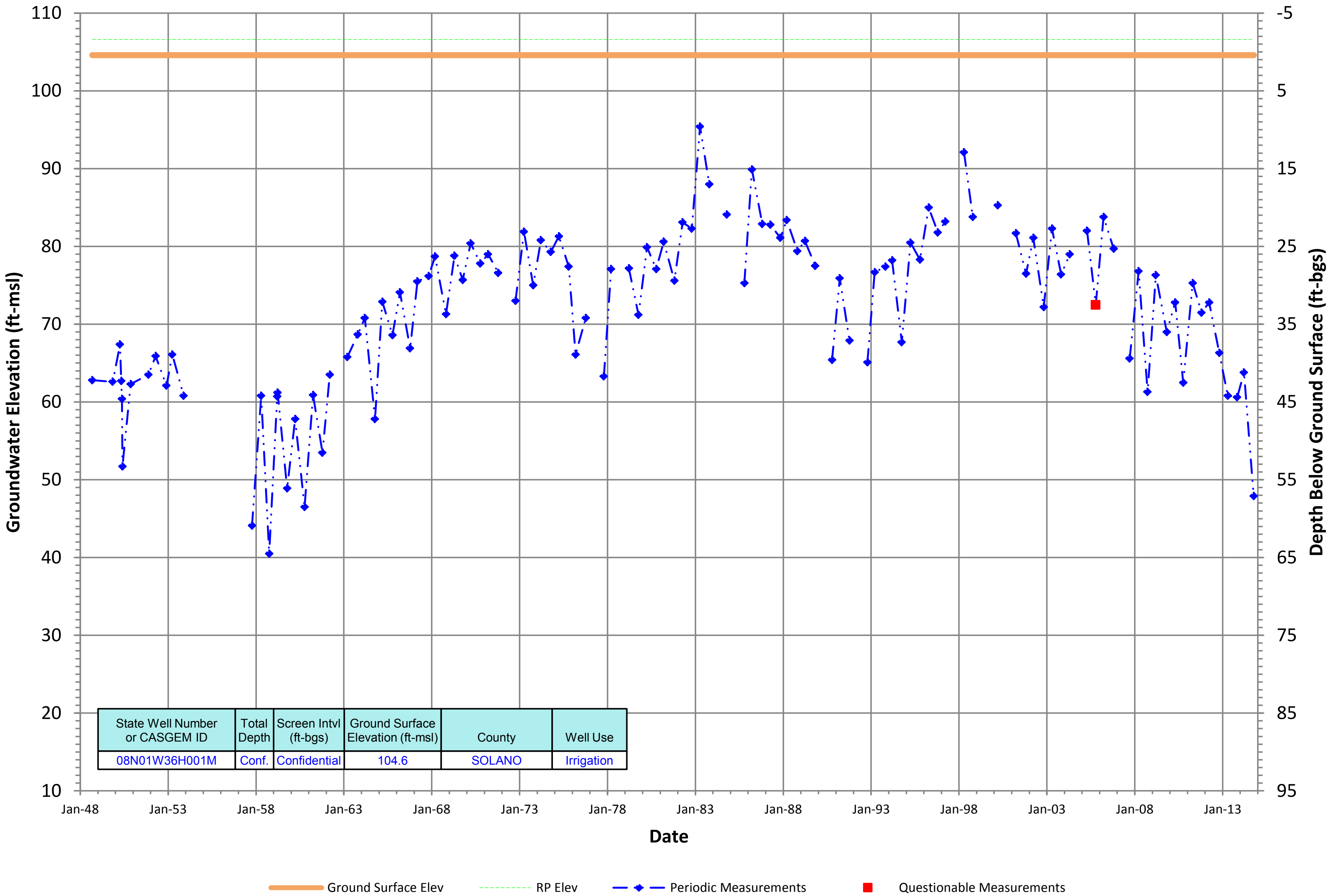
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



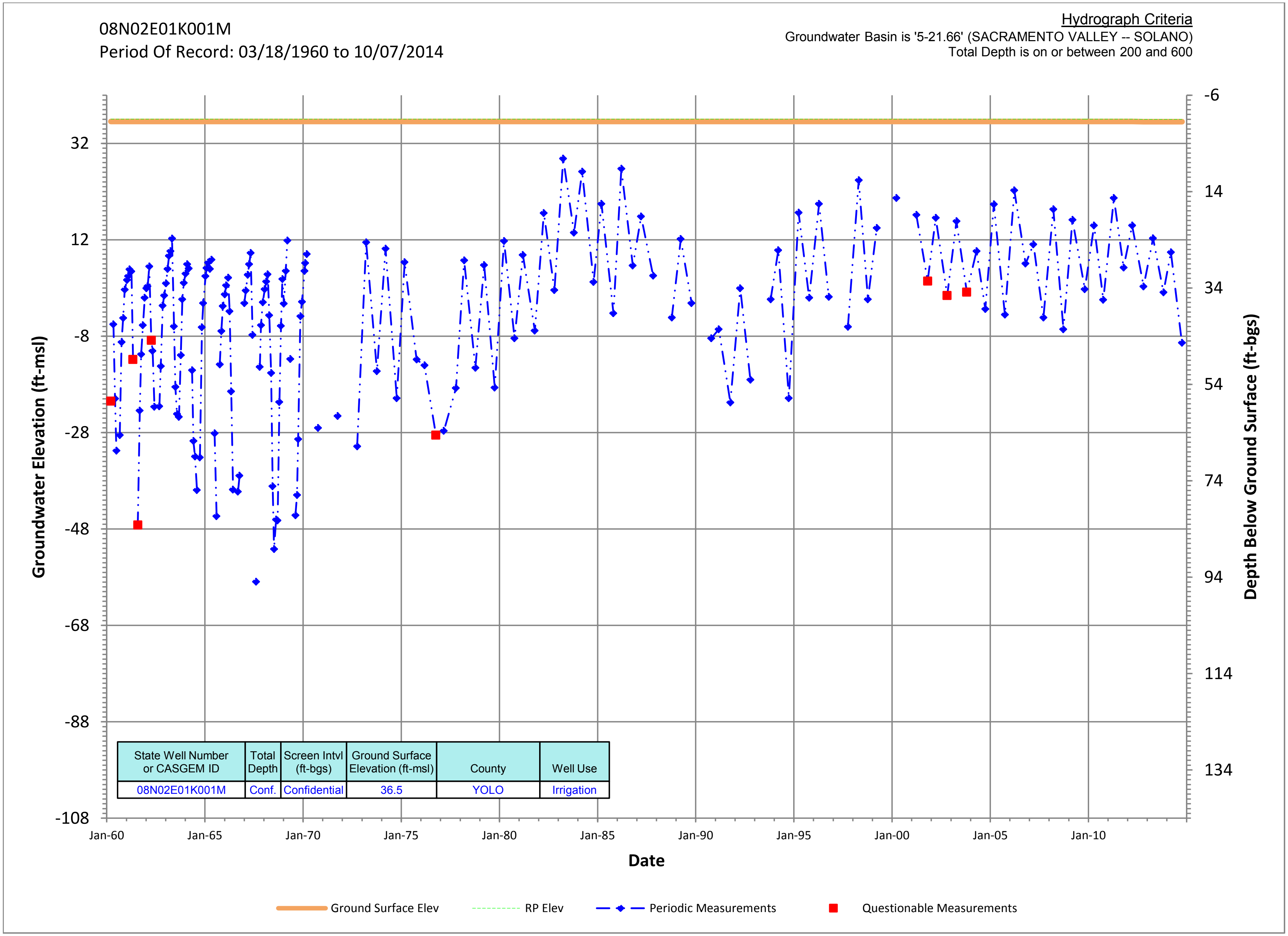
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W35R001M	Conf.	Confidential	110	SOLANO	Irrigation

08N01W36H001M
Period Of Record: 09/07/1948 to 10/09/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W36H001M	Conf.	Confidential	104.6	SOLANO	Irrigation


08N02E01K001M
Period Of Record: 03/18/1960 to 10/07/2014
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
Date
32
12
-8
-28
-48
-68
-88
-108
-6
14
34
54
74
94
114
134
Jan-60
Jan-65
Jan-70
Jan-75
Jan-80
Jan-85
Jan-90
Jan-95
Jan-00
Jan-05
Jan-10
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
08N02E01K001M
Conf.
Confidential
36.5
YOLO
Irrigation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

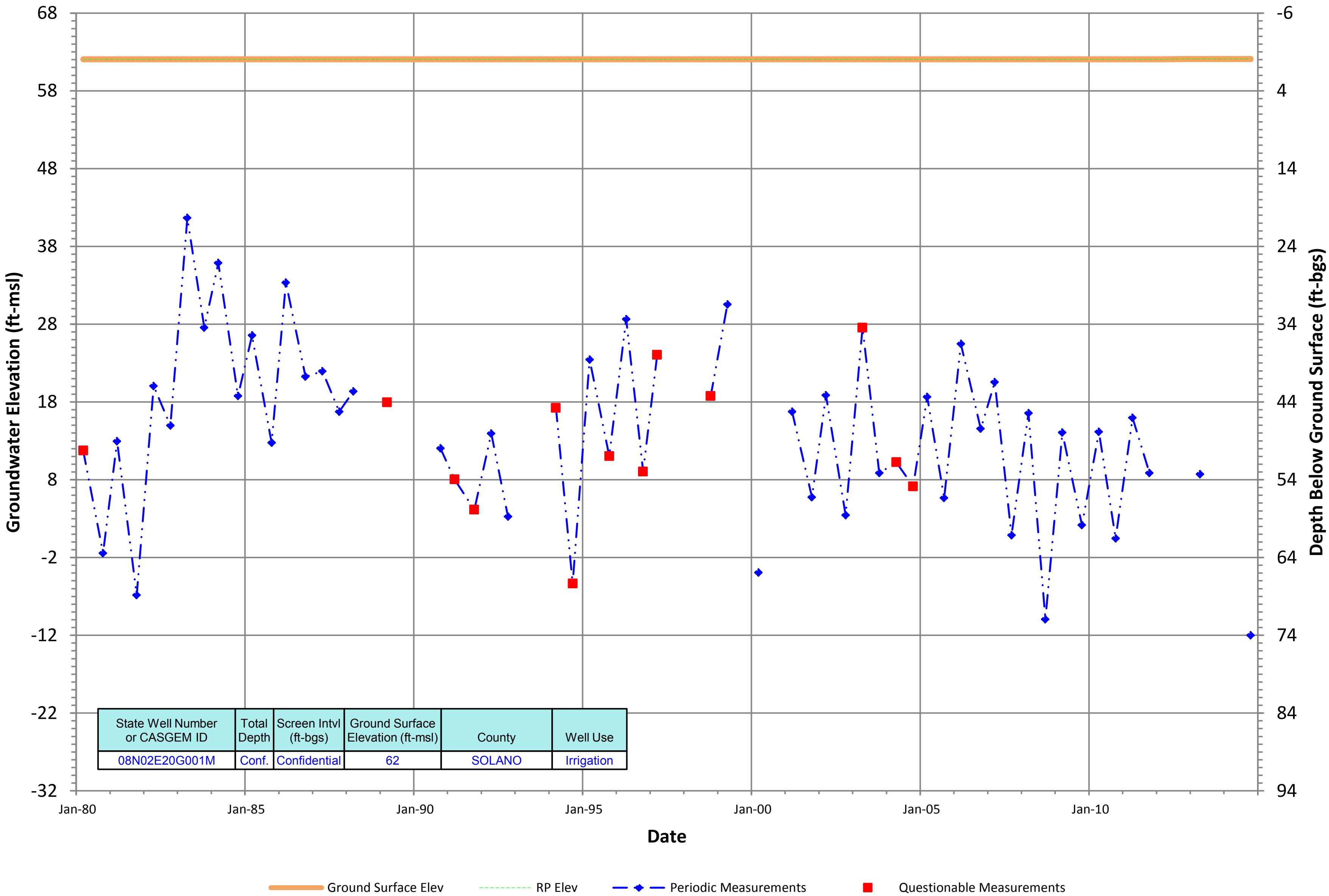
08N02E20G001M

Period Of Record: 03/28/1980 to 10/09/2014

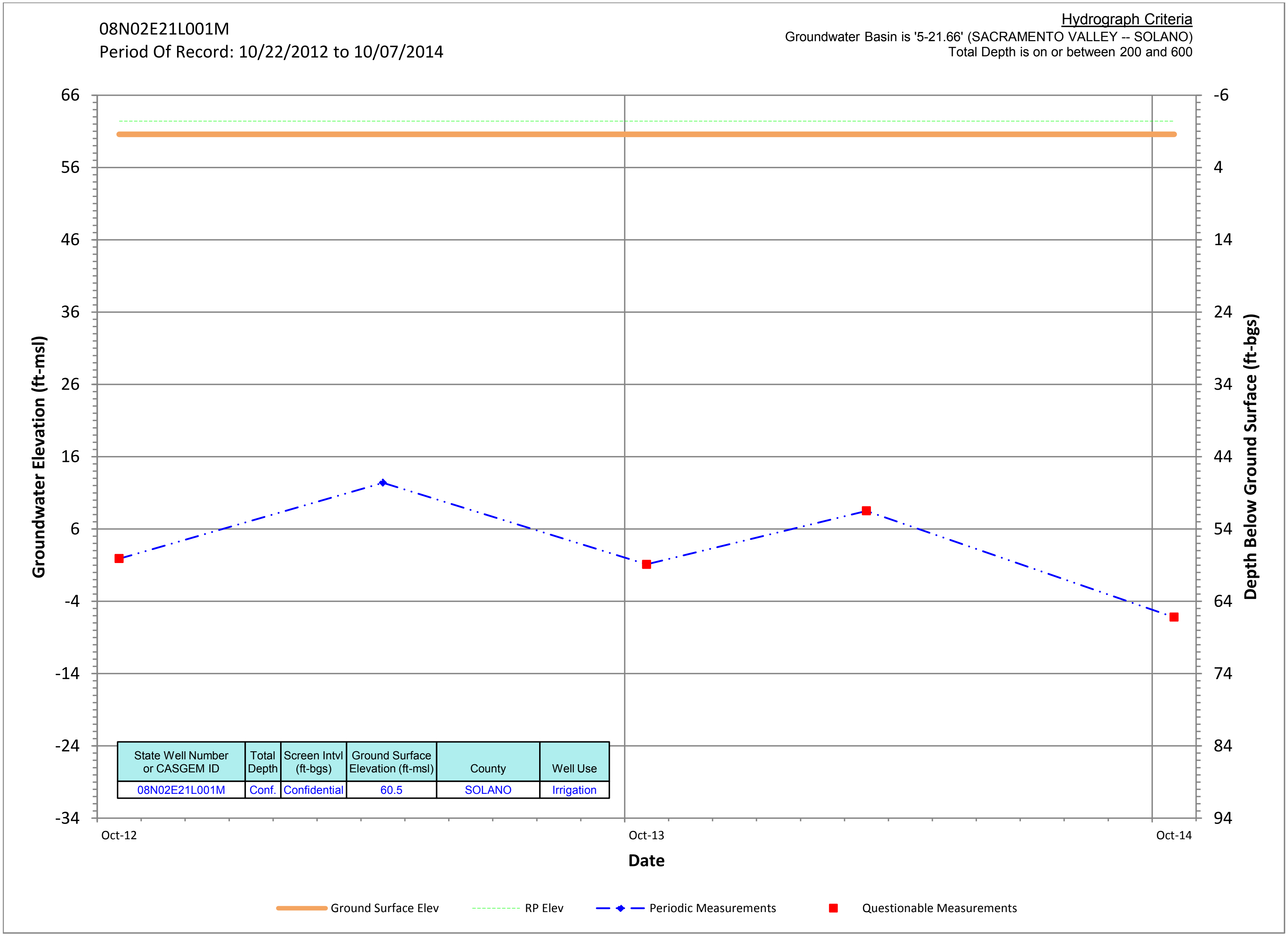
Hydrograph Criteria

Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)

Total Depth is on or between 200 and 600



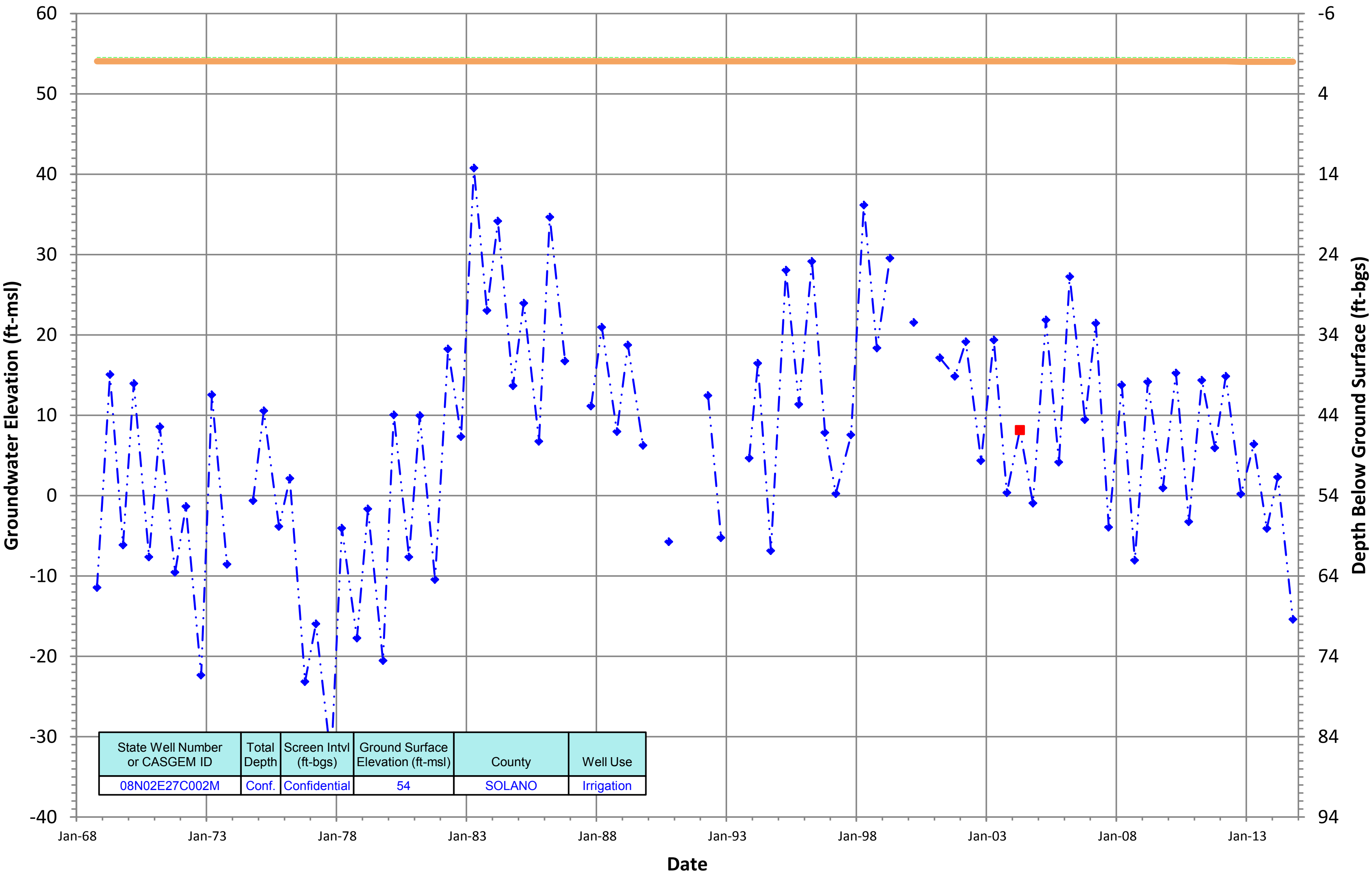
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N02E20G001M	Conf.	Confidential	62	SOLANO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N02E21L001M	Conf.	Confidential	60.5	SOLANO	Irrigation

08N02E27C002M
Period Of Record: 10/21/1968 to 10/07/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N02E27C002M	Conf.	Confidential	54	SOLANO	Irrigation

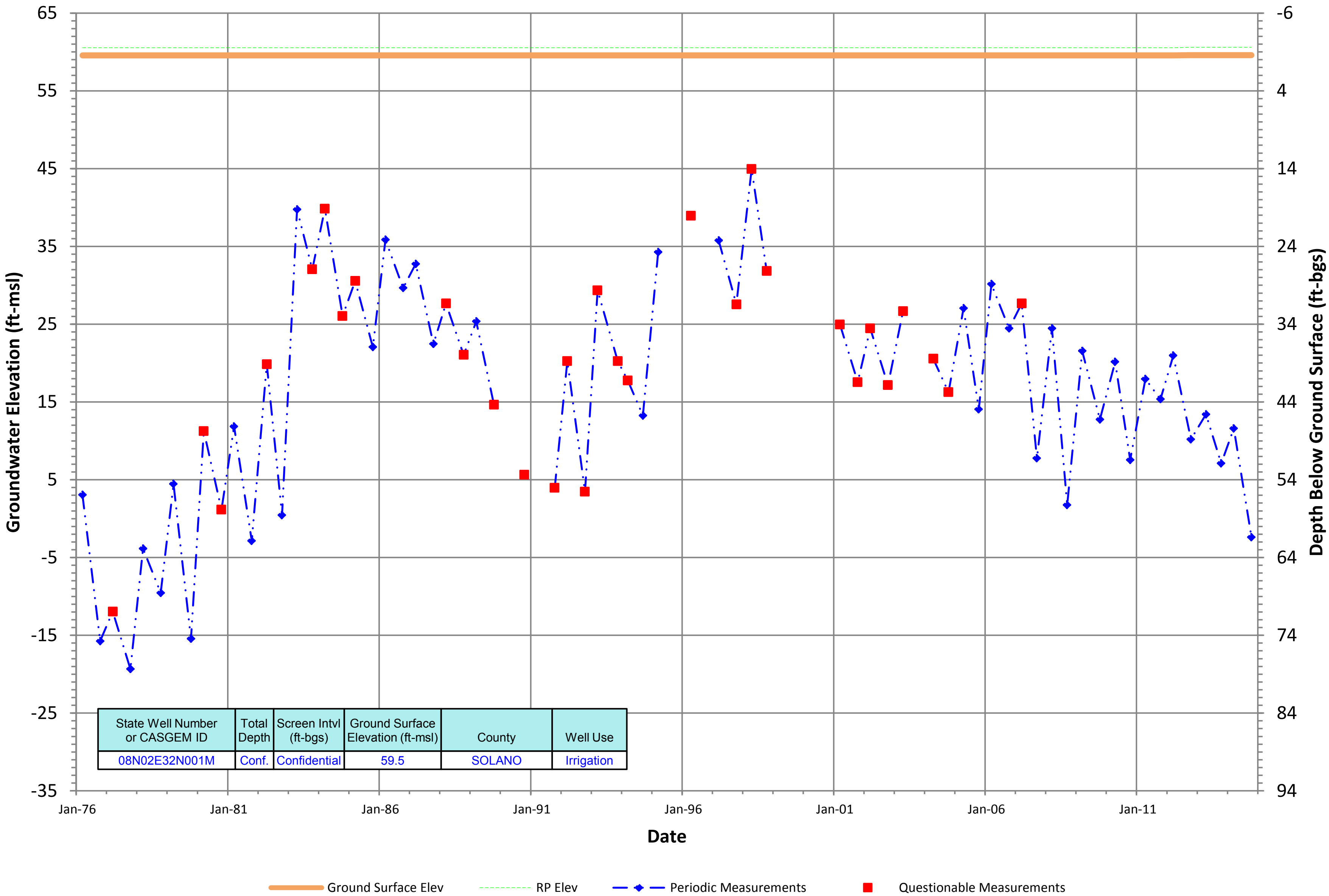
08N02E32N001M

Period Of Record: 03/05/1976 to 10/07/2014

Hydrograph Criteria

Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)

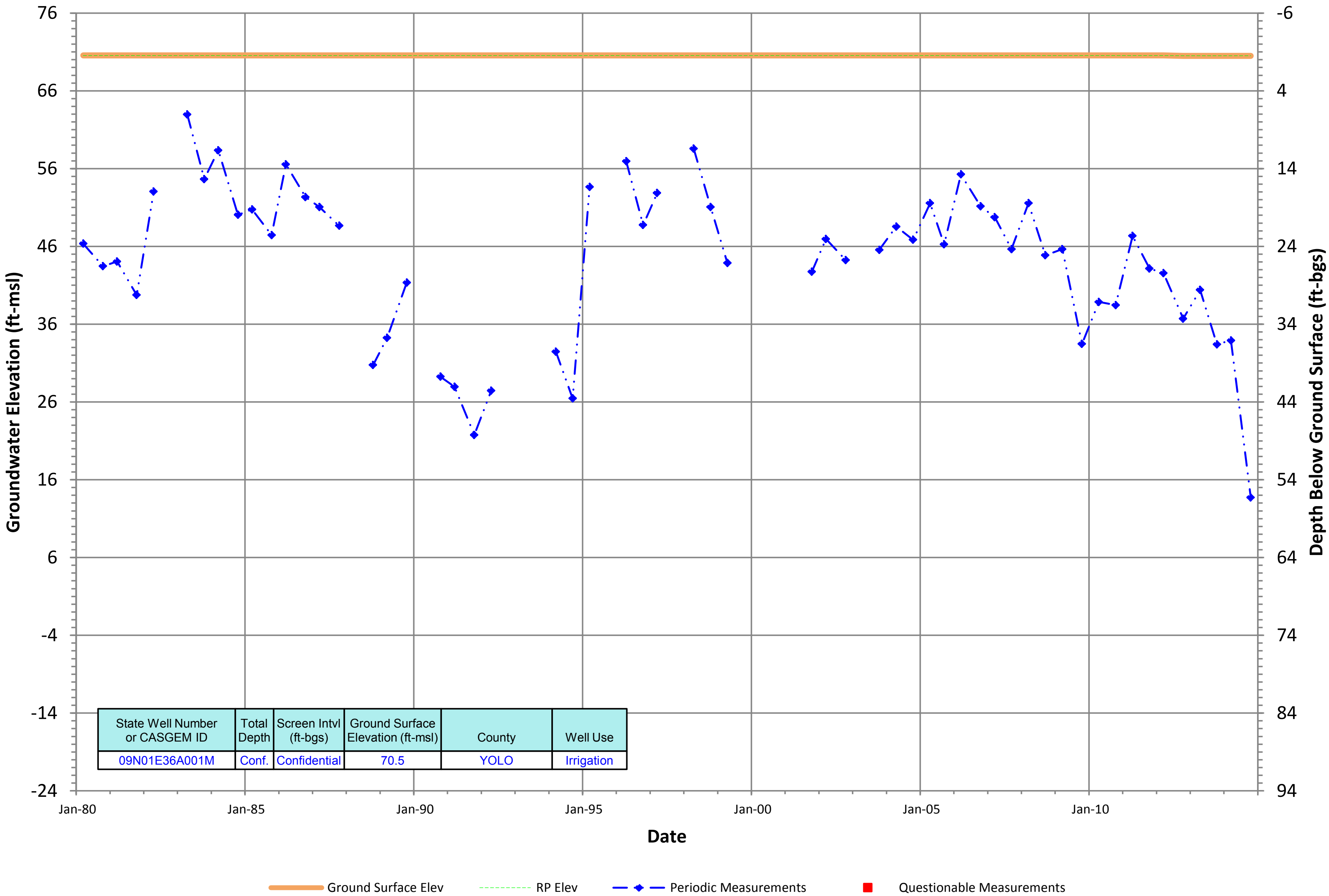
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N02E32N001M	Conf.	Confidential	59.5	SOLANO	Irrigation

09N01E36A001M
Period Of Record: 03/28/1980 to 10/07/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E36A001M	Conf.	Confidential	70.5	YOLO	Irrigation

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Deep Groundwater Monitoring Well Hydrographs- Solano Subbasin

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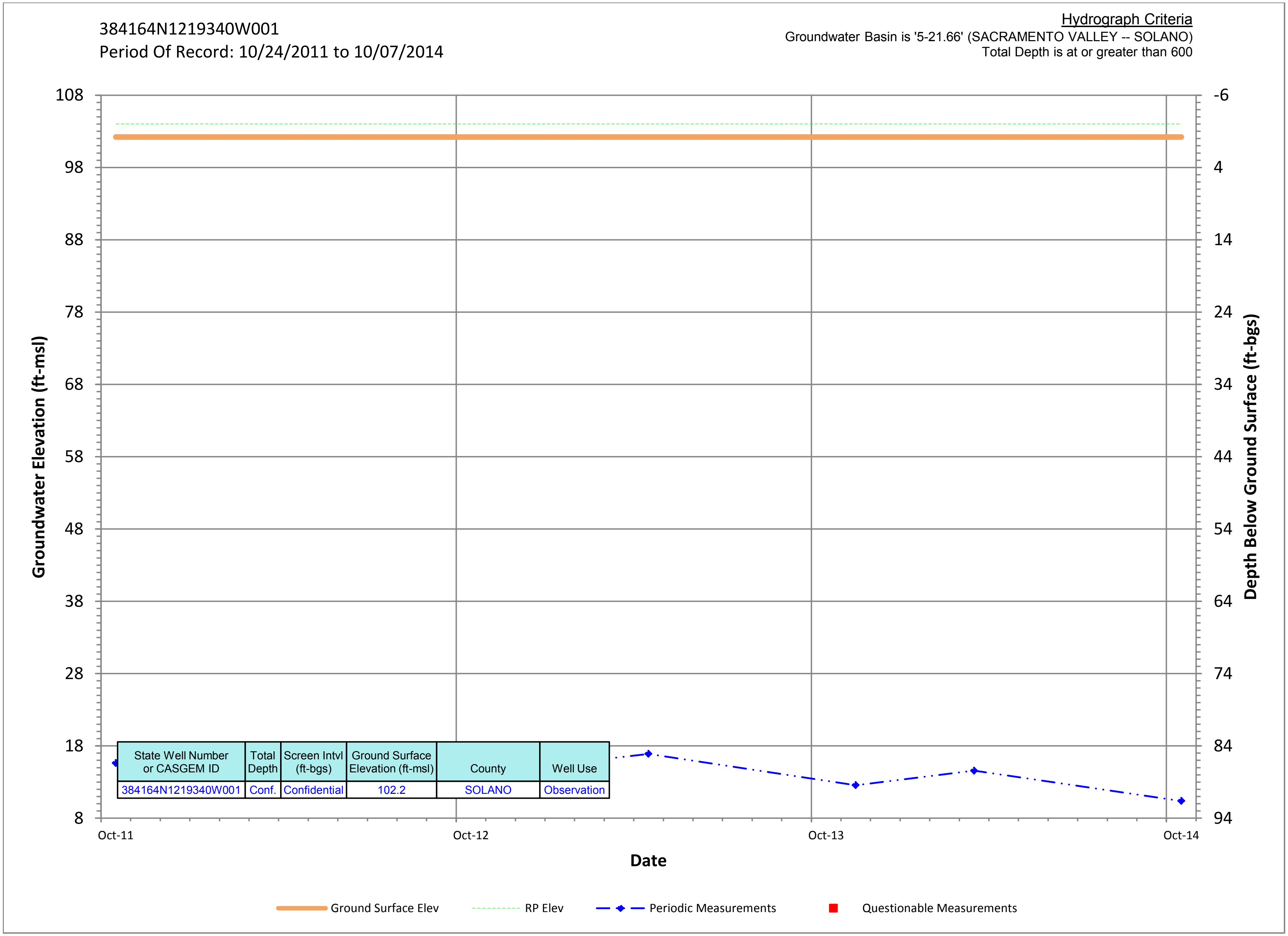
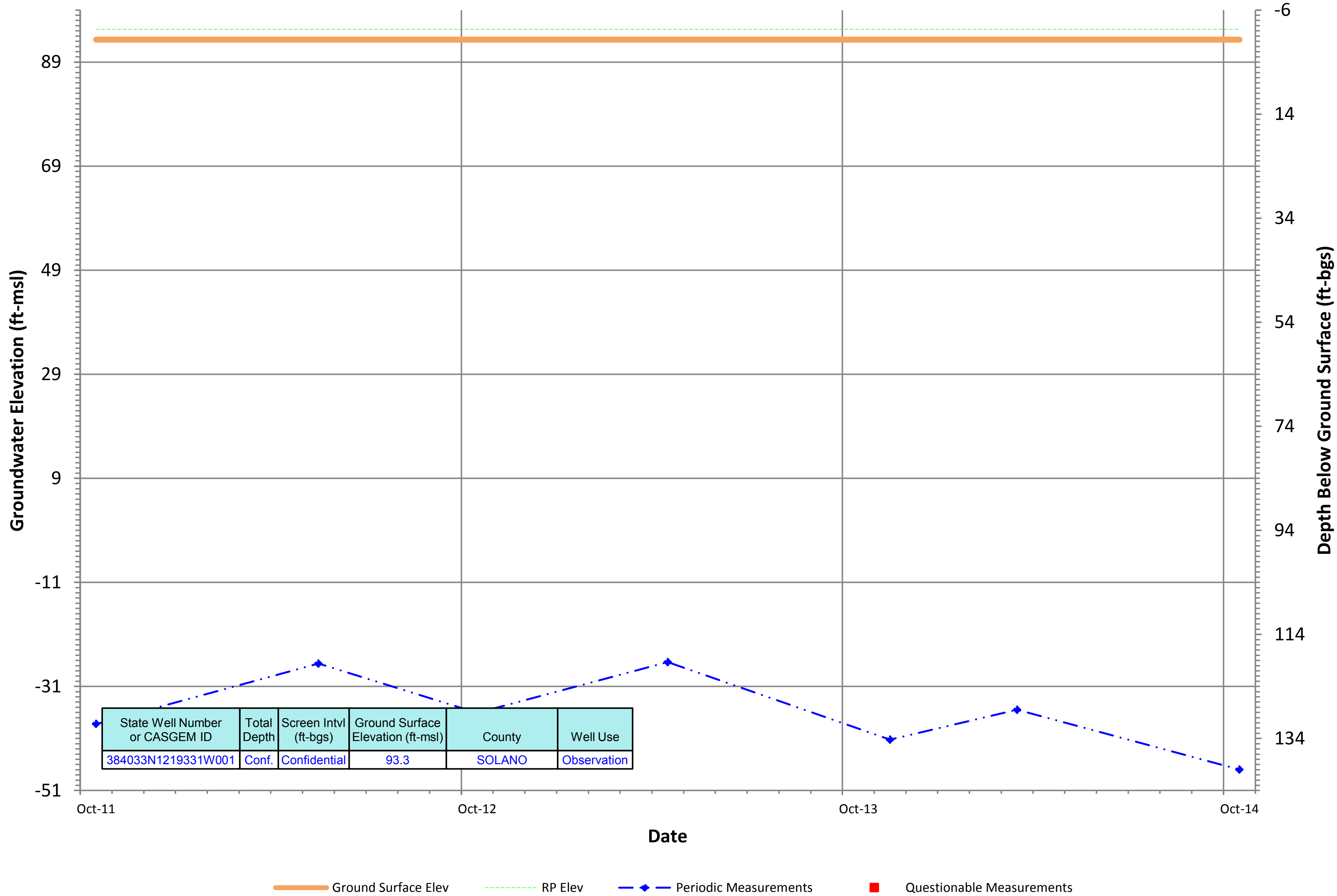


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
384164N1219340W001	Conf.	Confidential	102.2	SOLANO	Observation

384033N1219331W001
Period Of Record: 10/24/2011 to 10/07/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
384033N1219331W001	Conf.	Confidential	93.3	SOLANO	Observation

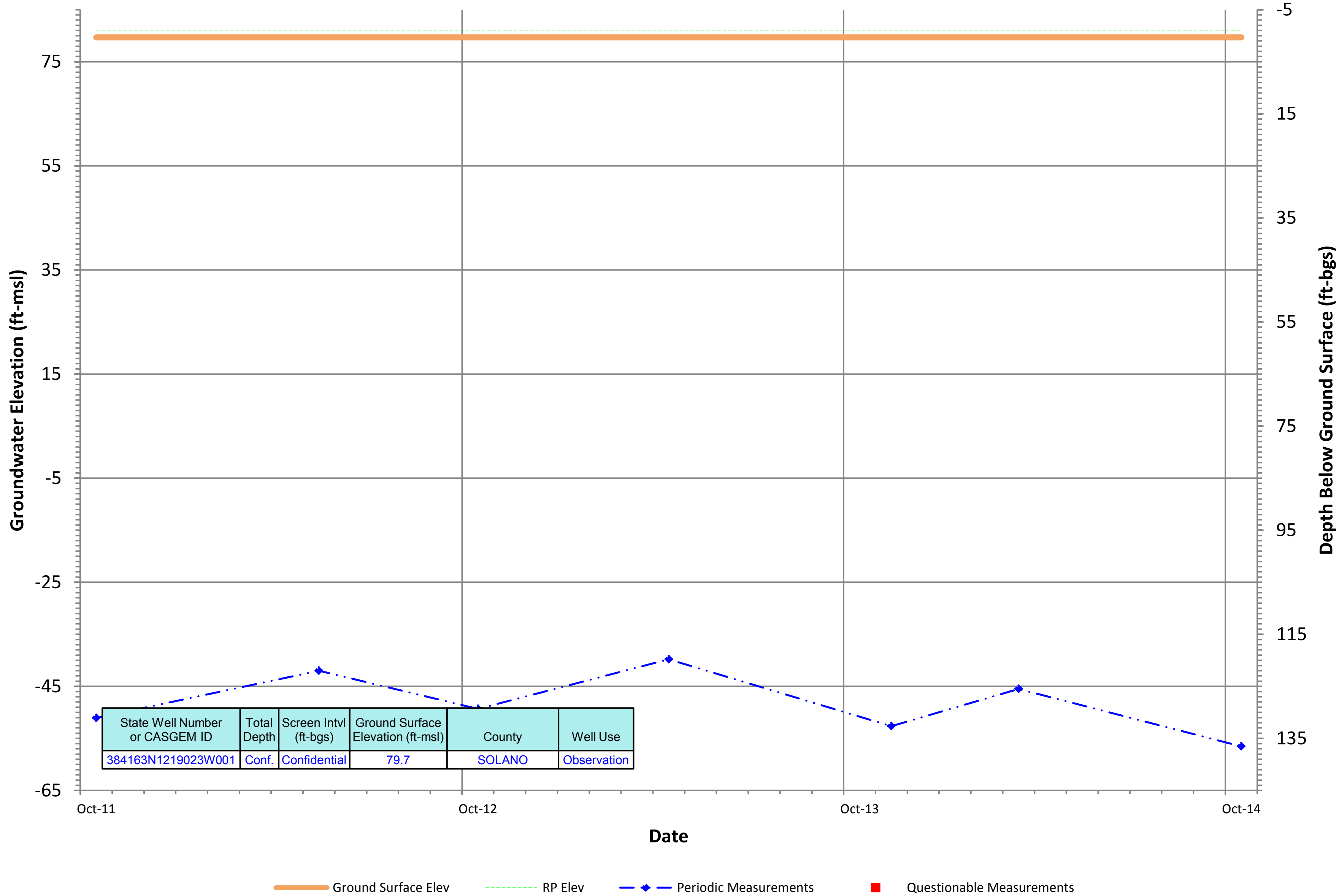
384163N1219023W001

Period Of Record: 10/24/2011 to 10/07/2014

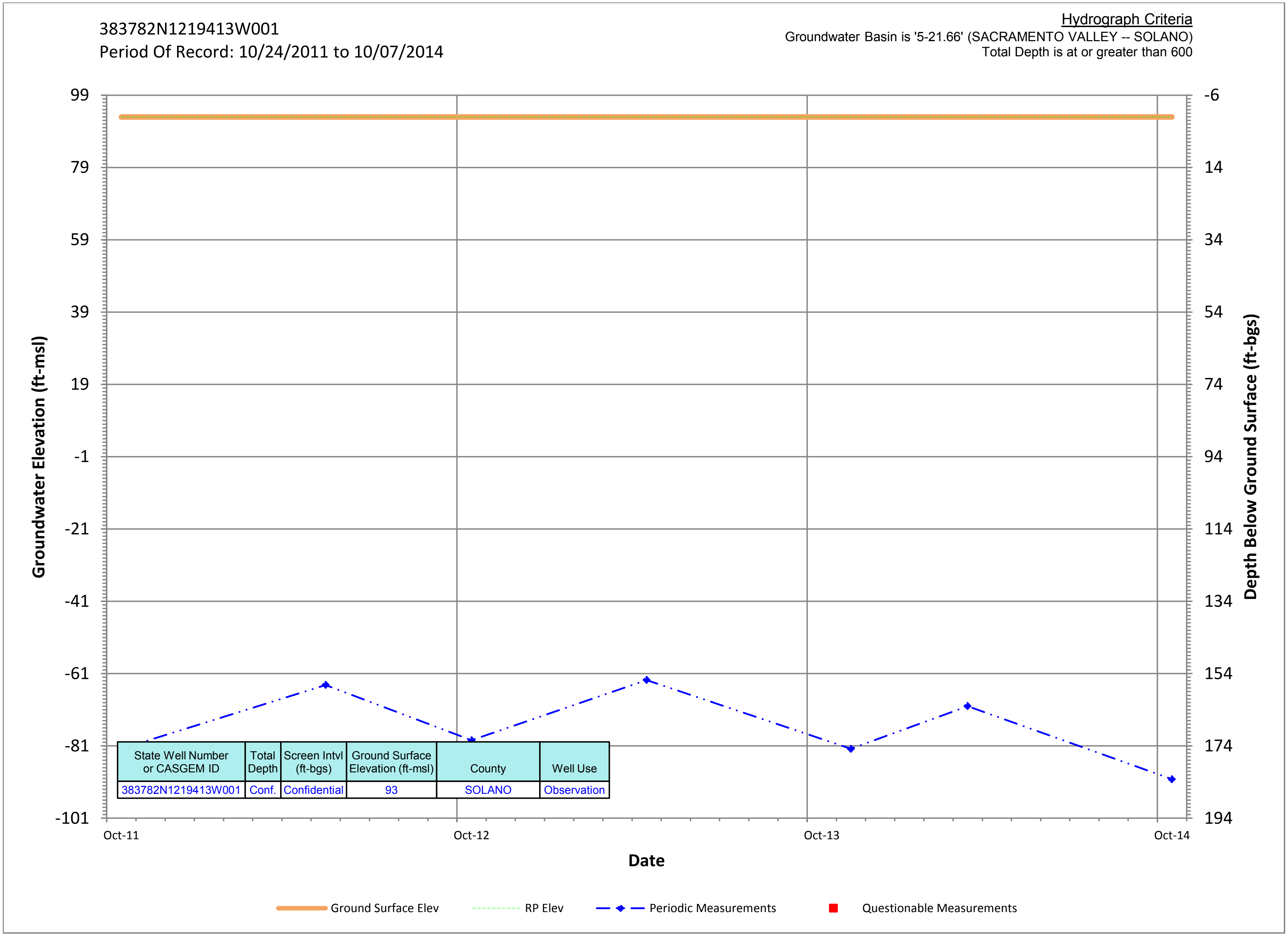
Hydrograph Criteria

Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)

Total Depth is at or greater than 600



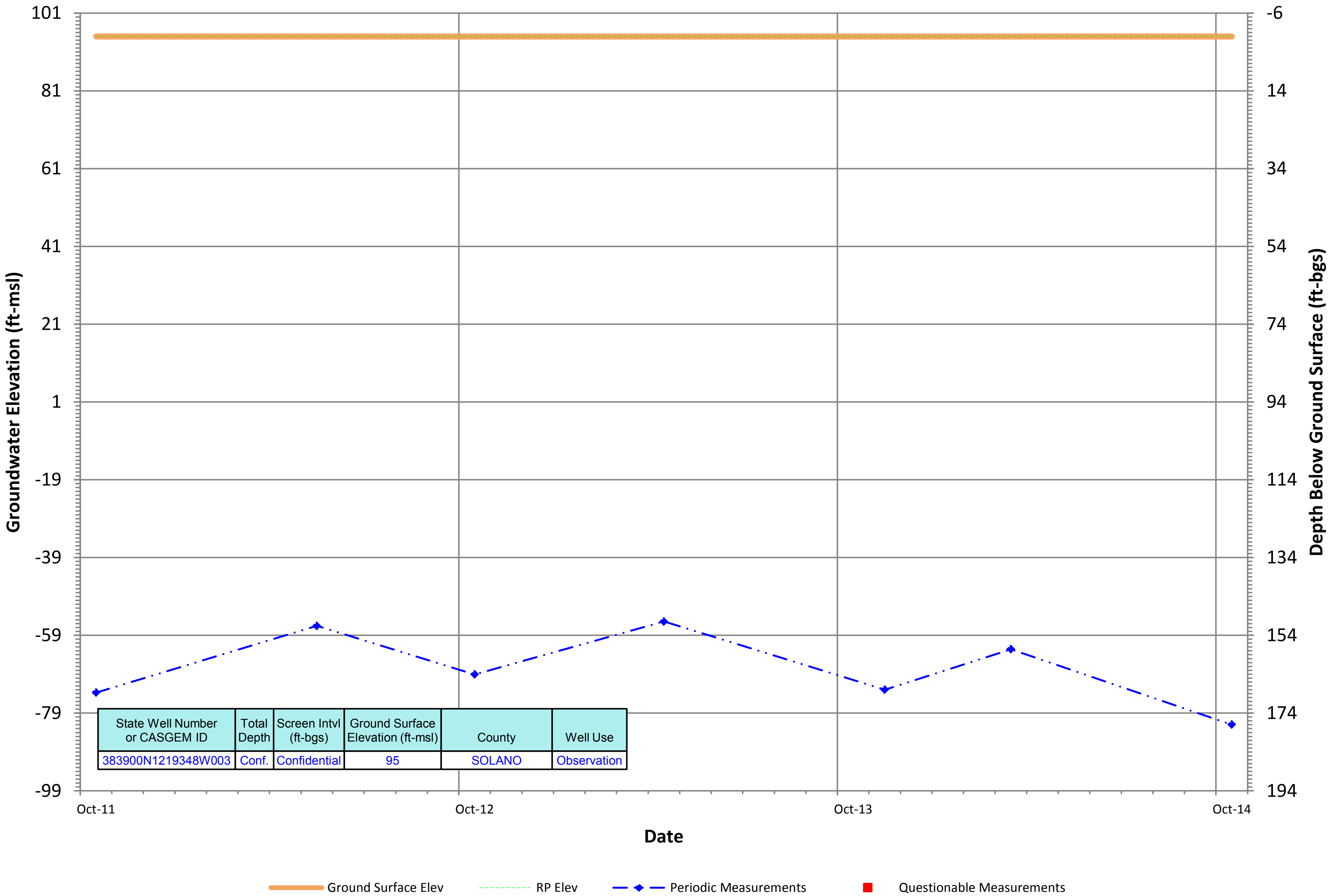
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
384163N1219023W001	Conf.	Confidential	79.7	SOLANO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
383782N1219413W001	Conf.	Confidential	93	SOLANO	Observation

383900N1219348W003
Period Of Record: 10/24/2011 to 10/07/2014

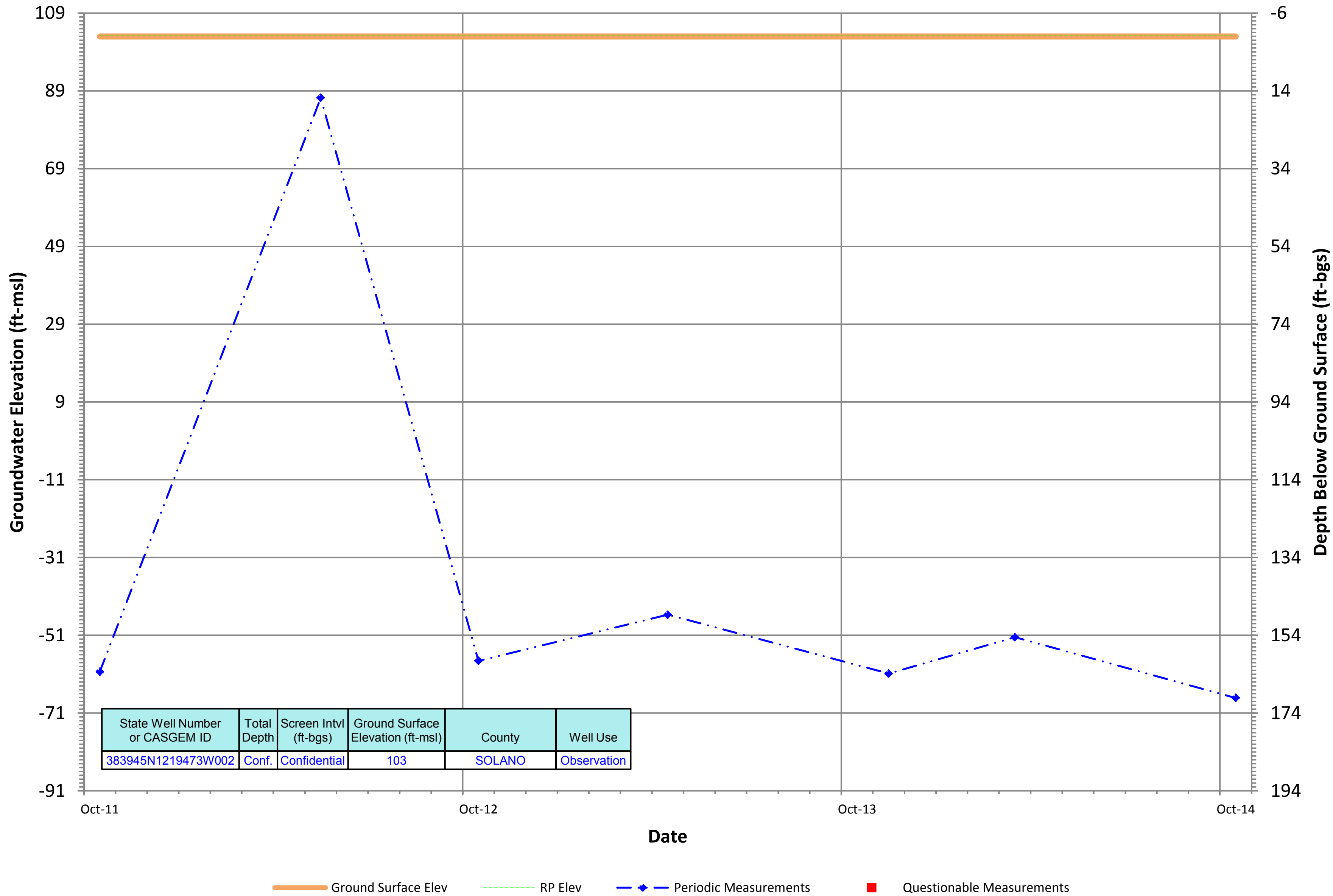
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
383900N1219348W003	Conf.	Confidential	95	SOLANO	Observation

383945N1219473W002
Period Of Record: 10/24/2011 to 10/07/2014

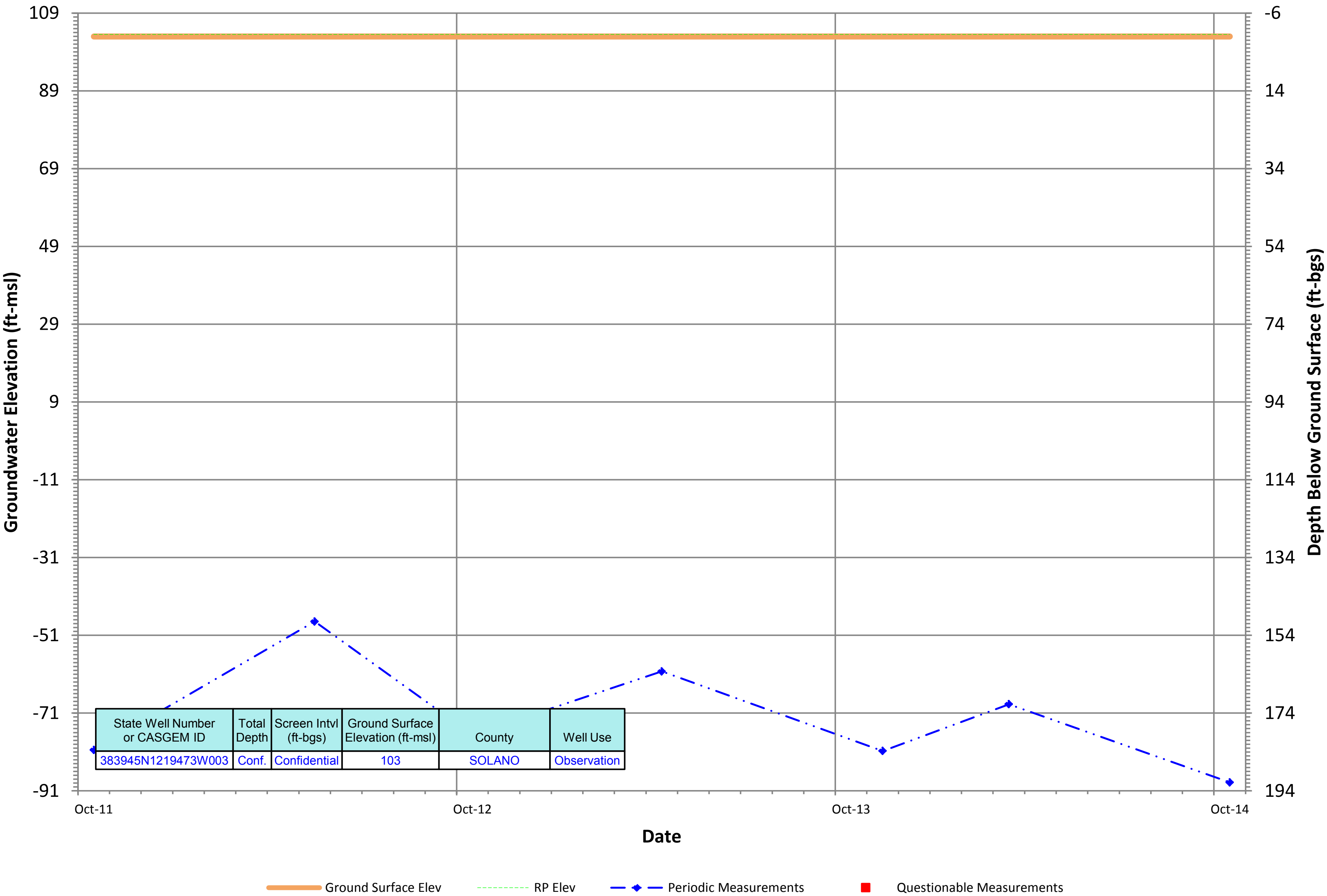
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
383945N1219473W002	Conf.	Confidential	103	SOLANO	Observation

383945N1219473W003
Period Of Record: 10/24/2011 to 10/07/2014

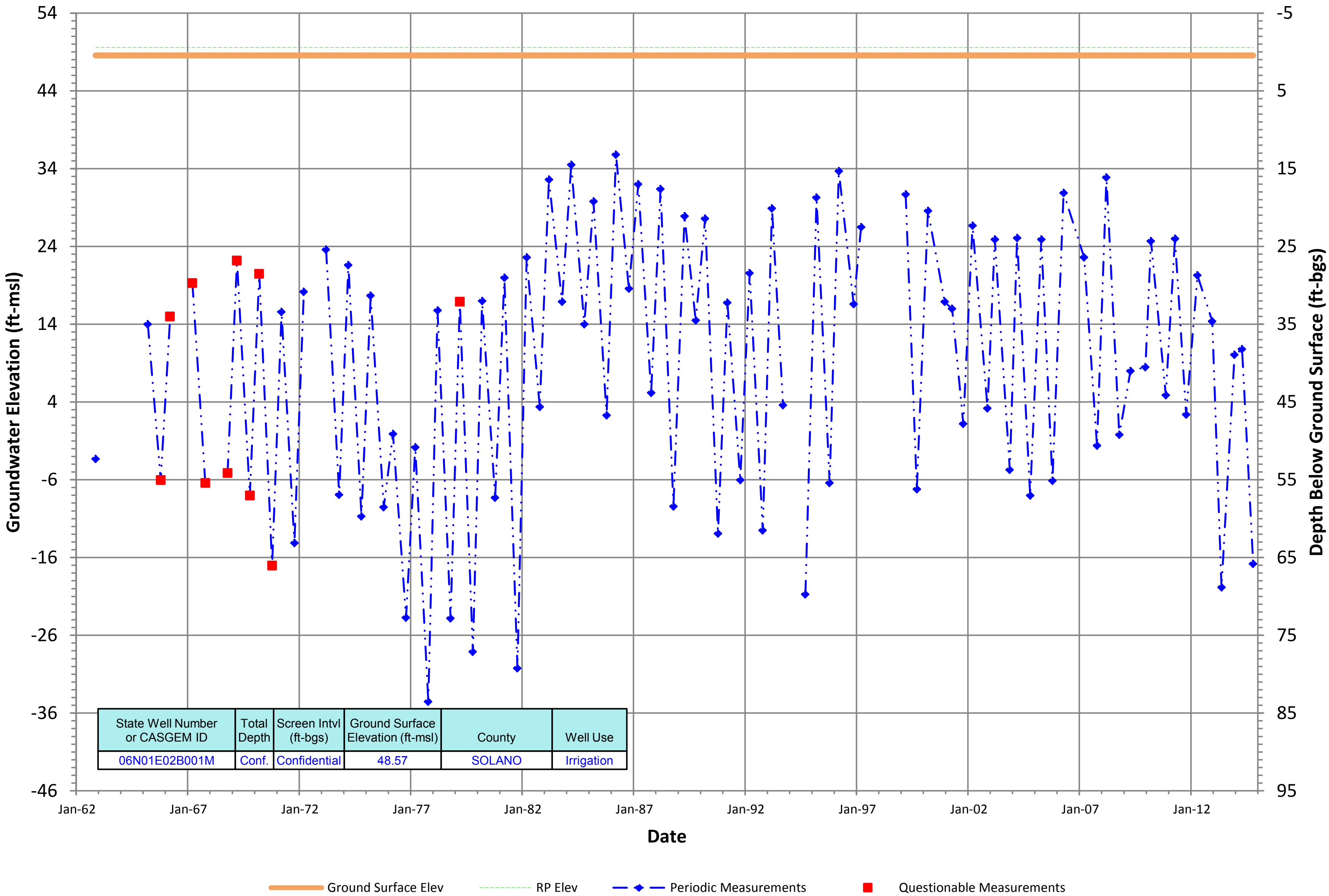
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
383945N1219473W003	Conf.	Confidential	103	SOLANO	Observation

06N01E02B001M
Period Of Record: 11/21/1962 to 10/29/2014

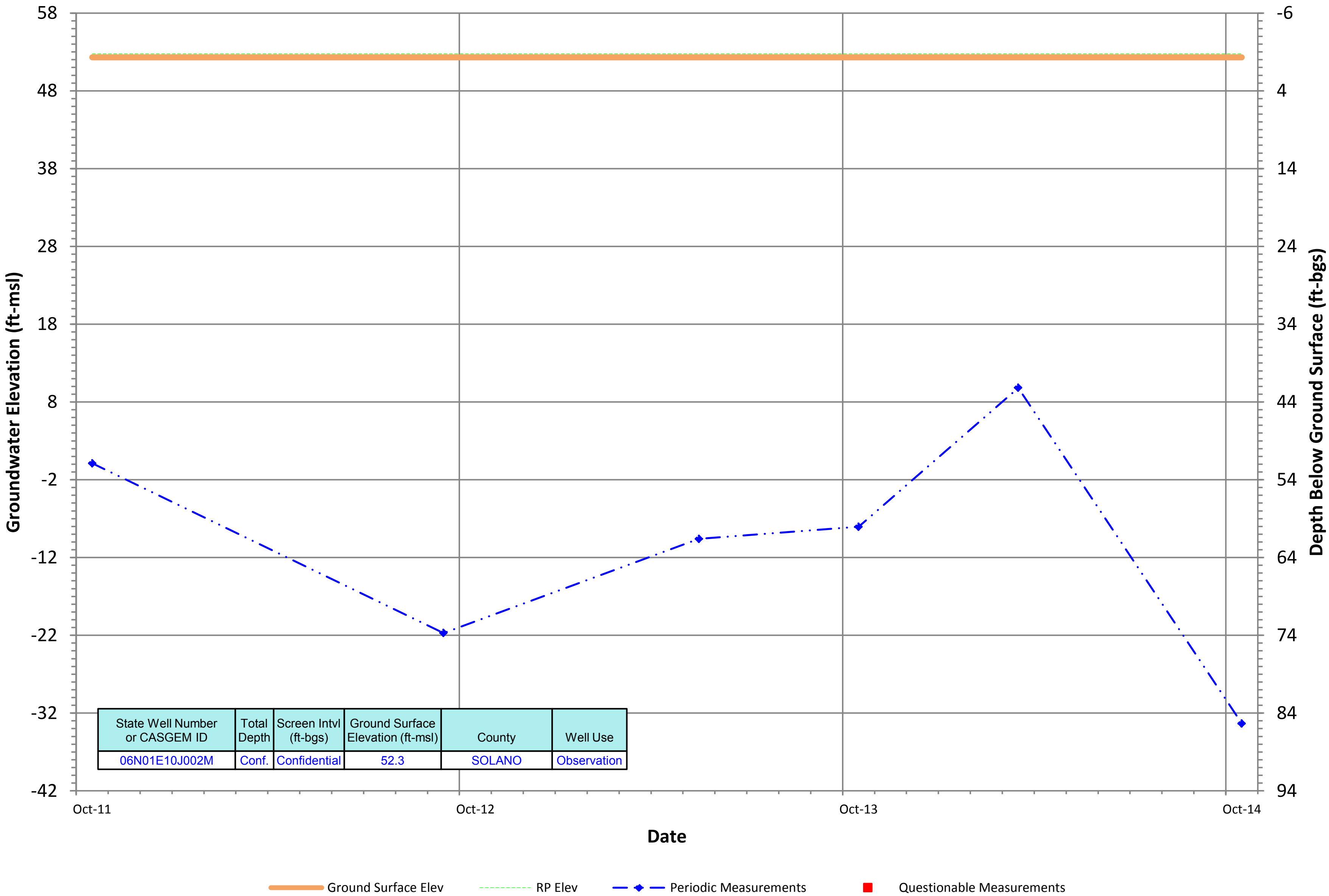
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E02B001M	Conf.	Confidential	48.57	SOLANO	Irrigation

06N01E10J002M
Period Of Record: 10/24/2011 to 10/14/2014

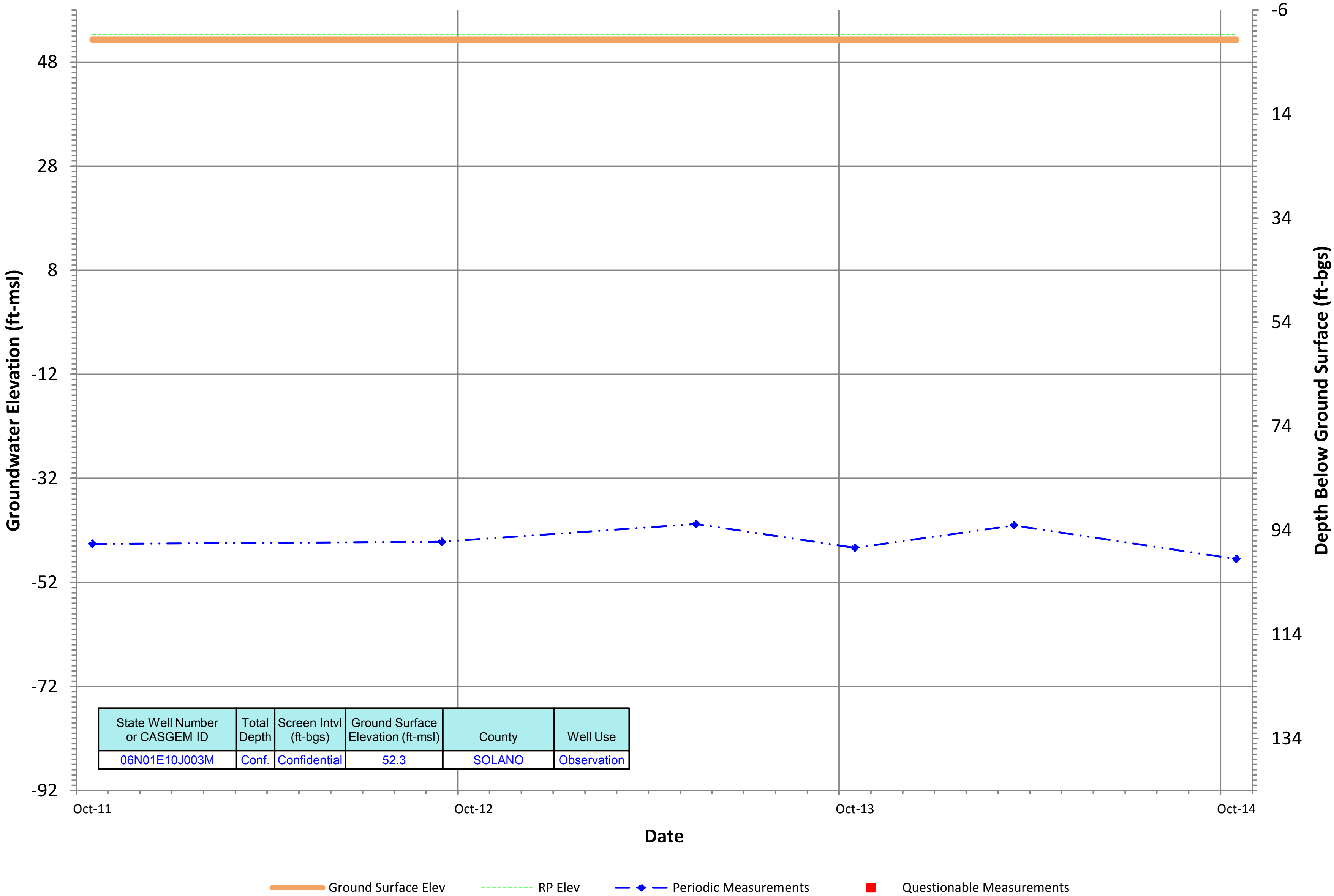
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E10J002M	Conf.	Confidential	52.3	SOLANO	Observation

06N01E10J003M
Period Of Record: 10/24/2011 to 10/14/2014

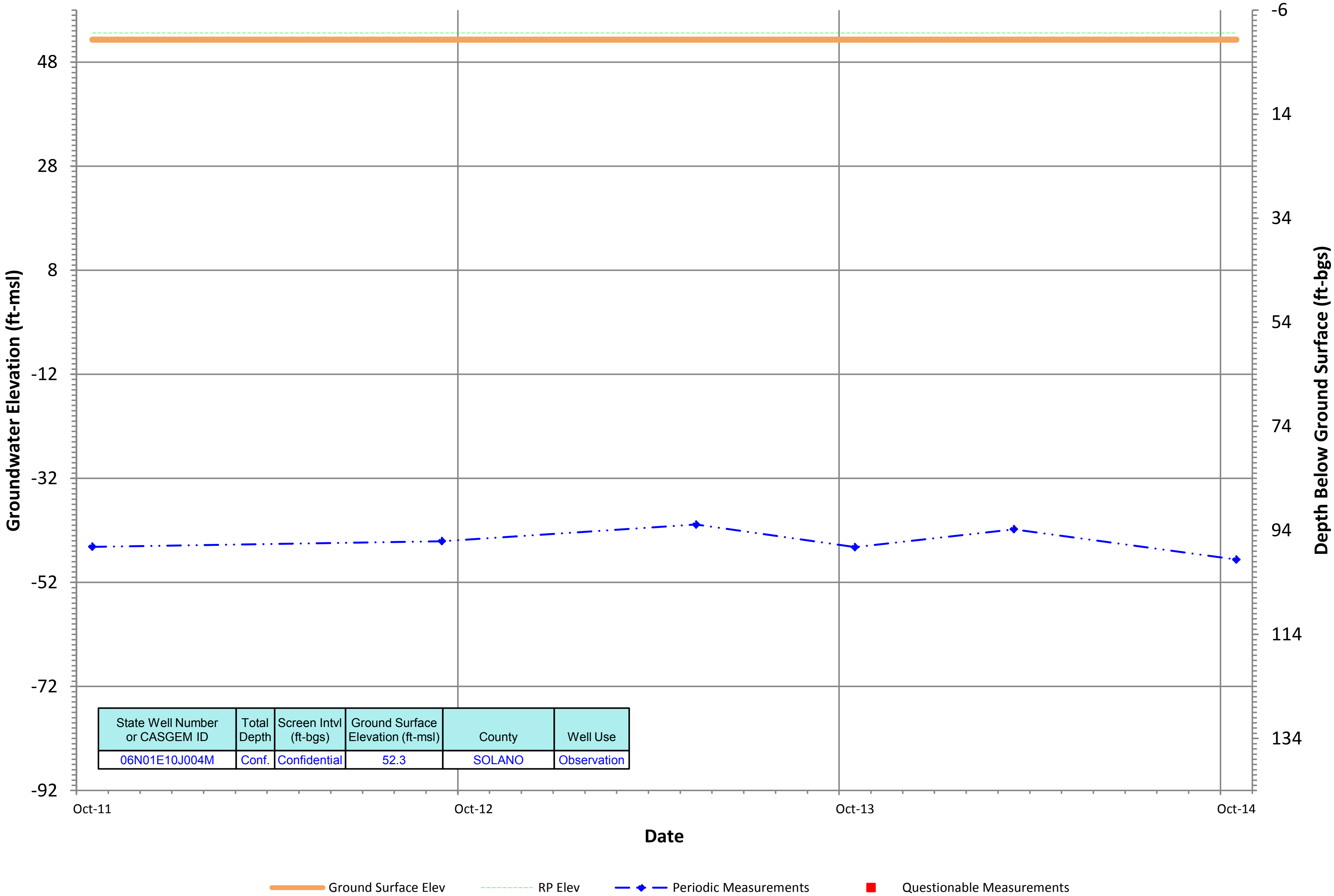
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E10J003M	Conf.	Confidential	52.3	SOLANO	Observation

06N01E10J004M
Period Of Record: 10/24/2011 to 10/14/2014

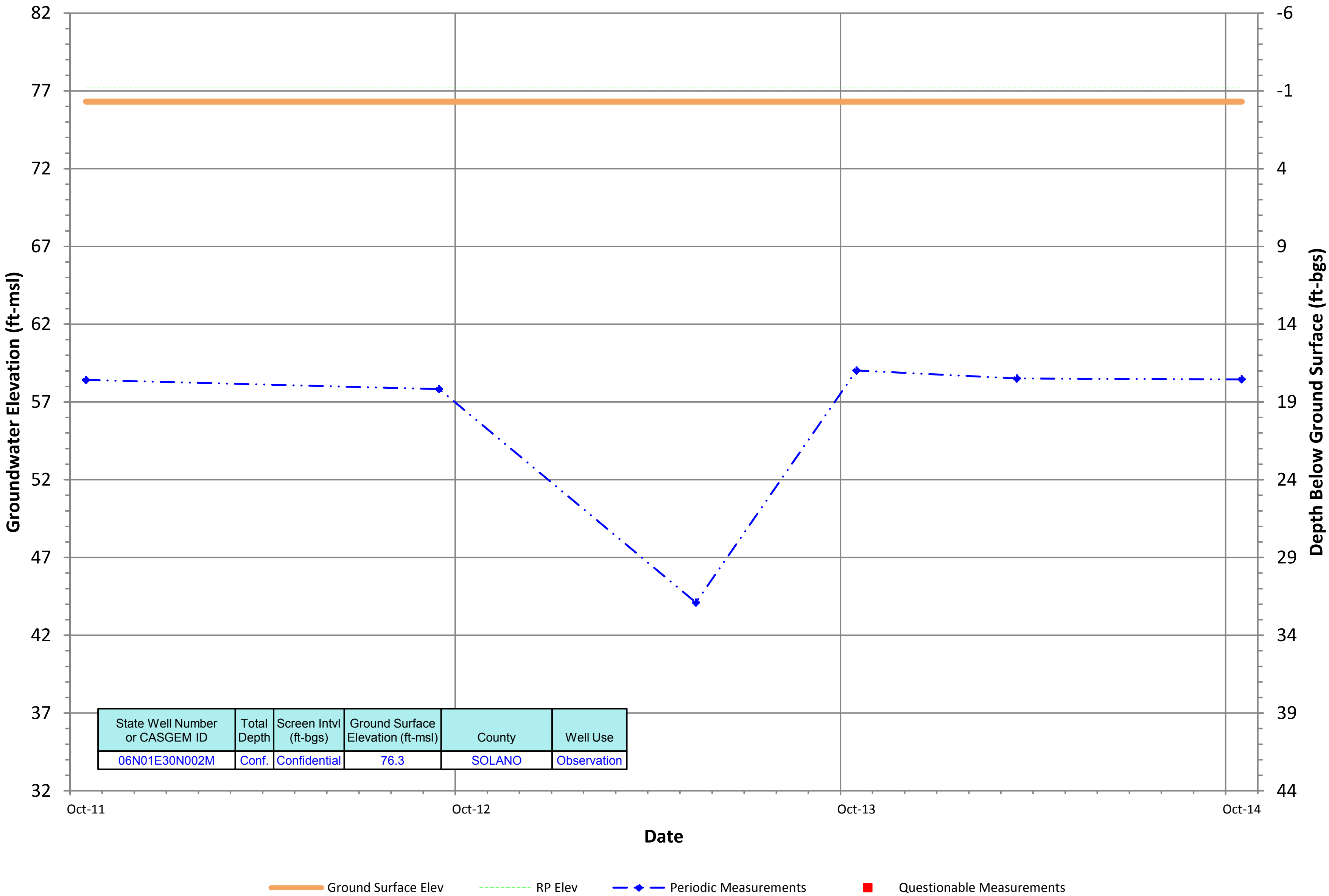
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



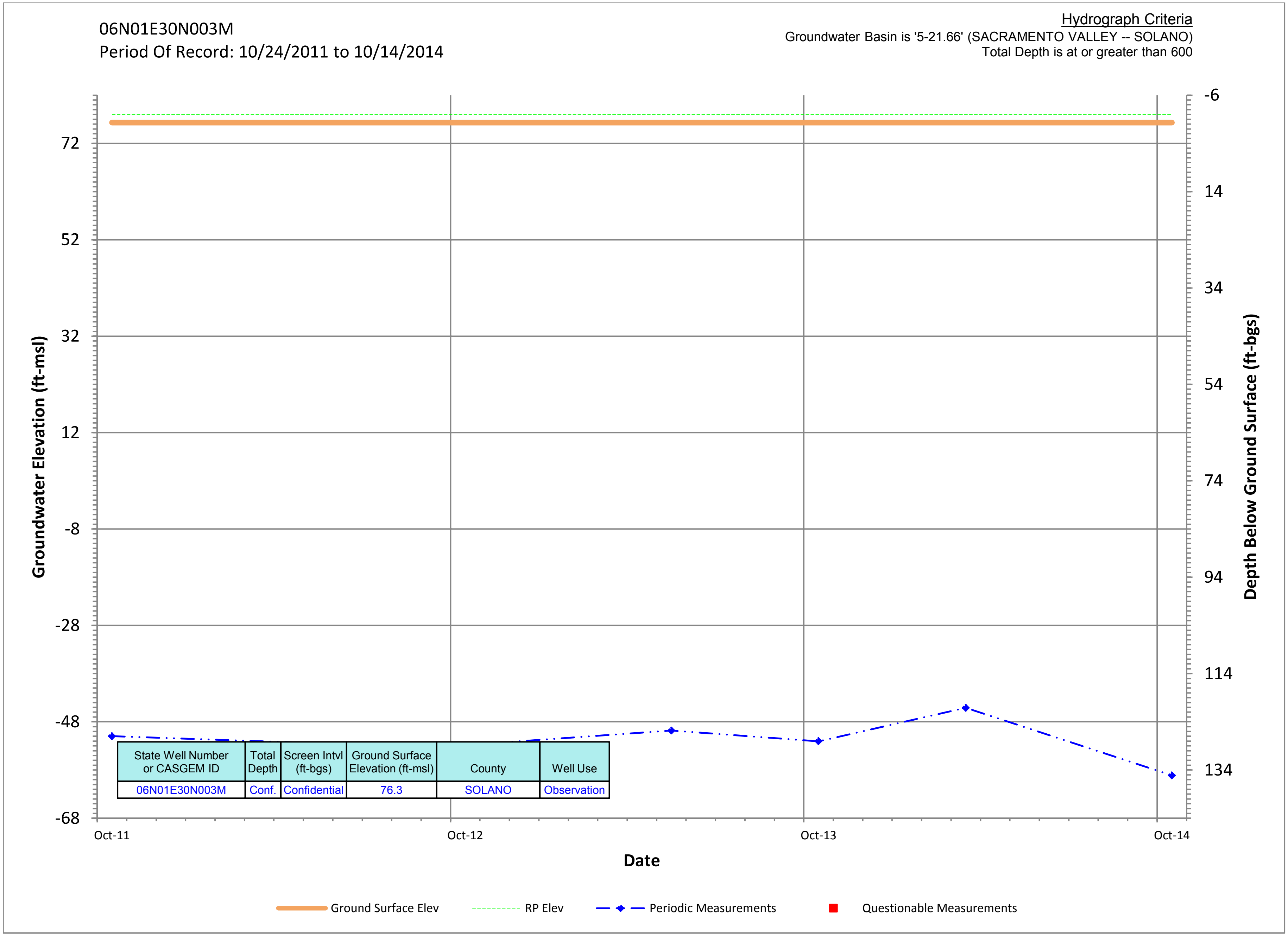
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E10J004M	Conf.	Confidential	52.3	SOLANO	Observation

06N01E30N002M
Period Of Record: 10/24/2011 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



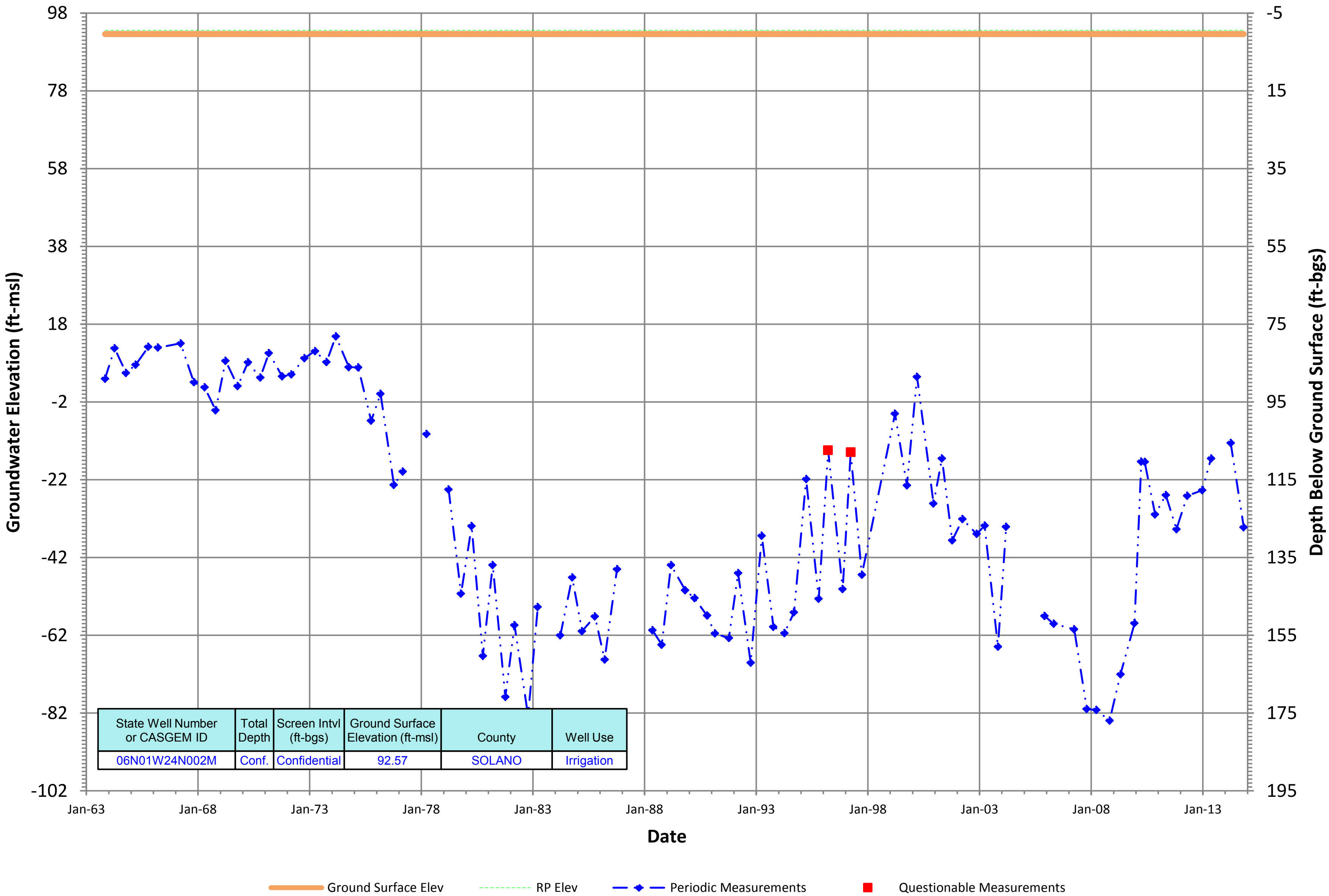
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E30N002M	Conf.	Confidential	76.3	SOLANO	Observation



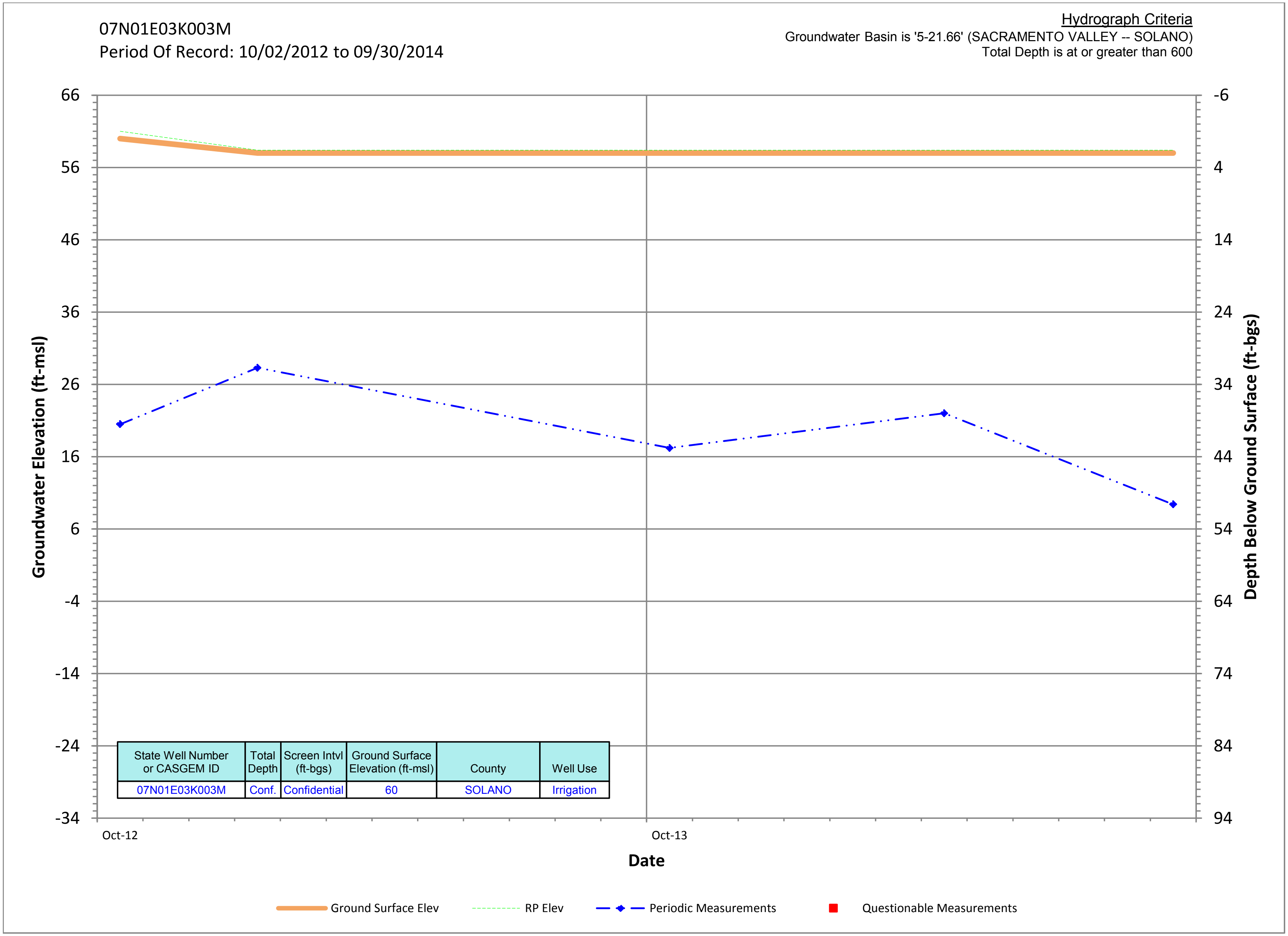
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01E30N003M	Conf.	Confidential	76.3	SOLANO	Observation

06N01W24N002M
Period Of Record: 11/01/1963 to 10/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



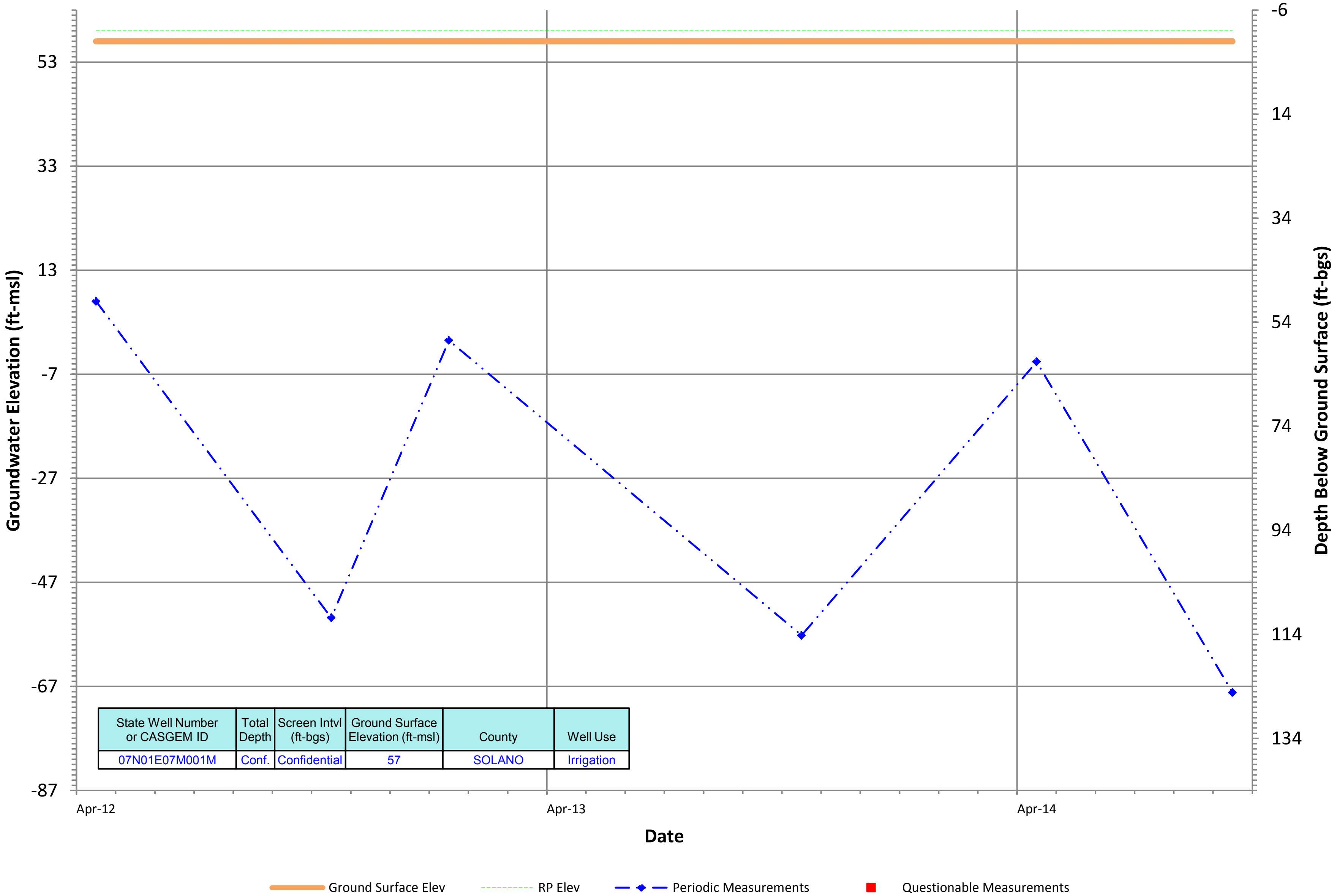
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N01W24N002M	Conf.	Confidential	92.57	SOLANO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E03K003M	Conf.	Confidential	60	SOLANO	Irrigation

07N01E07M001M
Period Of Record: 04/02/2012 to 09/29/2014

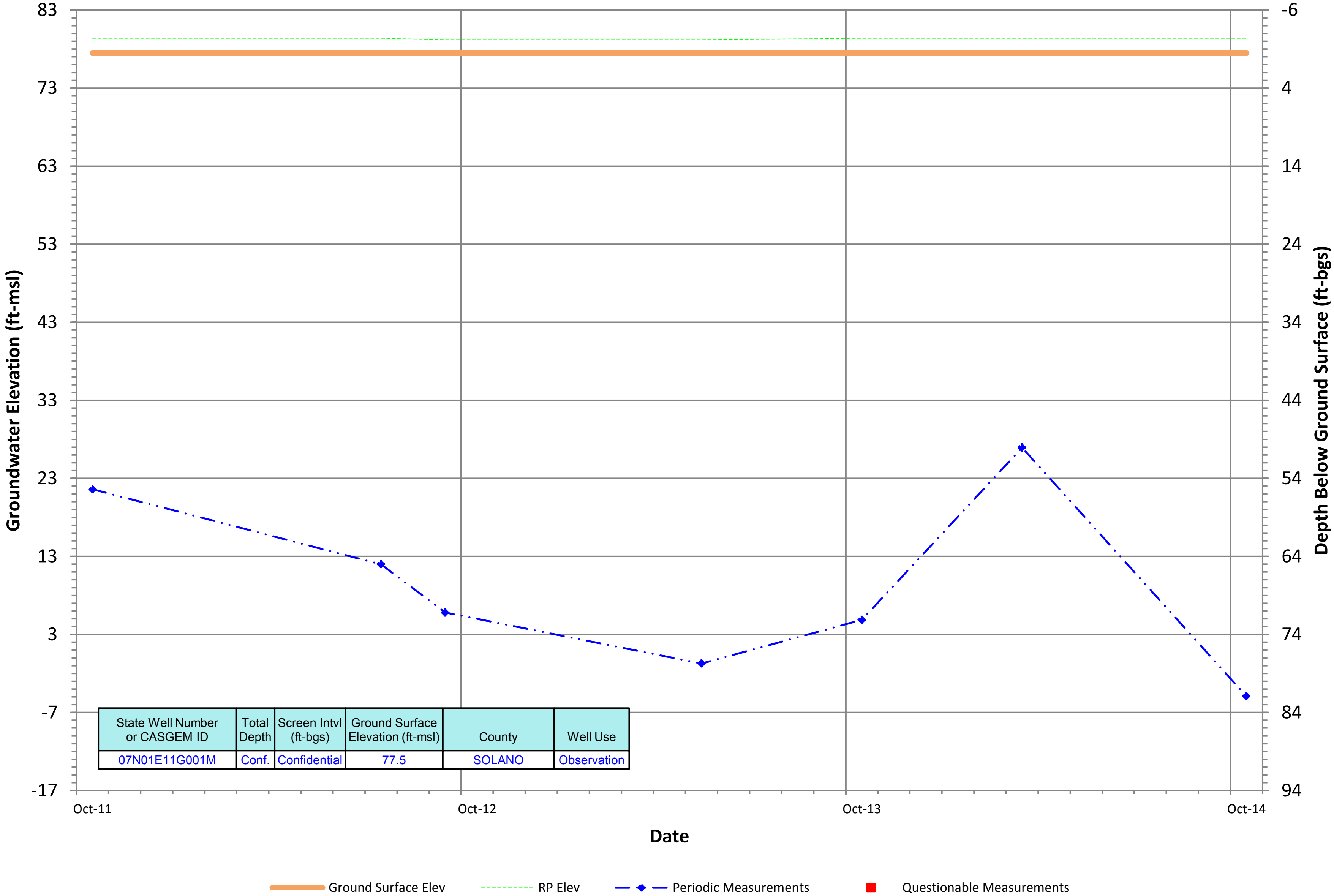
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E07M001M	Conf.	Confidential	57	SOLANO	Irrigation

07N01E11G001M
Period Of Record: 10/24/2011 to 10/14/2014

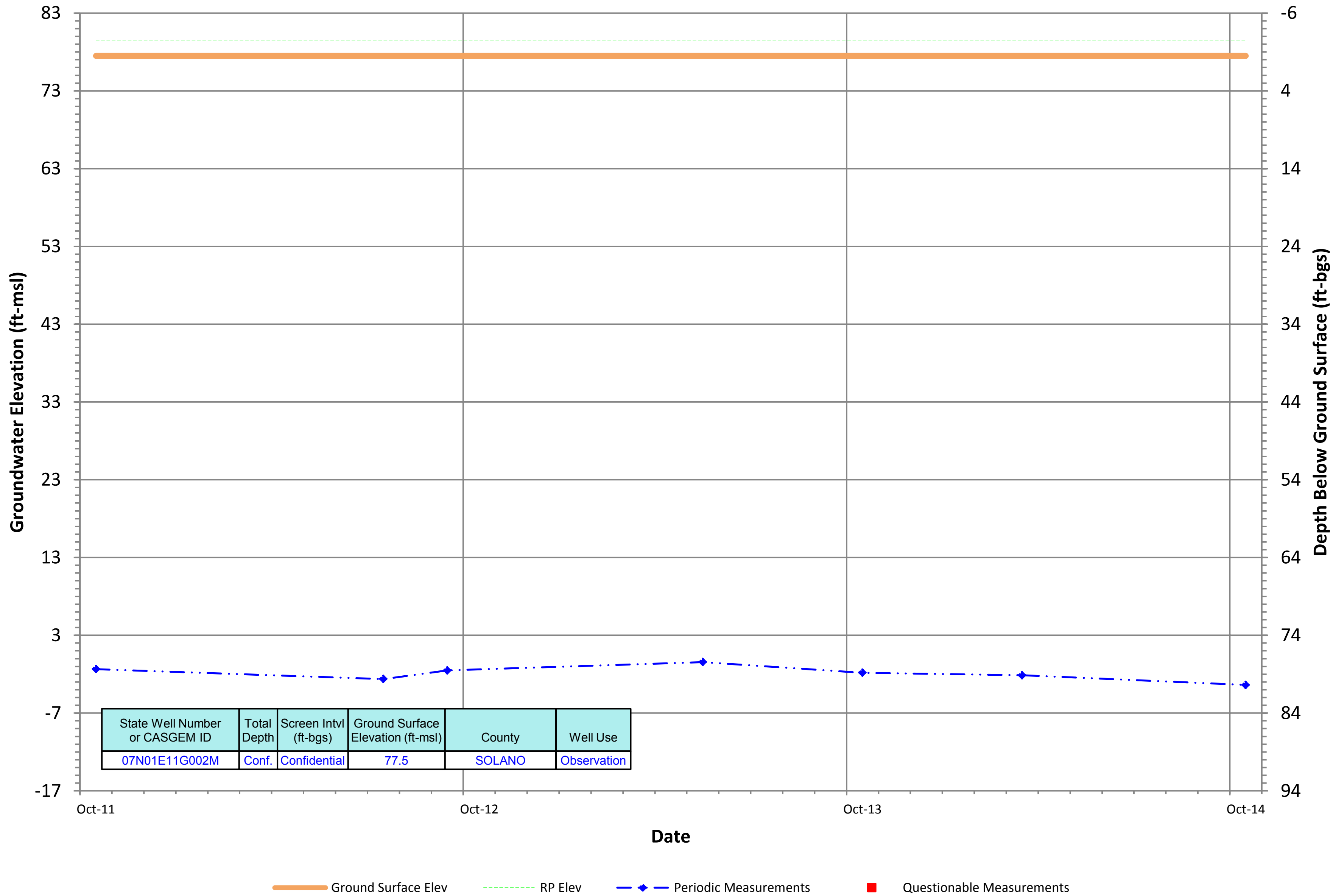
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E11G001M	Conf.	Confidential	77.5	SOLANO	Observation

07N01E11G002M
Period Of Record: 10/24/2011 to 10/14/2014

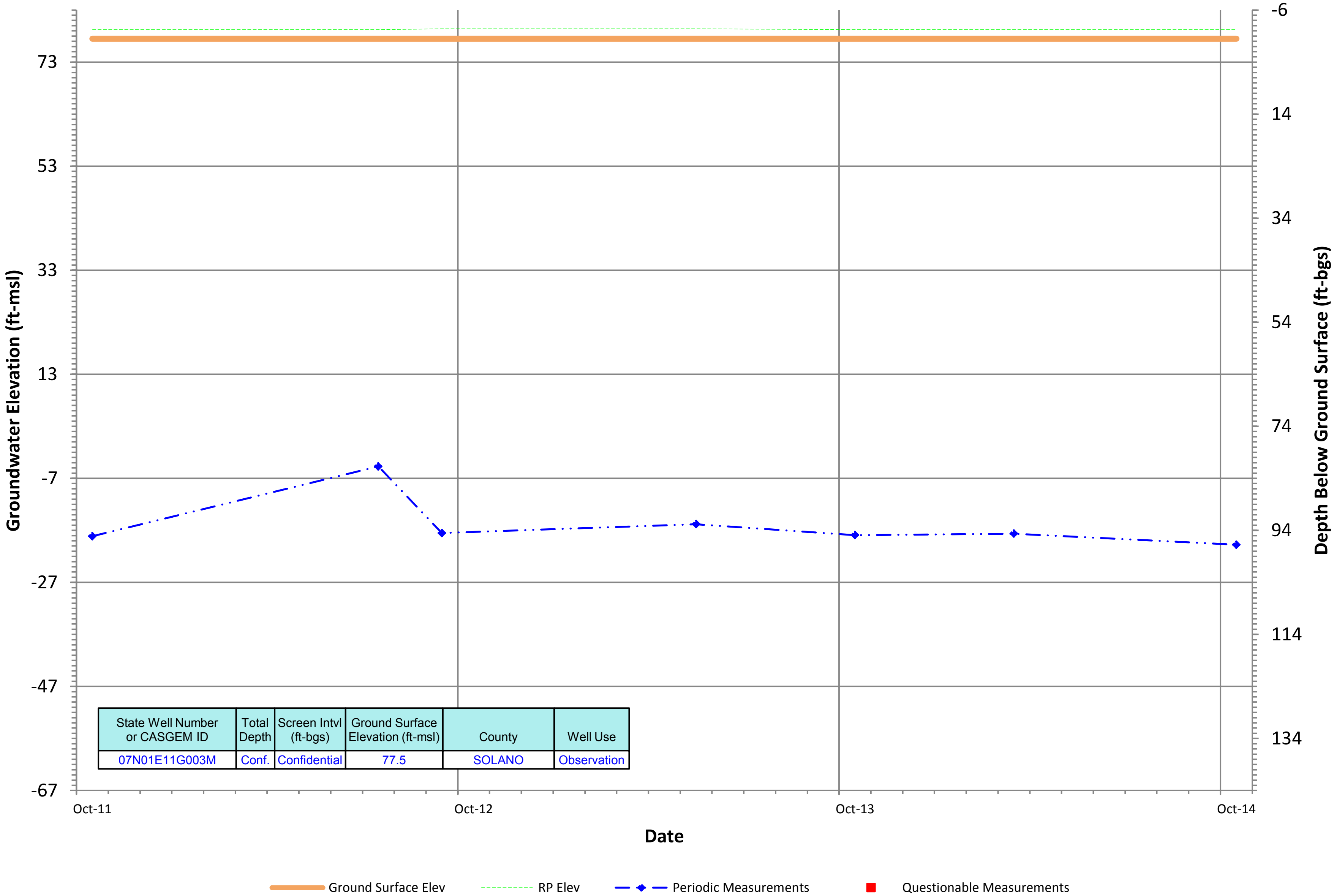
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



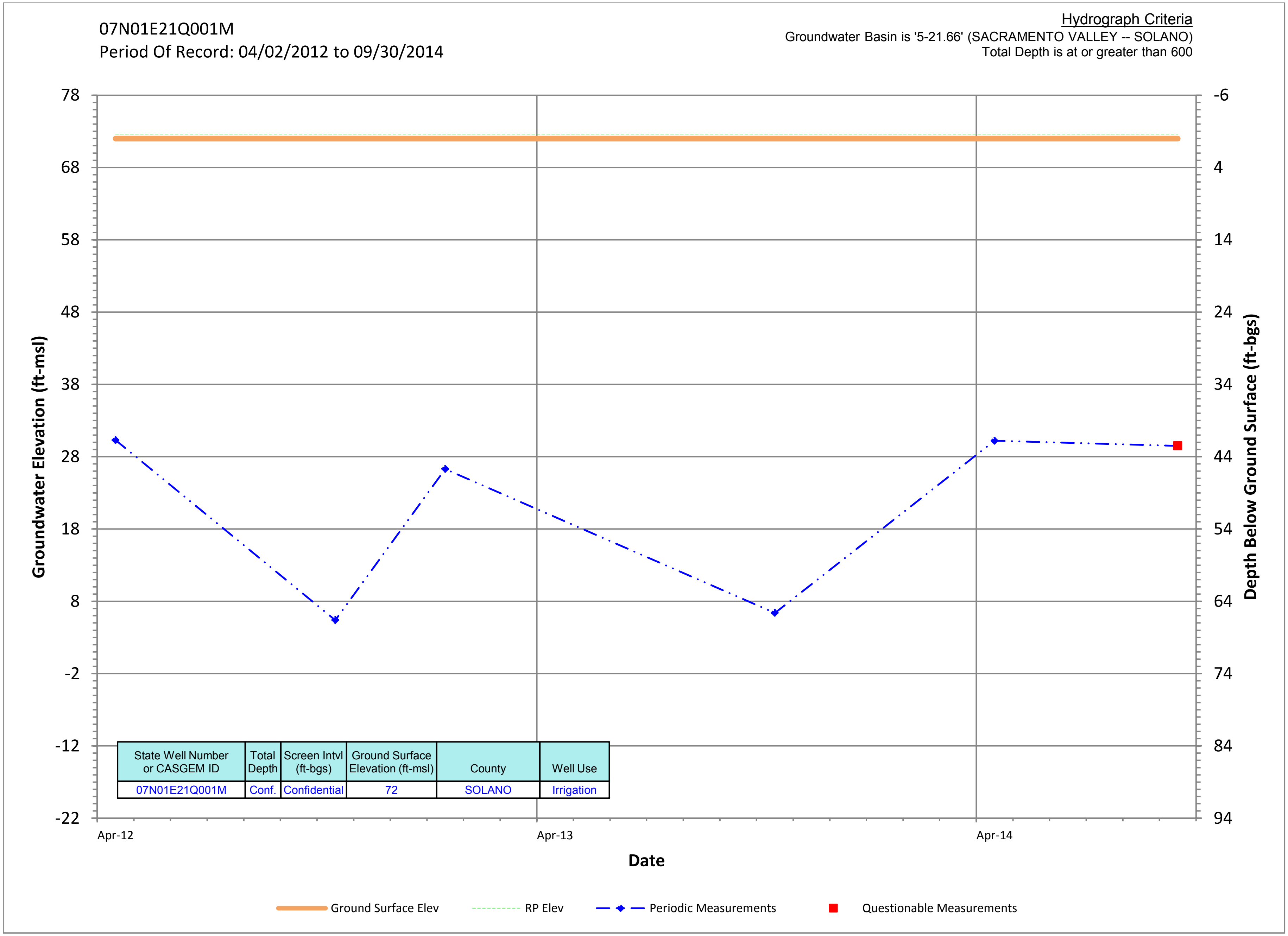
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E11G002M	Conf.	Confidential	77.5	SOLANO	Observation

07N01E11G003M
Period Of Record: 10/24/2011 to 10/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



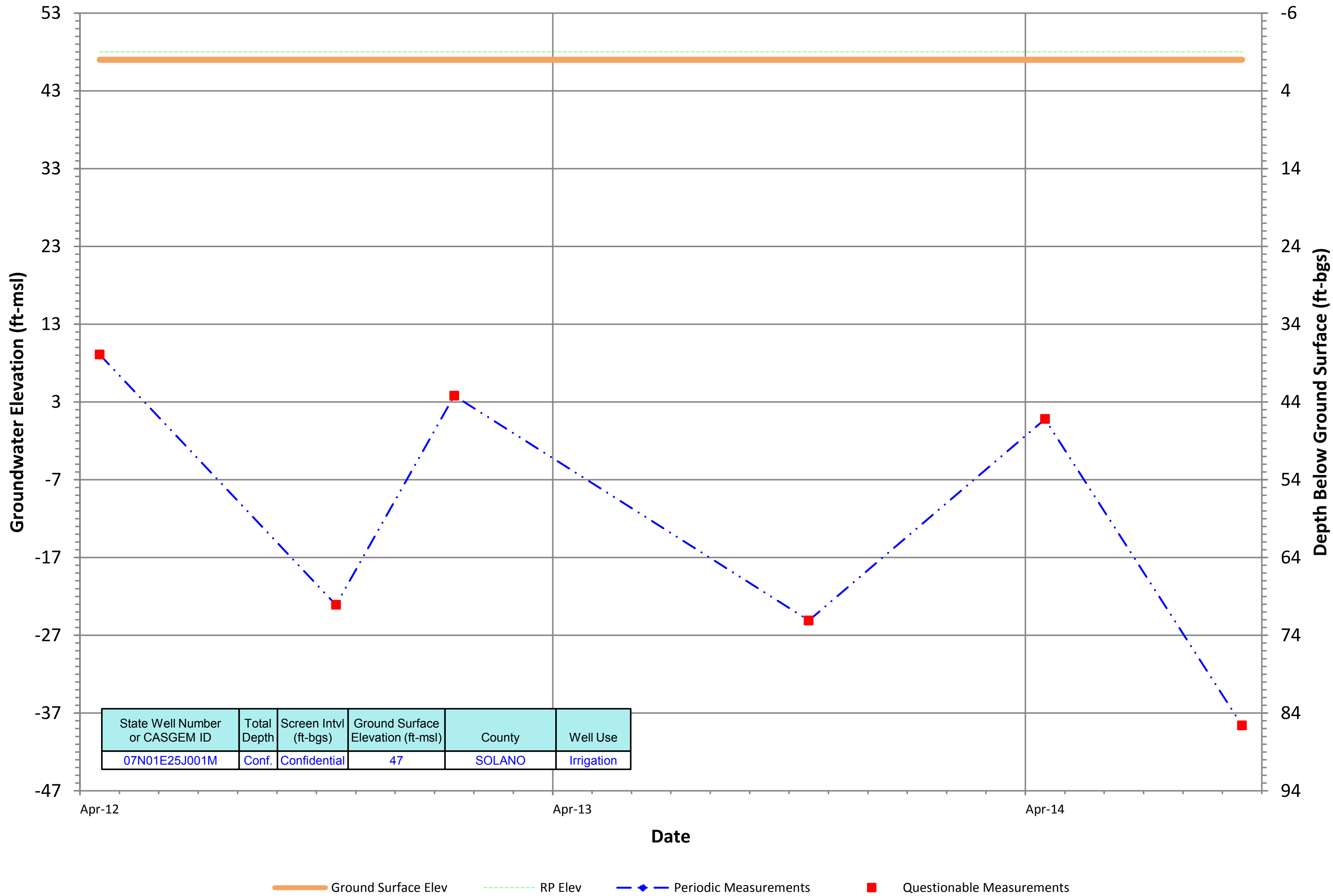
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E11G003M	Conf.	Confidential	77.5	SOLANO	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E21Q001M	Conf.	Confidential	72	SOLANO	Irrigation

07N01E25J001M
Period Of Record: 04/04/2012 to 09/29/2014

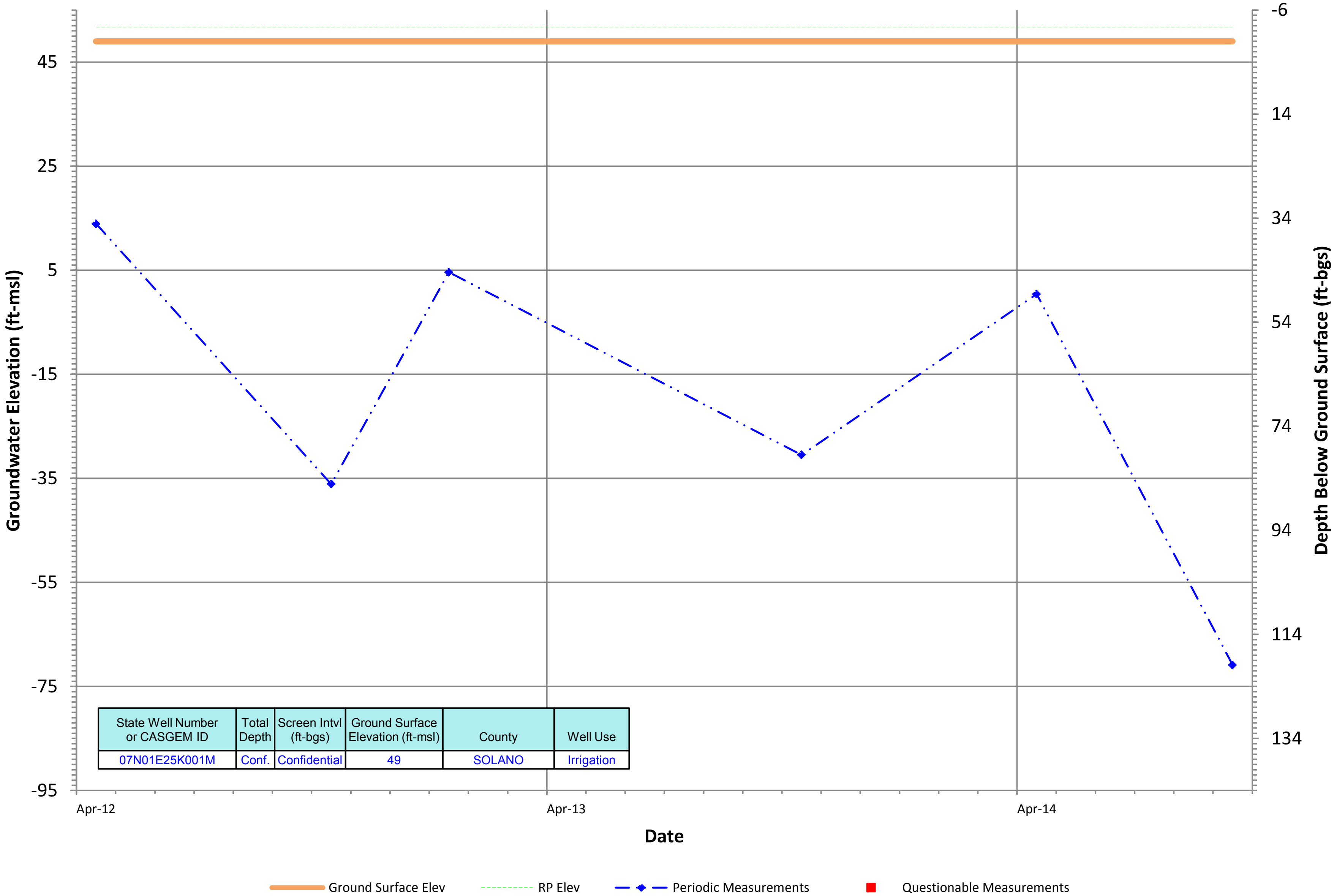
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E25J001M	Conf.	Confidential	47	SOLANO	Irrigation

07N01E25K001M
Period Of Record: 04/02/2012 to 09/29/2014

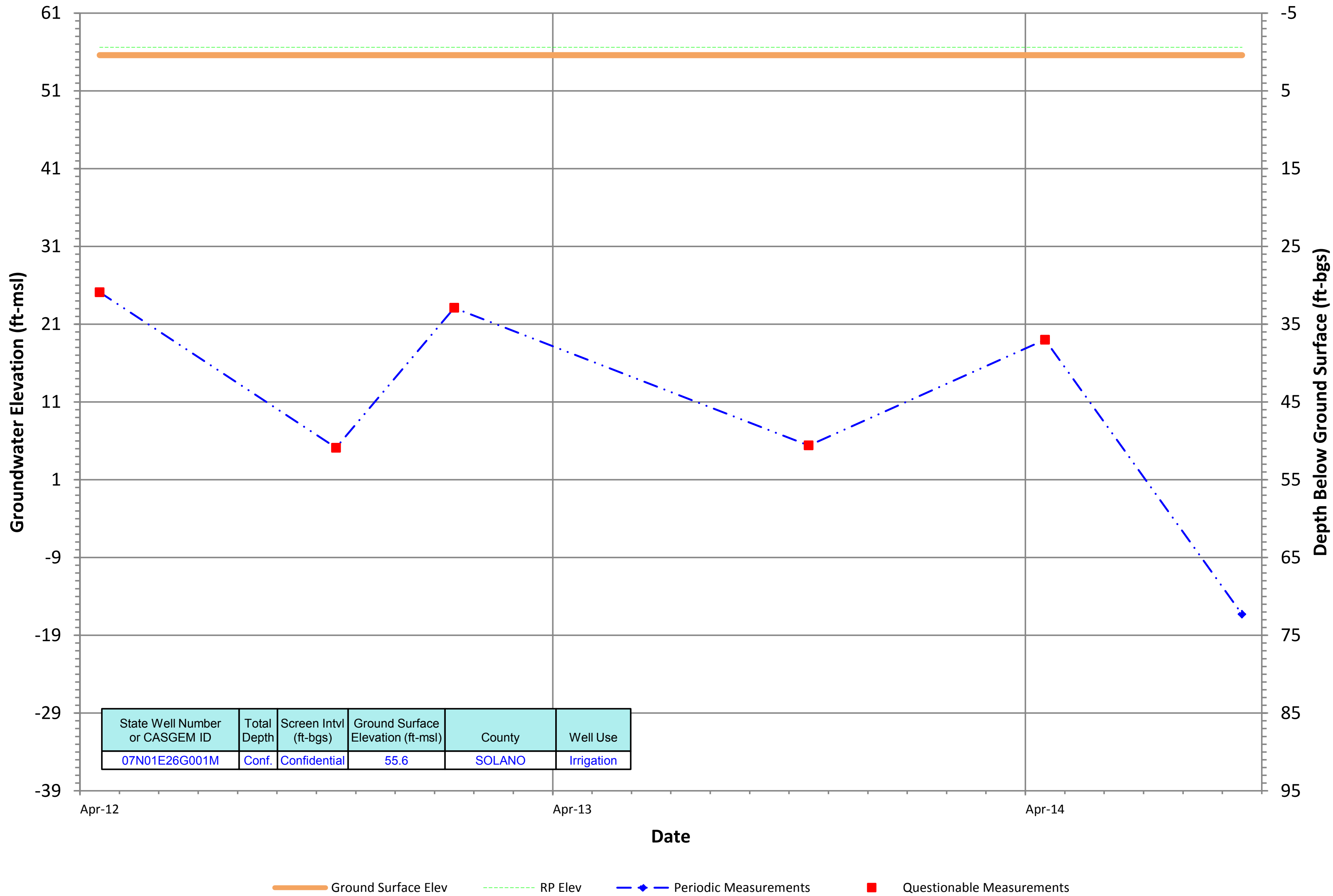
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E25K001M	Conf.	Confidential	49	SOLANO	Irrigation

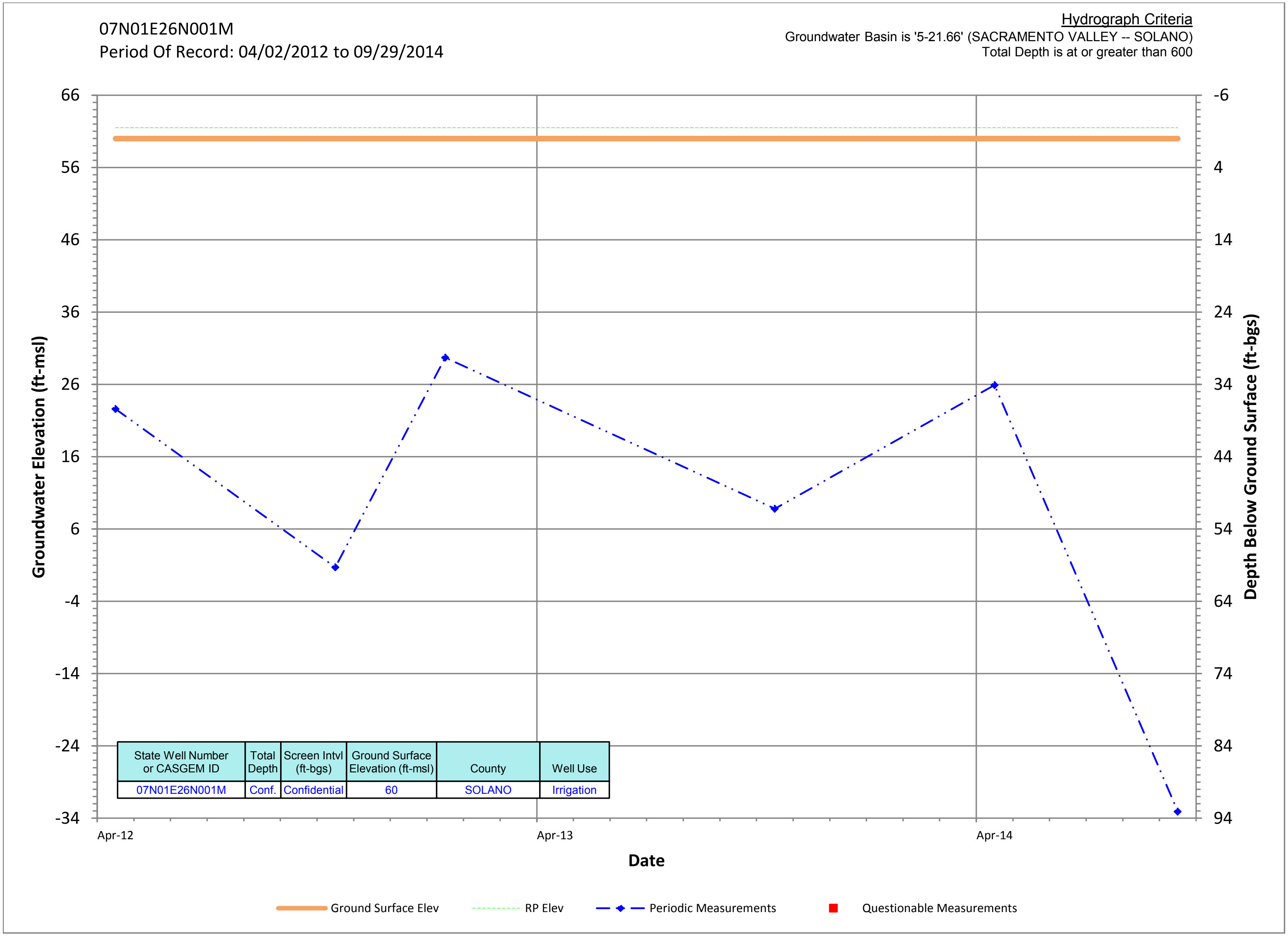
07N01E26G001M
Period Of Record: 04/02/2012 to 09/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E26G001M	Conf.	Confidential	55.6	SOLANO	Irrigation

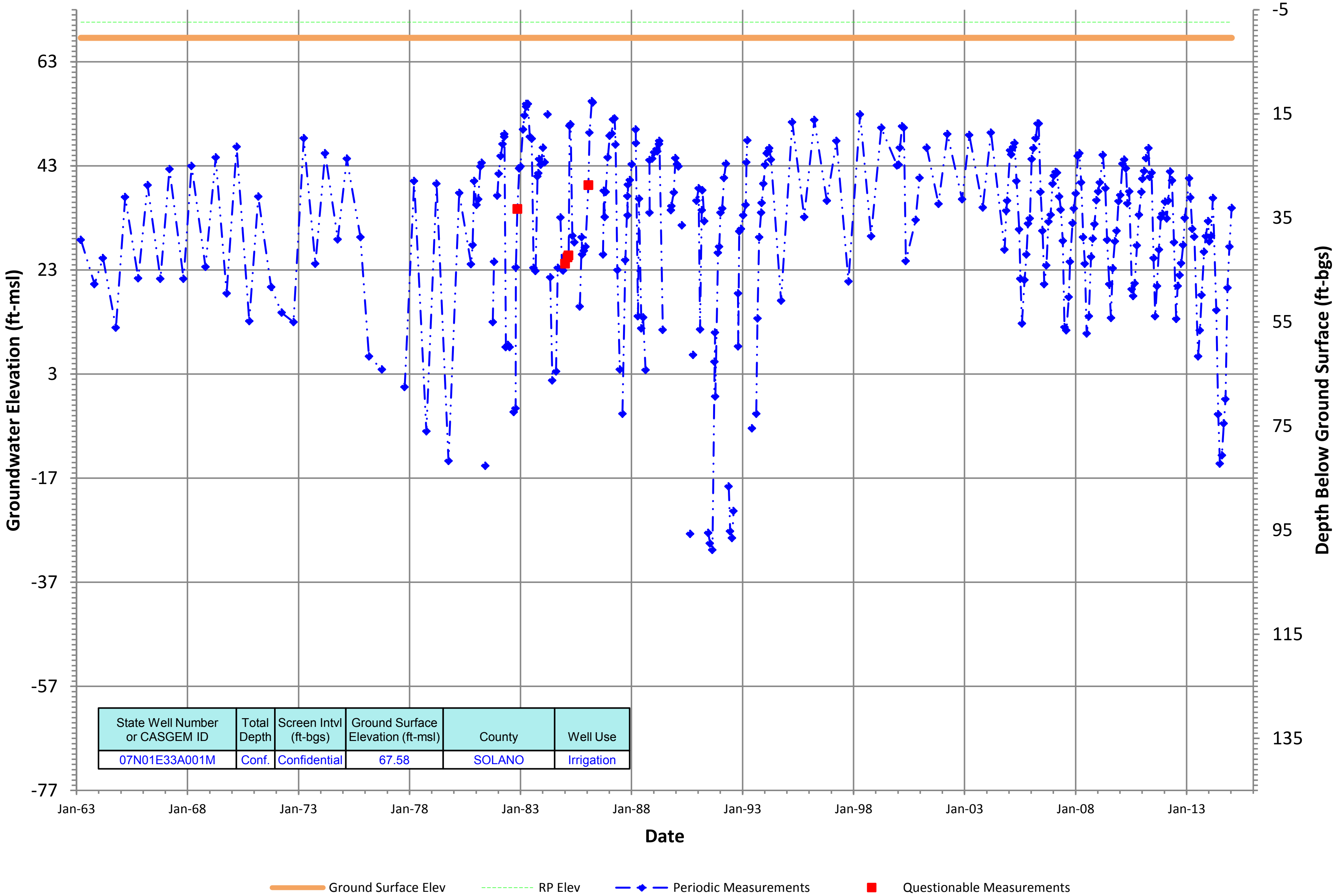
07N01E26N001M
Period Of Record: 04/02/2012 to 09/29/2014



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E26N001M	Conf.	Confidential	60	SOLANO	Irrigation

07N01E33A001M
Period Of Record: 03/12/1963 to 01/12/2015

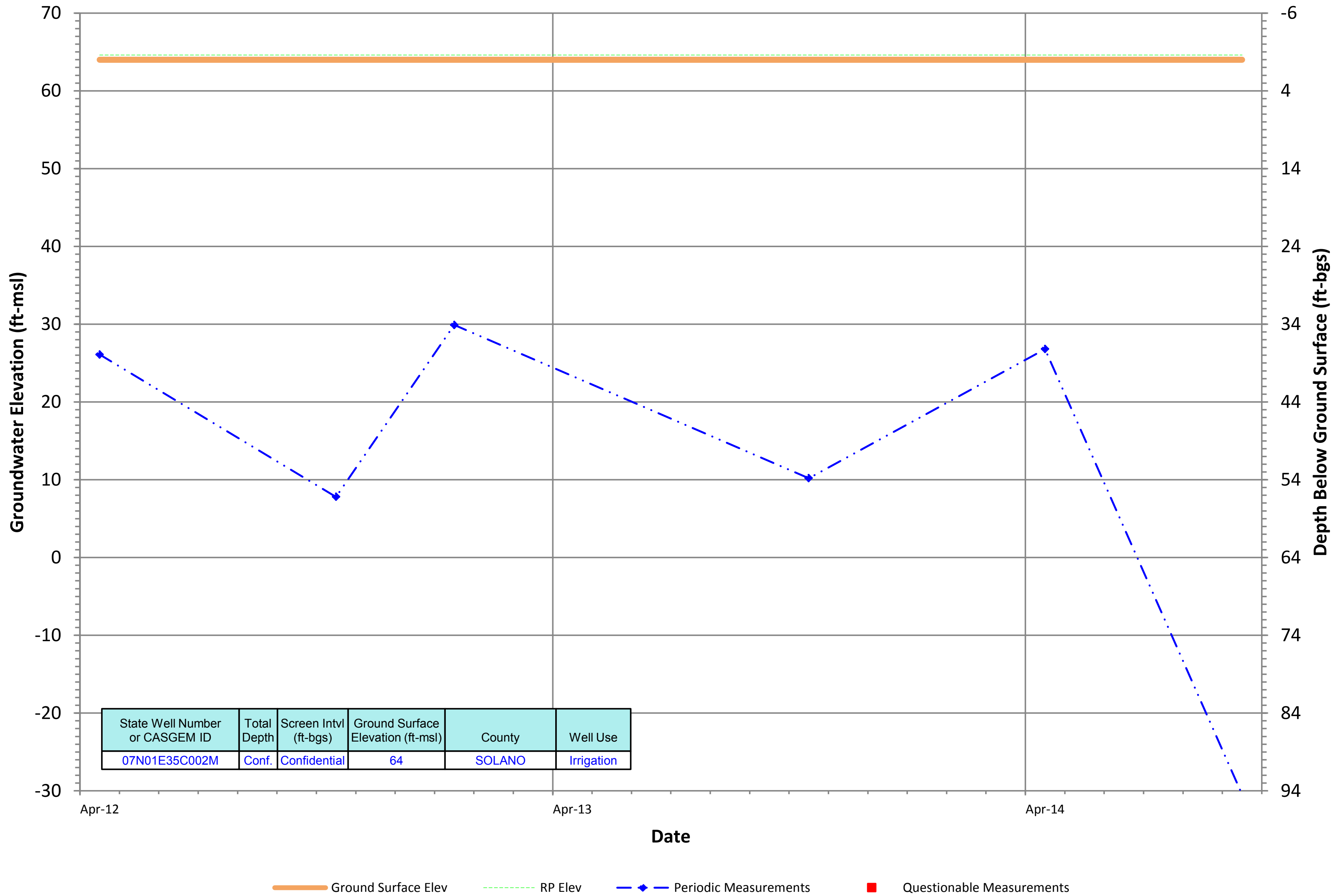
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E33A001M	Conf.	Confidential	67.58	SOLANO	Irrigation

07N01E35C002M
Period Of Record: 04/02/2012 to 09/29/2014

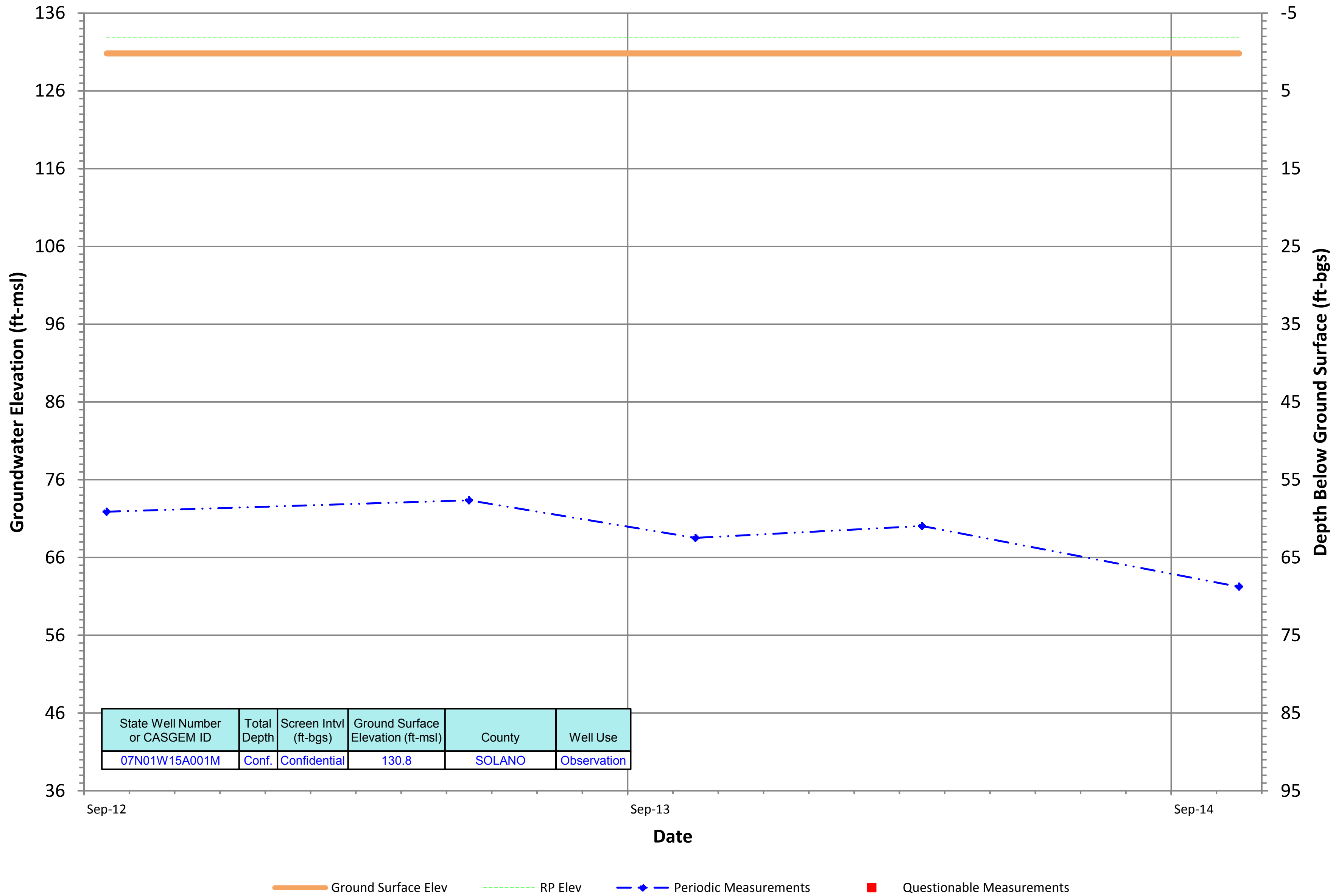
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01E35C002M	Conf.	Confidential	64	SOLANO	Irrigation

07N01W15A001M
Period Of Record: 09/25/2012 to 10/14/2014

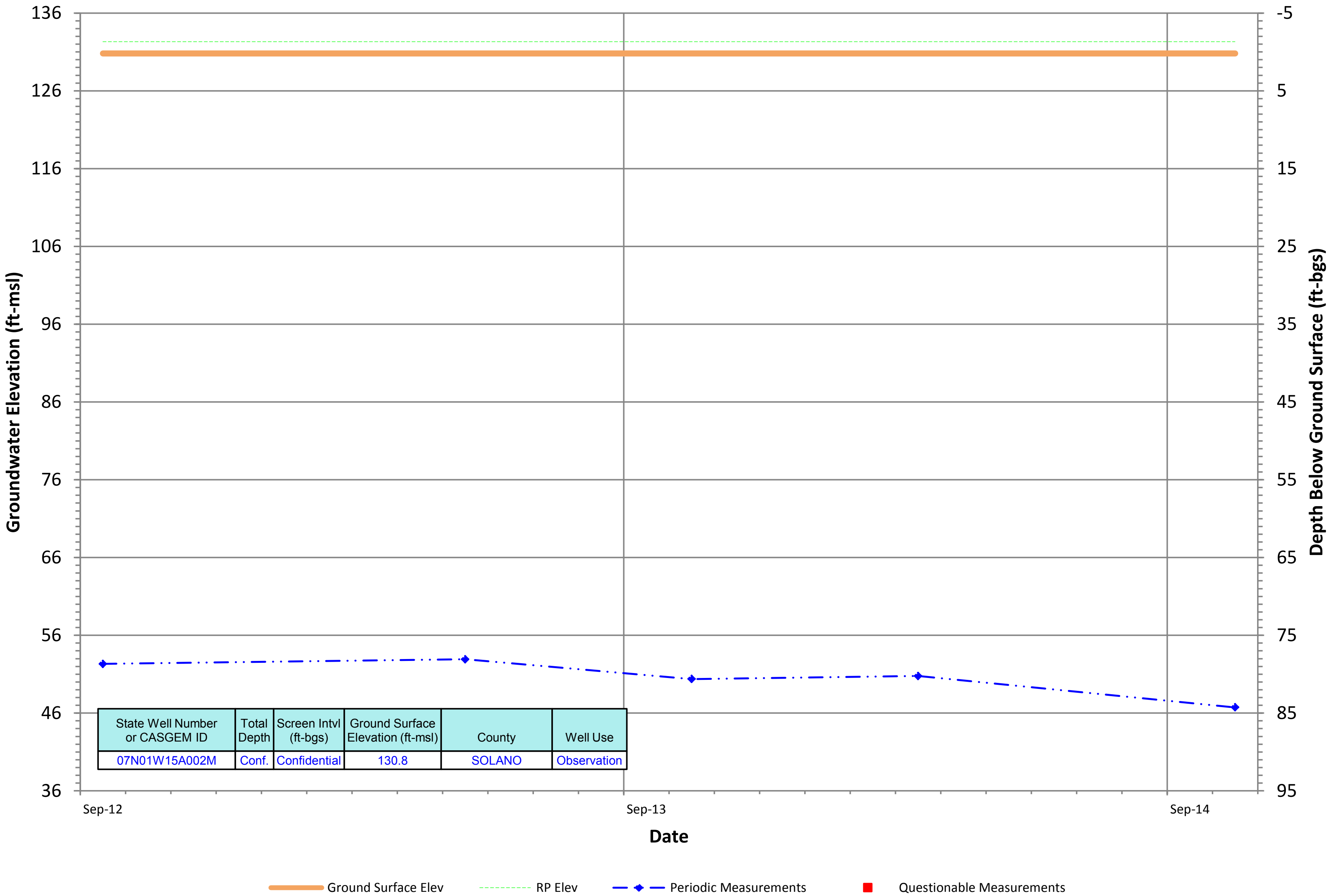
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01W15A001M	Conf.	Confidential	130.8	SOLANO	Observation

07N01W15A002M
Period Of Record: 09/25/2012 to 10/14/2014

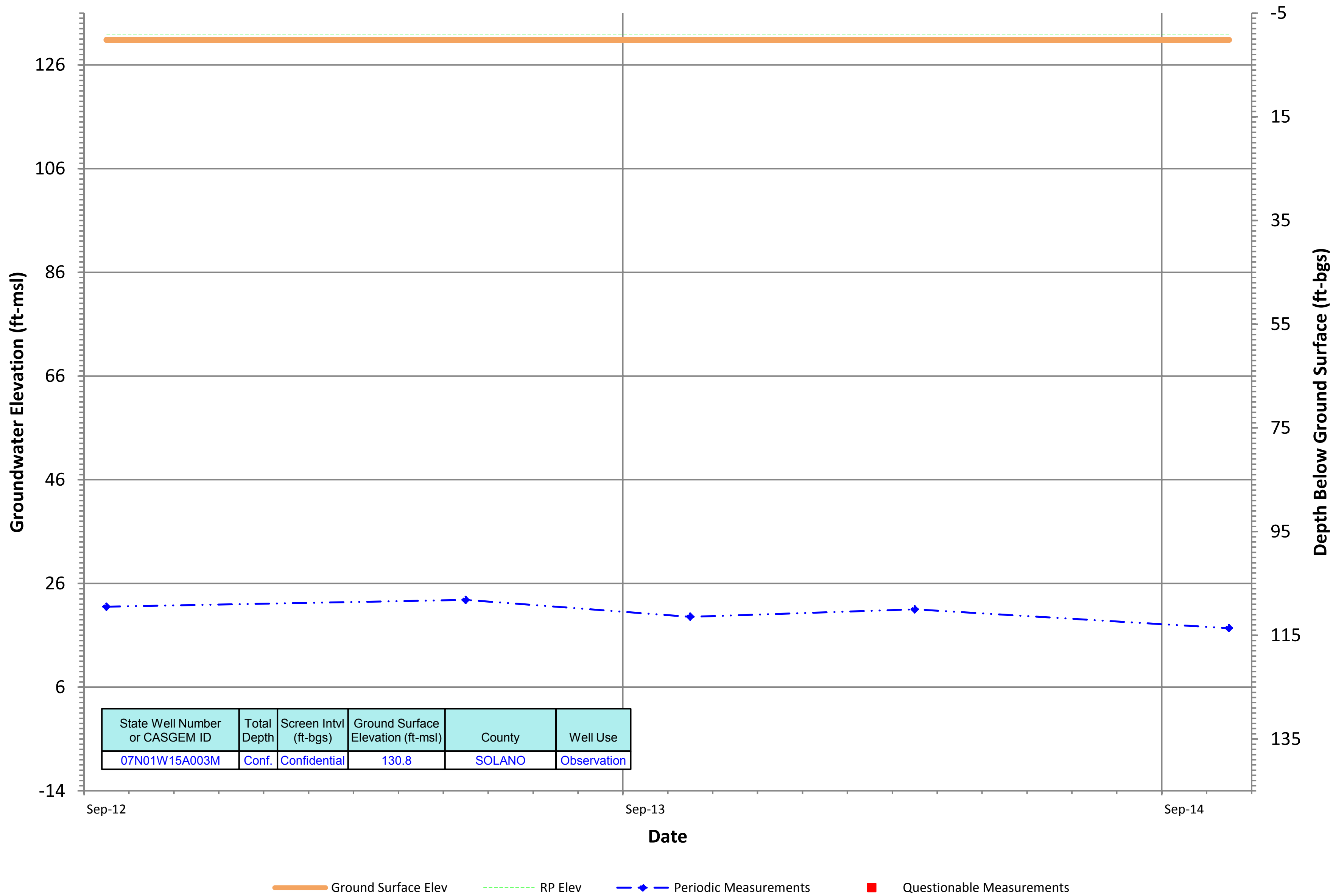
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01W15A002M	Conf.	Confidential	130.8	SOLANO	Observation

07N01W15A003M
Period Of Record: 09/25/2012 to 10/14/2014

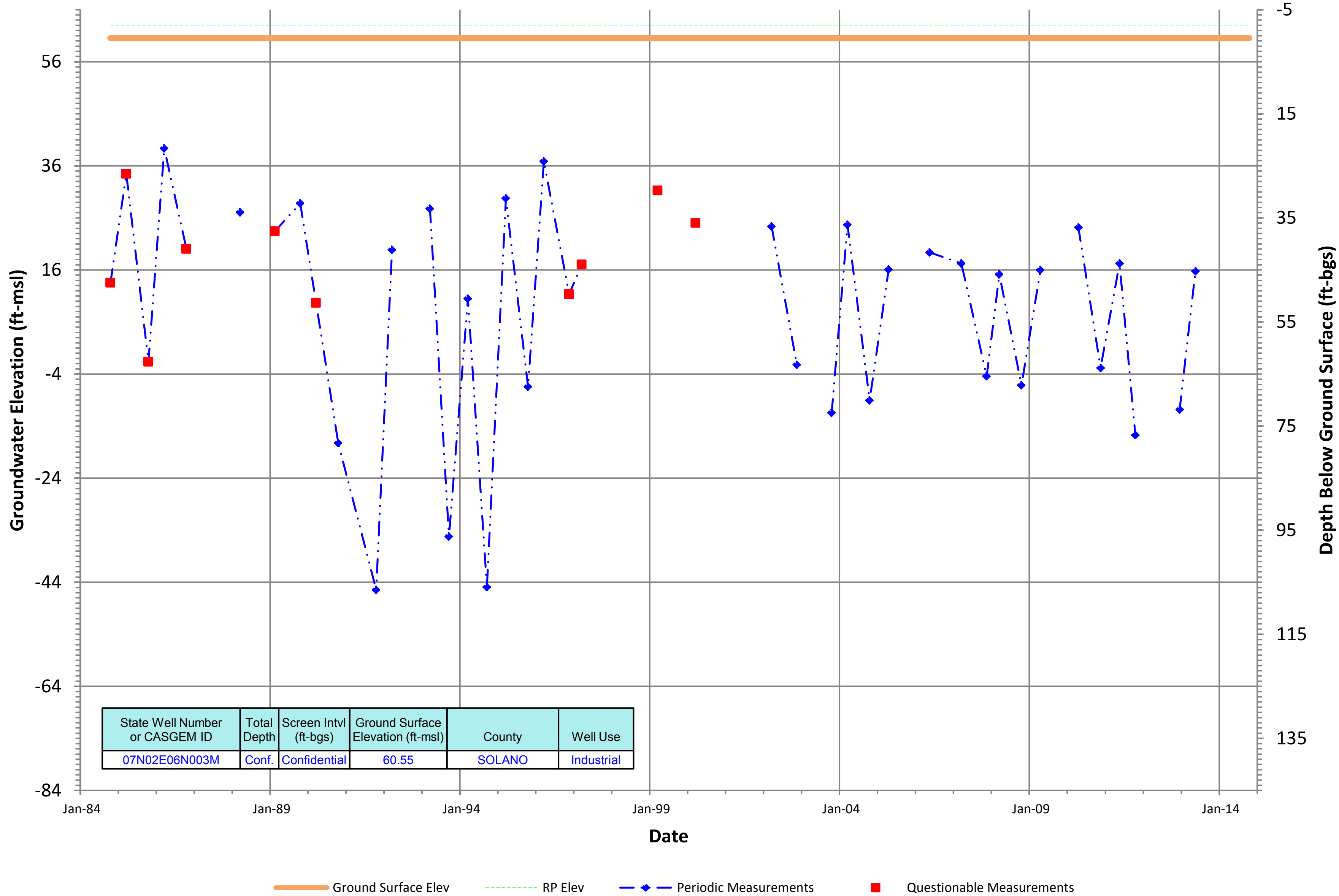
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



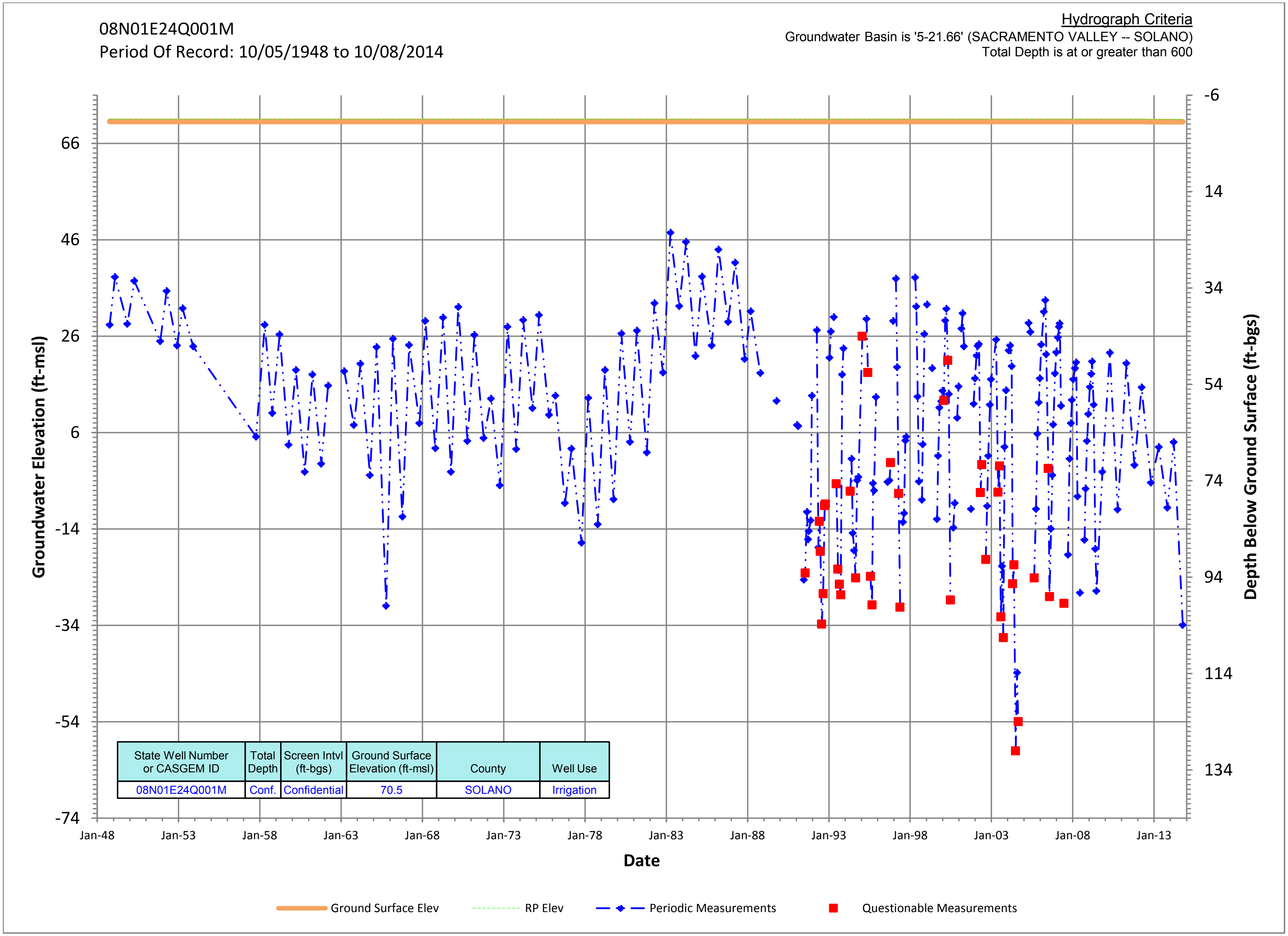
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N01W15A003M	Conf.	Confidential	130.8	SOLANO	Observation

07N02E06N003M
Period Of Record: 10/29/1984 to 10/28/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



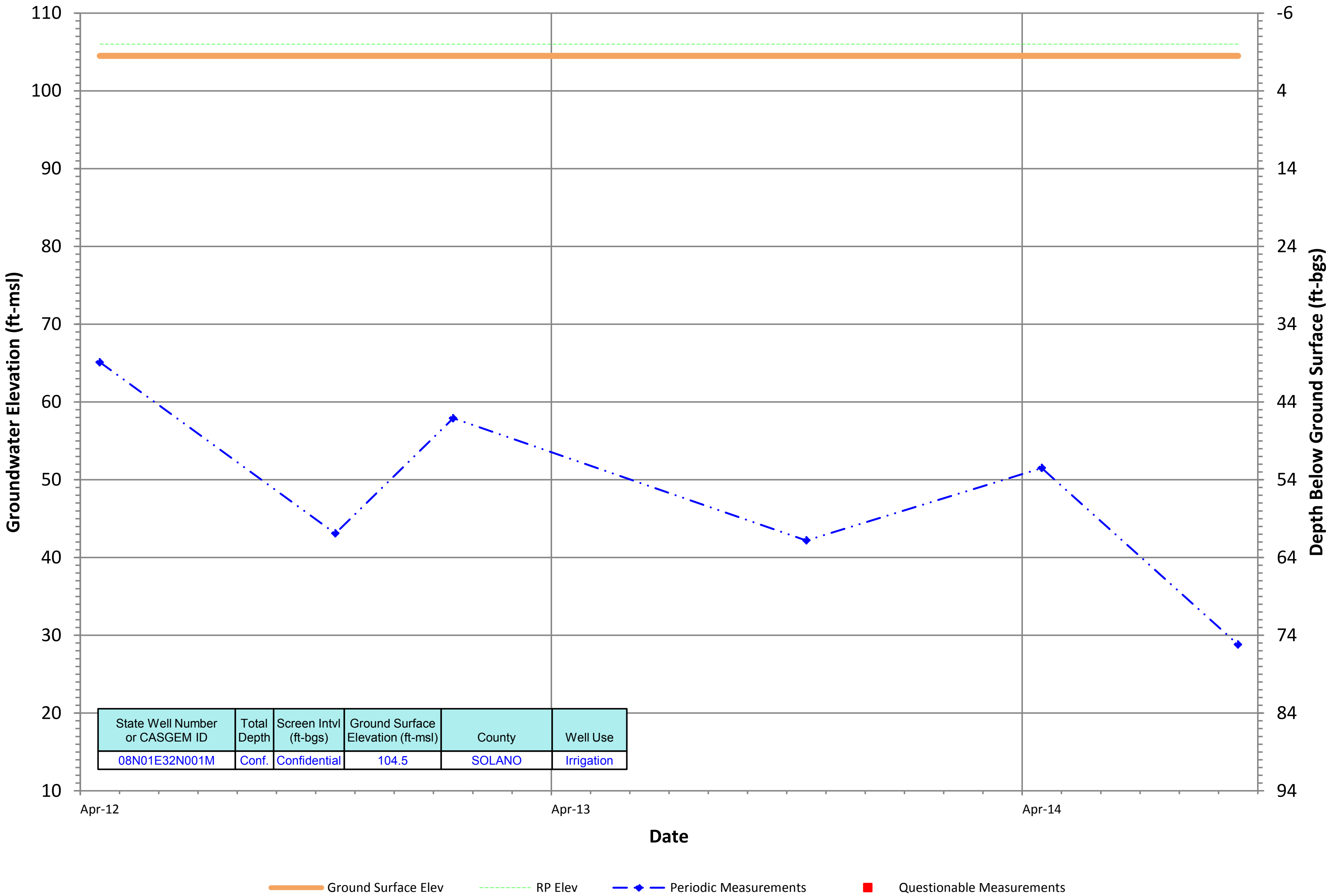
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N02E06N003M	Conf.	Confidential	60.55	SOLANO	Industrial



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E24Q001M	Conf.	Confidential	70.5	SOLANO	Irrigation

08N01E32N001M
Period Of Record: 04/02/2012 to 09/30/2014

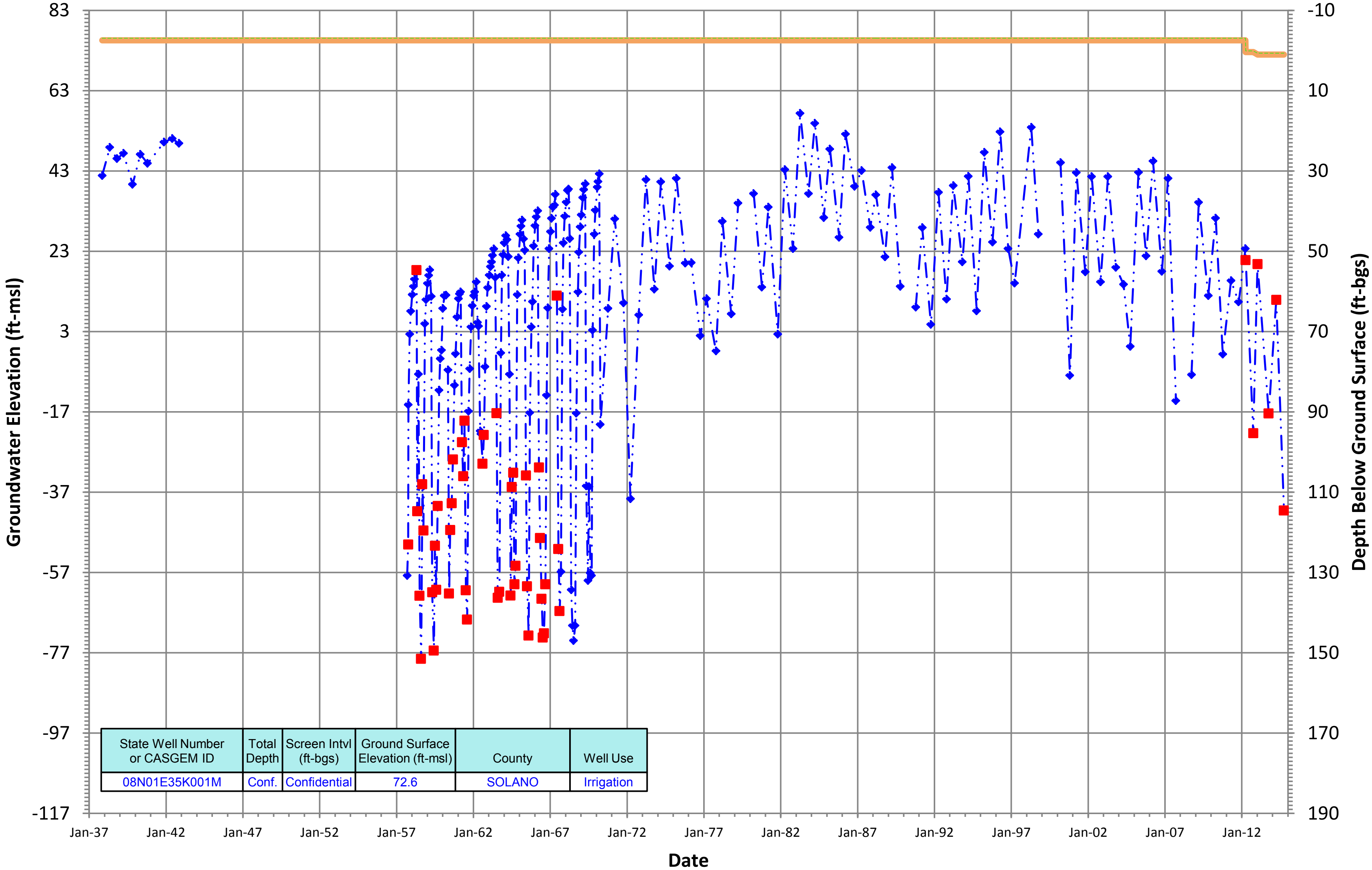
Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E32N001M	Conf.	Confidential	104.5	SOLANO	Irrigation

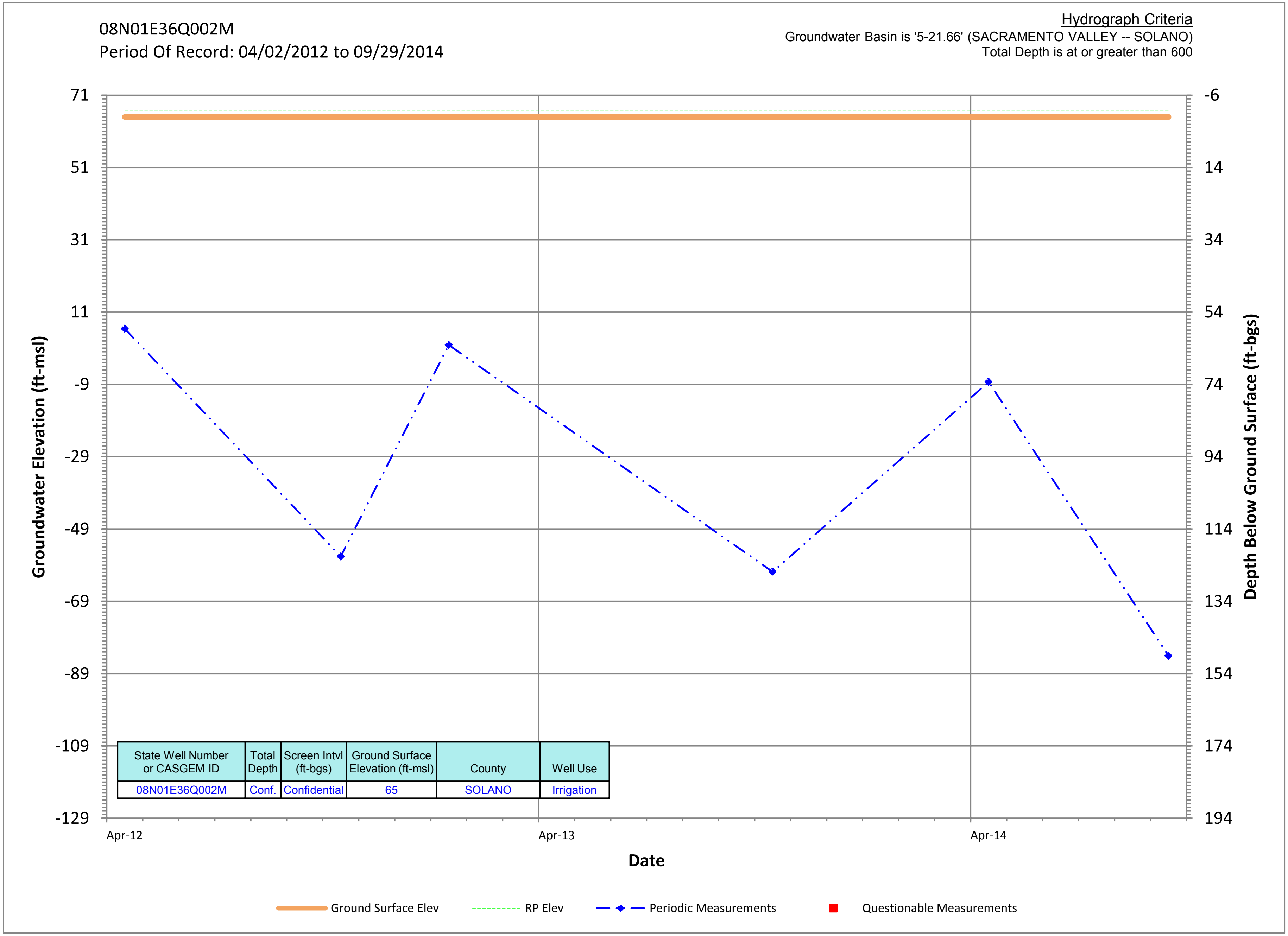
08N01E35K001M
Period Of Record: 11/03/1937 to 09/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E35K001M	Conf.	Confidential	72.6	SOLANO	Irrigation

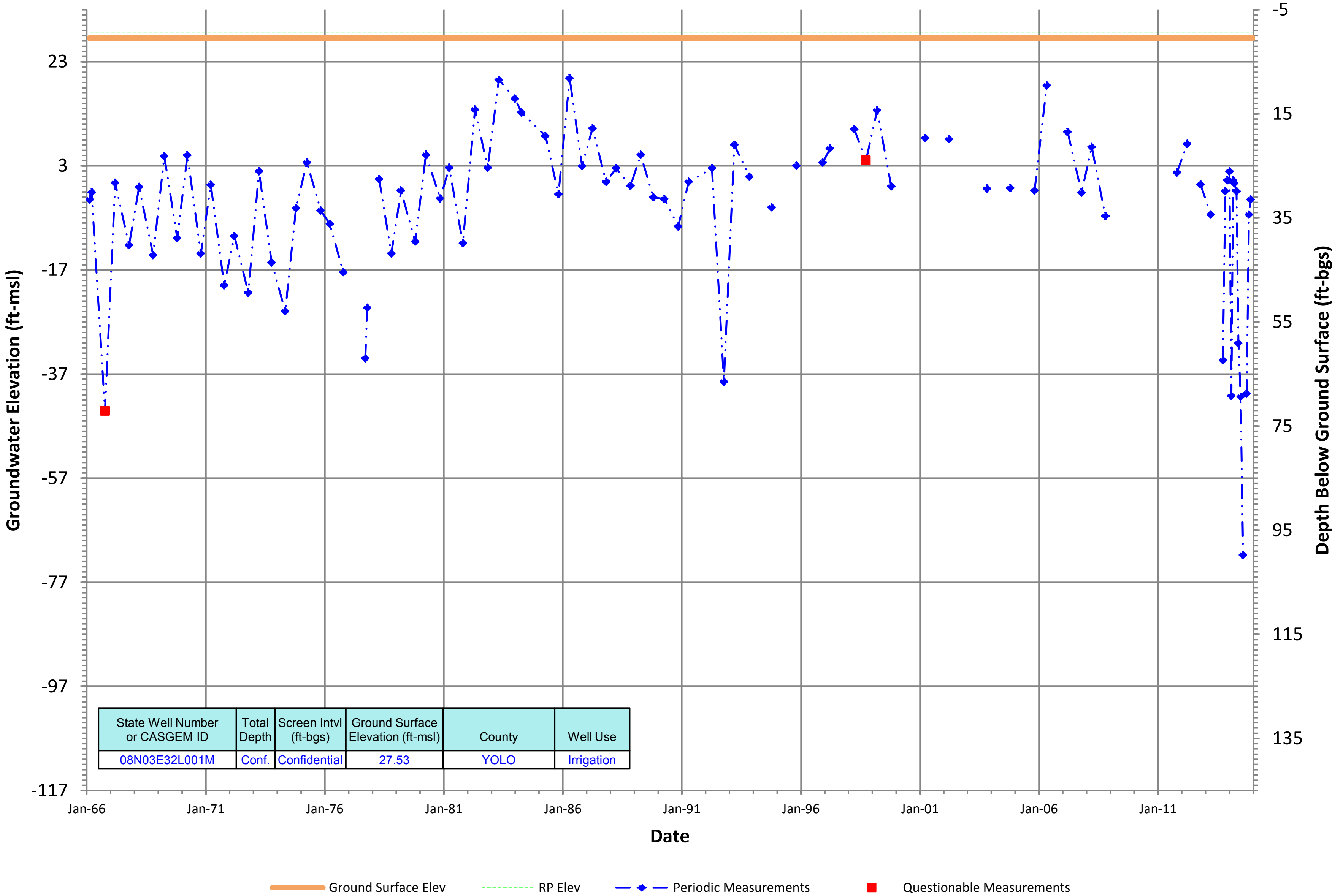
Ground Surface Elev — RP Elev — Periodic Measurements — Questionable Measurements



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E36Q002M	Conf.	Confidential	65	SOLANO	Irrigation

08N03E32L001M
Period Of Record: 02/16/1966 to 12/22/2014

Hydrograph Criteria
Groundwater Basin is '5-21.66' (SACRAMENTO VALLEY -- SOLANO)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N03E32L001M	Conf.	Confidential	27.53	YOLO	Irrigation

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Shallow Groundwater Monitoring Well Hydrographs- South American Subbasin

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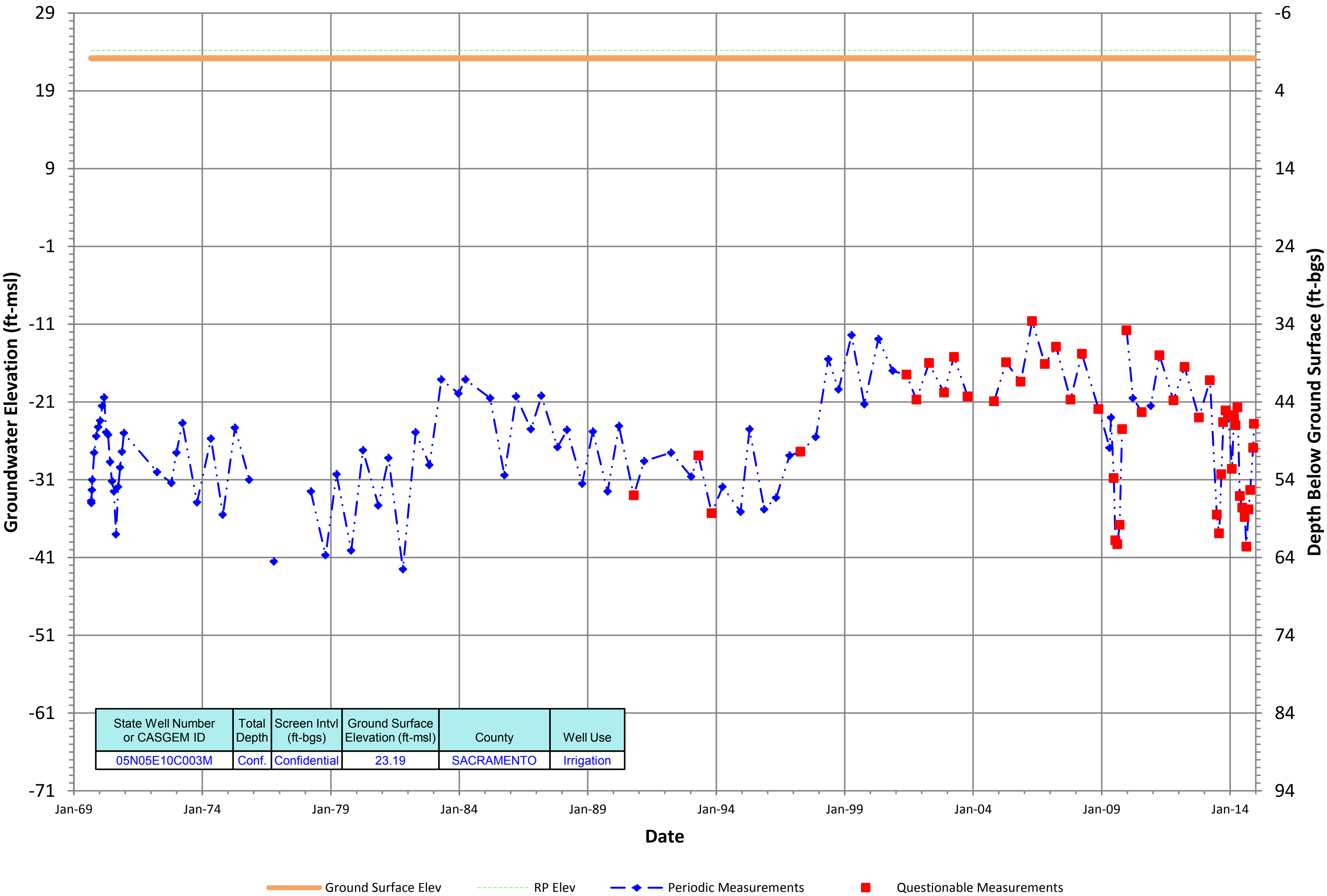
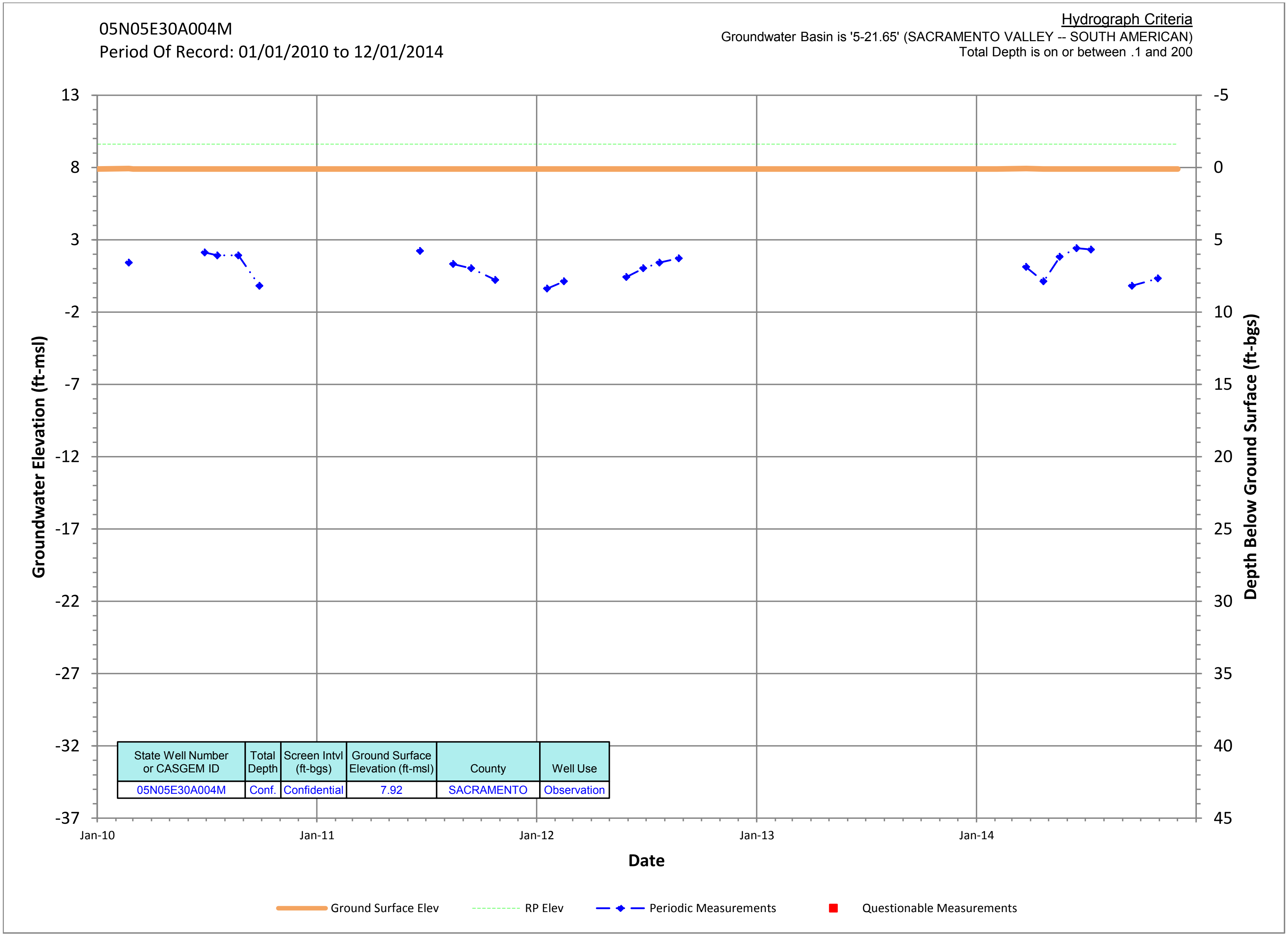
05N05E10C003M
Period Of Record: 09/03/1969 to 12/08/2014

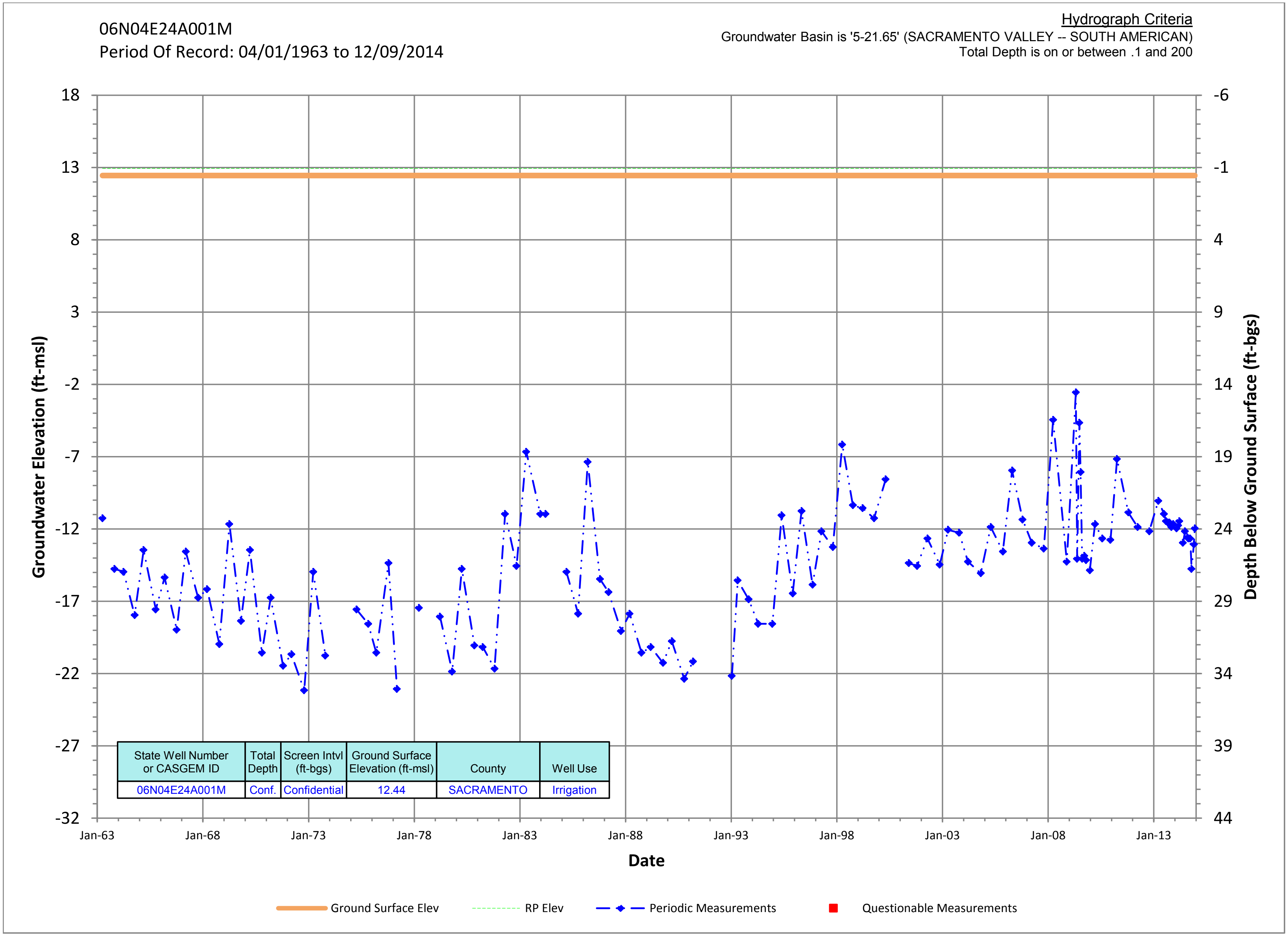
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200

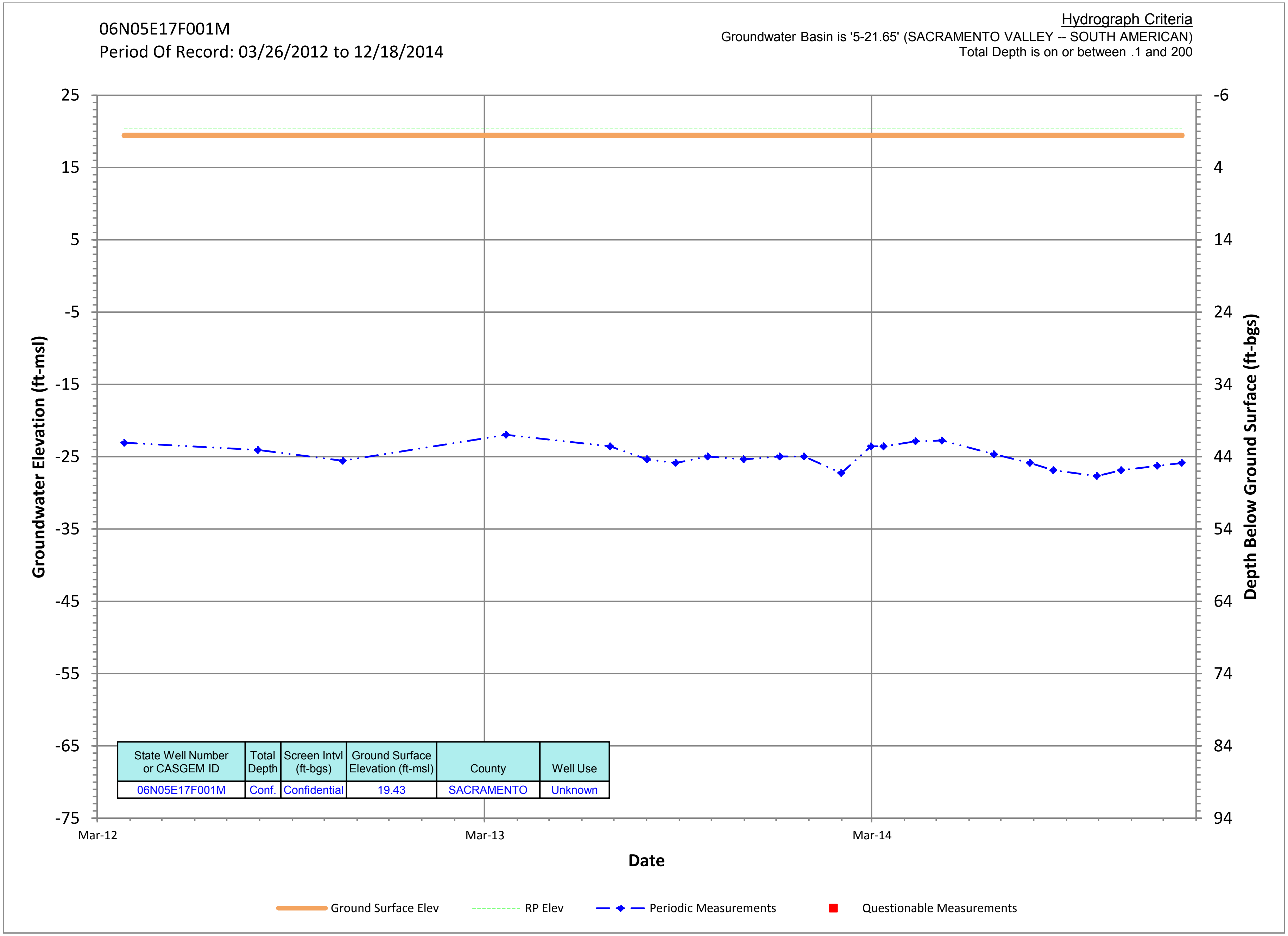


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N05E10C003M	Conf.	Confidential	23.19	SACRAMENTO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N05E30A004M	Conf.	Confidential	7.92	SACRAMENTO	Observation

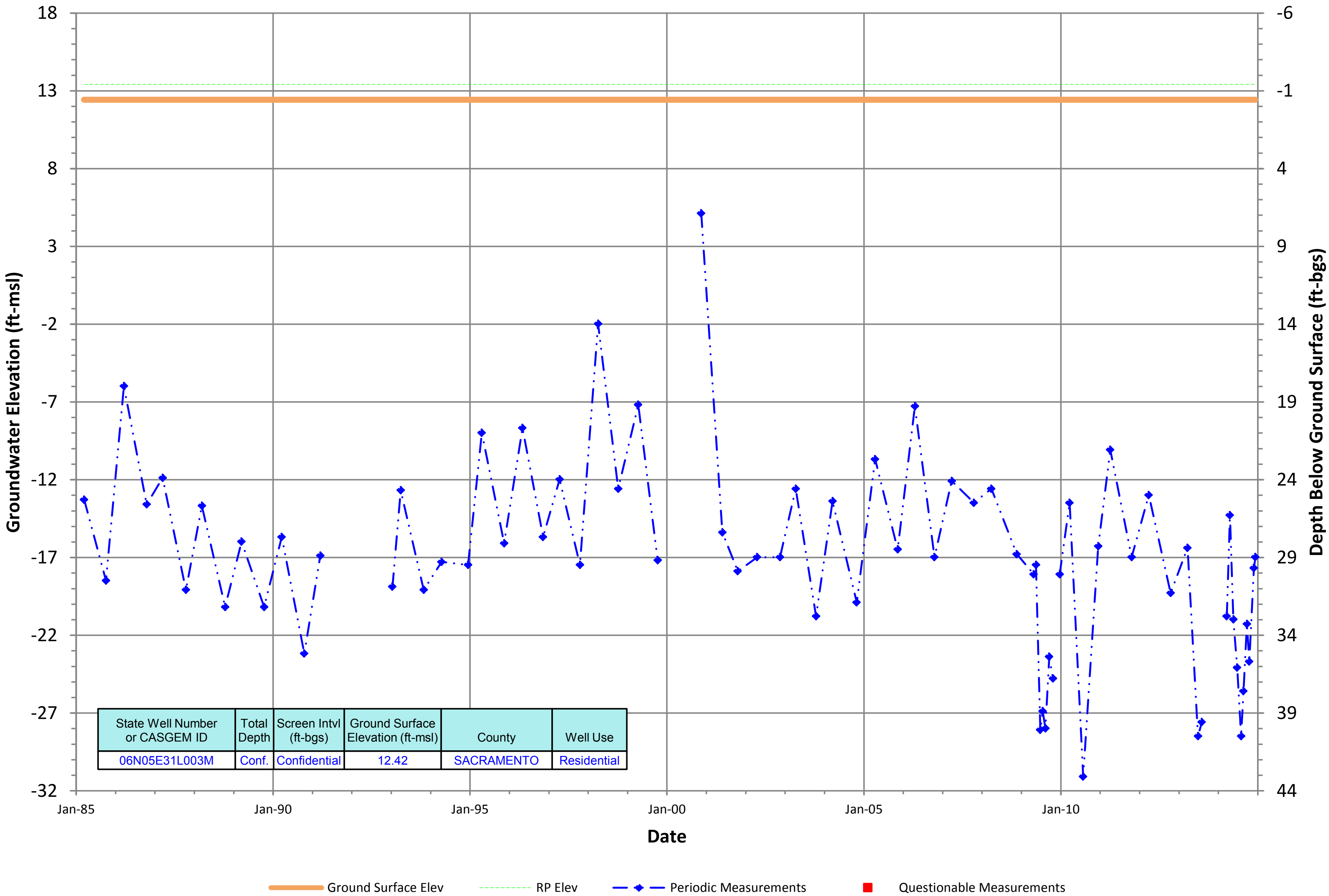

06N04E24A001M
Period Of Record: 04/01/1963 to 12/09/2014
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
18
13
8
3
-2
-7
-12
-17
-22
-27
-32
-6
-1
4
9
14
19
24
29
34
39
44
Jan-63
Jan-68
Jan-73
Jan-78
Jan-83
Jan-88
Jan-93
Jan-98
Jan-03
Jan-08
Jan-13
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
06N04E24A001M
Conf.
Confidential
12.44
SACRAMENTO
Irrigation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N05E17F001M	Conf.	Confidential	19.43	SACRAMENTO	Unknown

06N05E31L003M
Period Of Record: 03/15/1985 to 12/09/2014

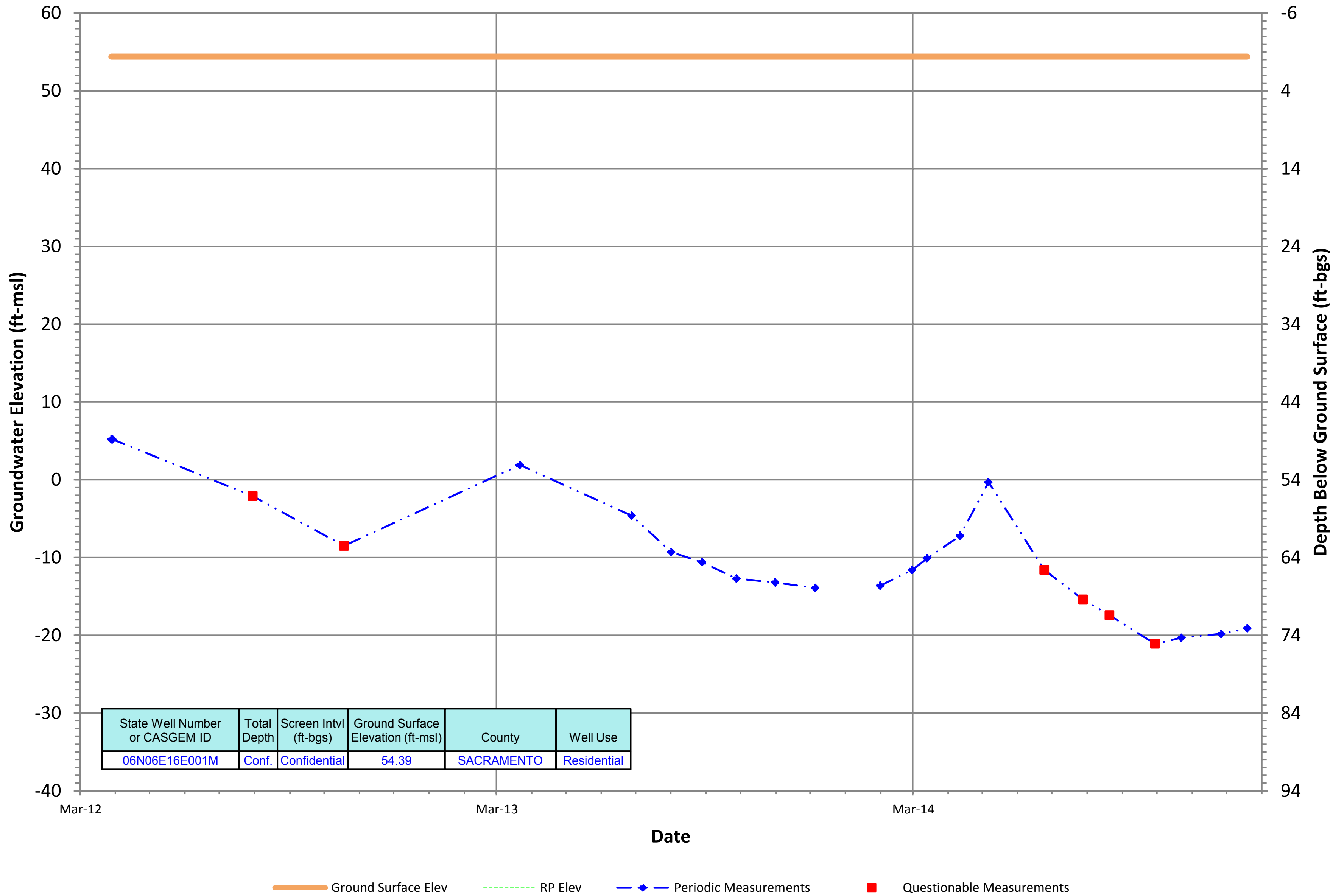
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



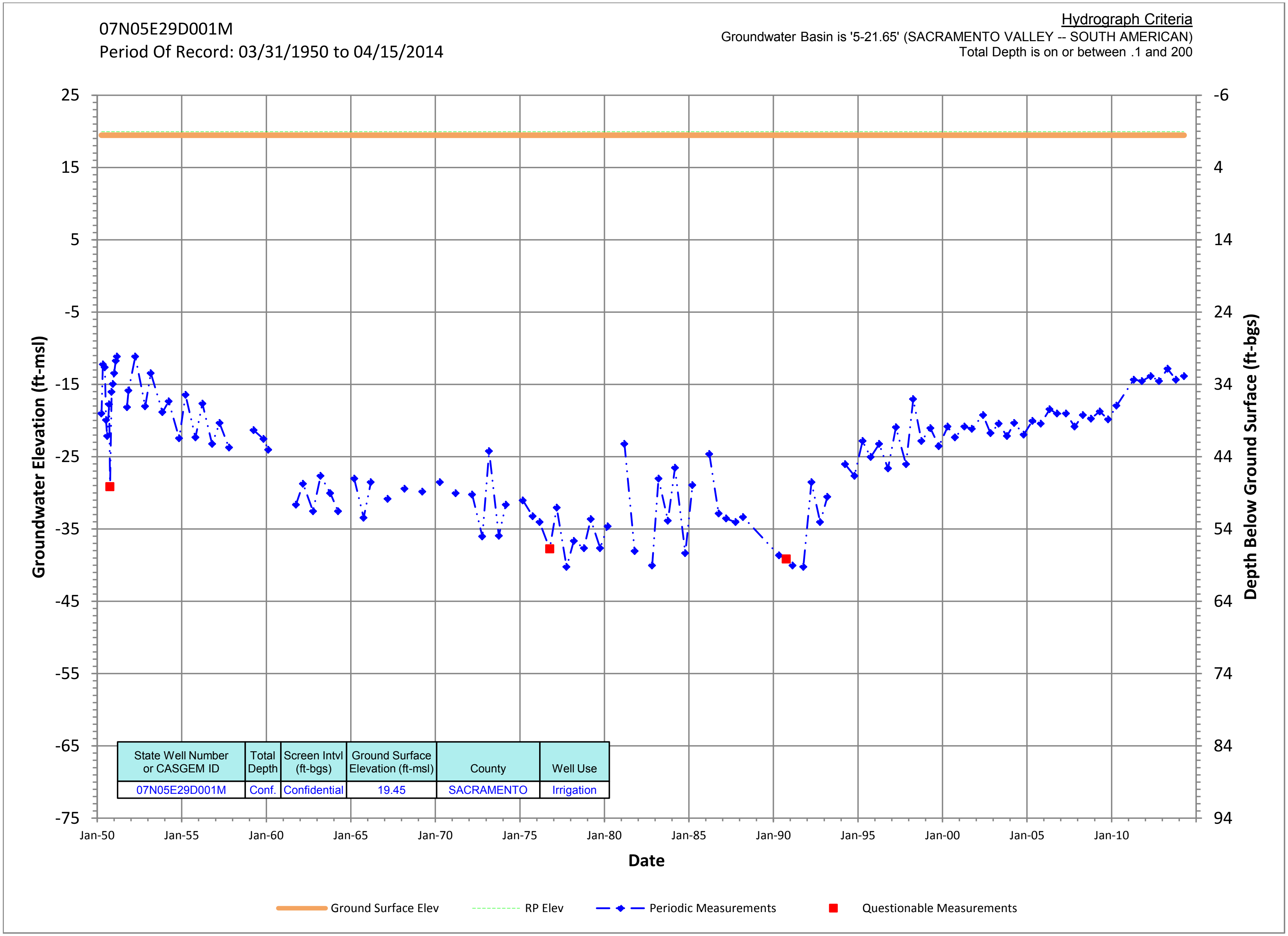
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N05E31L003M	Conf.	Confidential	12.42	SACRAMENTO	Residential

06N06E16E001M
Period Of Record: 03/28/2012 to 12/19/2014

Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



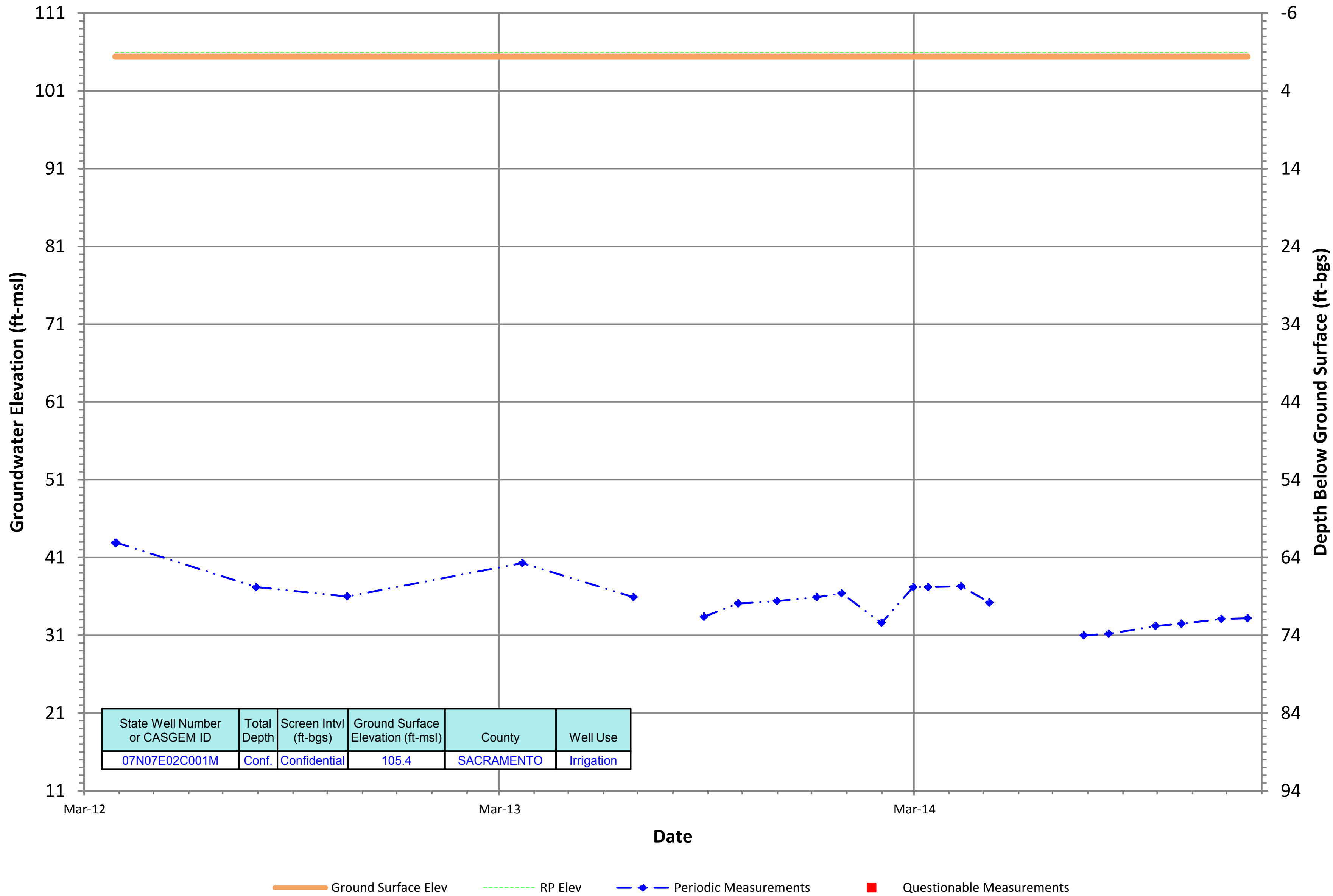
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N06E16E001M	Conf.	Confidential	54.39	SACRAMENTO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N05E29D001M	Conf.	Confidential	19.45	SACRAMENTO	Irrigation

07N07E02C001M
Period Of Record: 03/28/2012 to 12/19/2014

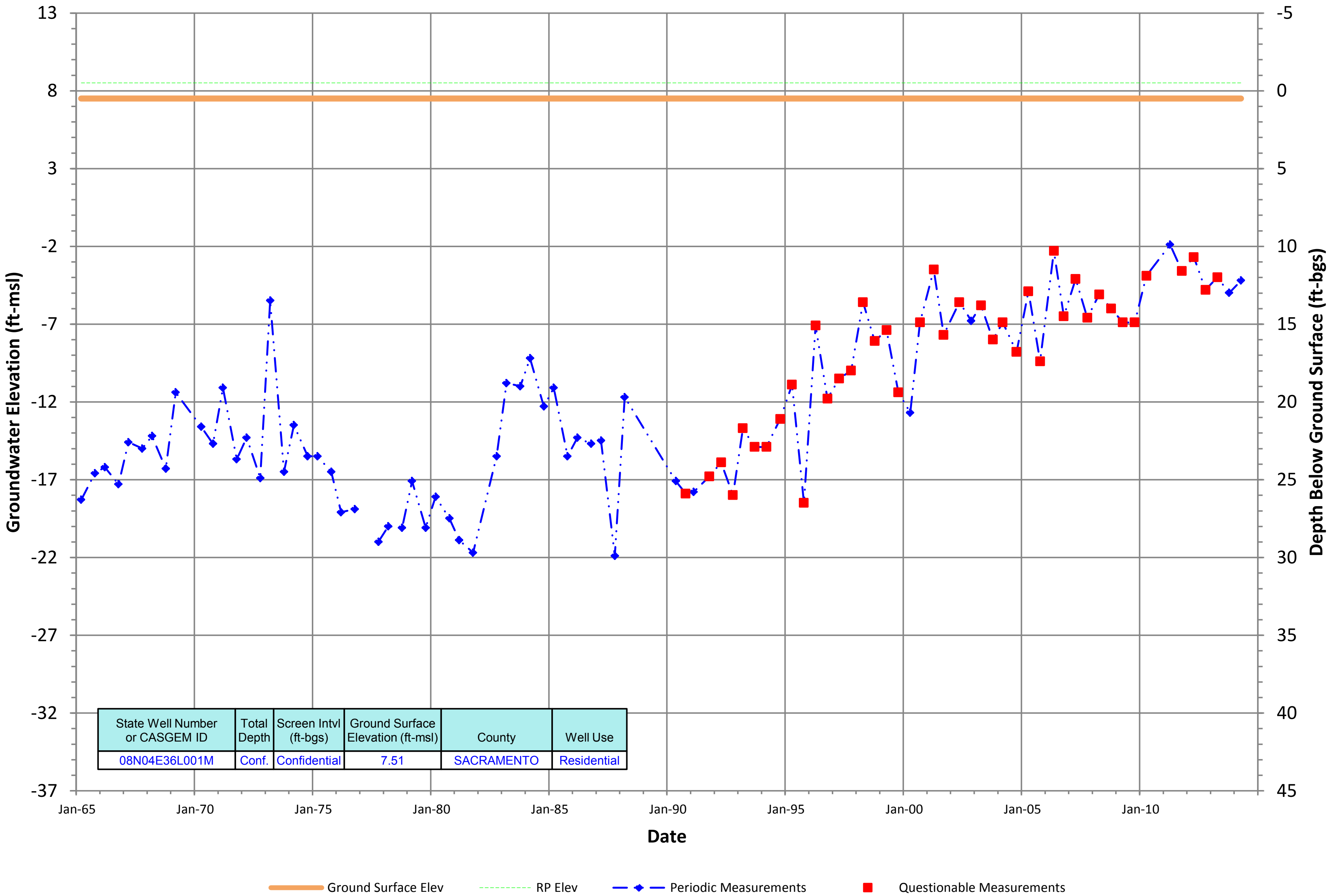
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N07E02C001M	Conf.	Confidential	105.4	SACRAMENTO	Irrigation

08N04E36L001M
Period Of Record: 03/19/1965 to 04/15/2014

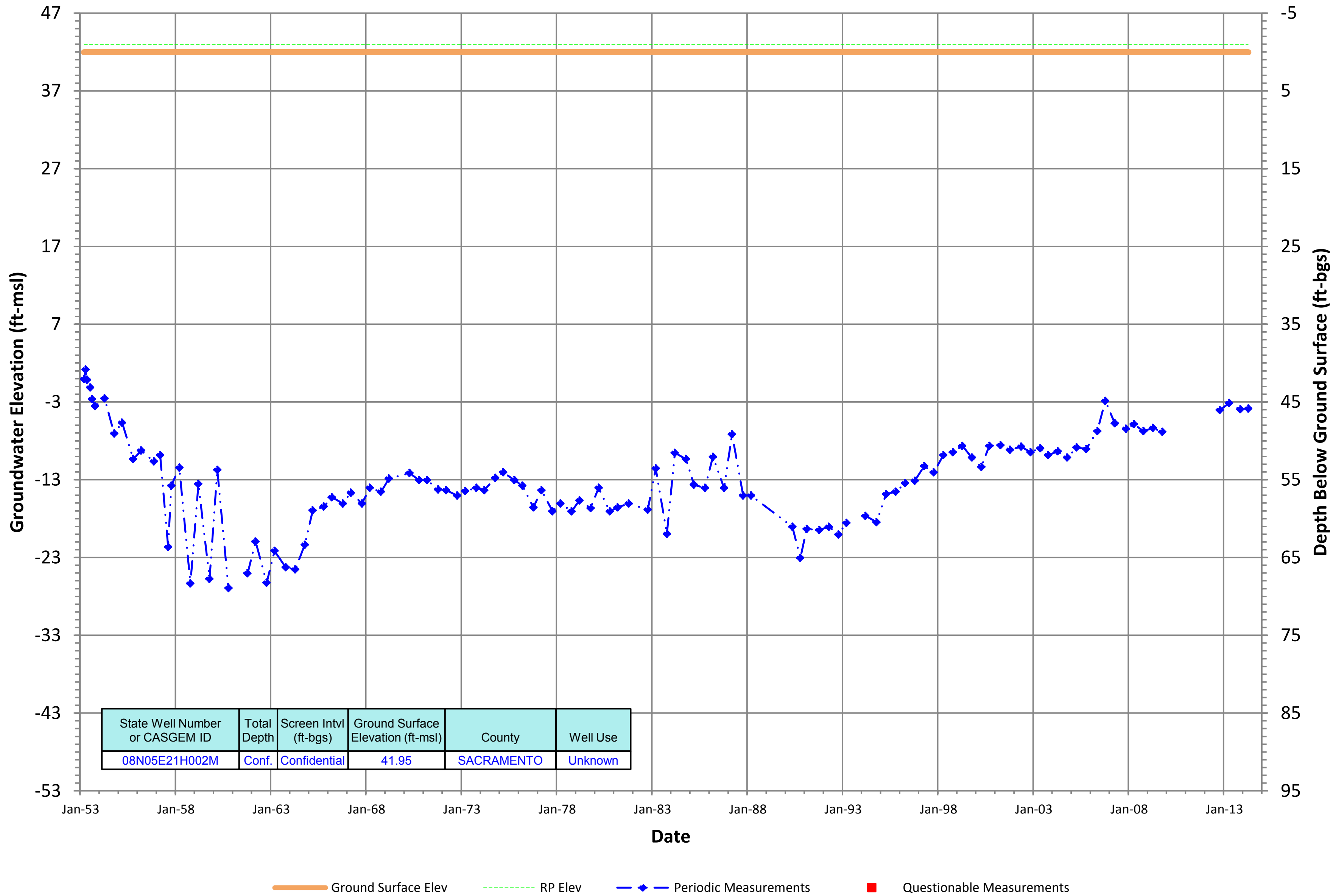
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N04E36L001M	Conf.	Confidential	7.51	SACRAMENTO	Residential

08N05E21H002M
Period Of Record: 03/05/1953 to 04/17/2014

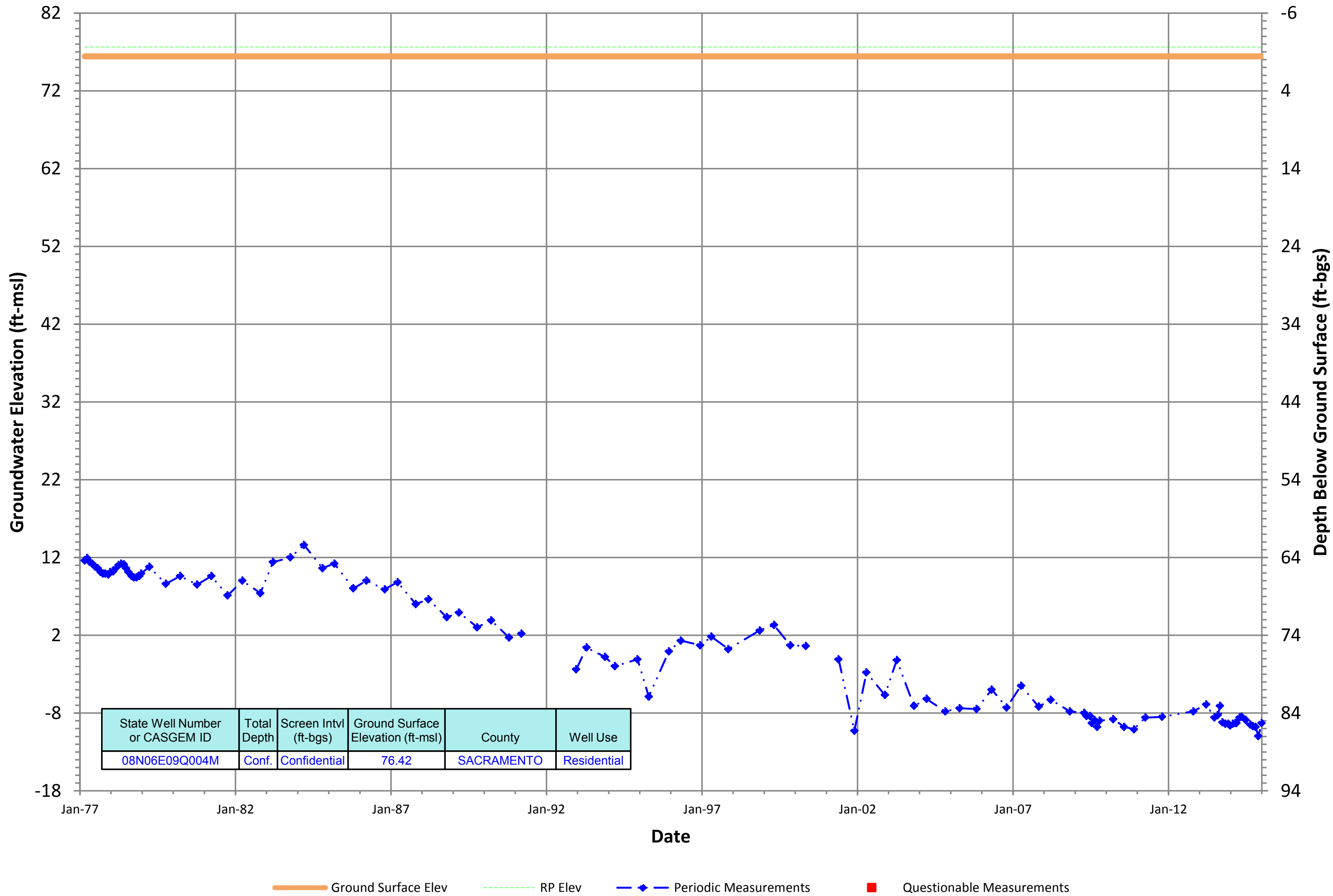
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N05E21H002M	Conf.	Confidential	41.95	SACRAMENTO	Unknown

08N06E09Q004M
Period Of Record: 02/25/1977 to 12/30/2014

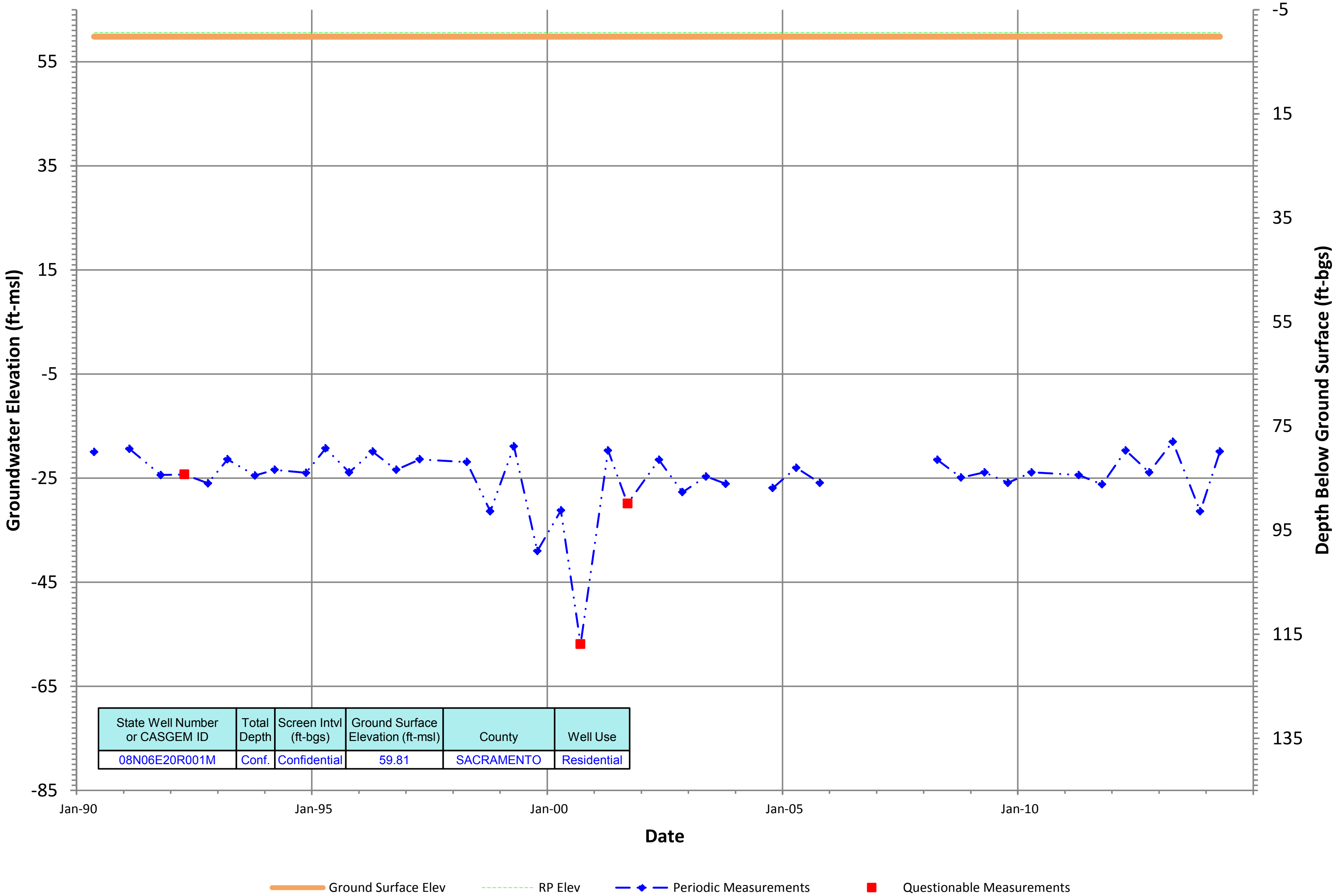
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N06E09Q004M	Conf.	Confidential	76.42	SACRAMENTO	Residential

08N06E20R001M
Period Of Record: 05/05/1990 to 04/14/2014

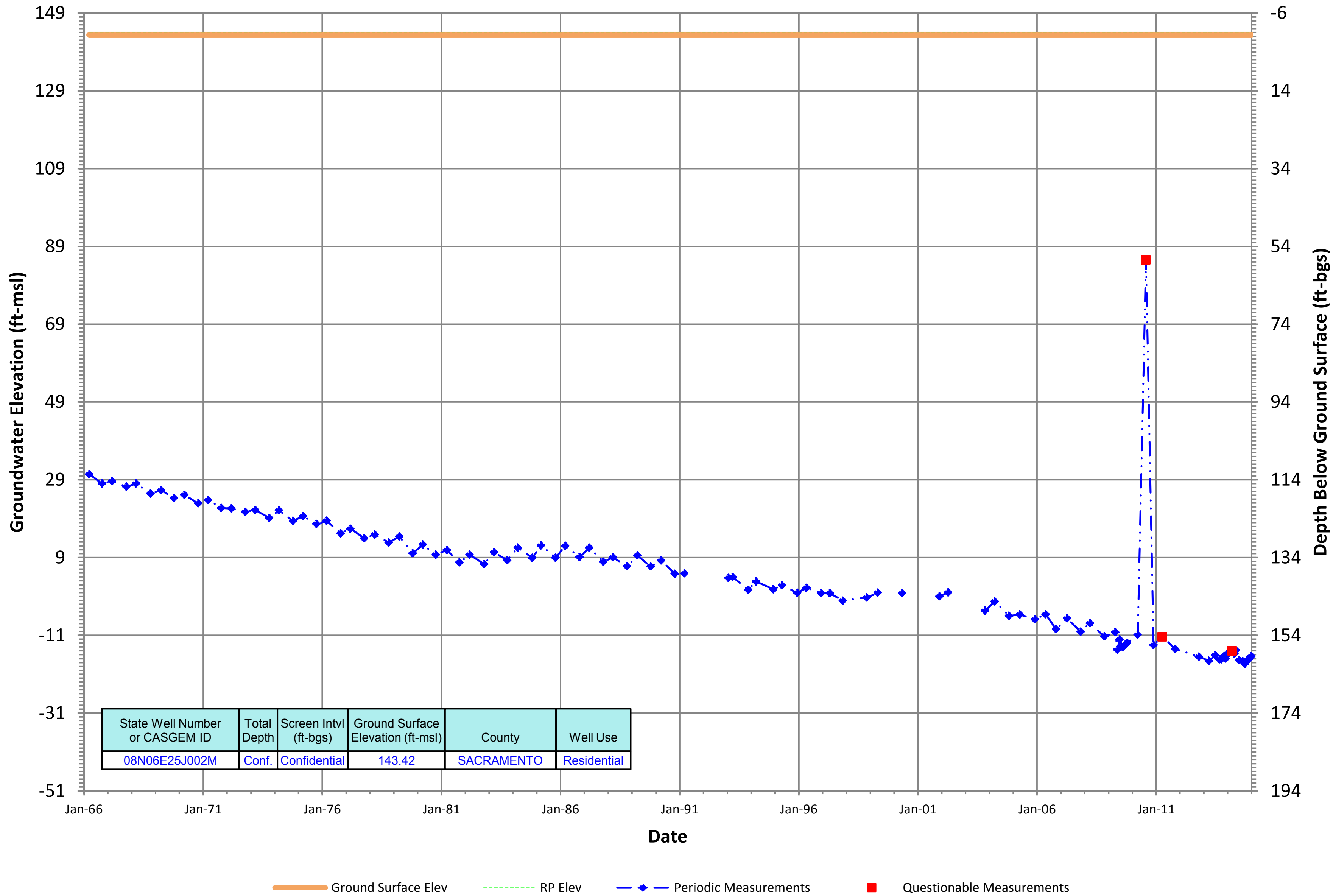
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N06E20R001M	Conf.	Confidential	59.81	SACRAMENTO	Residential

08N06E25J002M
Period Of Record: 03/22/1966 to 12/30/2014

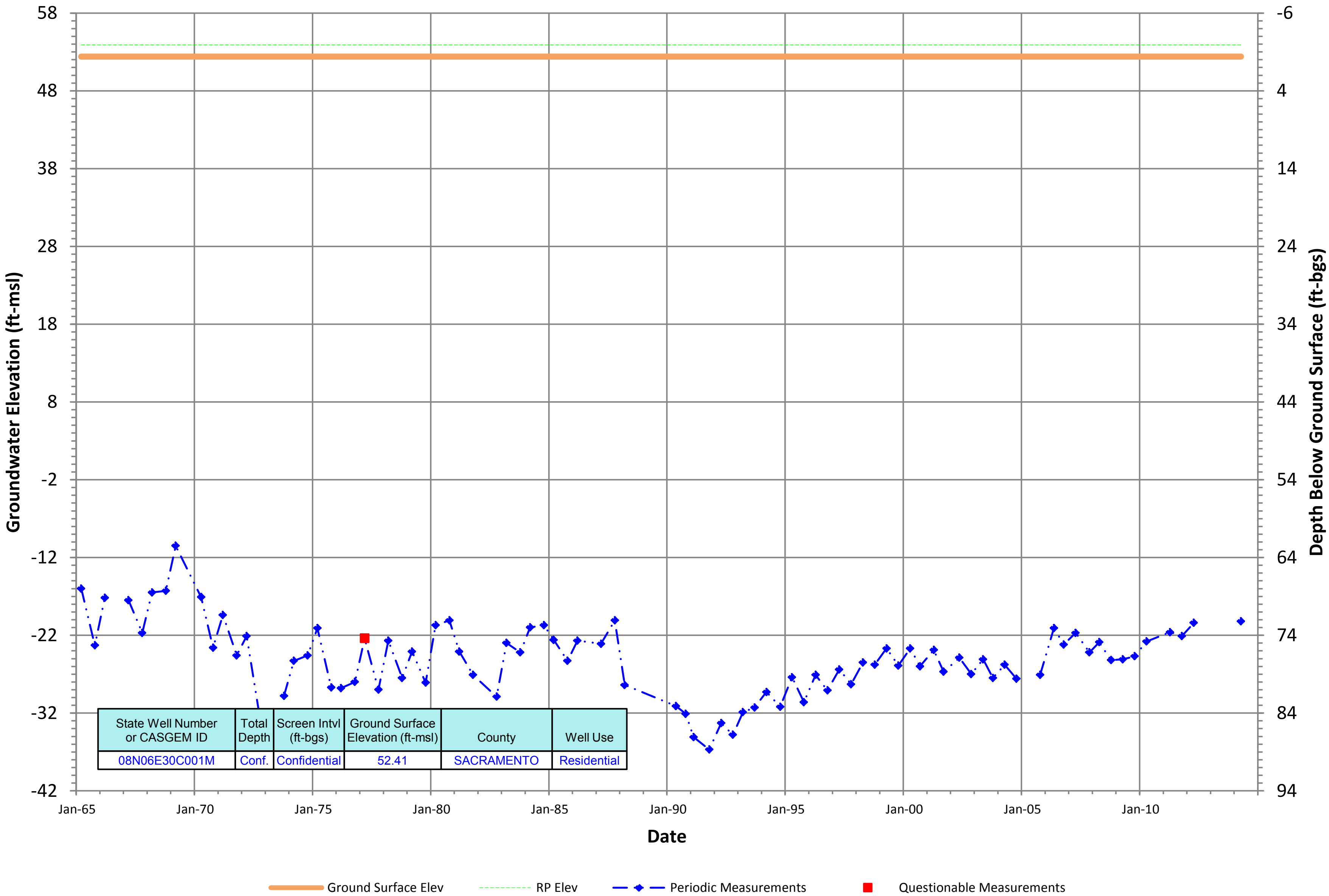
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N06E25J002M	Conf.	Confidential	143.42	SACRAMENTO	Residential

08N06E30C001M
Period Of Record: 03/09/1965 to 04/10/2014

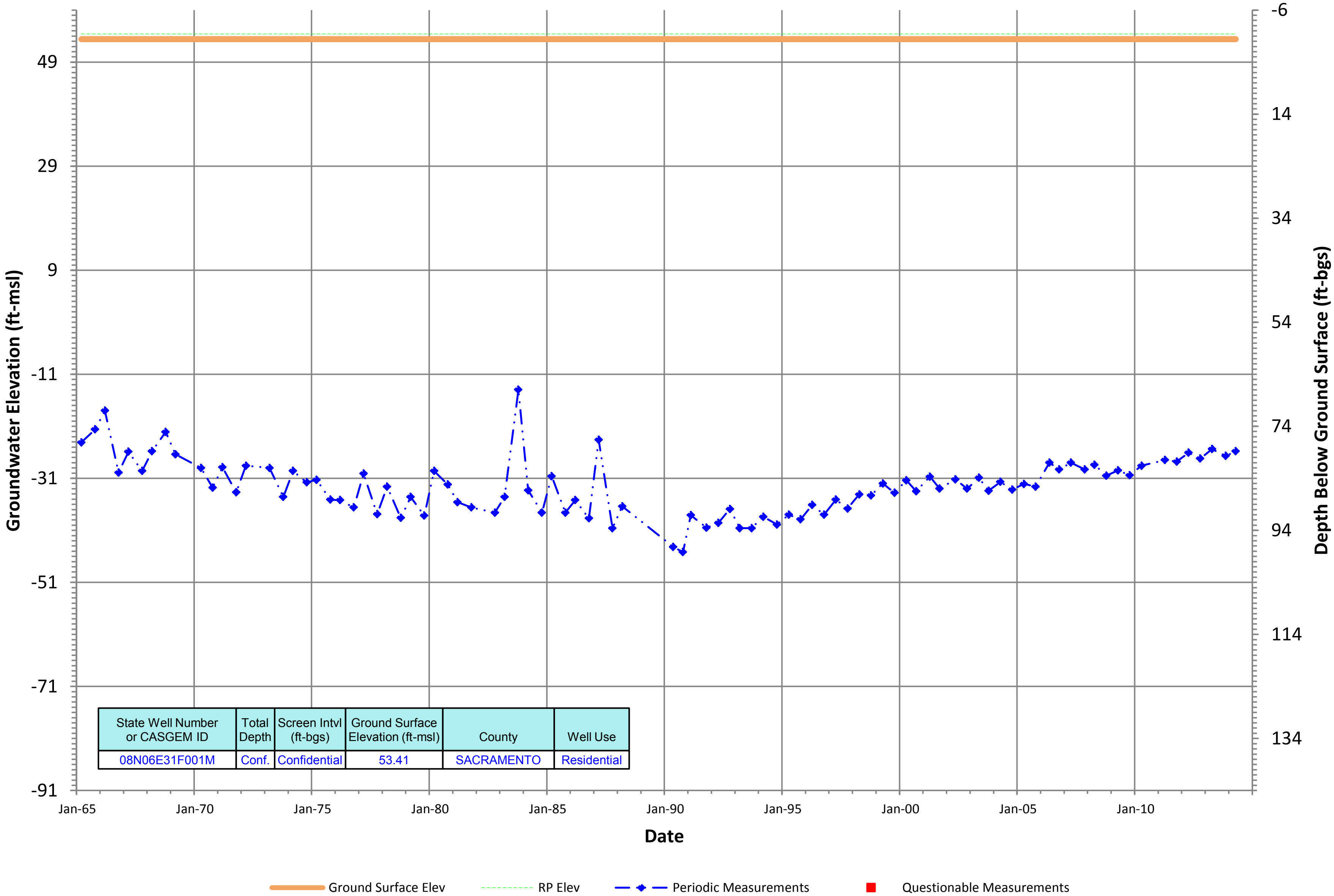
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N06E30C001M	Conf.	Confidential	52.41	SACRAMENTO	Residential

08N06E31F001M
Period Of Record: 03/09/1965 to 04/17/2014

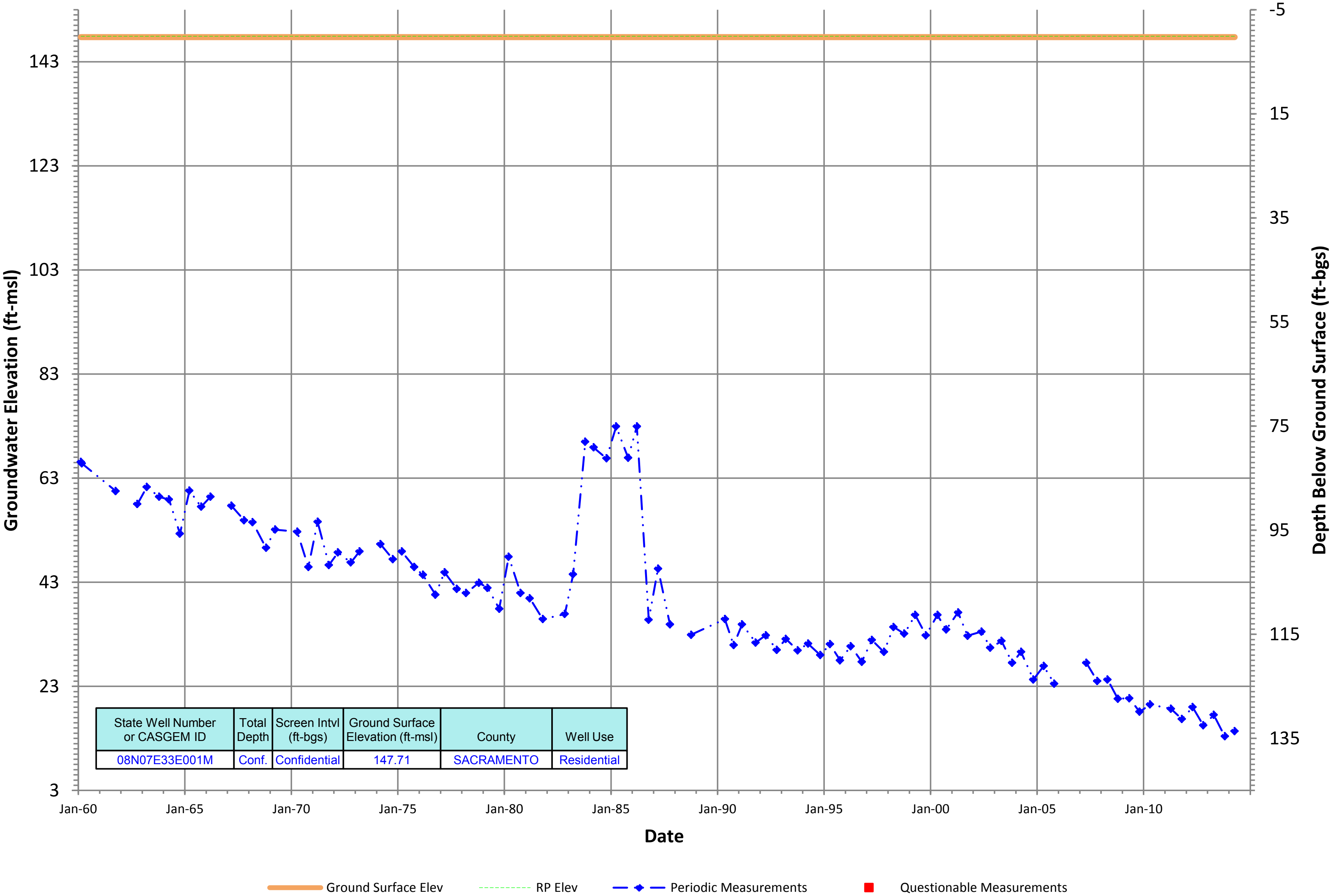
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N06E31F001M	Conf.	Confidential	53.41	SACRAMENTO	Residential

08N07E33E001M
Period Of Record: 02/15/1960 to 04/09/2014

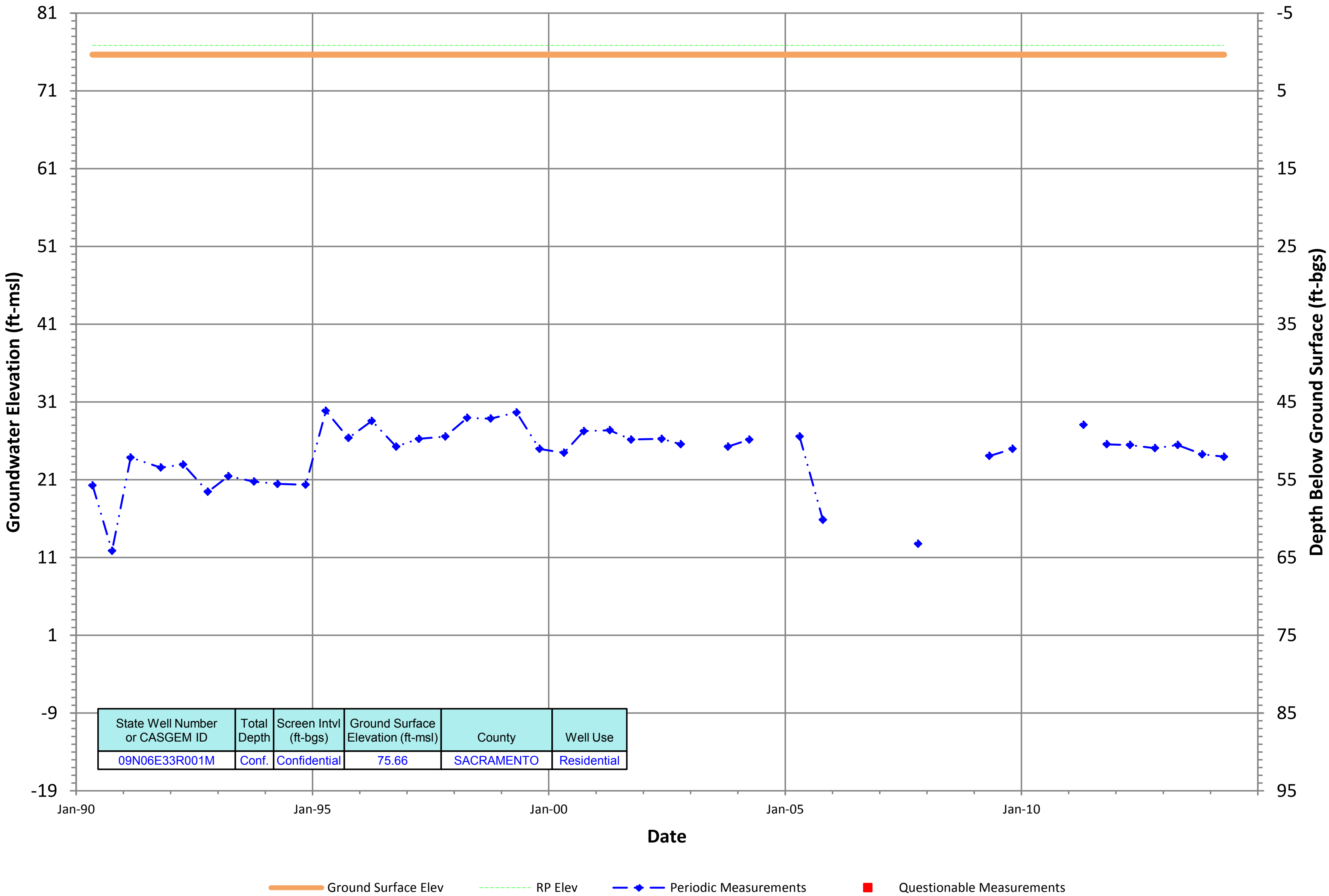
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N07E33E001M	Conf.	Confidential	147.71	SACRAMENTO	Residential

09N06E33R001M
Period Of Record: 05/07/1990 to 04/14/2014

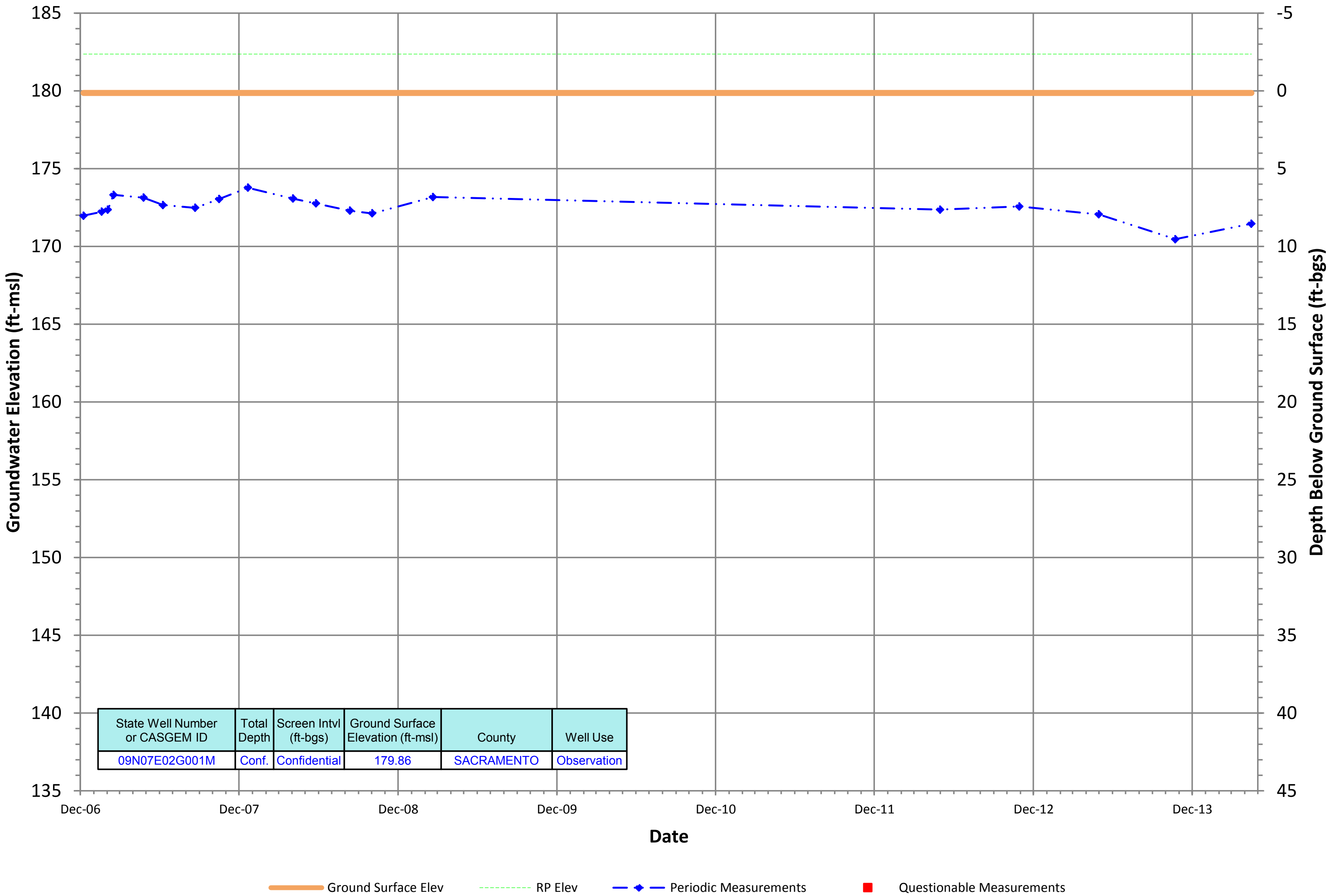
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N06E33R001M	Conf.	Confidential	75.66	SACRAMENTO	Residential

09N07E02G001M
Period Of Record: 12/08/2006 to 04/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N07E02G001M	Conf.	Confidential	179.86	SACRAMENTO	Observation

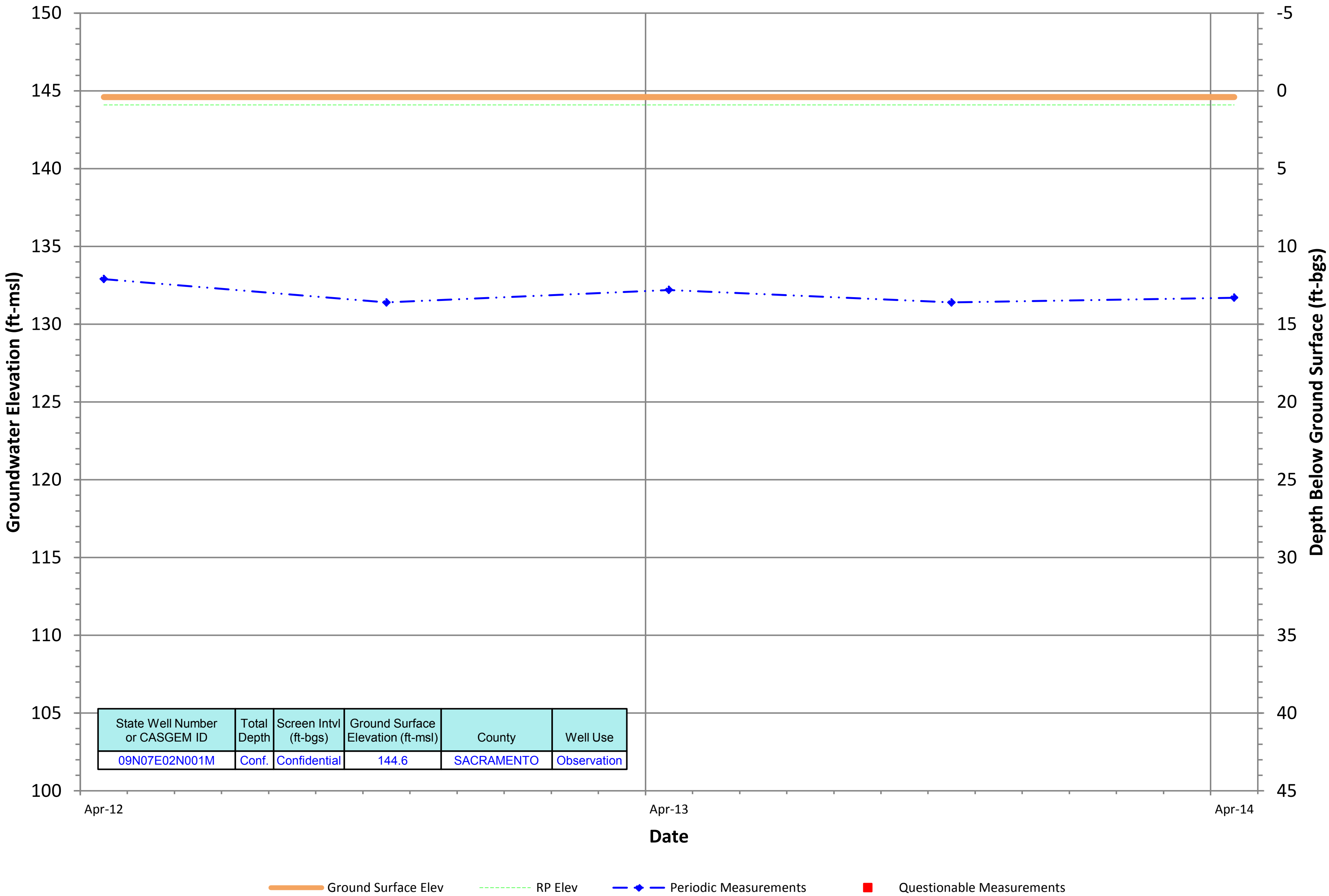
09N07E02N001M

Period Of Record: 04/30/2012 to 04/16/2014

Hydrograph Criteria

Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)

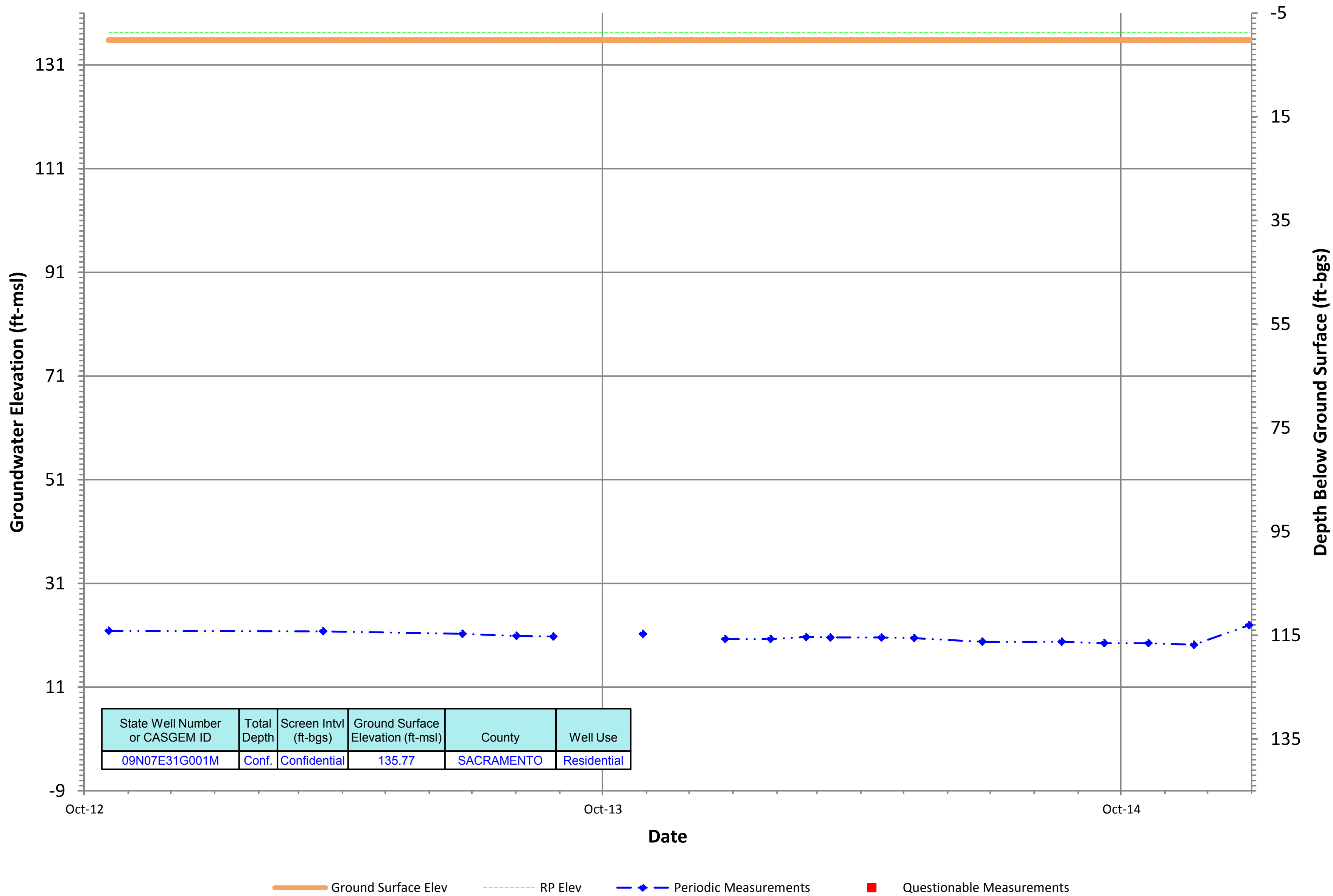
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N07E02N001M	Conf.	Confidential	144.6	SACRAMENTO	Observation

09N07E31G001M
Period Of Record: 10/18/2012 to 12/30/2014

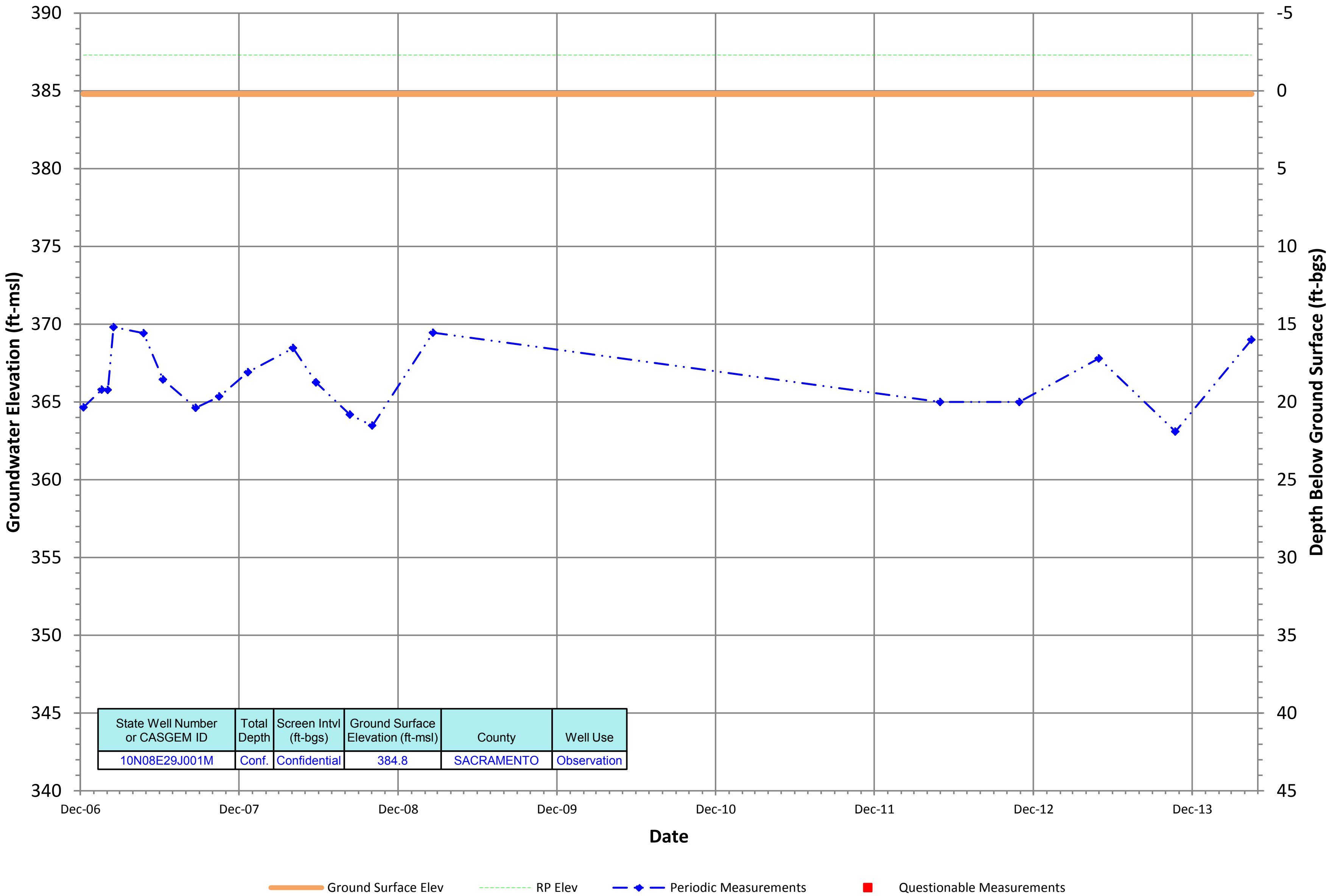
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N07E31G001M	Conf.	Confidential	135.77	SACRAMENTO	Residential

10N08E29J001M
Period Of Record: 12/08/2006 to 04/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N08E29J001M	Conf.	Confidential	384.8	SACRAMENTO	Observation

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Intermediate Depth Groundwater Monitoring Well Hydrographs- South American Subbasin

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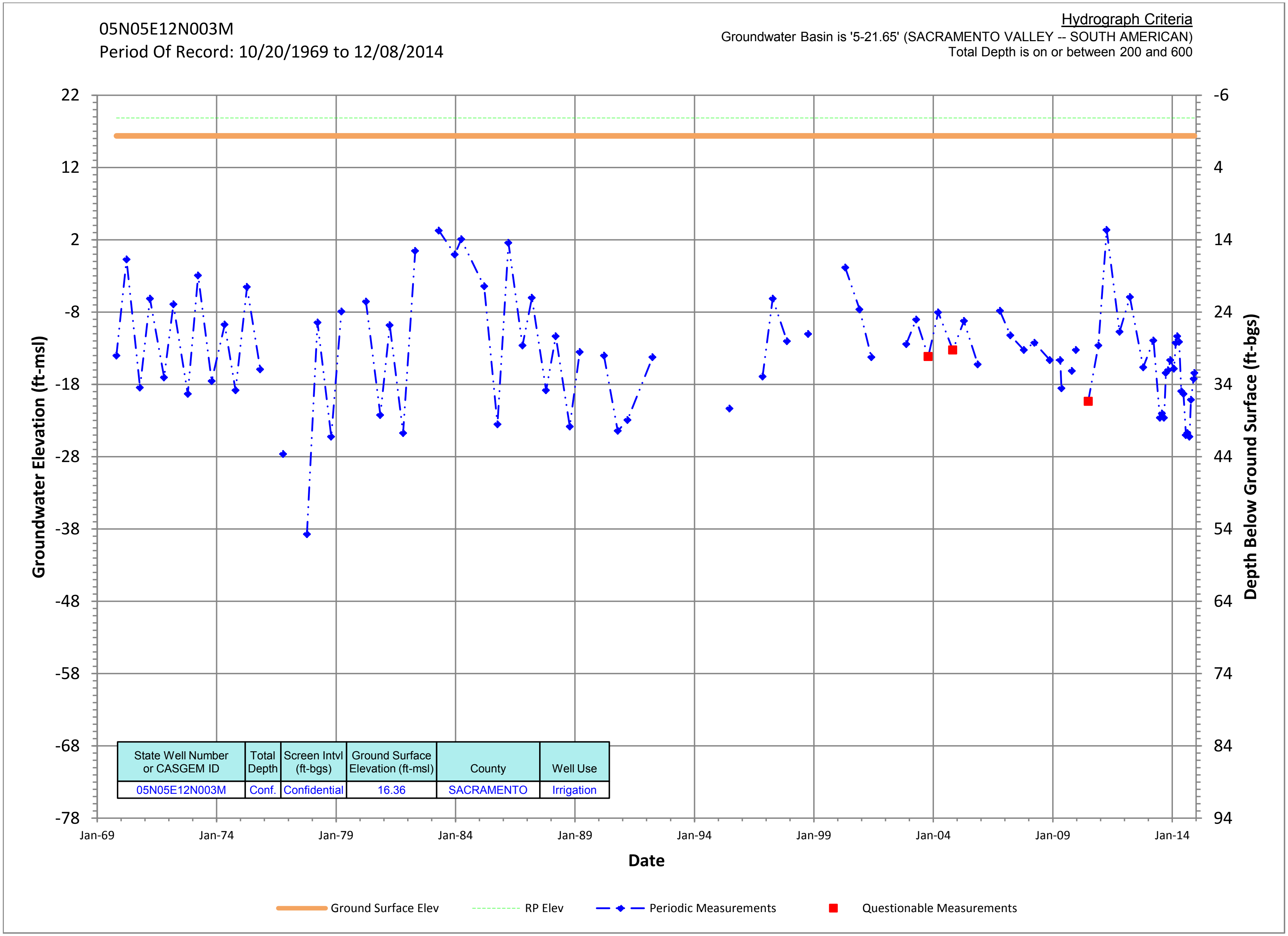


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
05N05E12N003M	Conf.	Confidential	16.36	SACRAMENTO	Irrigation

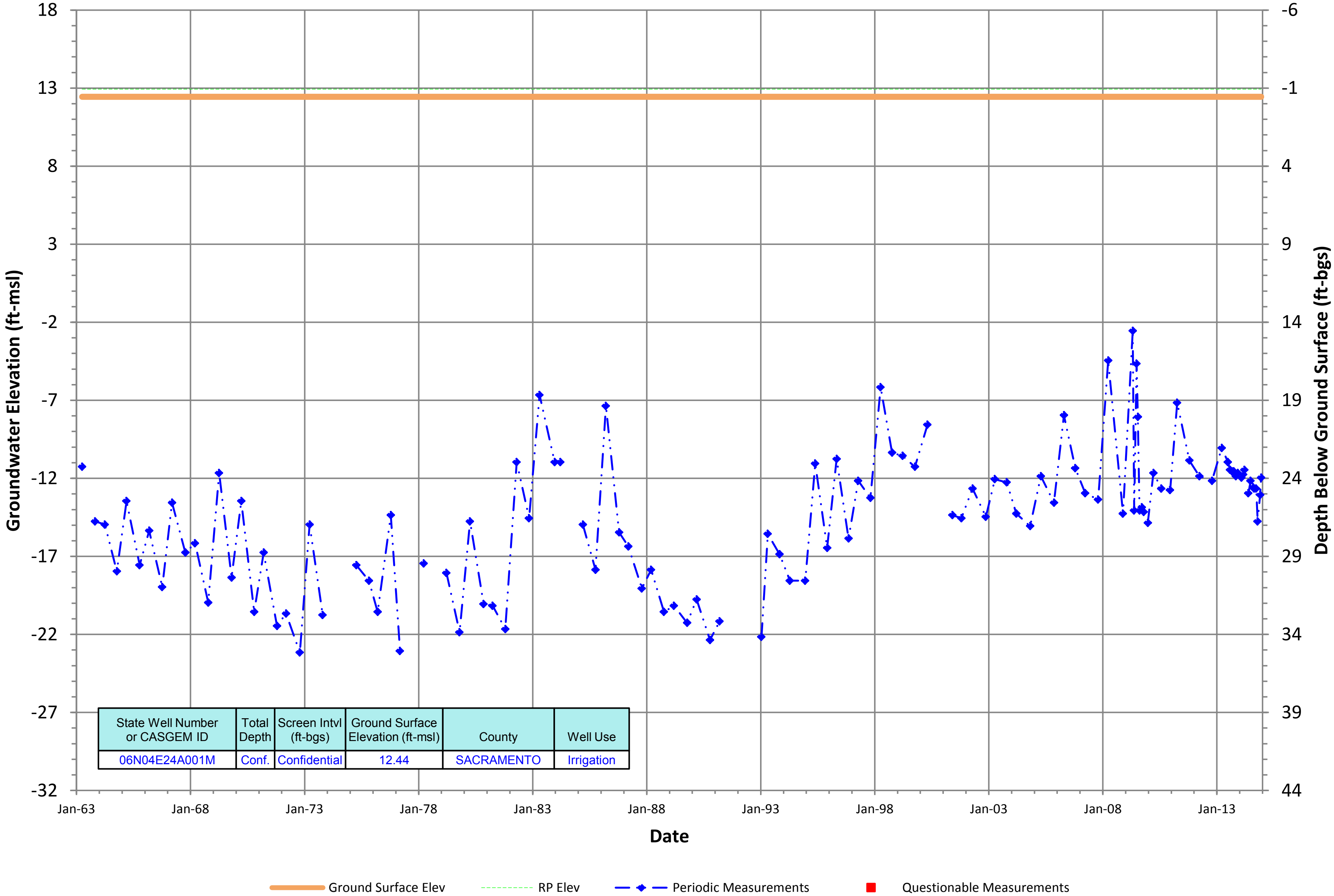
06N04E24A001M

Period Of Record: 04/01/1963 to 12/09/2014

Hydrograph Criteria

Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)

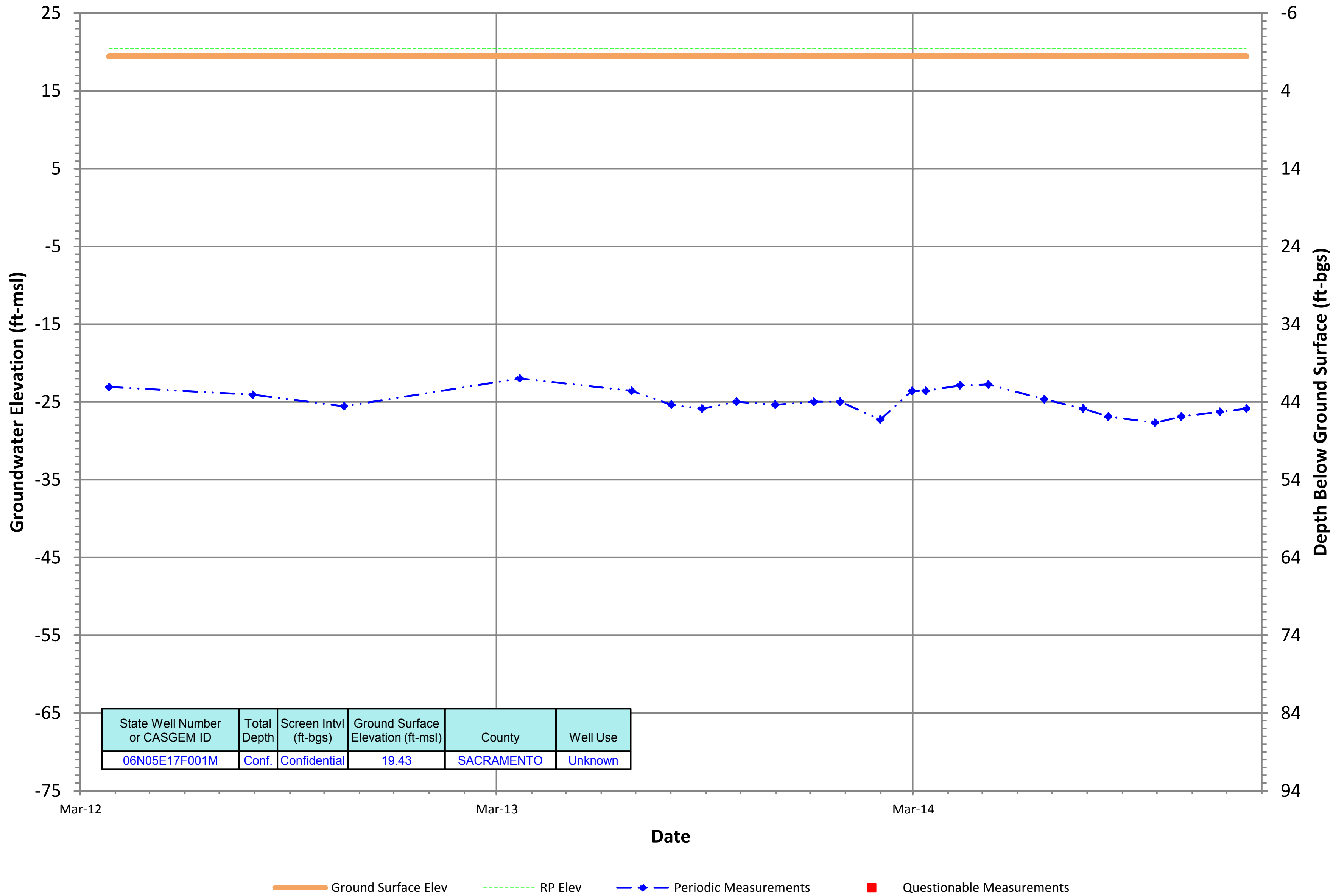
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N04E24A001M	Conf.	Confidential	12.44	SACRAMENTO	Irrigation

06N05E17F001M
Period Of Record: 03/26/2012 to 12/18/2014

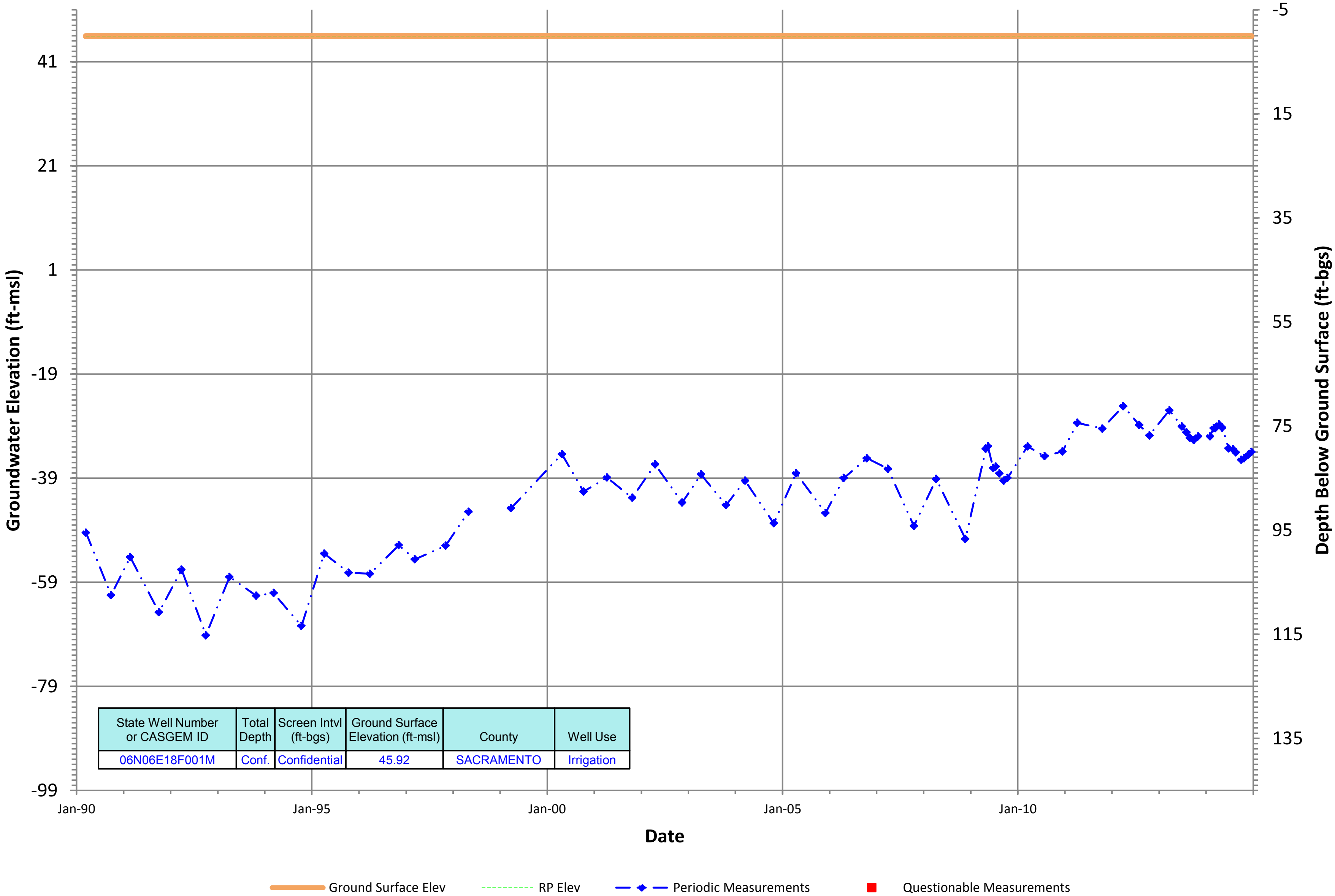
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N05E17F001M	Conf.	Confidential	19.43	SACRAMENTO	Unknown

06N06E18F001M
Period Of Record: 03/14/1990 to 12/19/2014

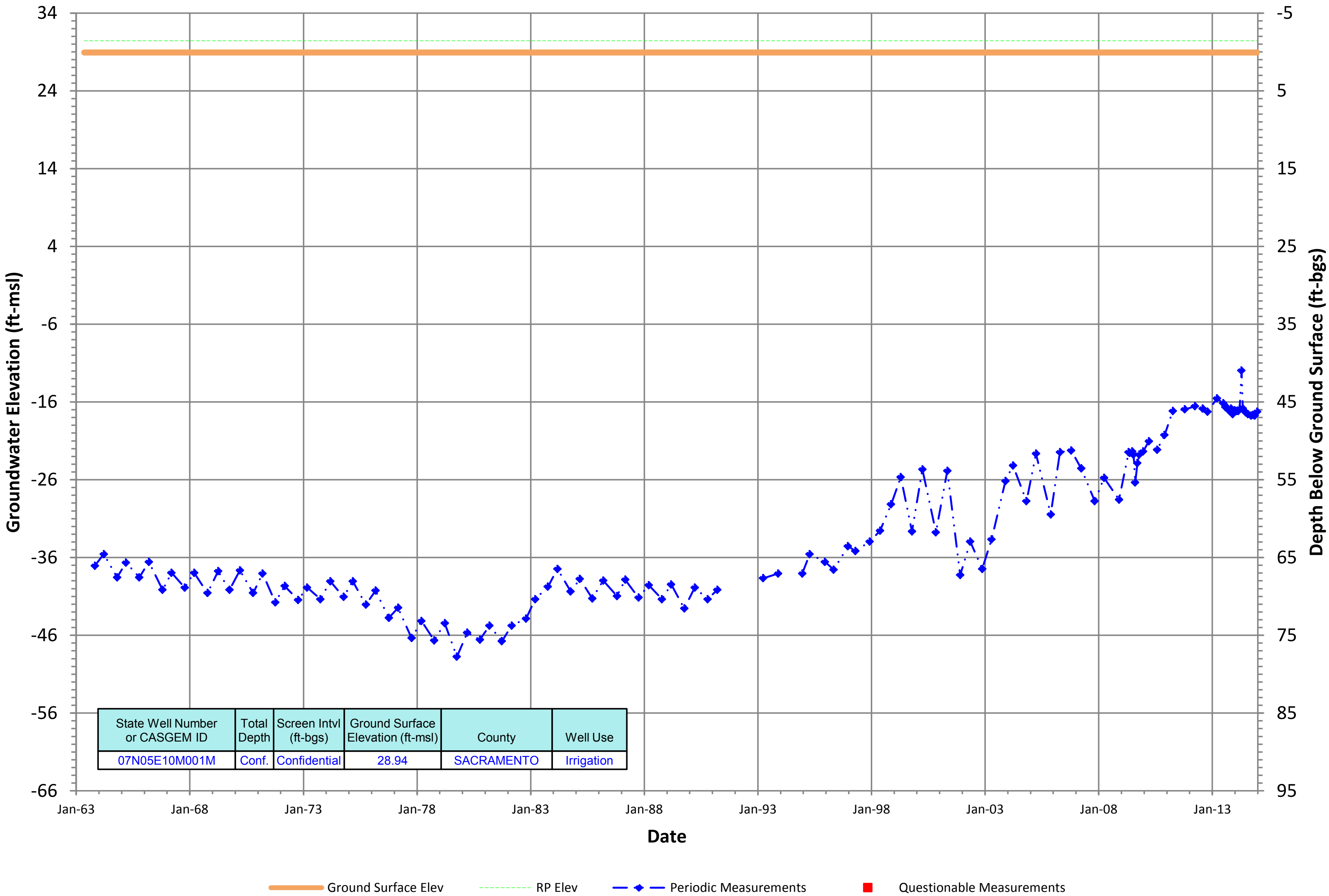
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
06N06E18F001M	Conf.	Confidential	45.92	SACRAMENTO	Irrigation

07N05E10M001M
Period Of Record: 05/10/1963 to 12/23/2014

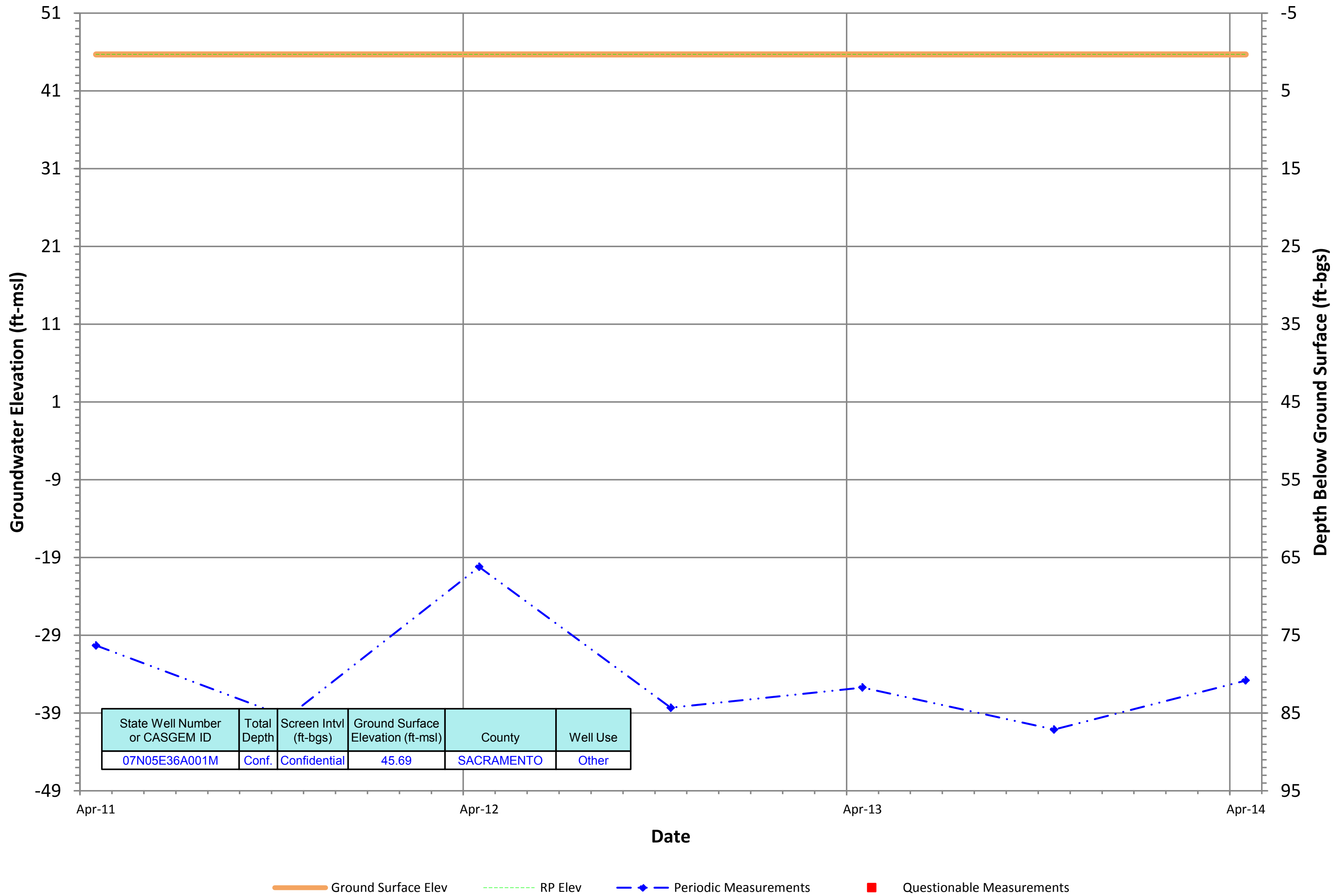
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N05E10M001M	Conf.	Confidential	28.94	SACRAMENTO	Irrigation

07N05E36A001M
Period Of Record: 04/13/2011 to 04/14/2014

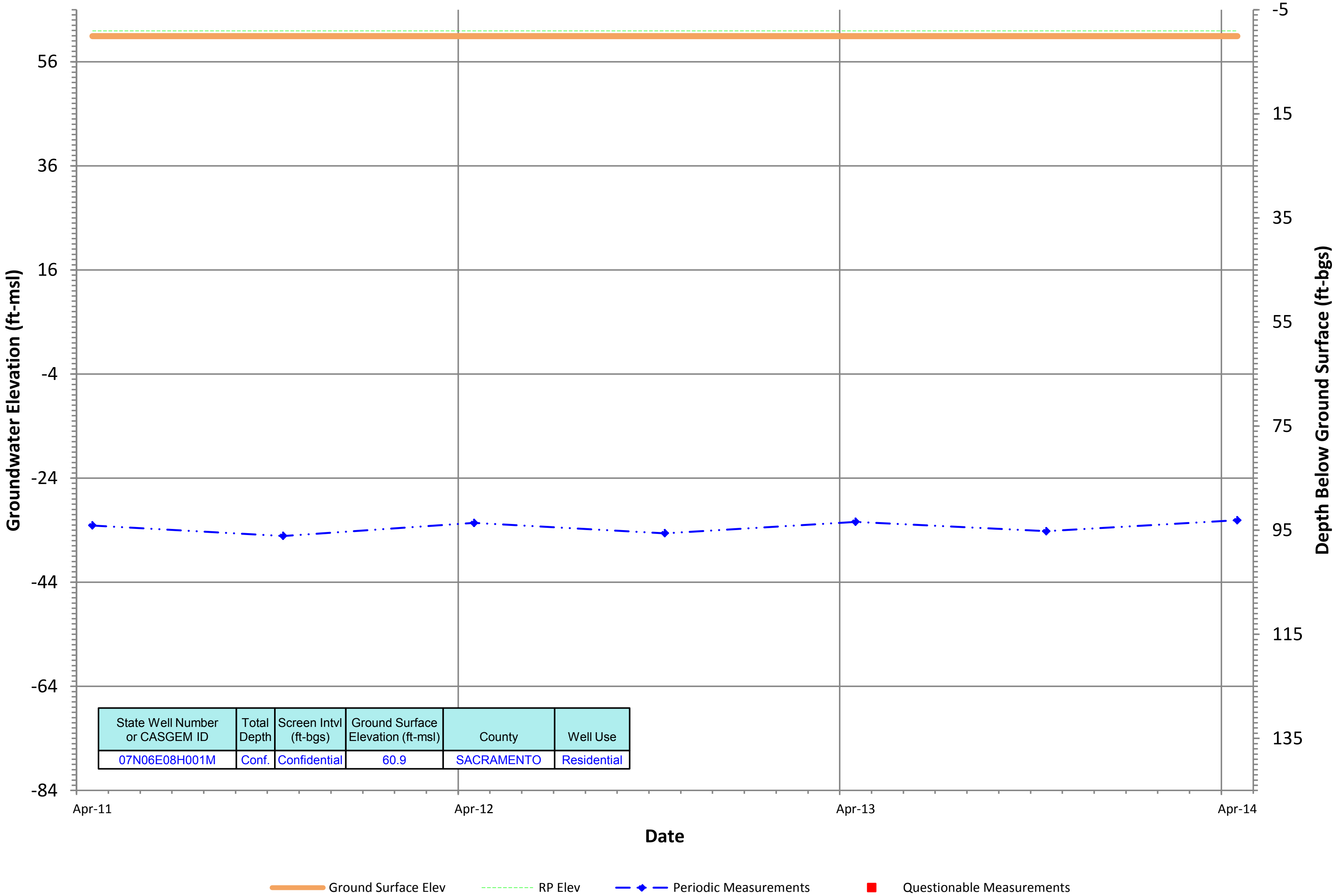
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N05E36A001M	Conf.	Confidential	45.69	SACRAMENTO	Other

07N06E08H001M
Period Of Record: 04/13/2011 to 04/14/2014

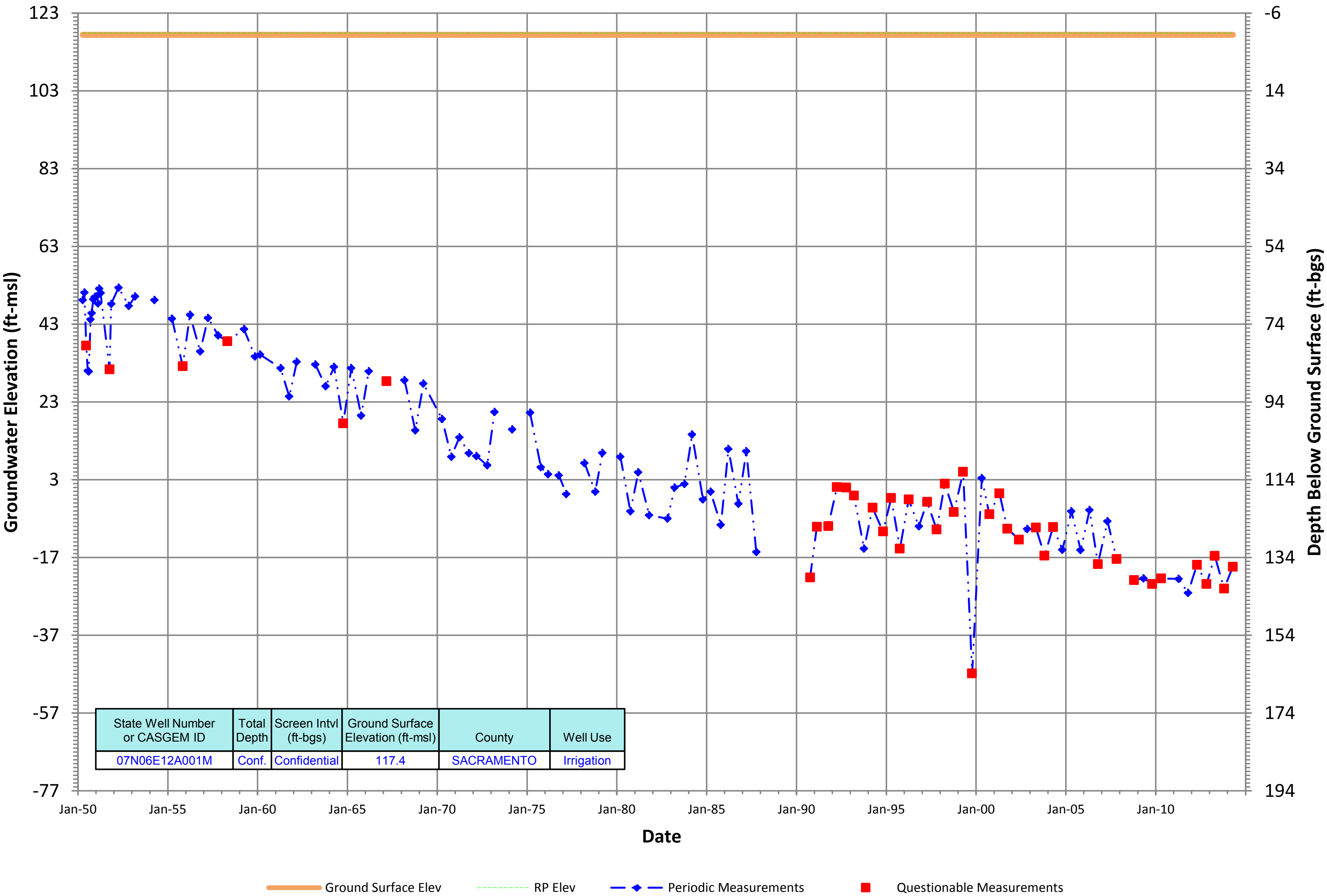
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N06E08H001M	Conf.	Confidential	60.9	SACRAMENTO	Residential

07N06E12A001M
Period Of Record: 04/06/1950 to 04/17/2014

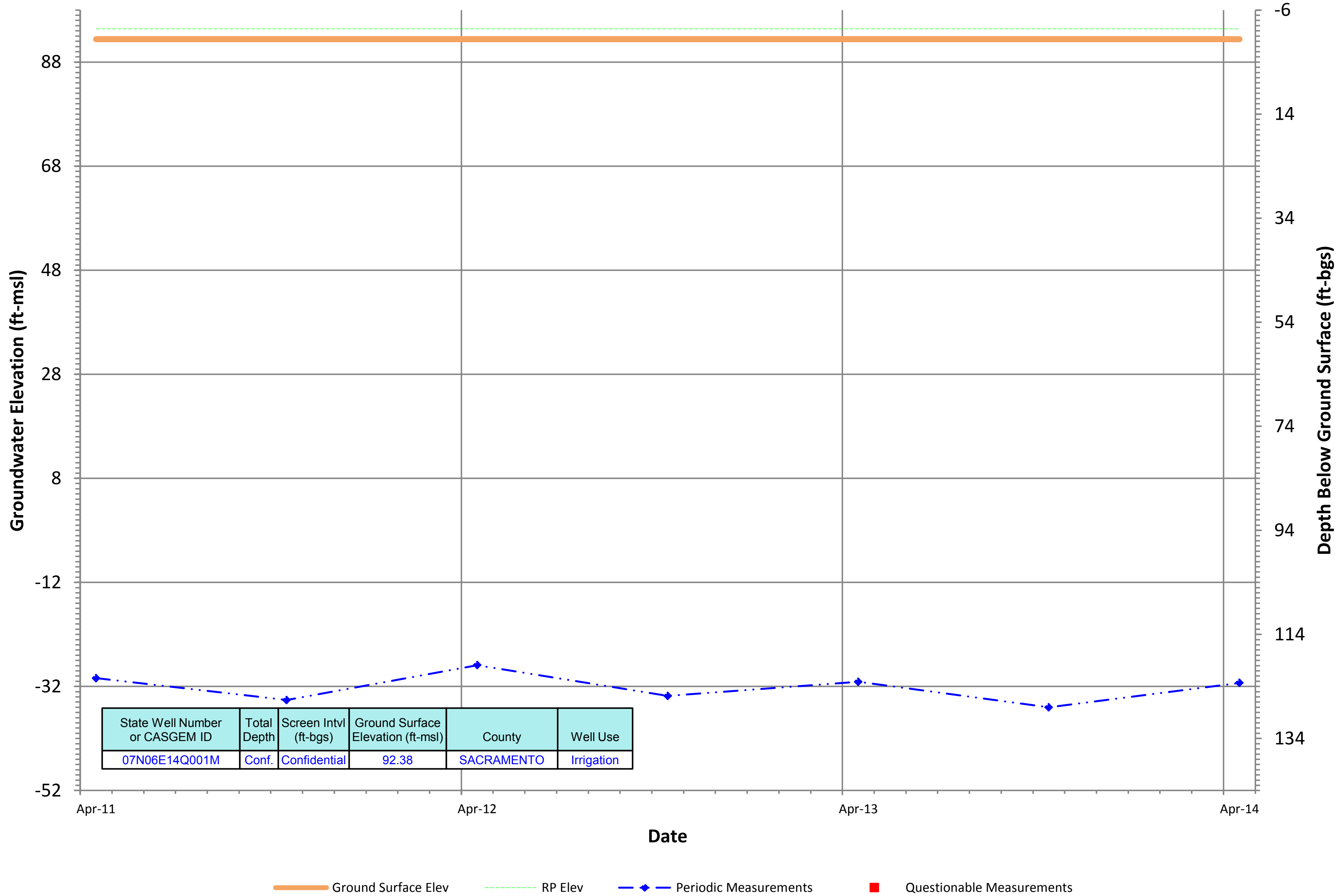
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N06E12A001M	Conf.	Confidential	117.4	SACRAMENTO	Irrigation

07N06E14Q001M
Period Of Record: 04/12/2011 to 04/14/2014

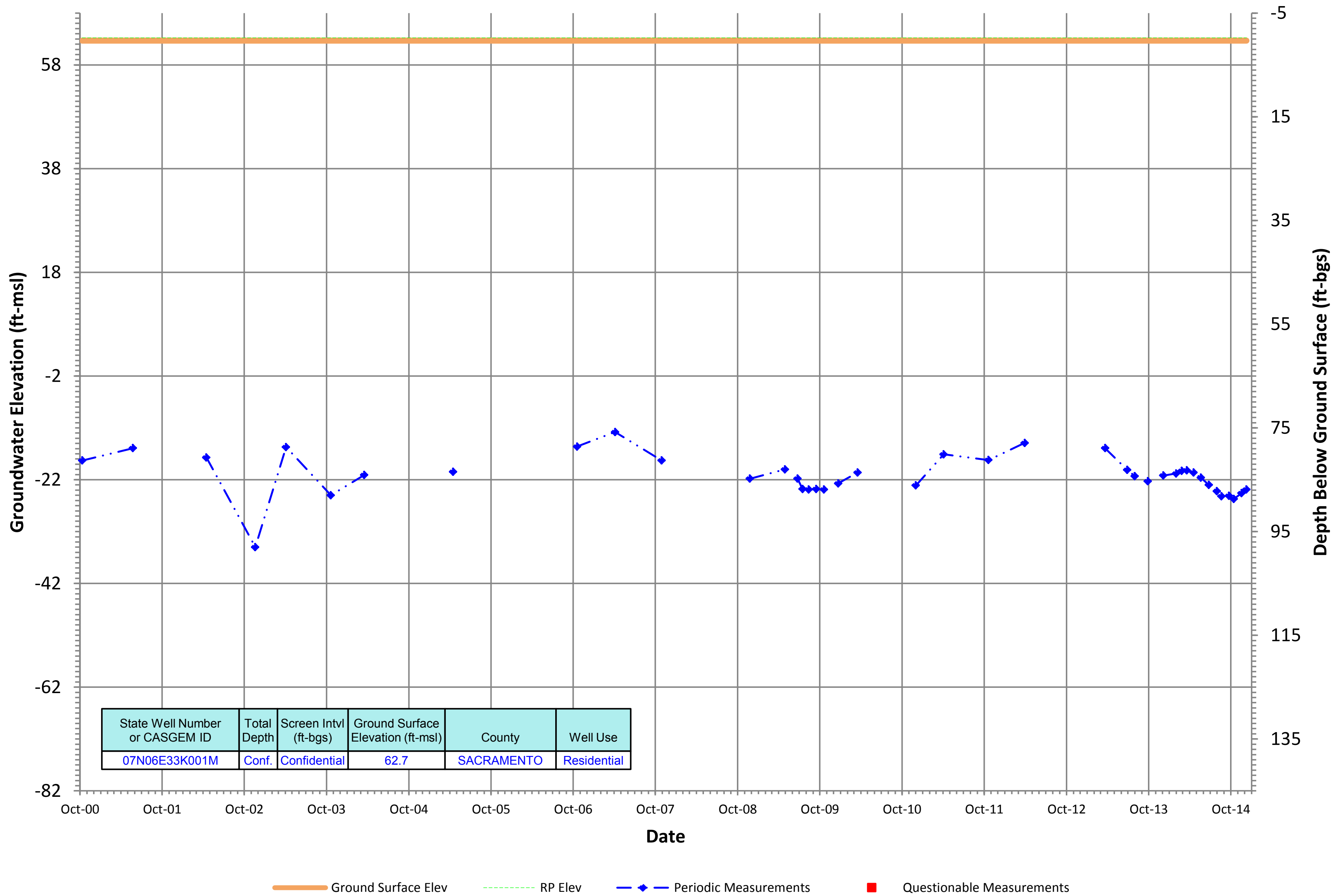
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N06E14Q001M	Conf.	Confidential	92.38	SACRAMENTO	Irrigation

07N06E33K001M
Period Of Record: 10/10/2000 to 12/09/2014

Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N06E33K001M	Conf.	Confidential	62.7	SACRAMENTO	Residential

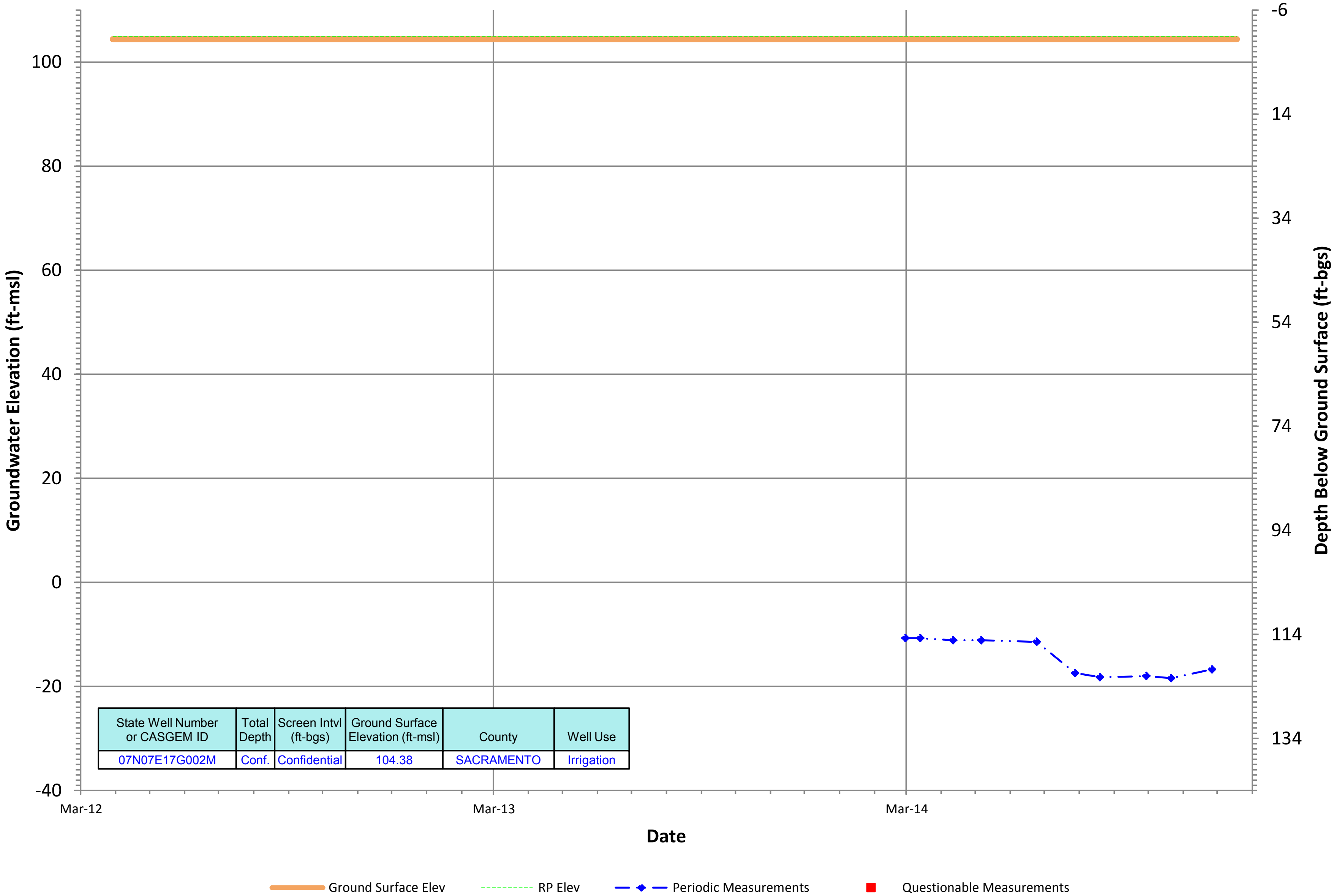
07N07E17G002M

Period Of Record: 03/29/2012 to 12/18/2014

Hydrograph Criteria

Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)

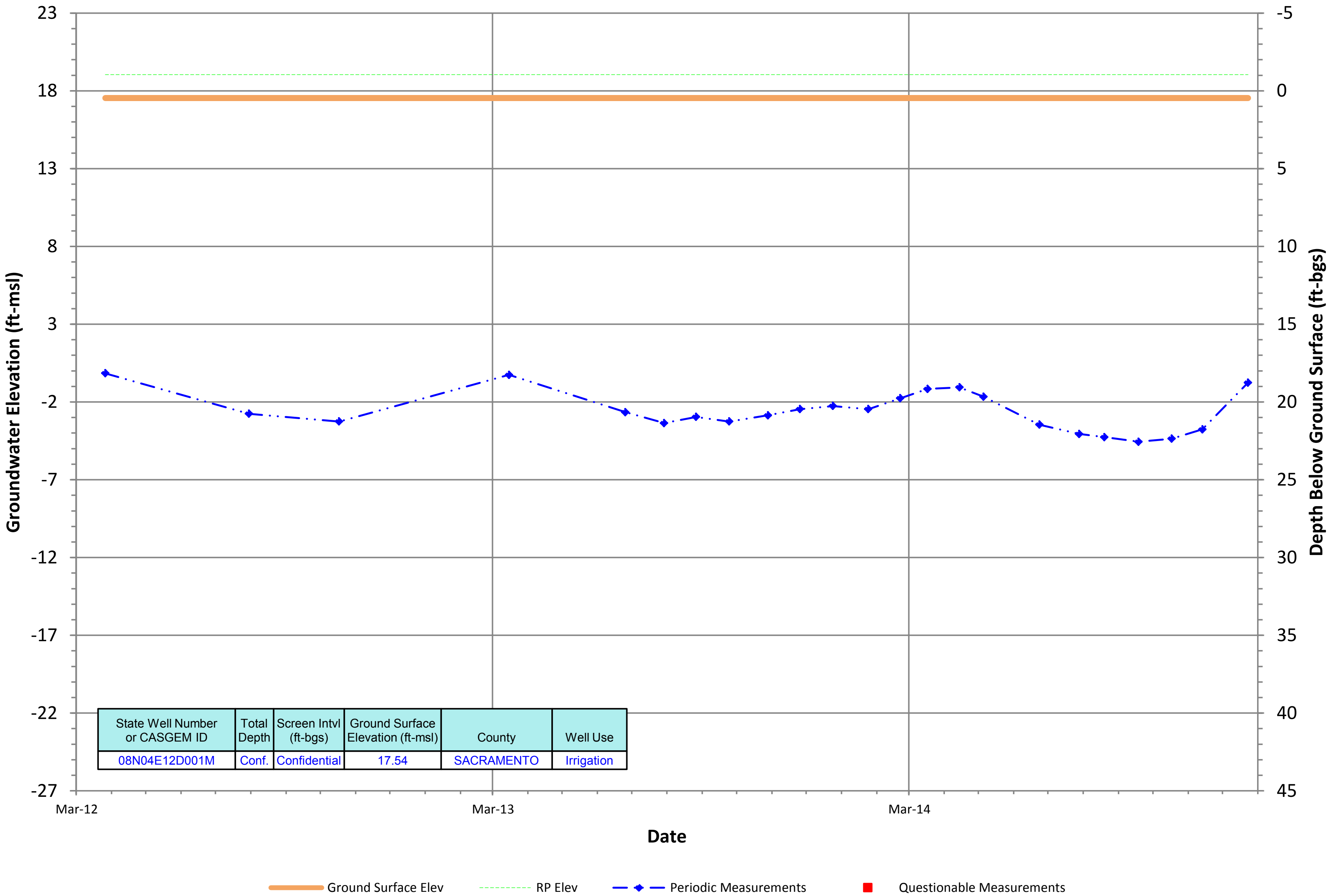
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
07N07E17G002M	Conf.	Confidential	104.38	SACRAMENTO	Irrigation

08N04E12D001M
Period Of Record: 03/26/2012 to 12/23/2014

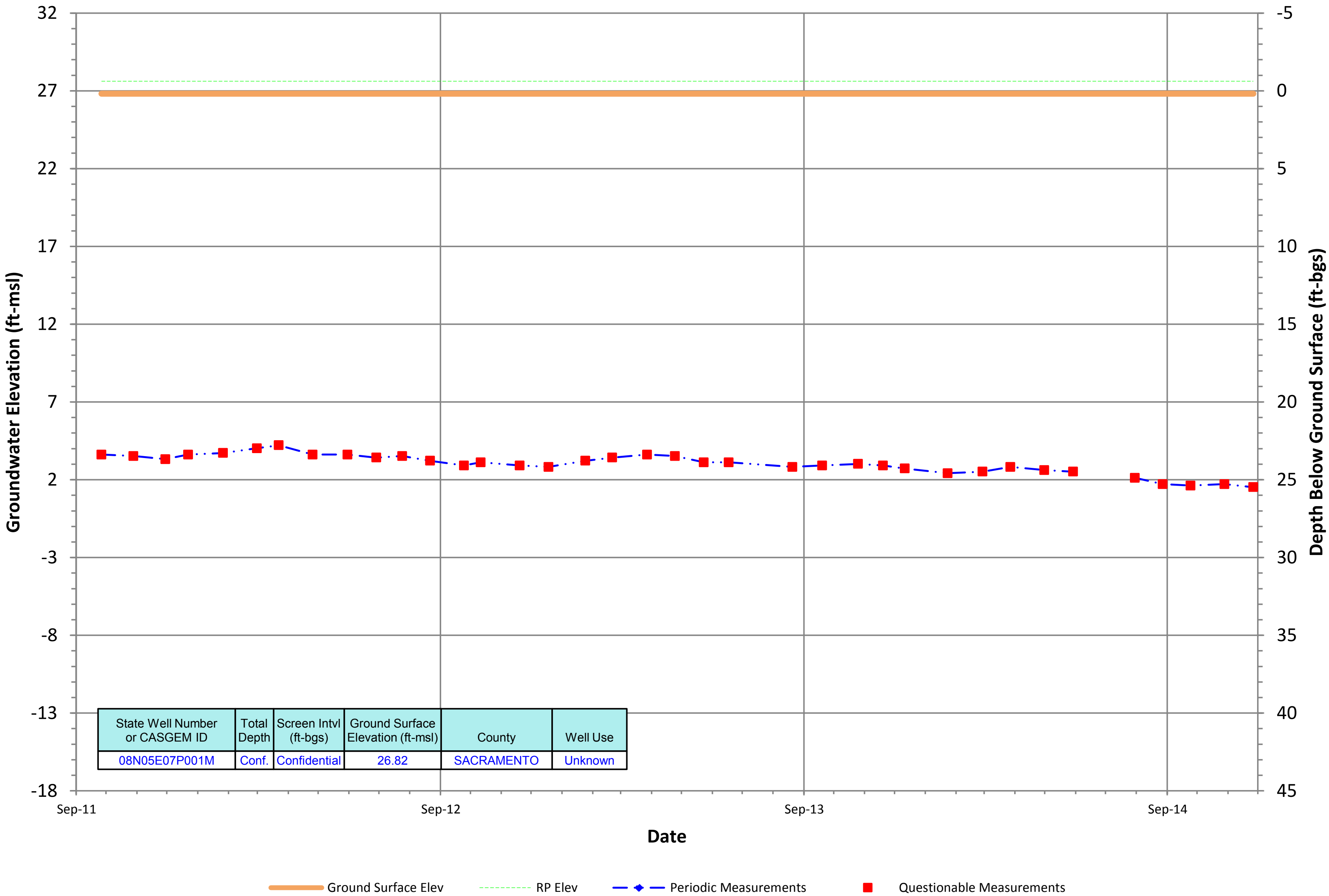
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N04E12D001M	Conf.	Confidential	17.54	SACRAMENTO	Irrigation

08N05E07P001M
Period Of Record: 09/26/2011 to 11/26/2014

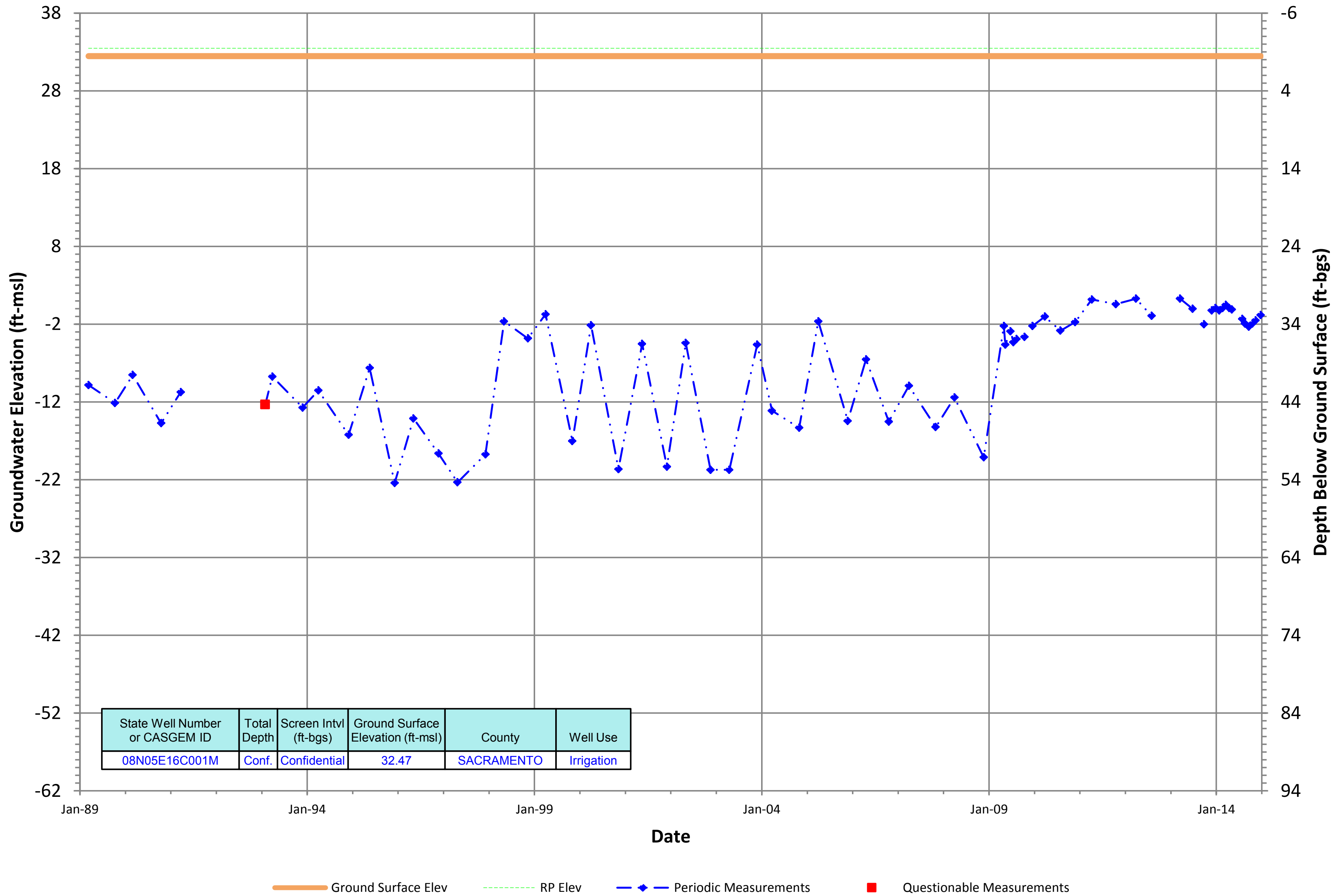
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



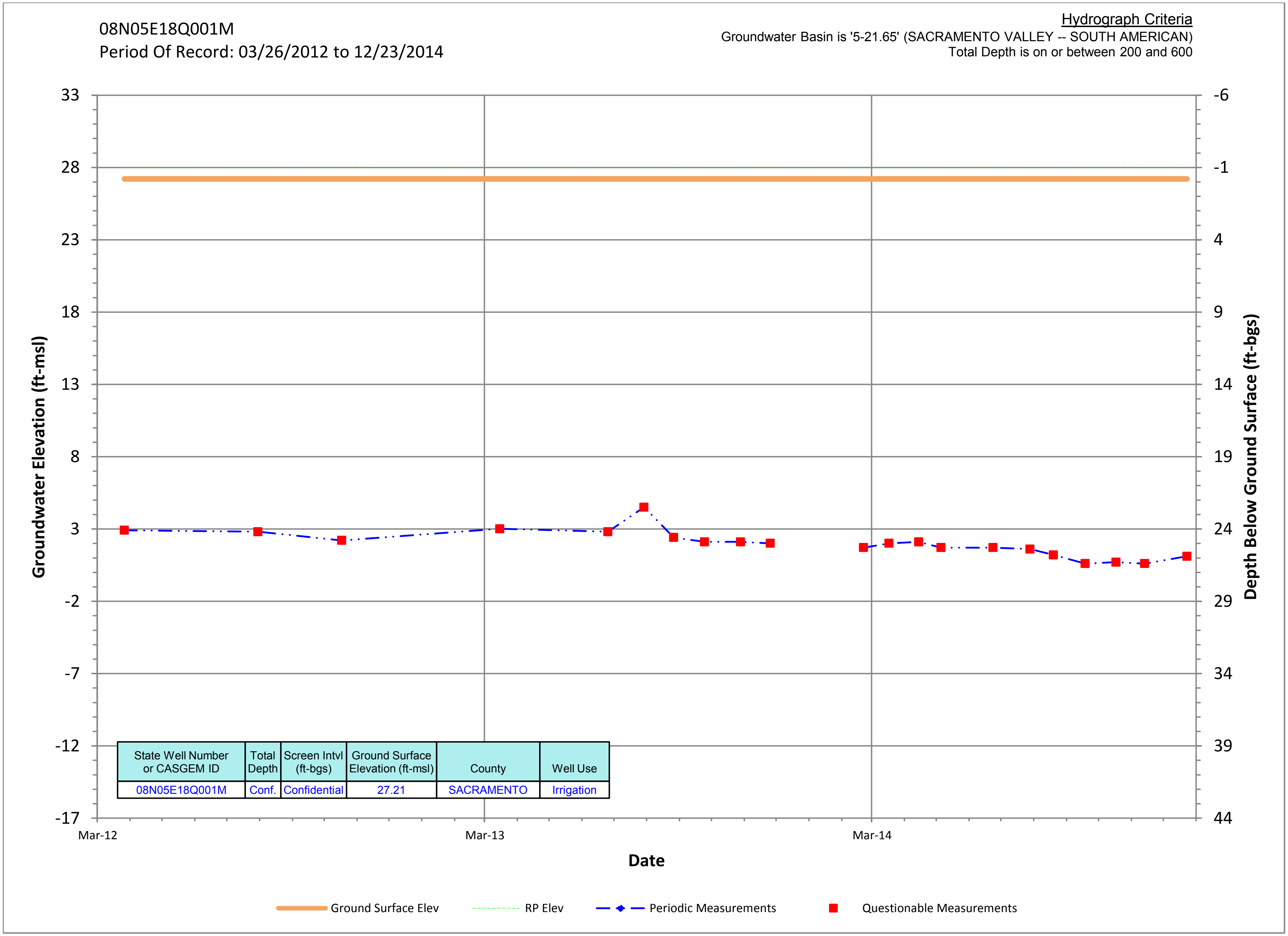
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N05E07P001M	Conf.	Confidential	26.82	SACRAMENTO	Unknown

08N05E16C001M
Period Of Record: 03/10/1989 to 12/23/2014

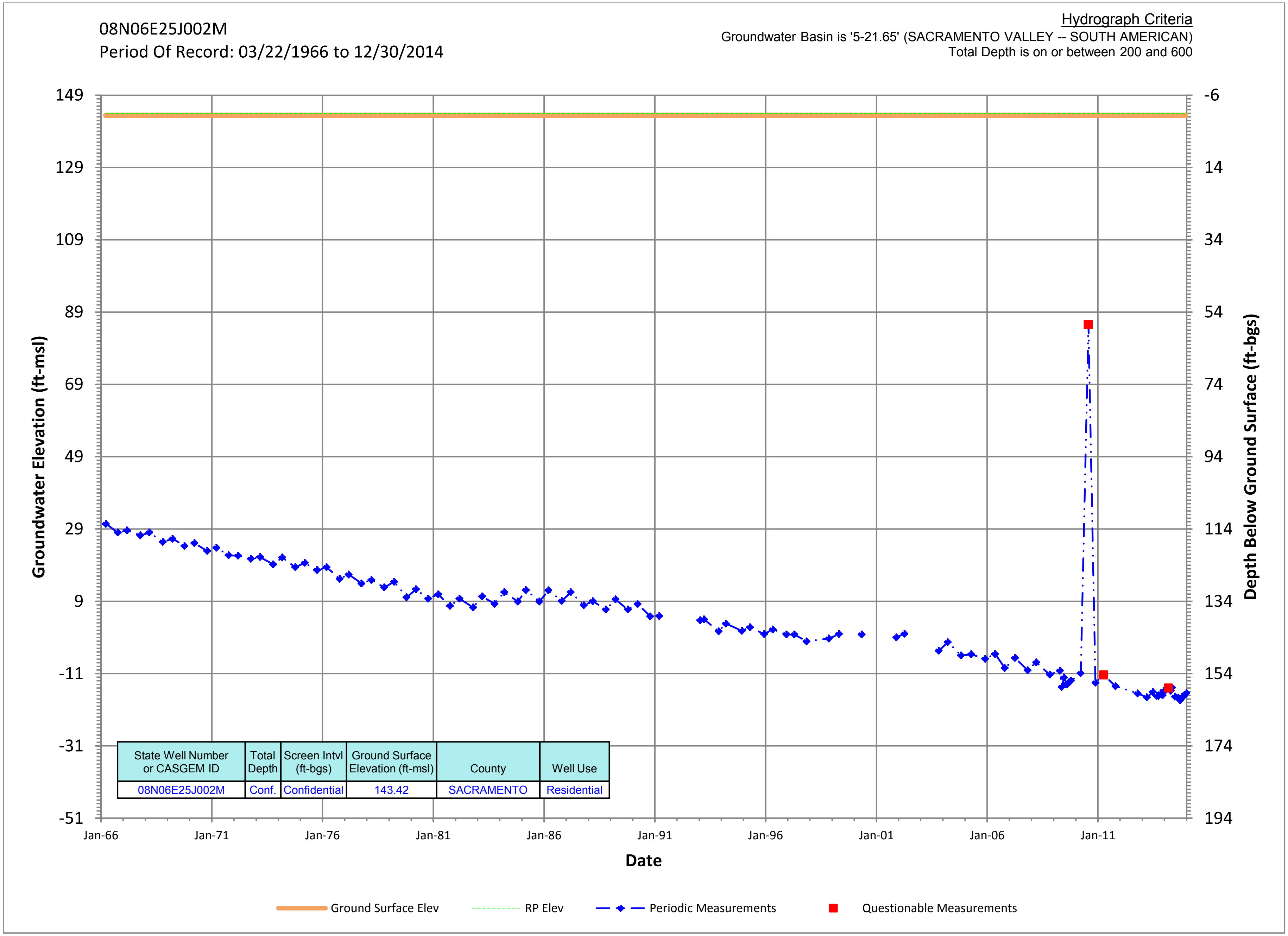
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N05E16C001M	Conf.	Confidential	32.47	SACRAMENTO	Irrigation



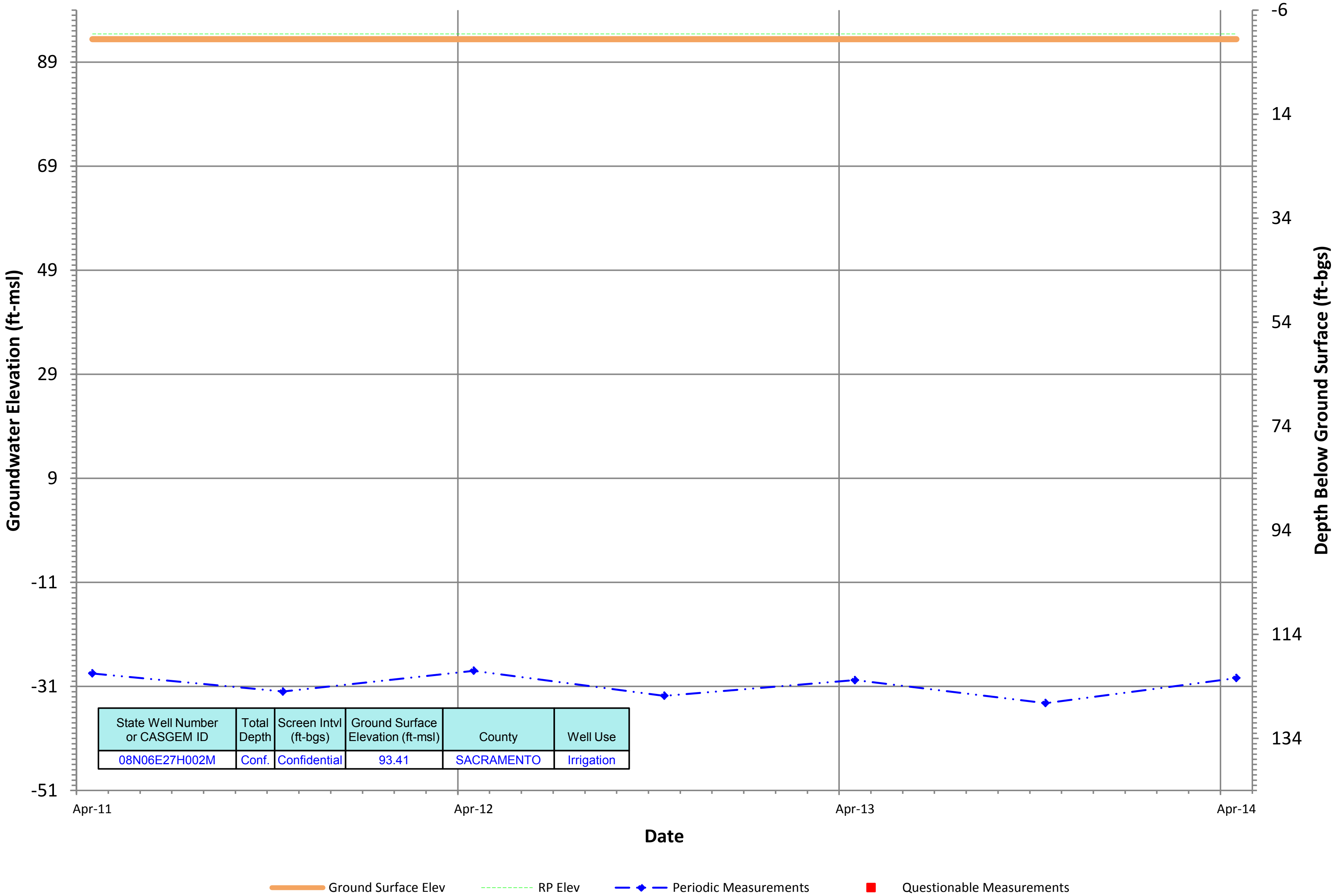
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N05E18Q001M	Conf.	Confidential	27.21	SACRAMENTO	Irrigation



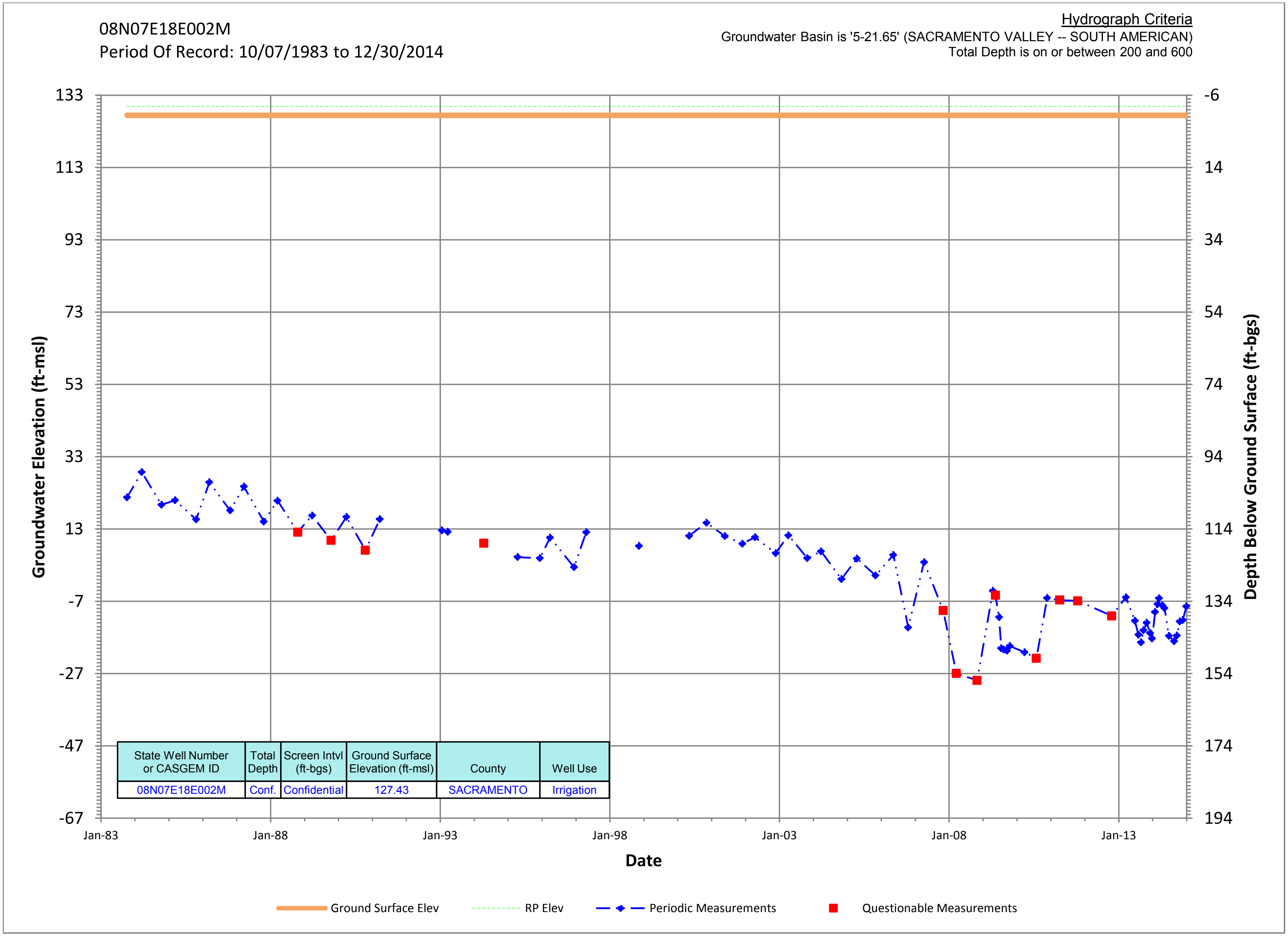
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N06E25J002M	Conf.	Confidential	143.42	SACRAMENTO	Residential

08N06E27H002M
Period Of Record: 04/26/2011 to 04/17/2014

Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



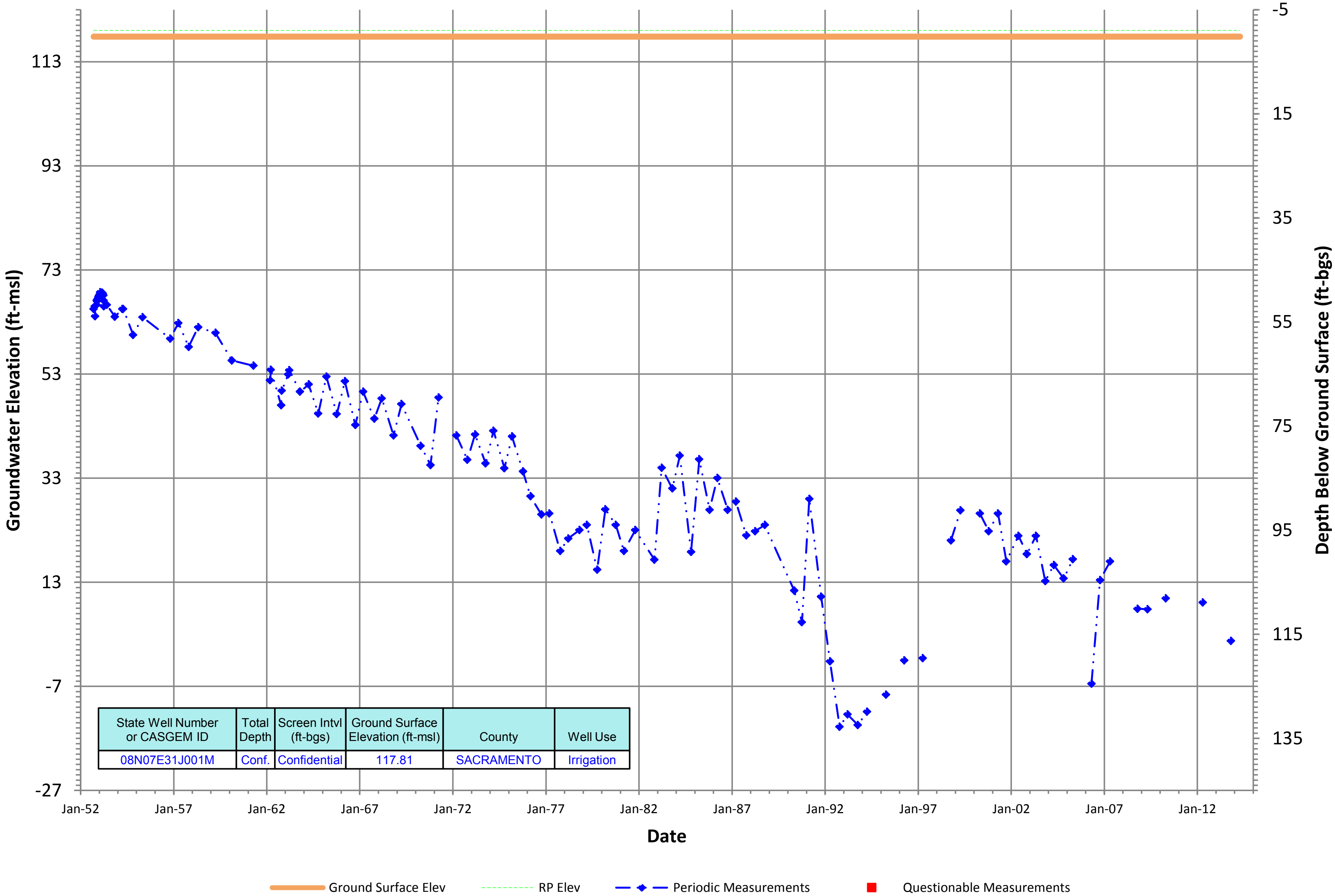
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N06E27H002M	Conf.	Confidential	93.41	SACRAMENTO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N07E18E002M	Conf.	Confidential	127.43	SACRAMENTO	Irrigation

08N07E31J001M
Period Of Record: 09/11/1952 to 04/17/2014

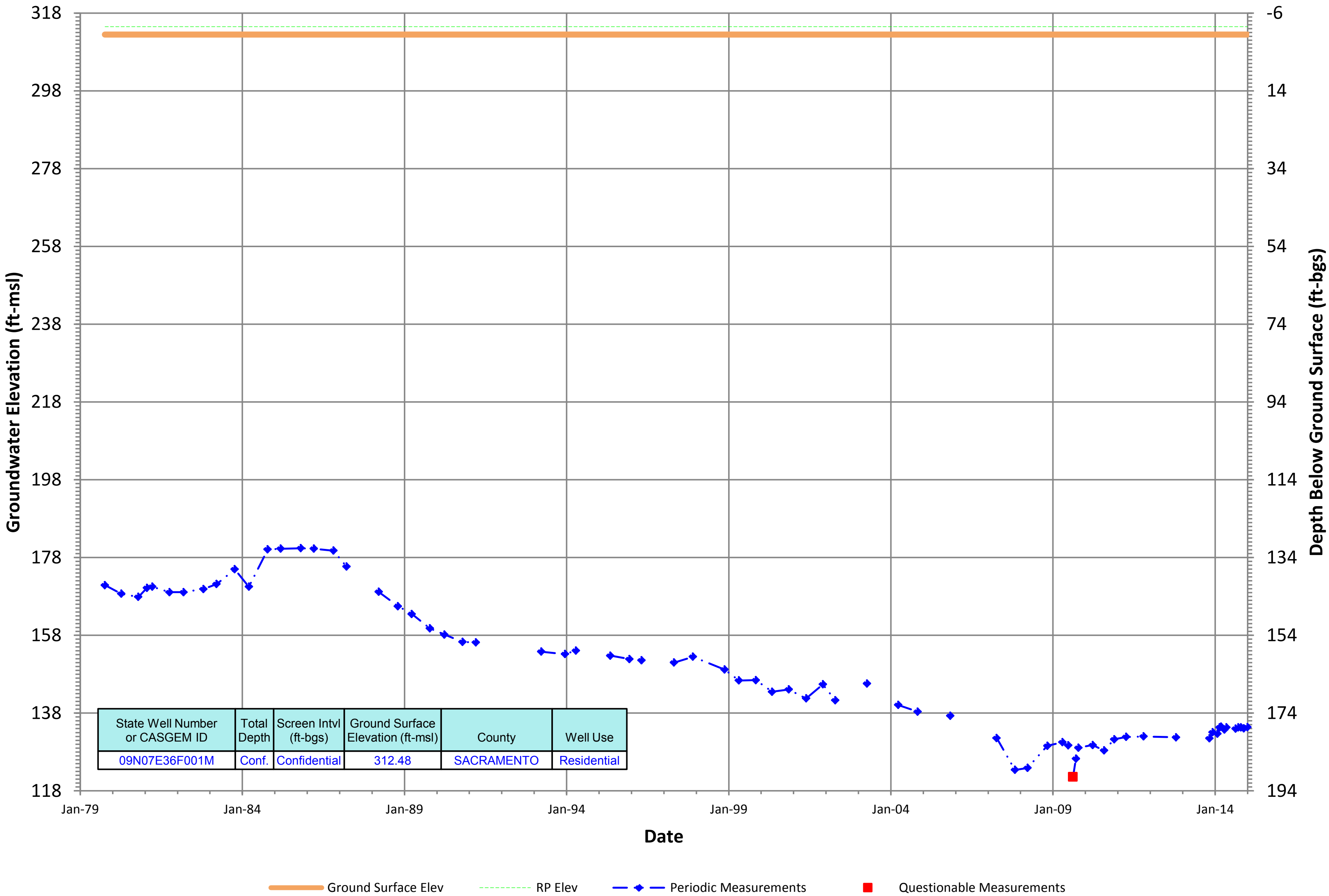
Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N07E31J001M	Conf.	Confidential	117.81	SACRAMENTO	Irrigation

09N07E36F001M
Period Of Record: 10/05/1979 to 12/30/2014

Hydrograph Criteria
Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N07E36F001M	Conf.	Confidential	312.48	SACRAMENTO	Residential

Deep Groundwater Monitoring Well Hydrographs- South American Subbasin

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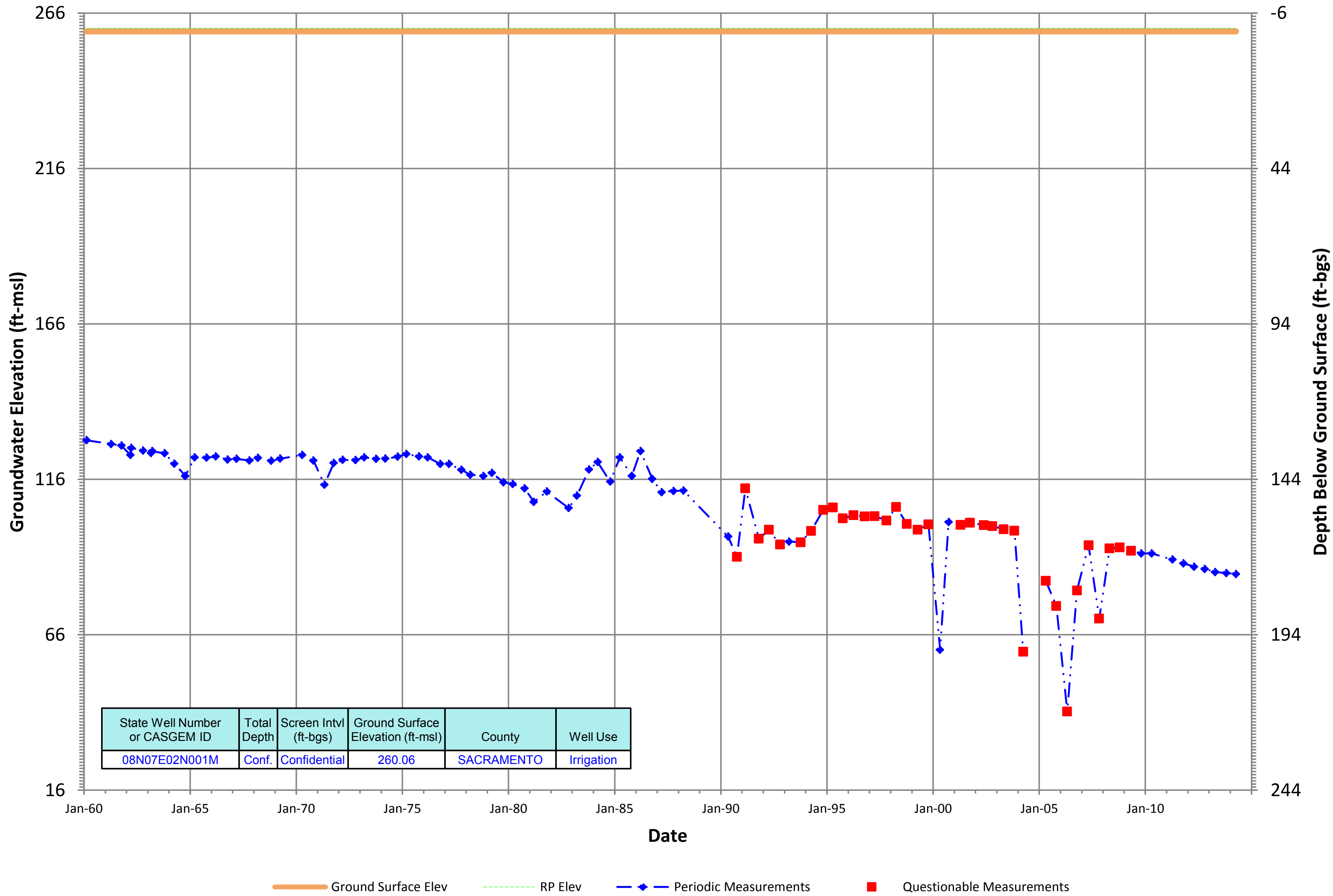
08N07E02N001M

Period Of Record: 02/15/1960 to 04/09/2014

Hydrograph Criteria

Groundwater Basin is '5-21.65' (SACRAMENTO VALLEY -- SOUTH AMERICAN)

Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N07E02N001M	Conf.	Confidential	260.06	SACRAMENTO	Irrigation

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Shallow Groundwater Monitoring Well Hydrographs- Sutter Subbasin

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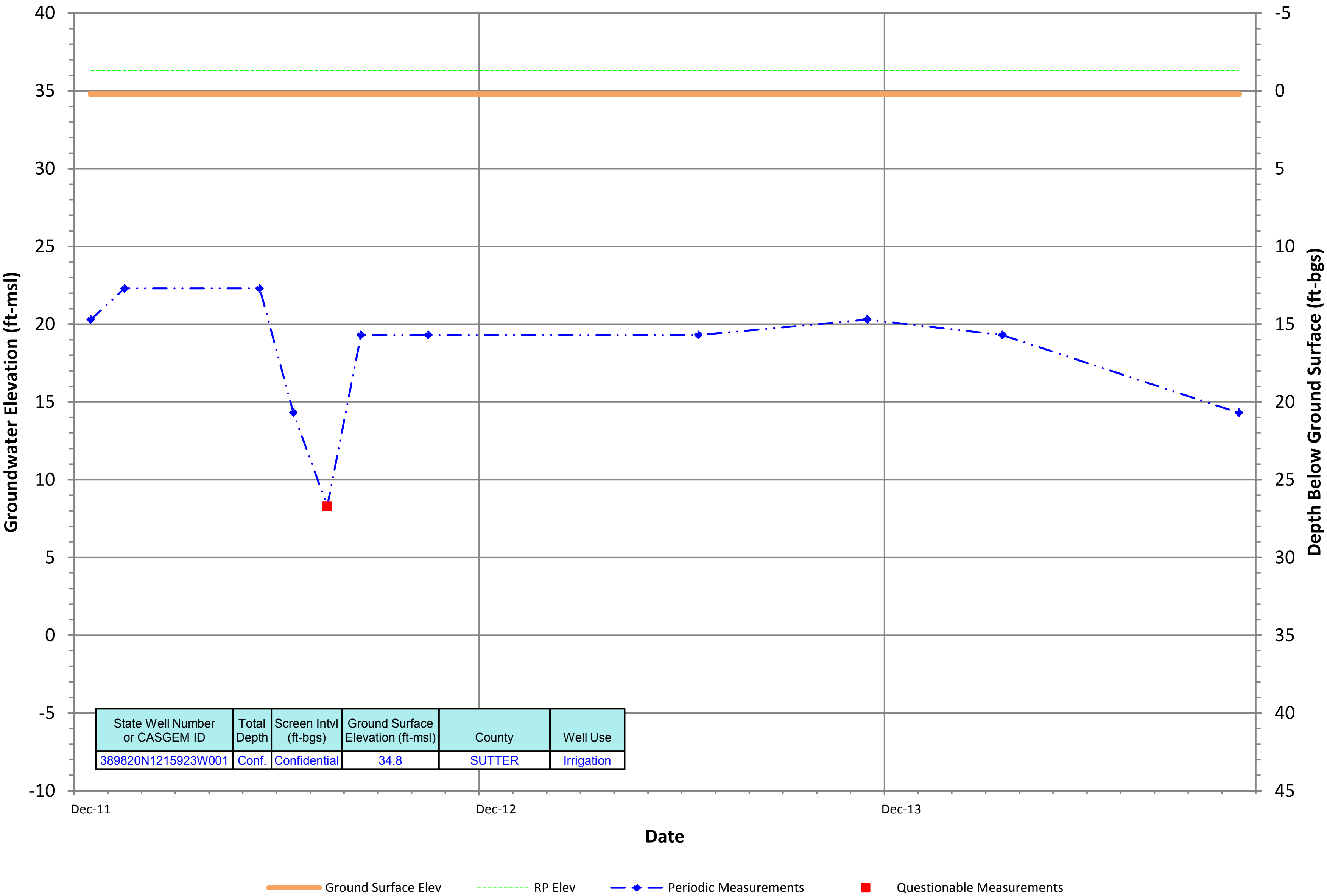
389820N1215923W001
Period Of Record: 12/01/2011 to 10/10/2014

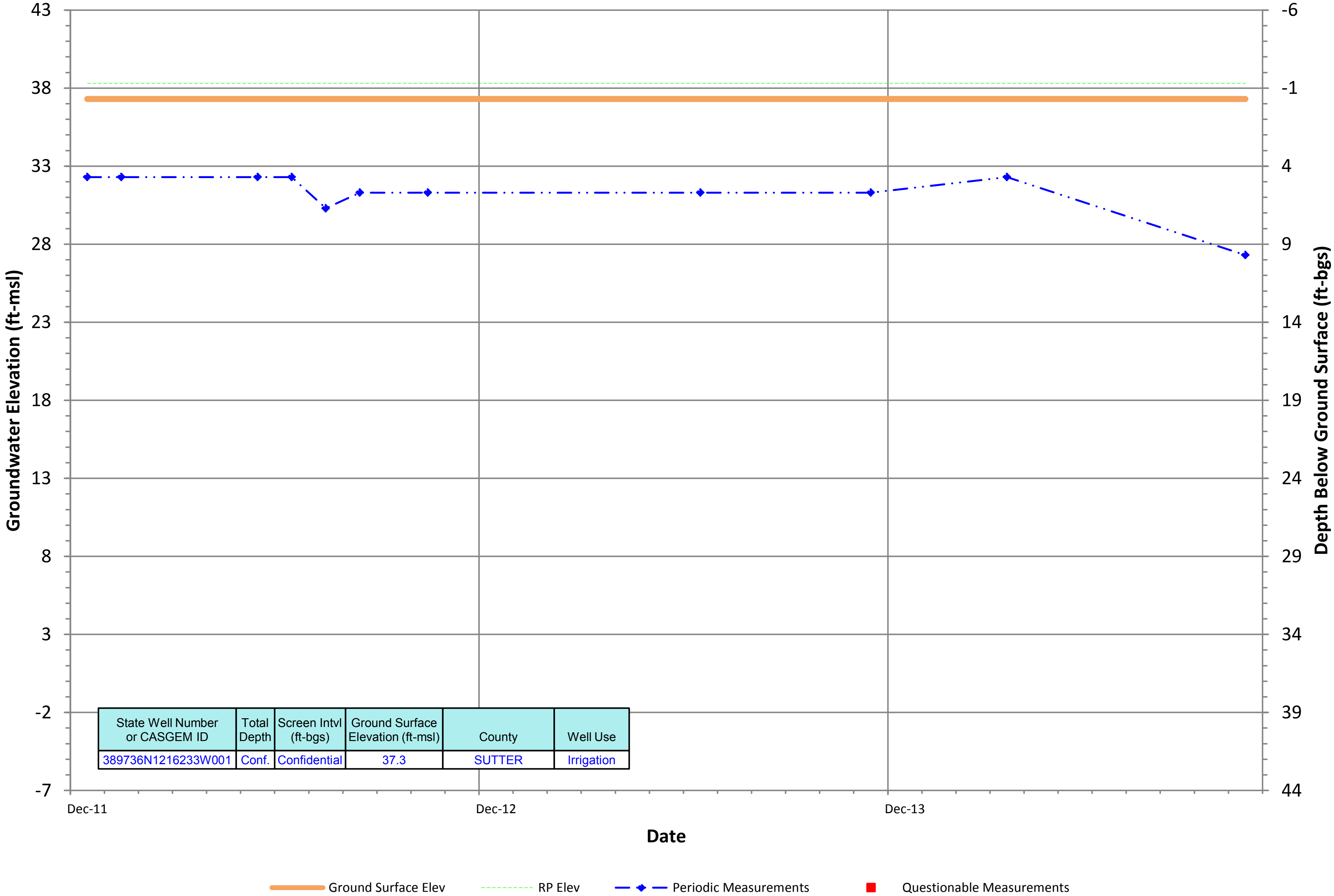
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
389820N1215923W001	Conf.	Confidential	34.8	SUTTER	Irrigation

389736N1216233W001
Period Of Record: 12/01/2011 to 10/10/2014

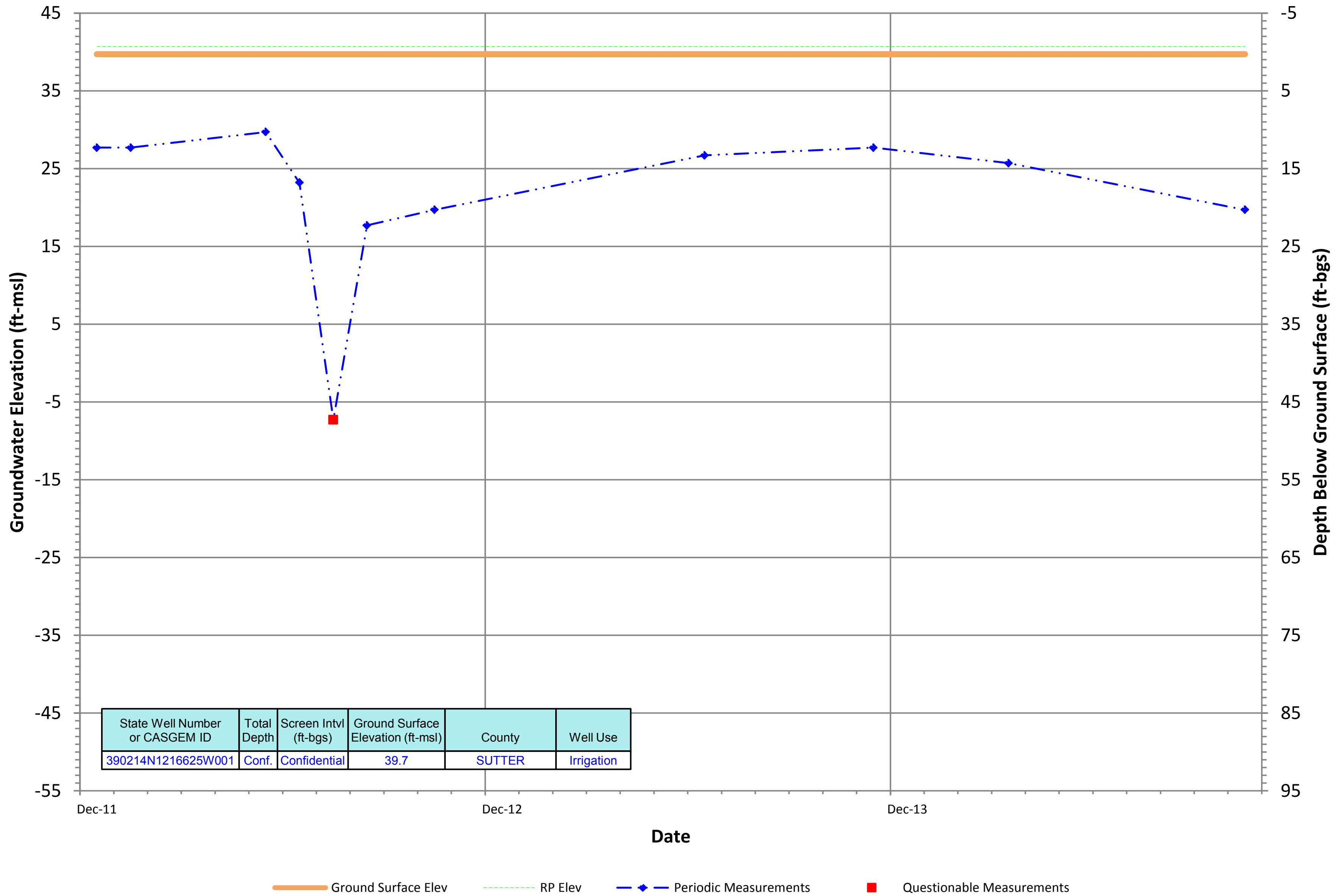
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
389736N1216233W001	Conf.	Confidential	37.3	SUTTER	Irrigation

390214N1216625W001
Period Of Record: 12/01/2011 to 10/10/2014

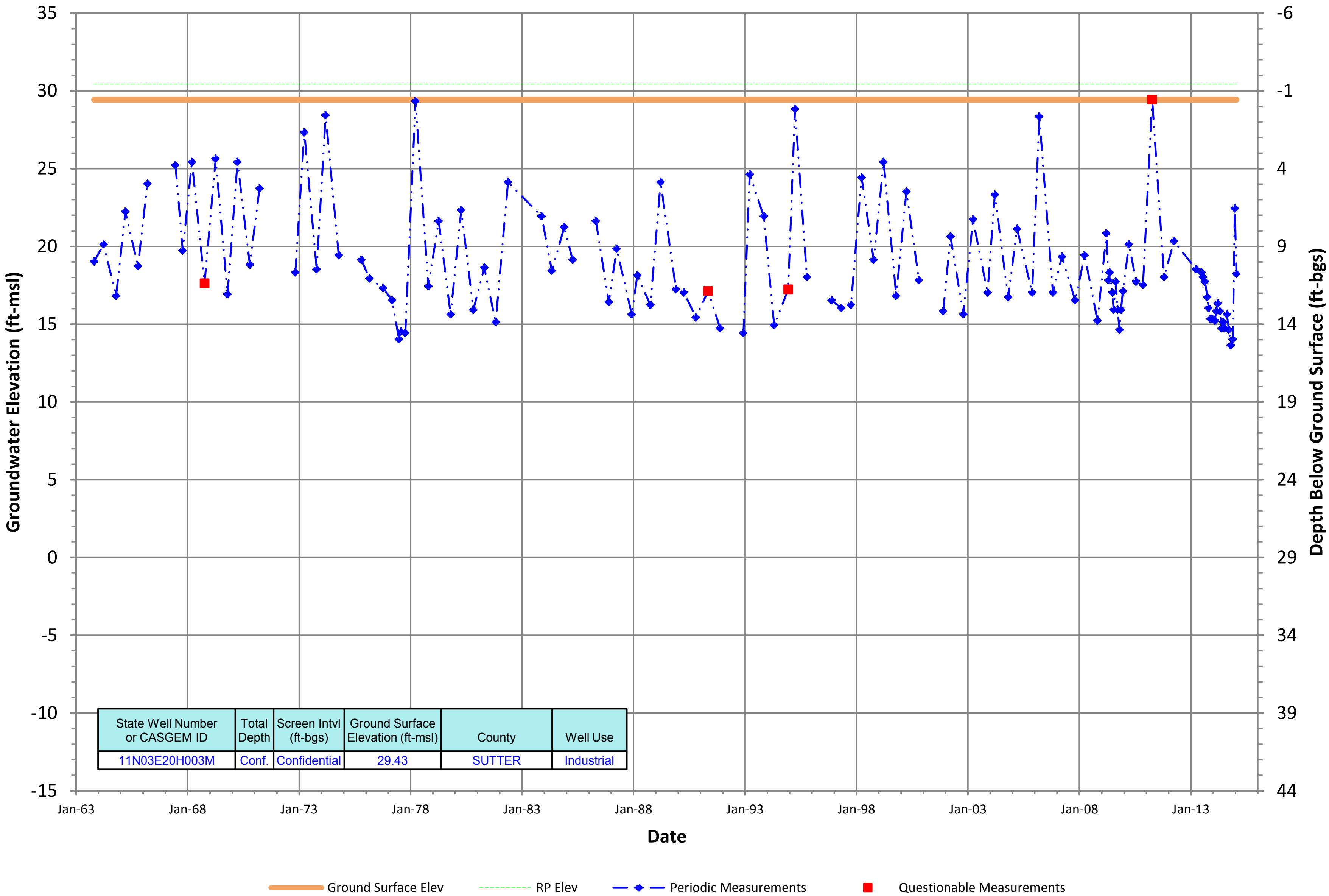
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
390214N1216625W001	Conf.	Confidential	39.7	SUTTER	Irrigation

11N03E20H003M
Period Of Record: 10/22/1963 to 01/16/2015

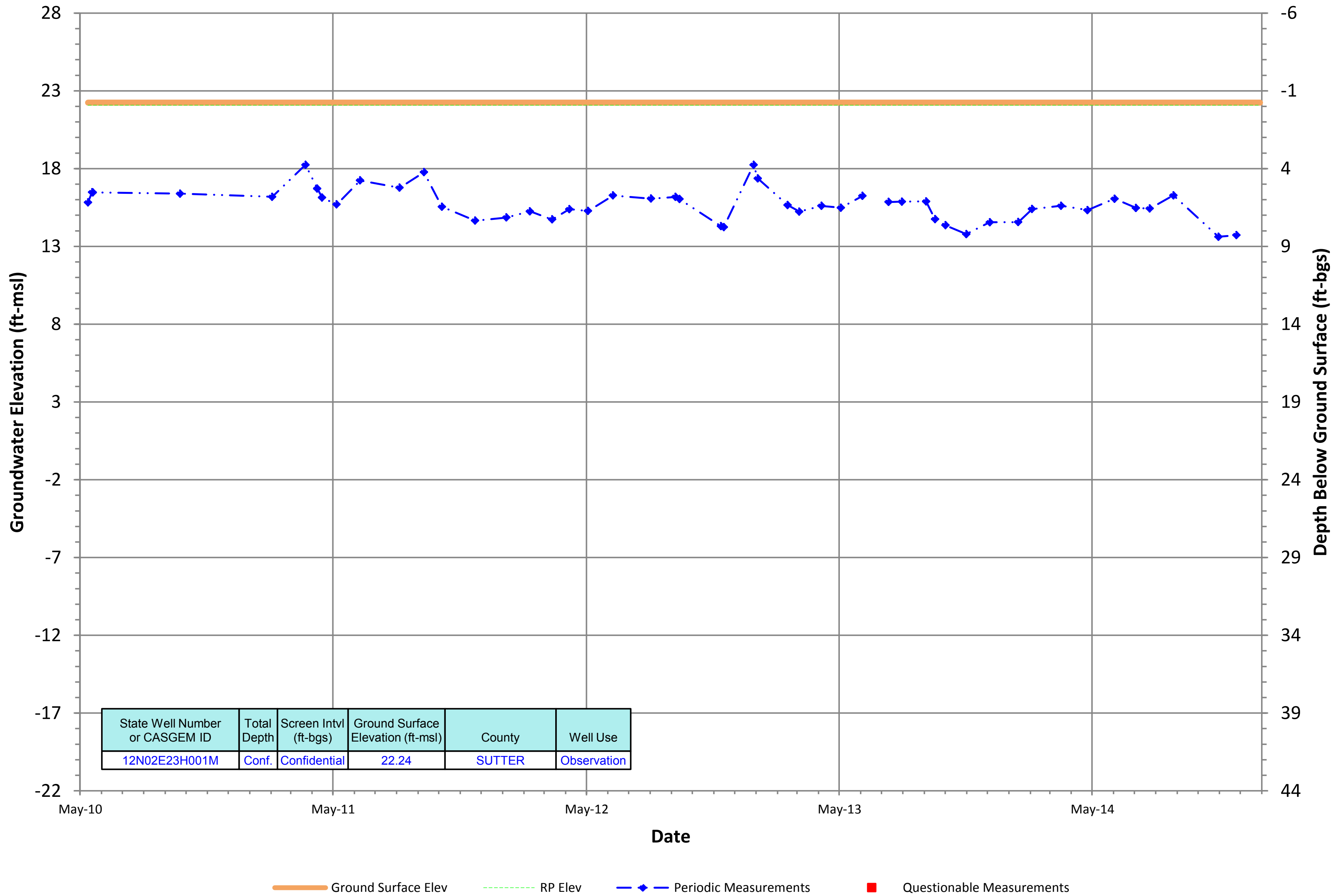
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N03E20H003M	Conf.	Confidential	29.43	SUTTER	Industrial

12N02E23H001M
Period Of Record: 05/12/2010 to 12/29/2014

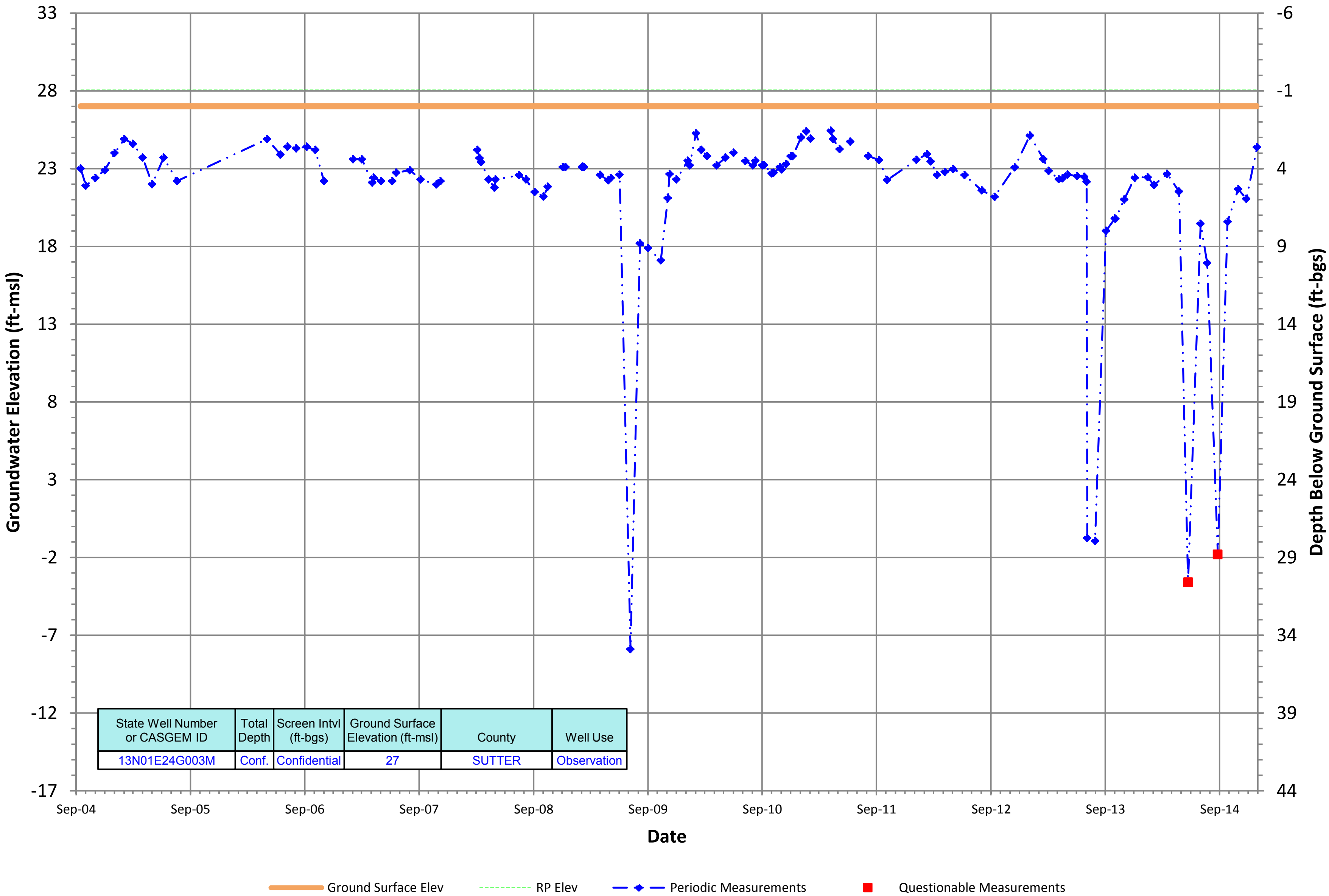
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E23H001M	Conf.	Confidential	22.24	SUTTER	Observation

13N01E24G003M
Period Of Record: 09/15/2004 to 12/29/2014

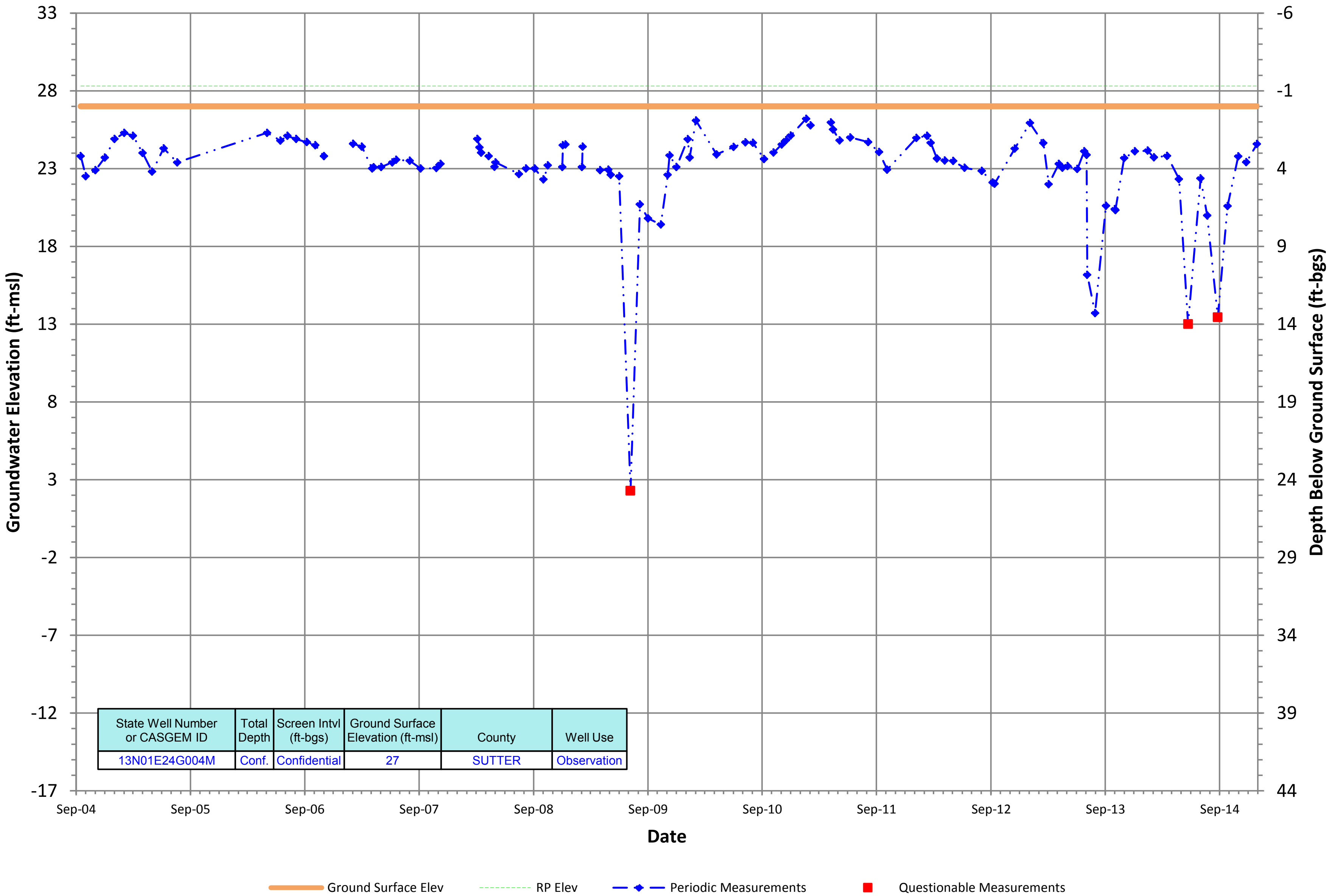
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



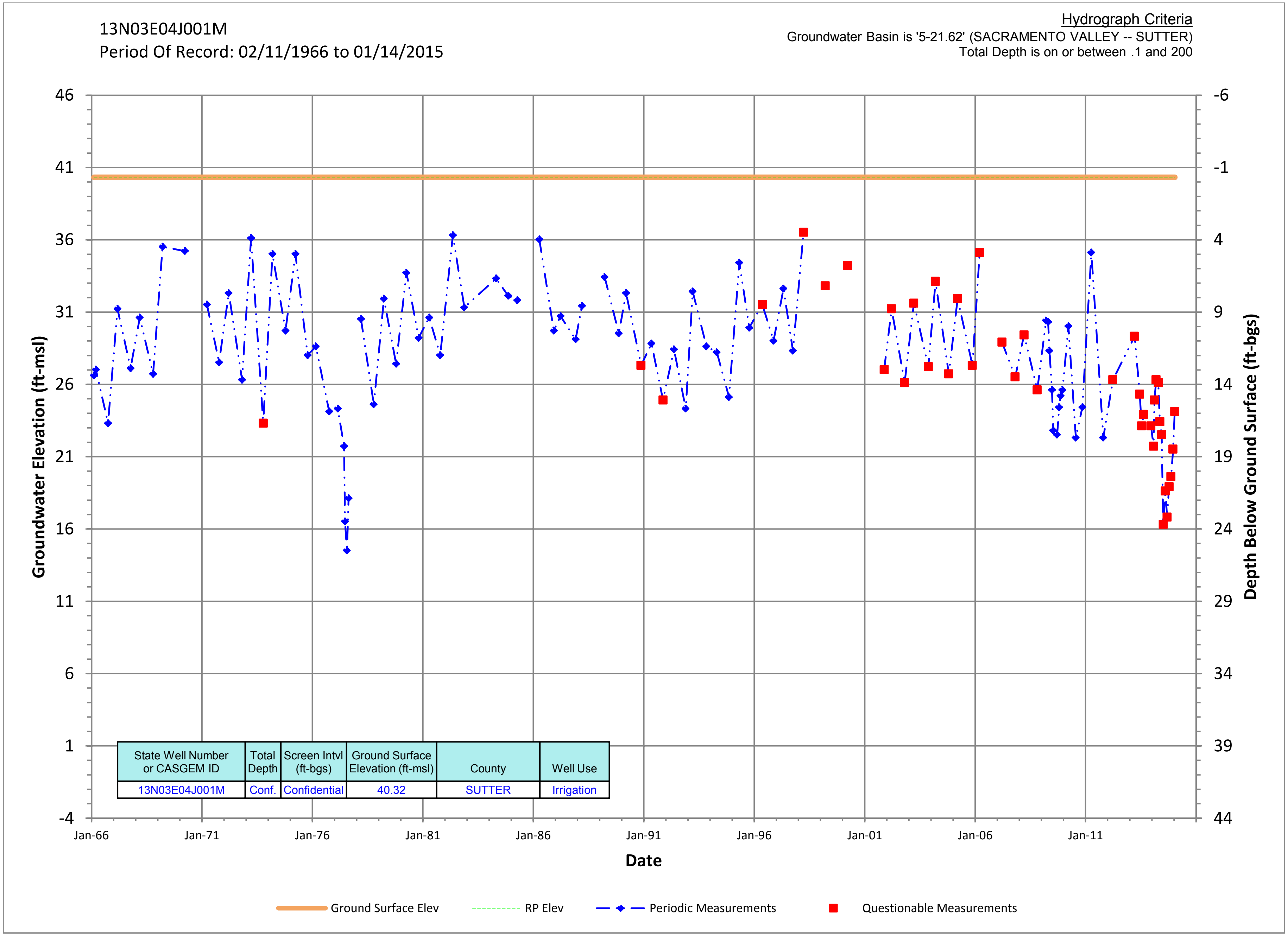
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E24G003M	Conf.	Confidential	27	SUTTER	Observation

13N01E24G004M
Period Of Record: 09/15/2004 to 12/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



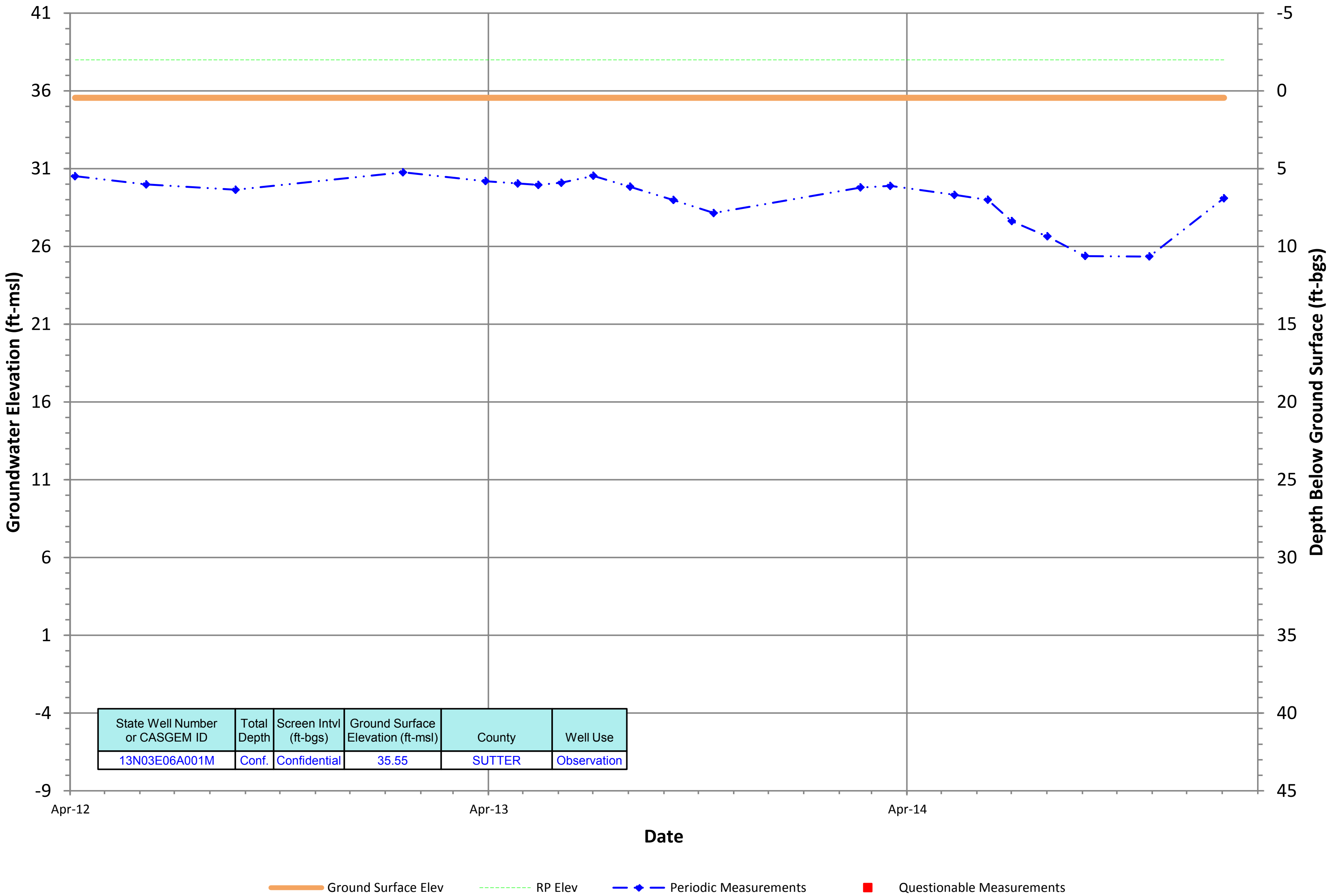
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E24G004M	Conf.	Confidential	27	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E04J001M	Conf.	Confidential	40.32	SUTTER	Irrigation

13N03E06A001M
Period Of Record: 04/05/2012 to 01/02/2015

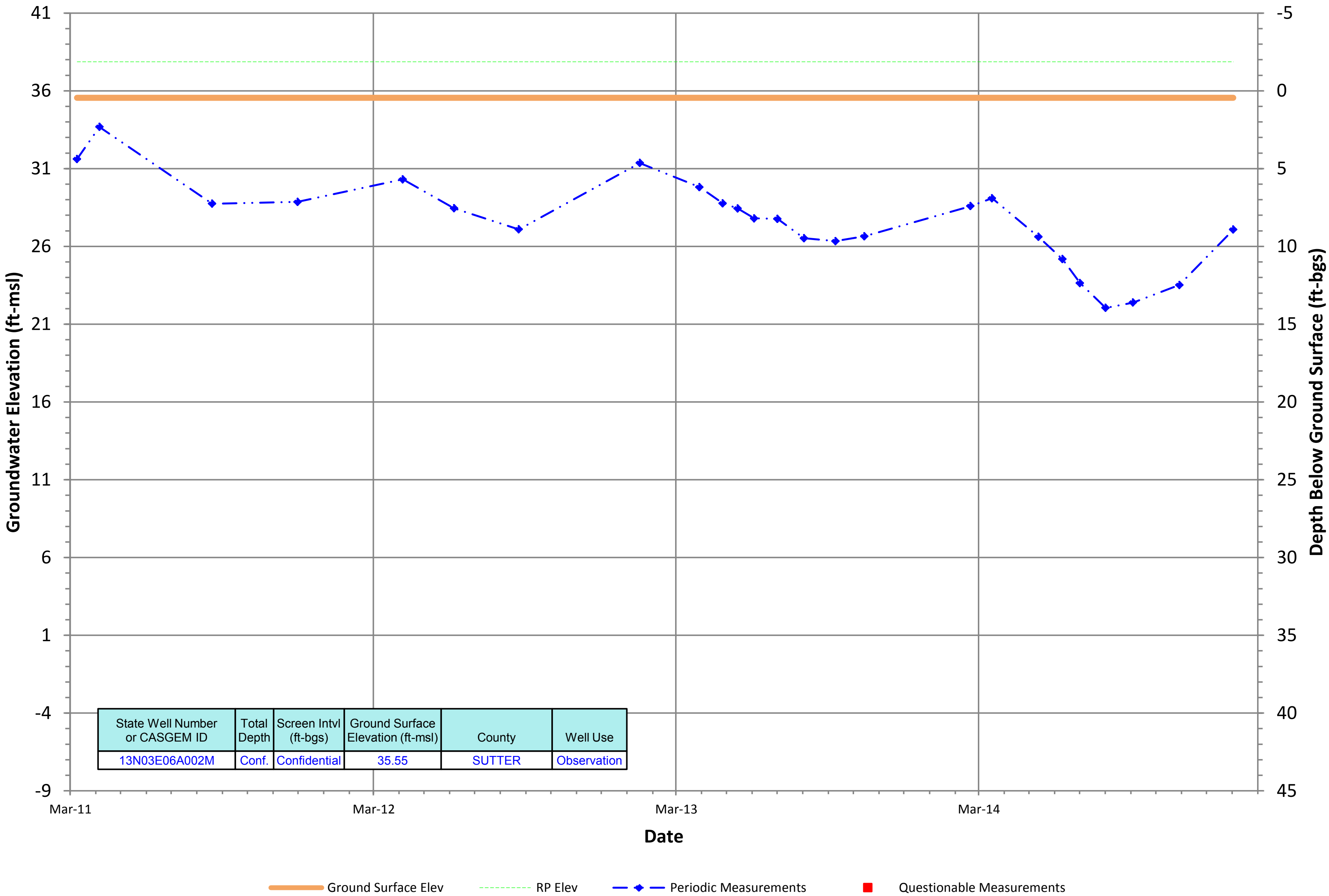
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E06A001M	Conf.	Confidential	35.55	SUTTER	Observation

13N03E06A002M
Period Of Record: 03/09/2011 to 01/02/2015

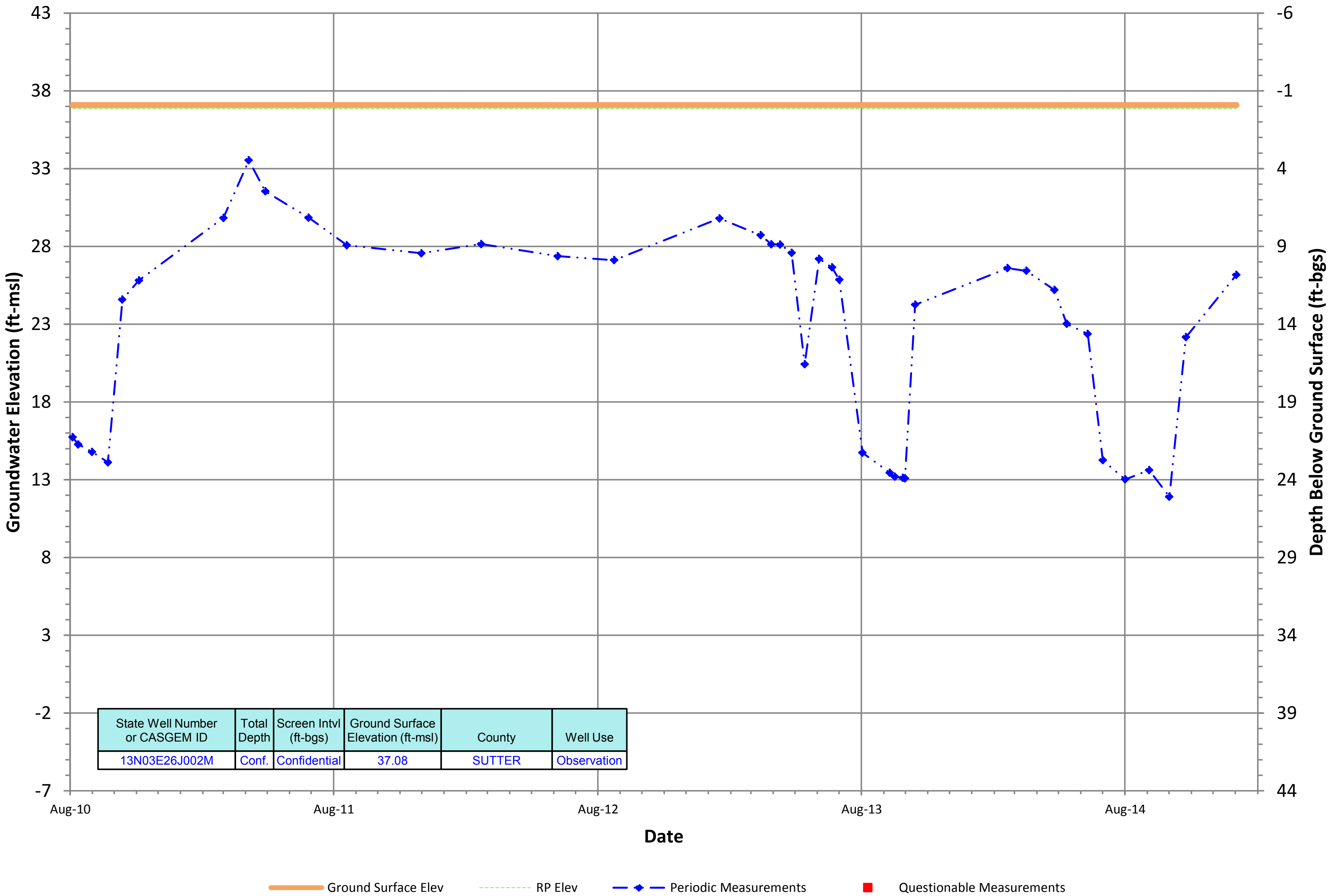
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E06A002M	Conf.	Confidential	35.55	SUTTER	Observation

13N03E26J002M
Period Of Record: 08/04/2010 to 01/02/2015

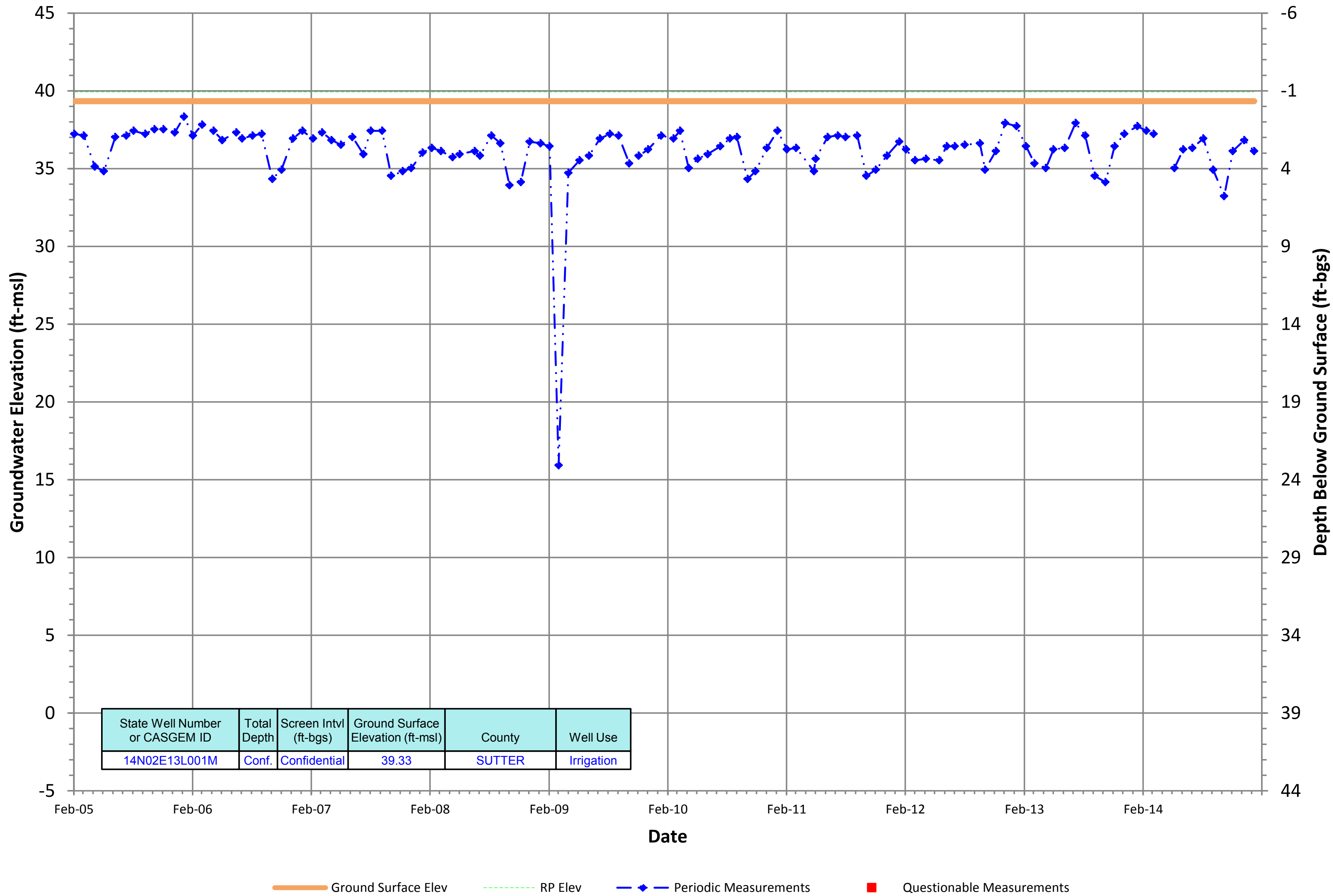
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E26J002M	Conf.	Confidential	37.08	SUTTER	Observation

14N02E13L001M
Period Of Record: 02/02/2005 to 01/08/2015

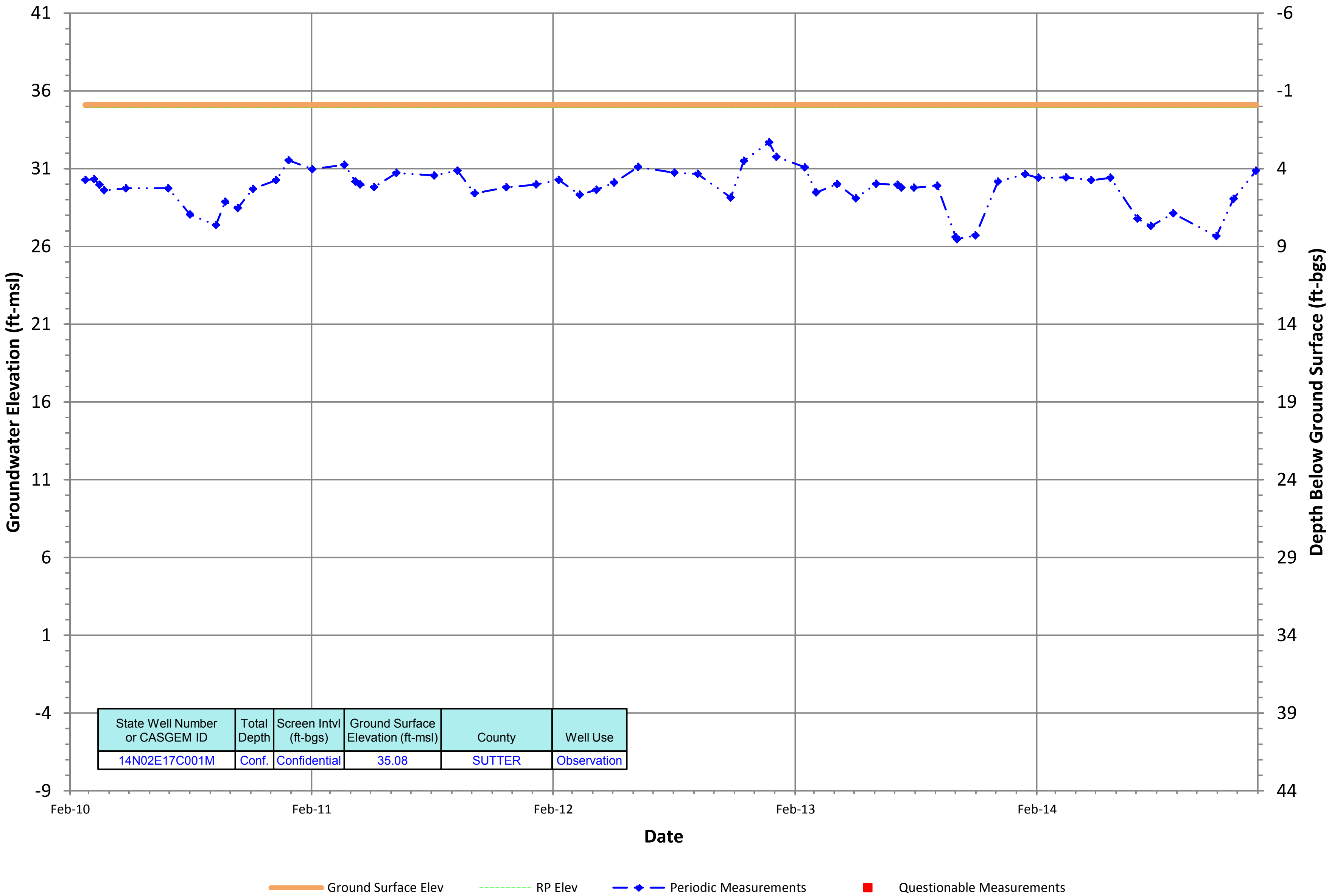
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E13L001M	Conf.	Confidential	39.33	SUTTER	Irrigation

14N02E17C001M
Period Of Record: 02/24/2010 to 12/29/2014

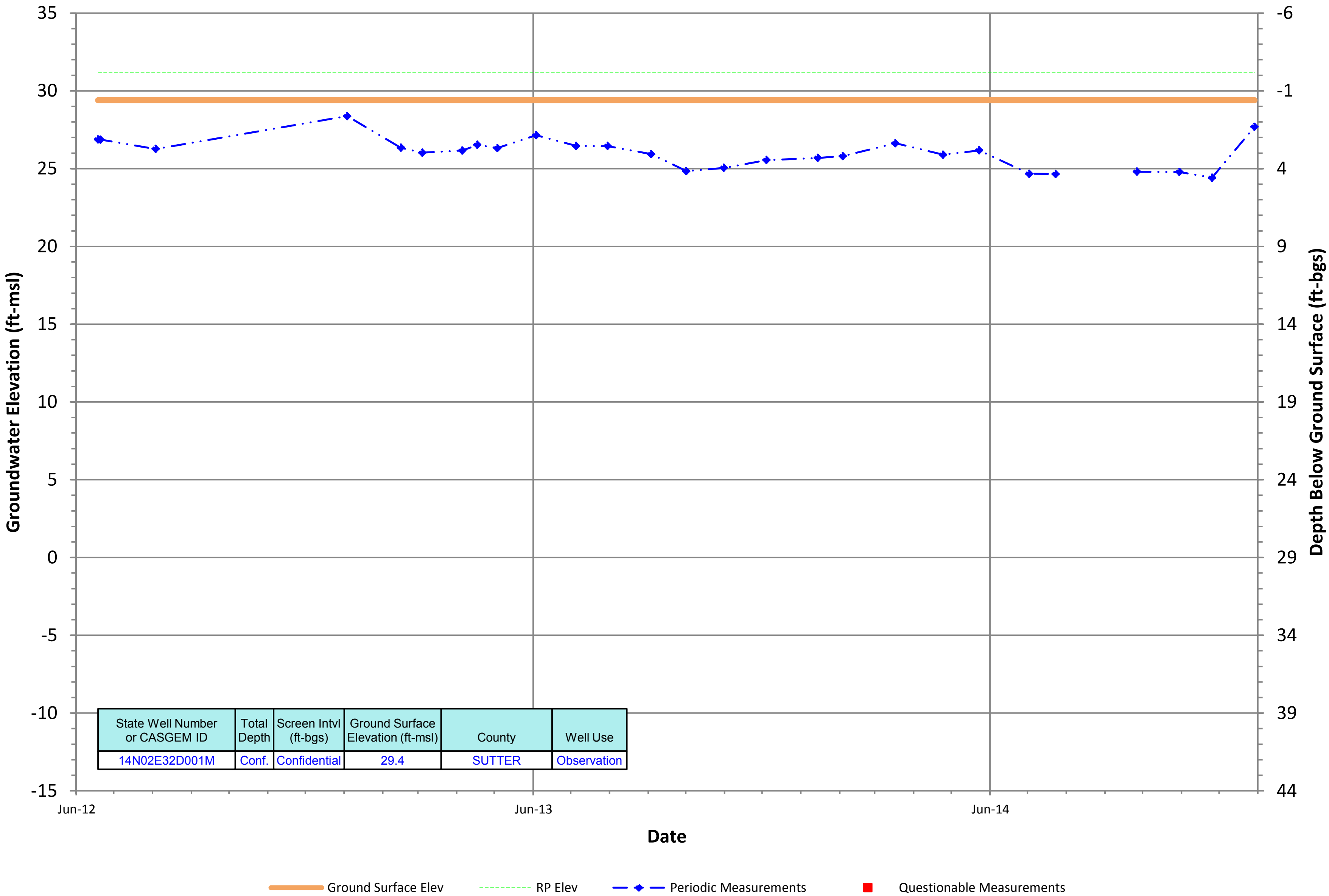
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E17C001M	Conf.	Confidential	35.08	SUTTER	Observation

14N02E32D001M
Period Of Record: 06/18/2012 to 12/29/2014

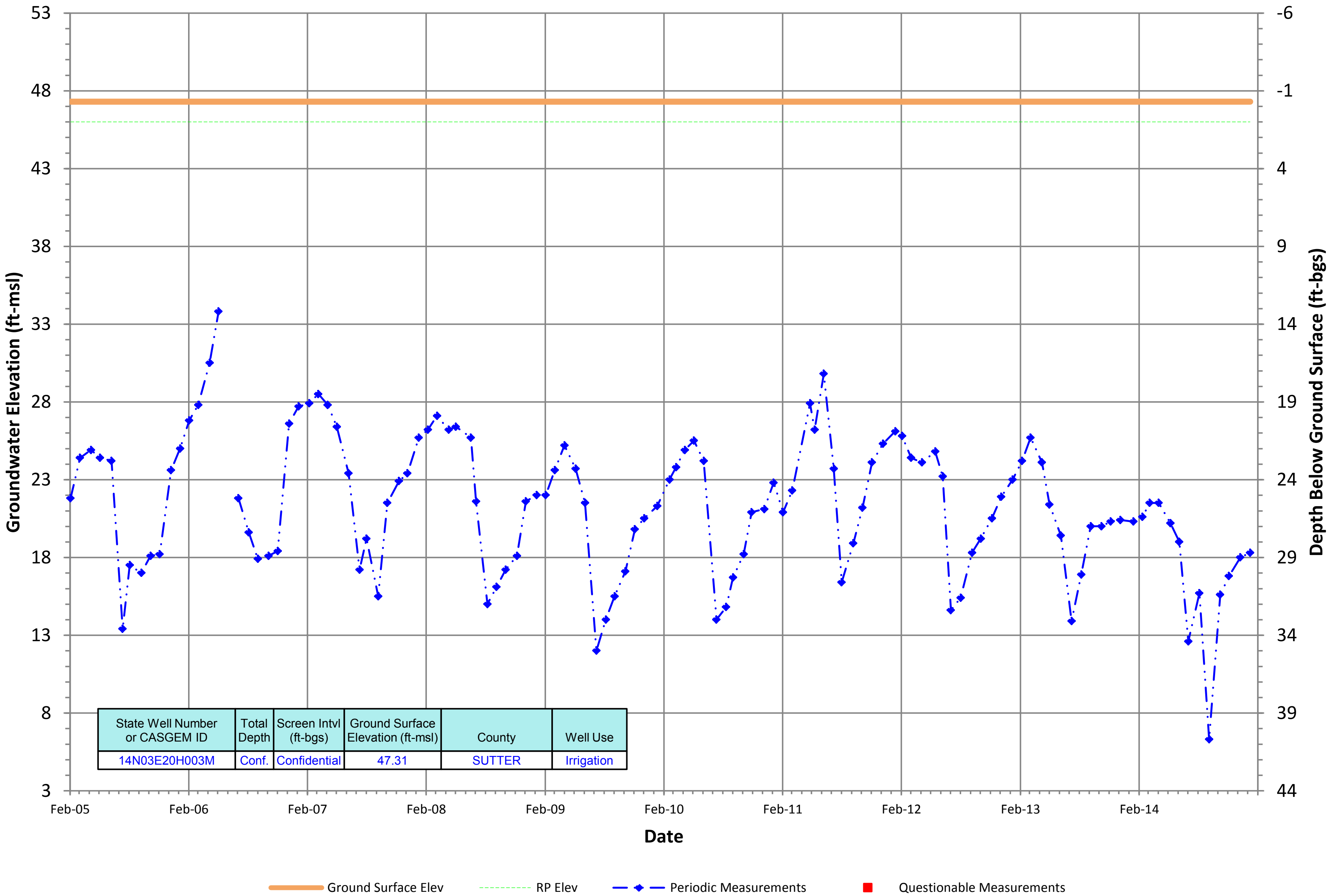
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E32D001M	Conf.	Confidential	29.4	SUTTER	Observation

14N03E20H003M
Period Of Record: 02/02/2005 to 01/08/2015

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03E20H003M	Conf.	Confidential	47.31	SUTTER	Irrigation

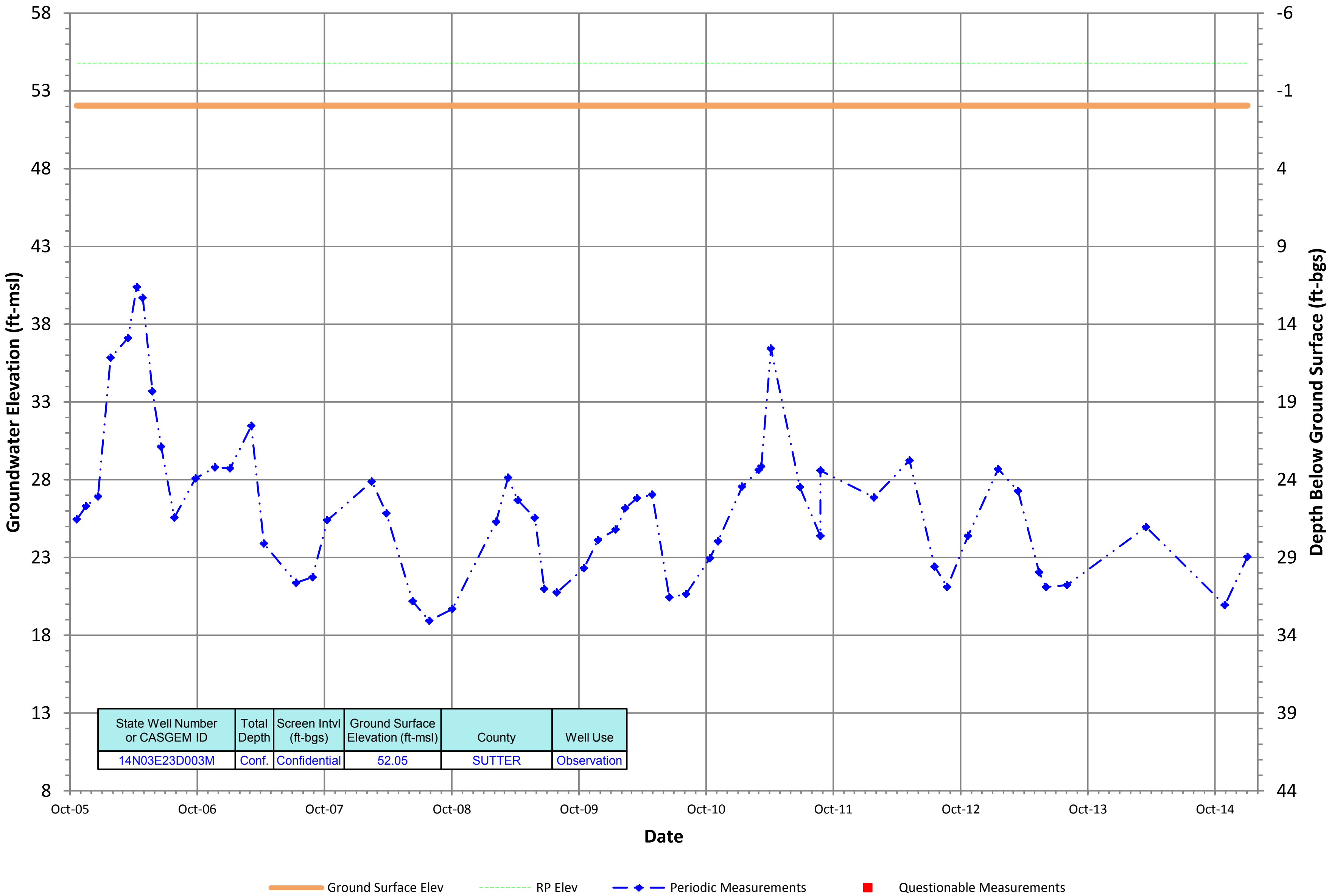
14N03E23D003M

Period Of Record: 10/20/2005 to 01/02/2015

Hydrograph Criteria

Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)

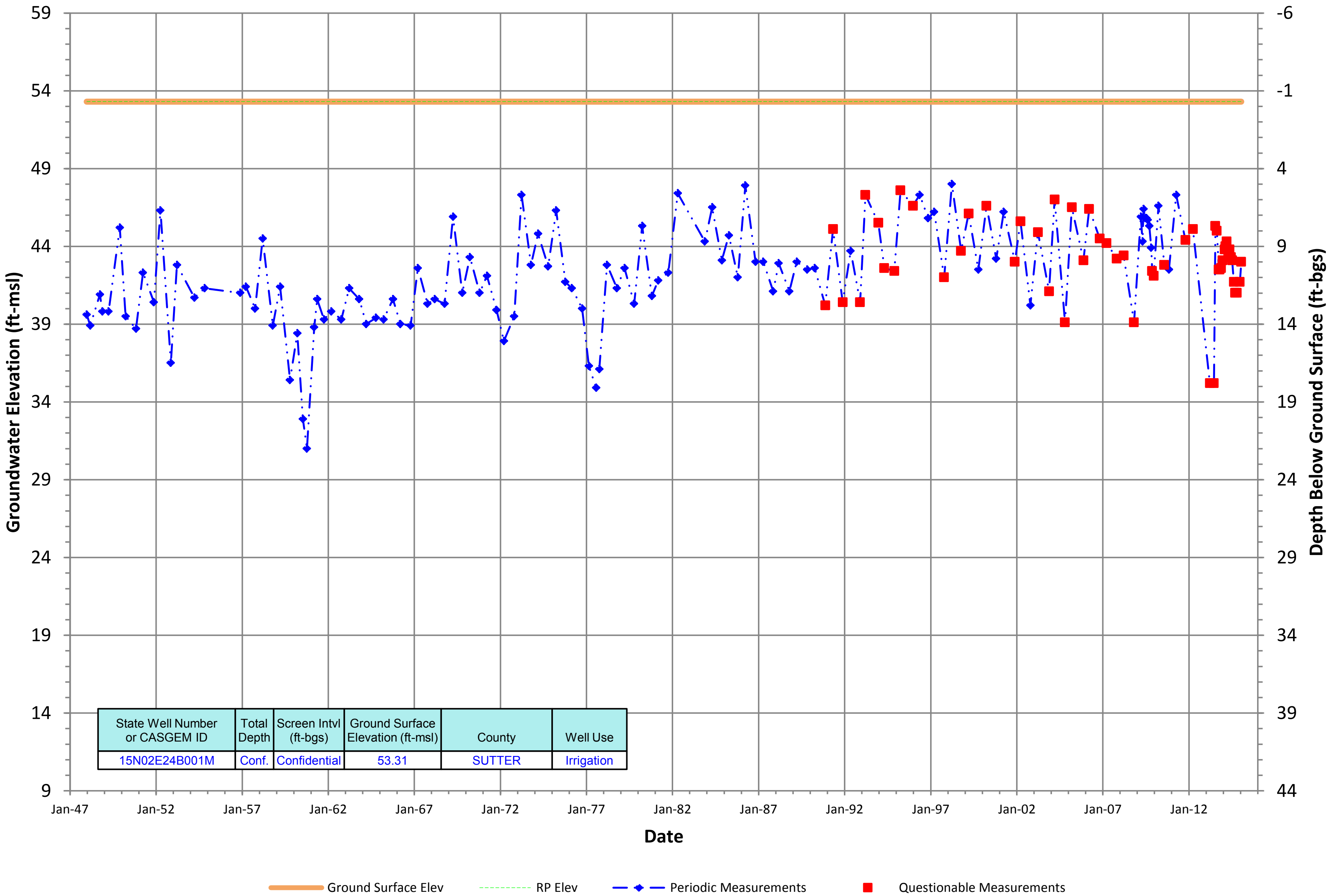
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03E23D003M	Conf.	Confidential	52.05	SUTTER	Observation

15N02E24B001M
Period Of Record: 12/22/1947 to 01/15/2015

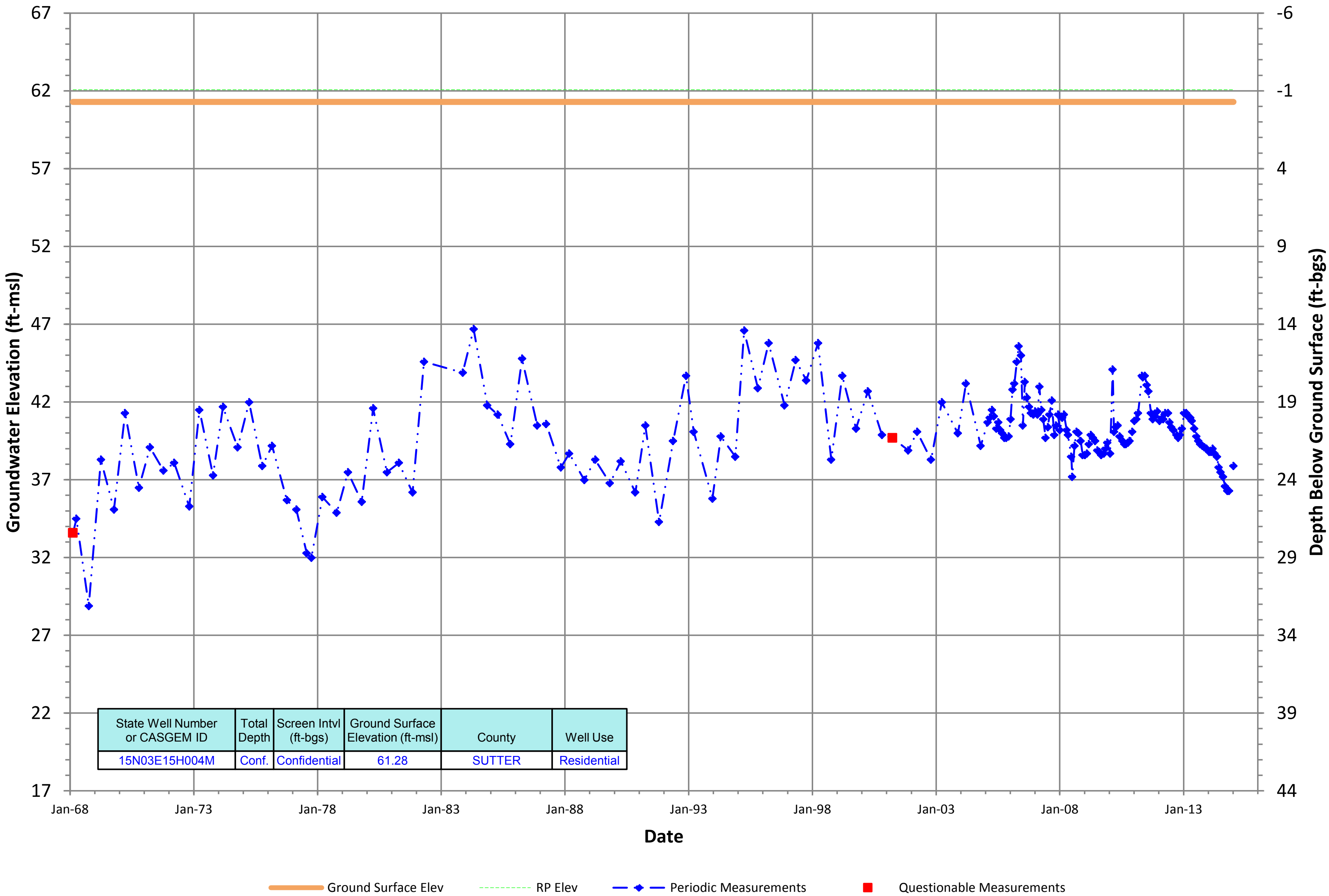
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



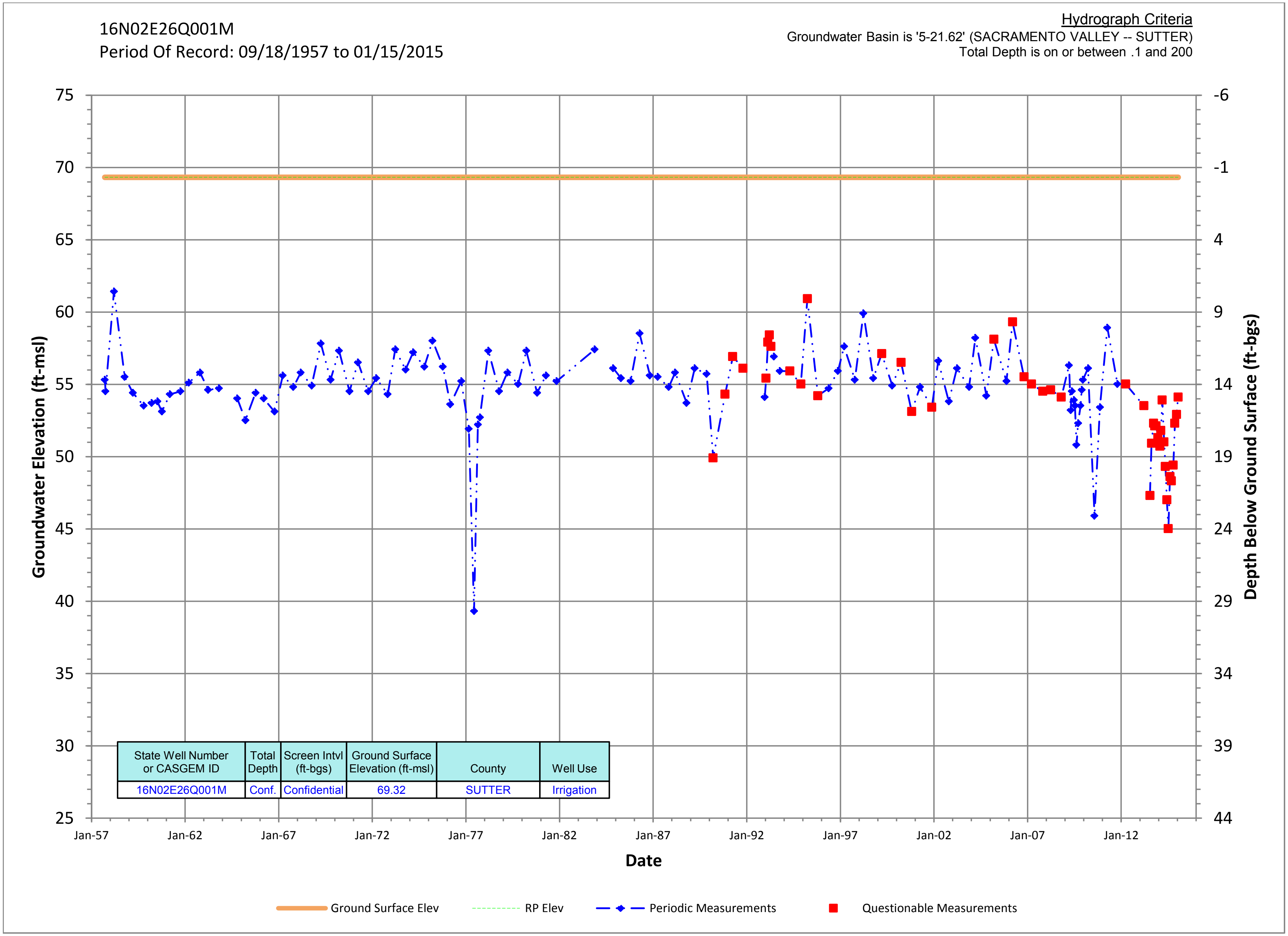
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N02E24B001M	Conf.	Confidential	53.31	SUTTER	Irrigation

15N03E15H004M
Period Of Record: 02/13/1968 to 01/08/2015

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N03E15H004M	Conf.	Confidential	61.28	SUTTER	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N02E26Q001M	Conf.	Confidential	69.32	SUTTER	Irrigation

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Intermediate Depth Groundwater Monitoring Well Hydrographs- Sutter Subbasin

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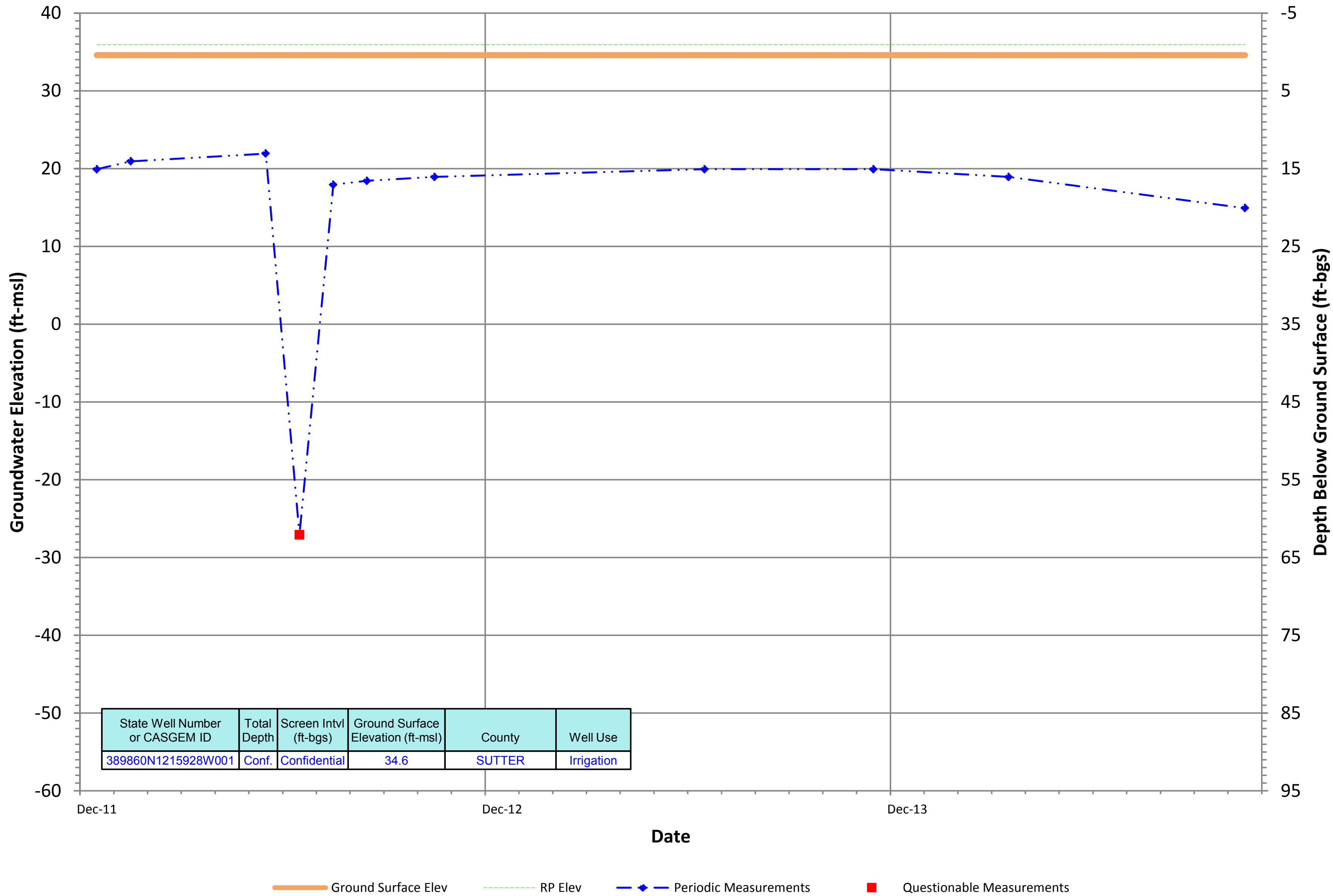
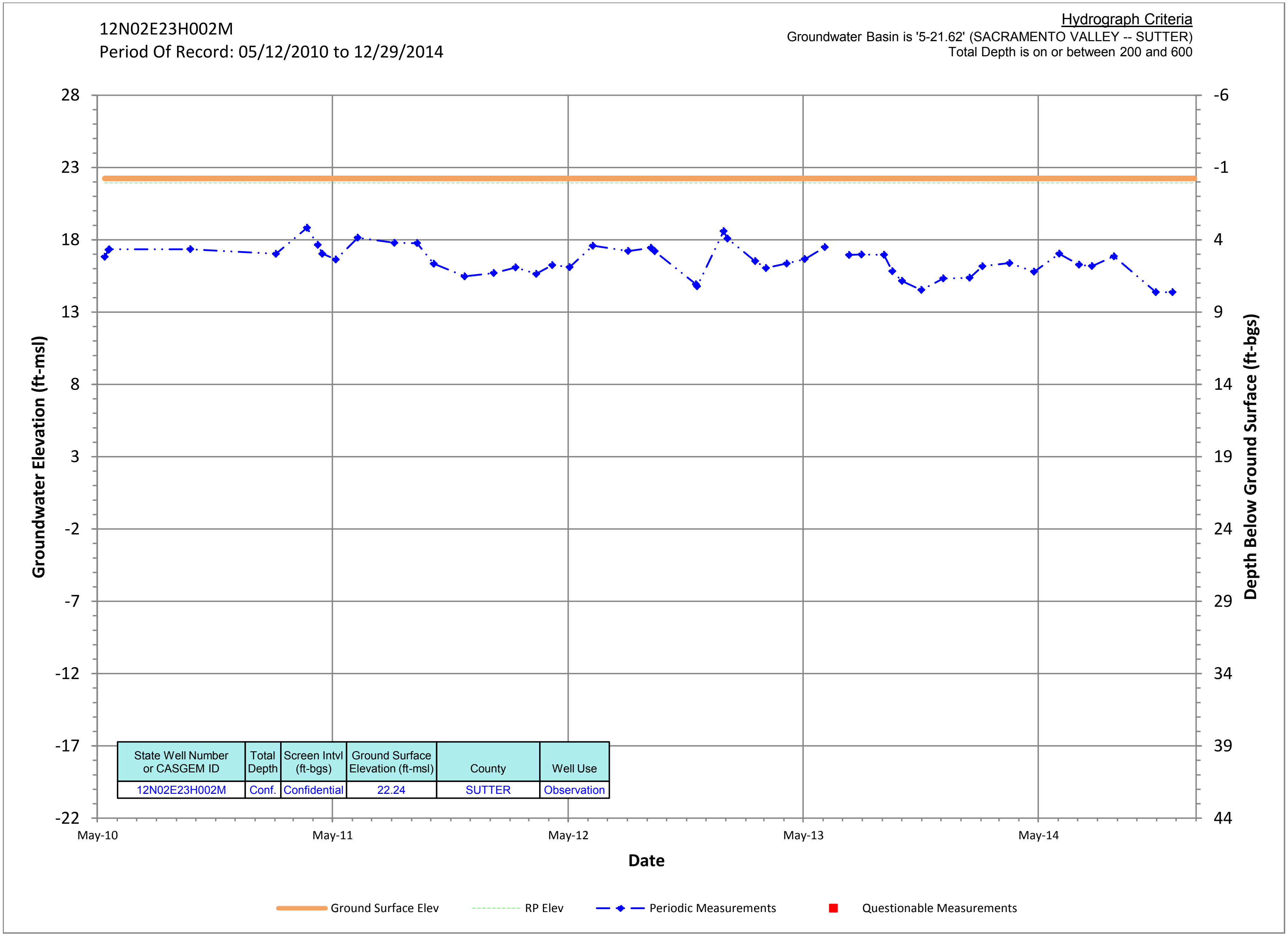
389860N1215928W001
Period Of Record: 12/01/2011 to 10/10/2014

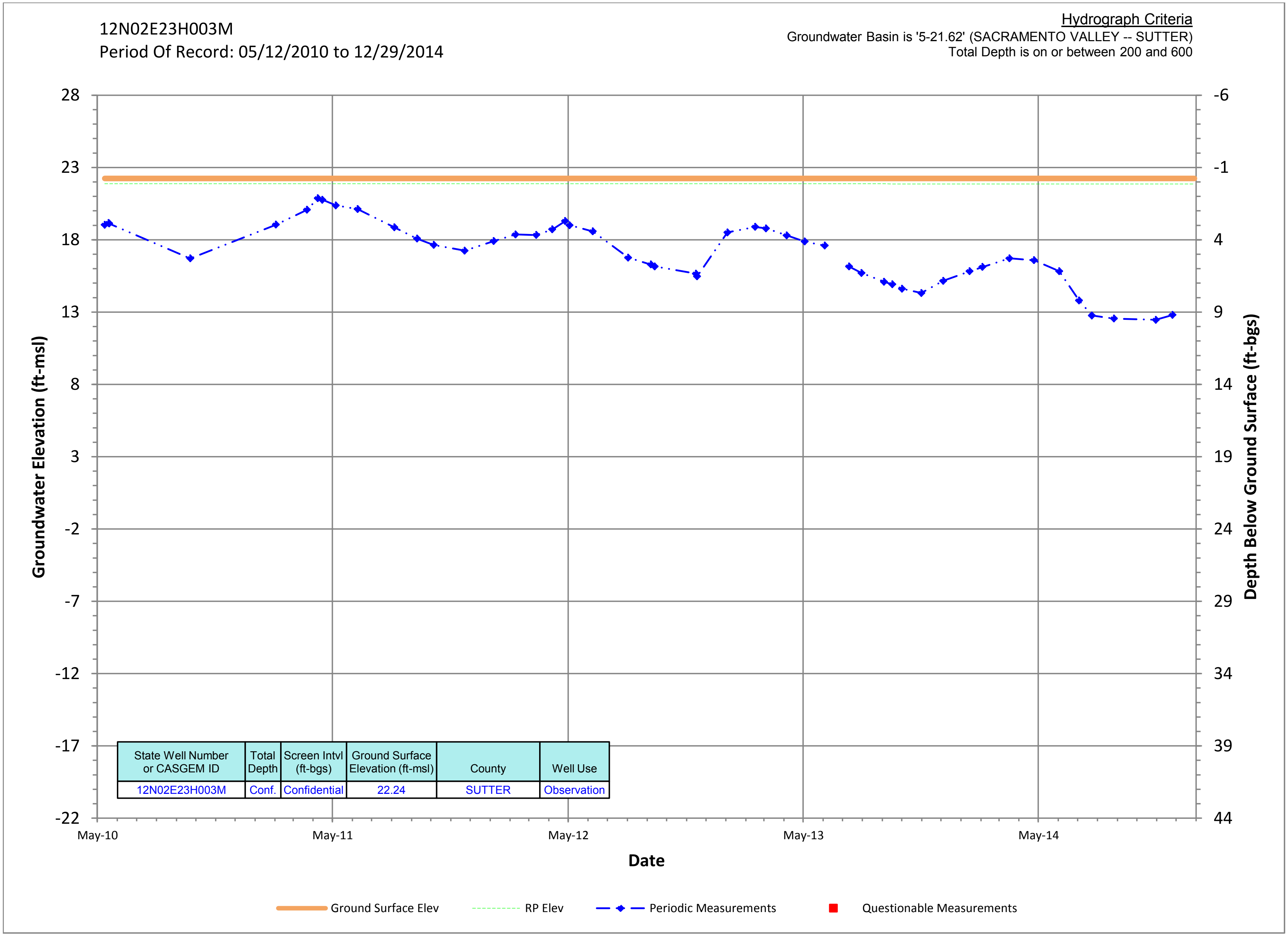
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



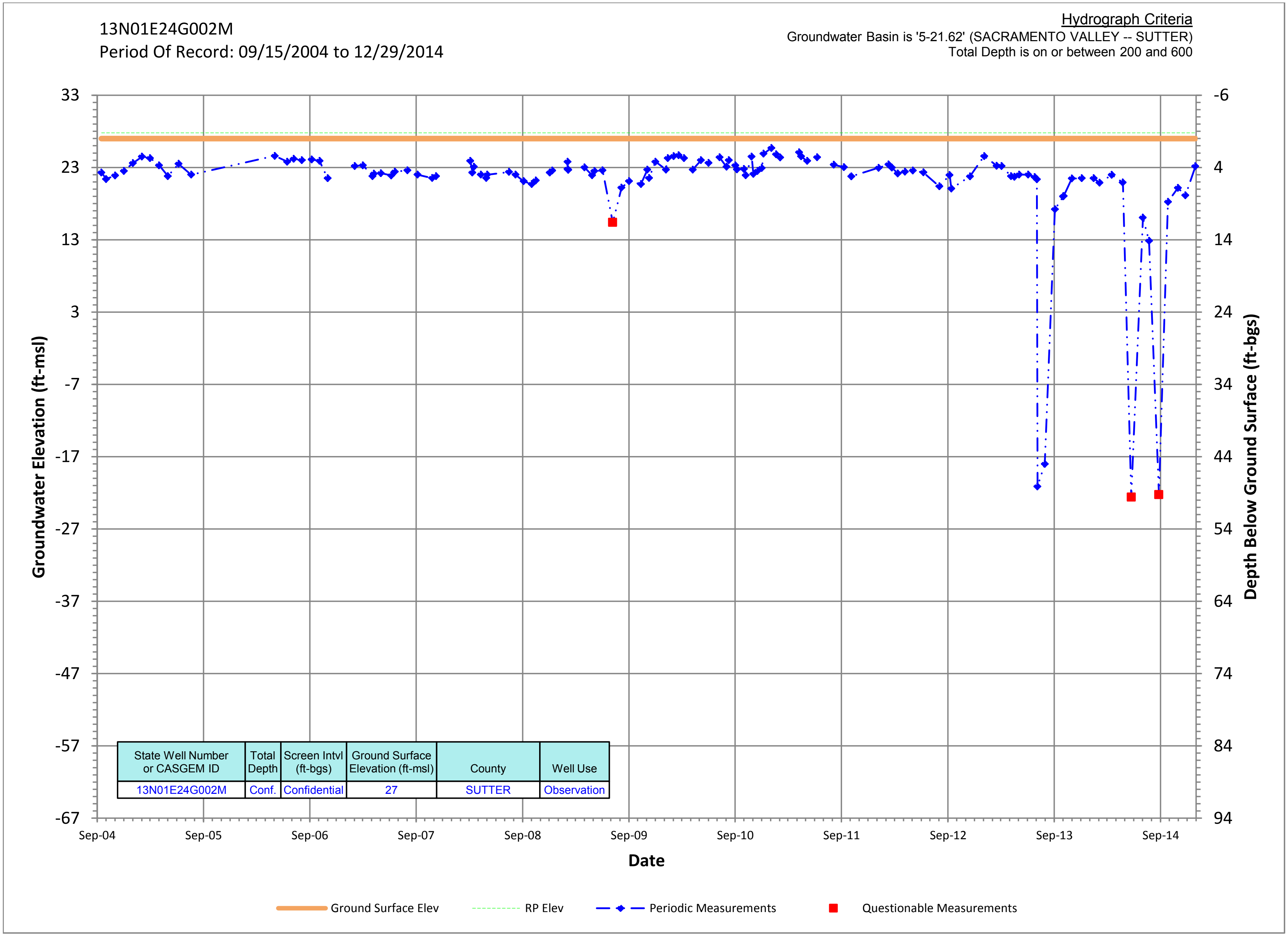
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
389860N1215928W001	Conf.	Confidential	34.6	SUTTER	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E23H002M	Conf.	Confidential	22.24	SUTTER	Observation



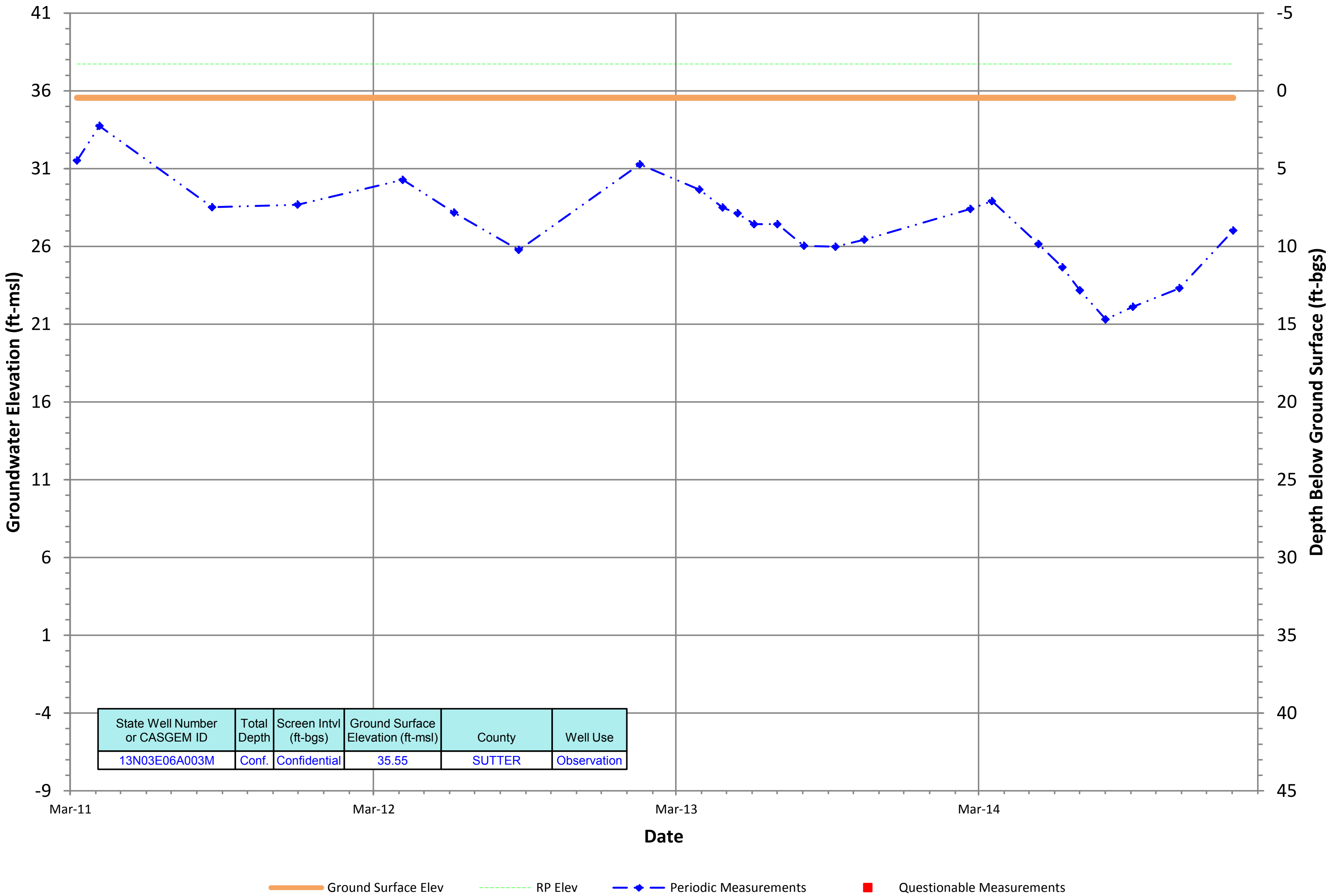
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E23H003M	Conf.	Confidential	22.24	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N01E24G002M	Conf.	Confidential	27	SUTTER	Observation

13N03E06A003M
Period Of Record: 03/09/2011 to 01/02/2015

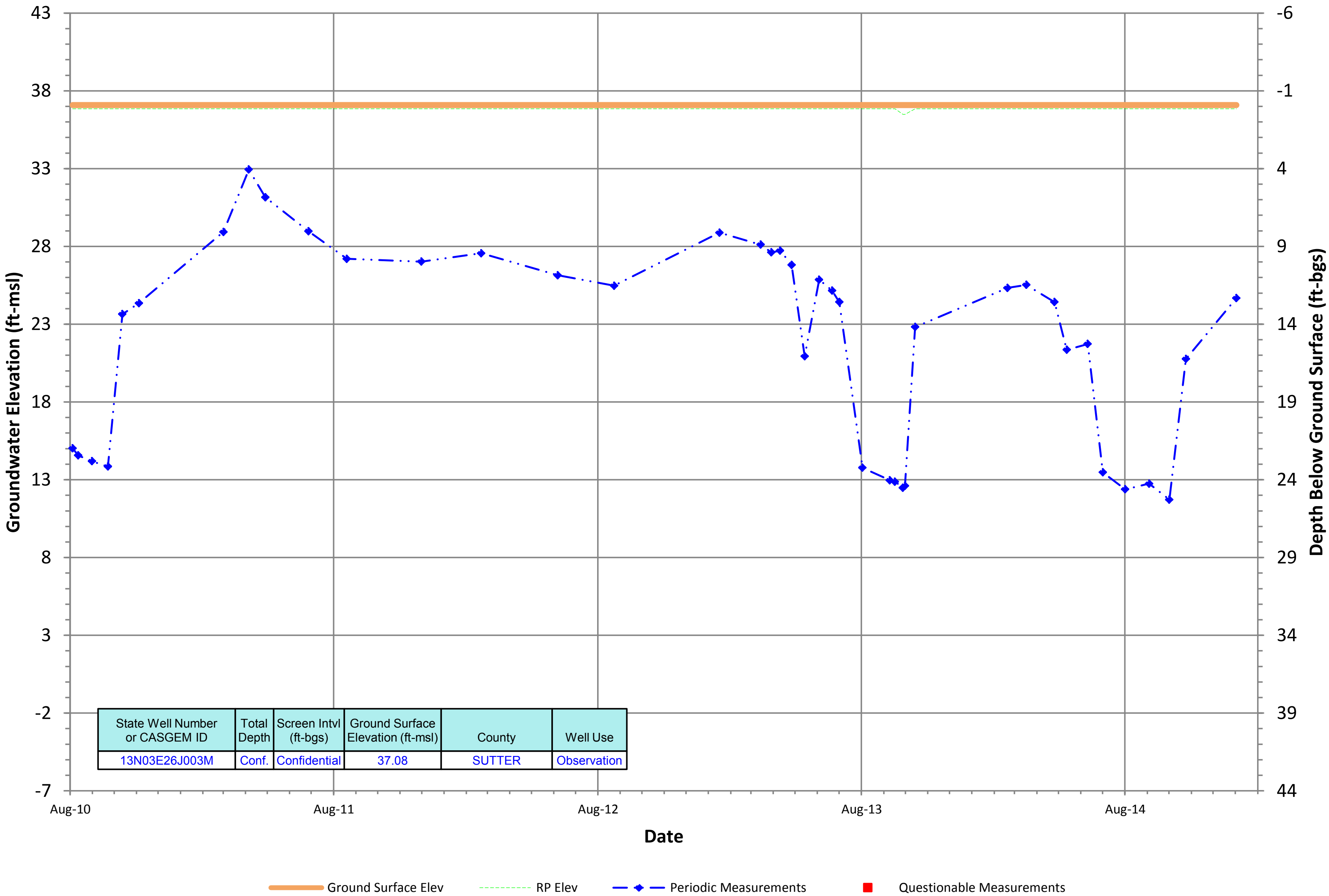
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E06A003M	Conf.	Confidential	35.55	SUTTER	Observation

13N03E26J003M
Period Of Record: 08/04/2010 to 01/02/2015

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E26J003M	Conf.	Confidential	37.08	SUTTER	Observation

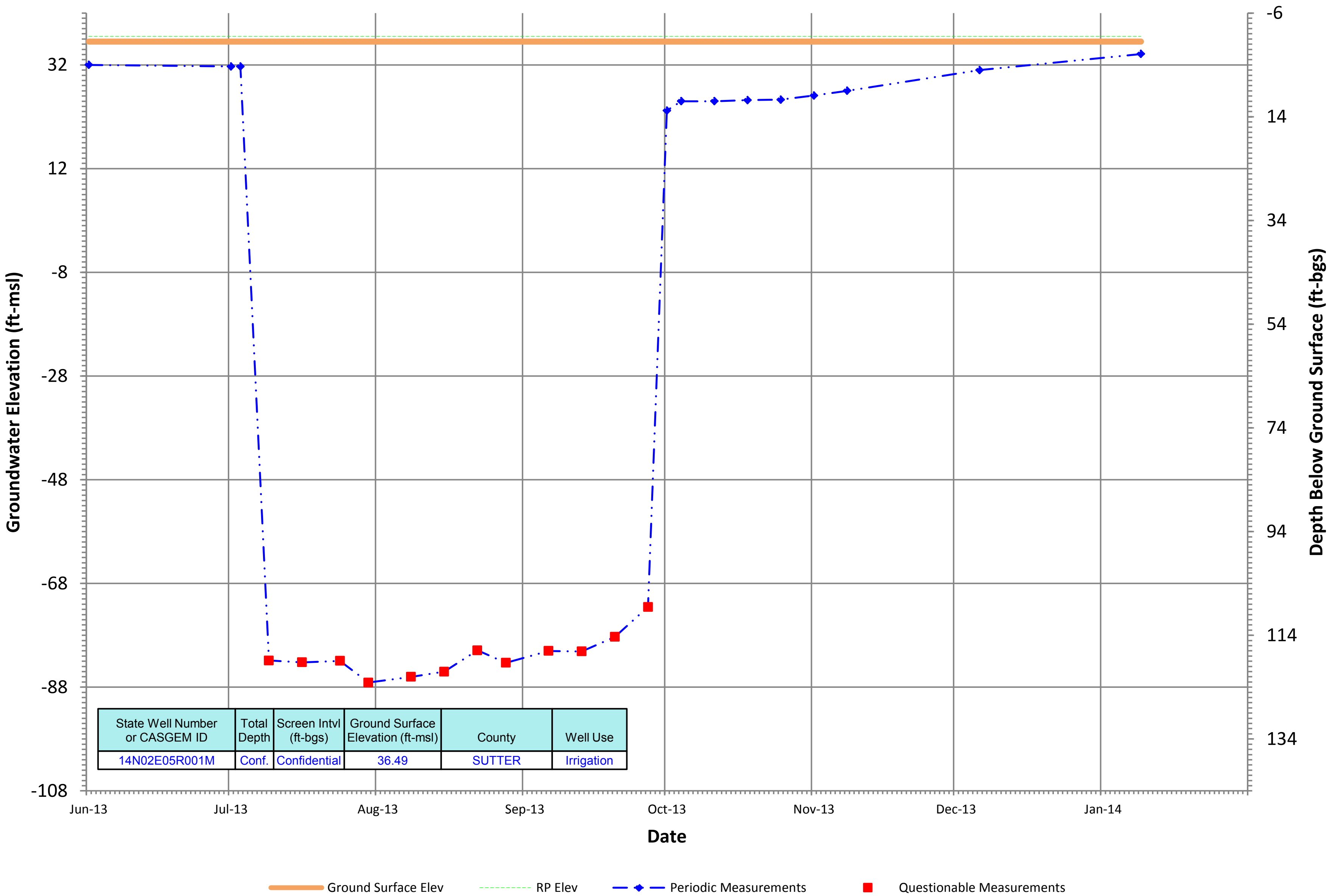
14N02E05R001M

Period Of Record: 06/01/2013 to 01/09/2014

Hydrograph Criteria

Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)

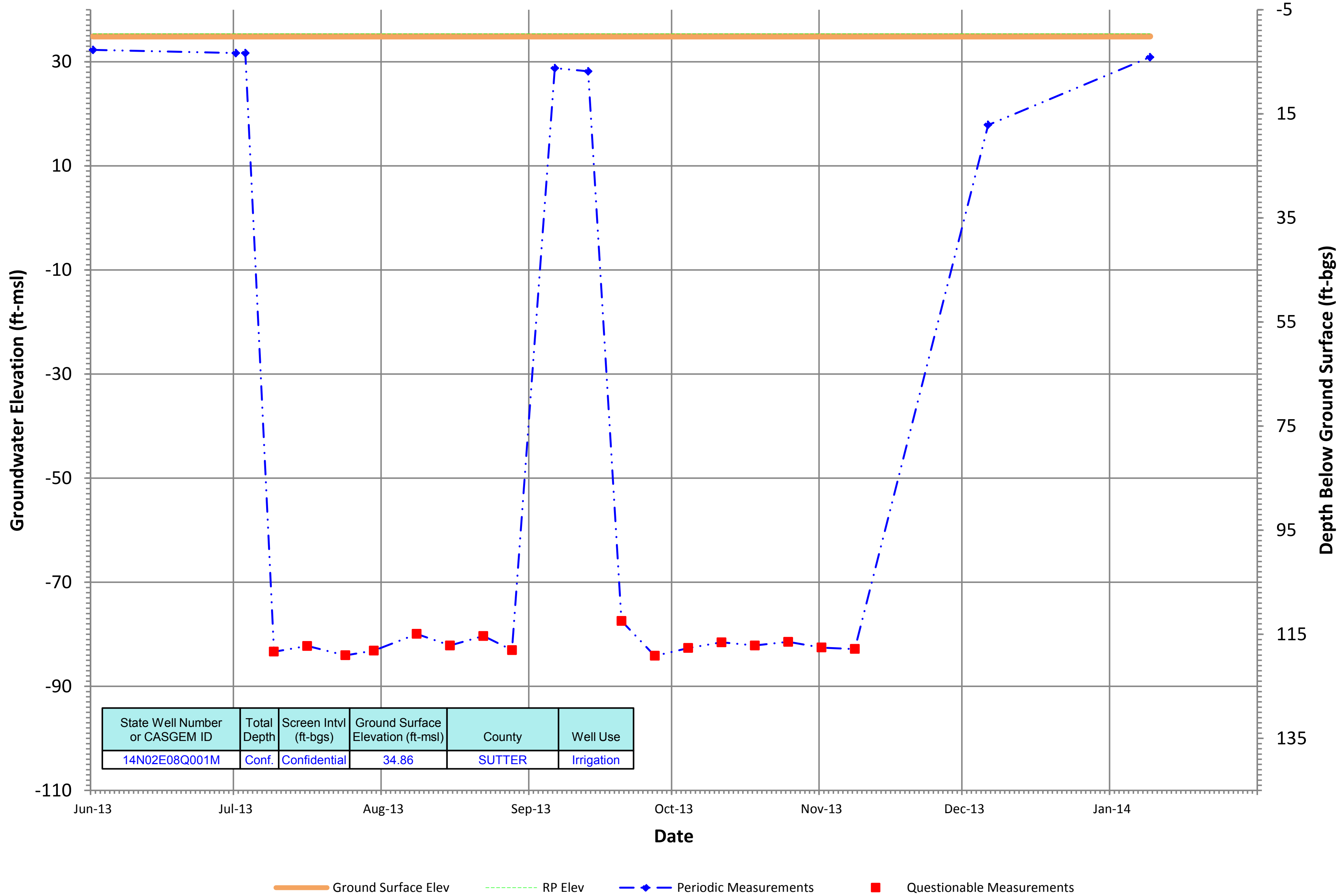
Total Depth is on or between 200 and 600



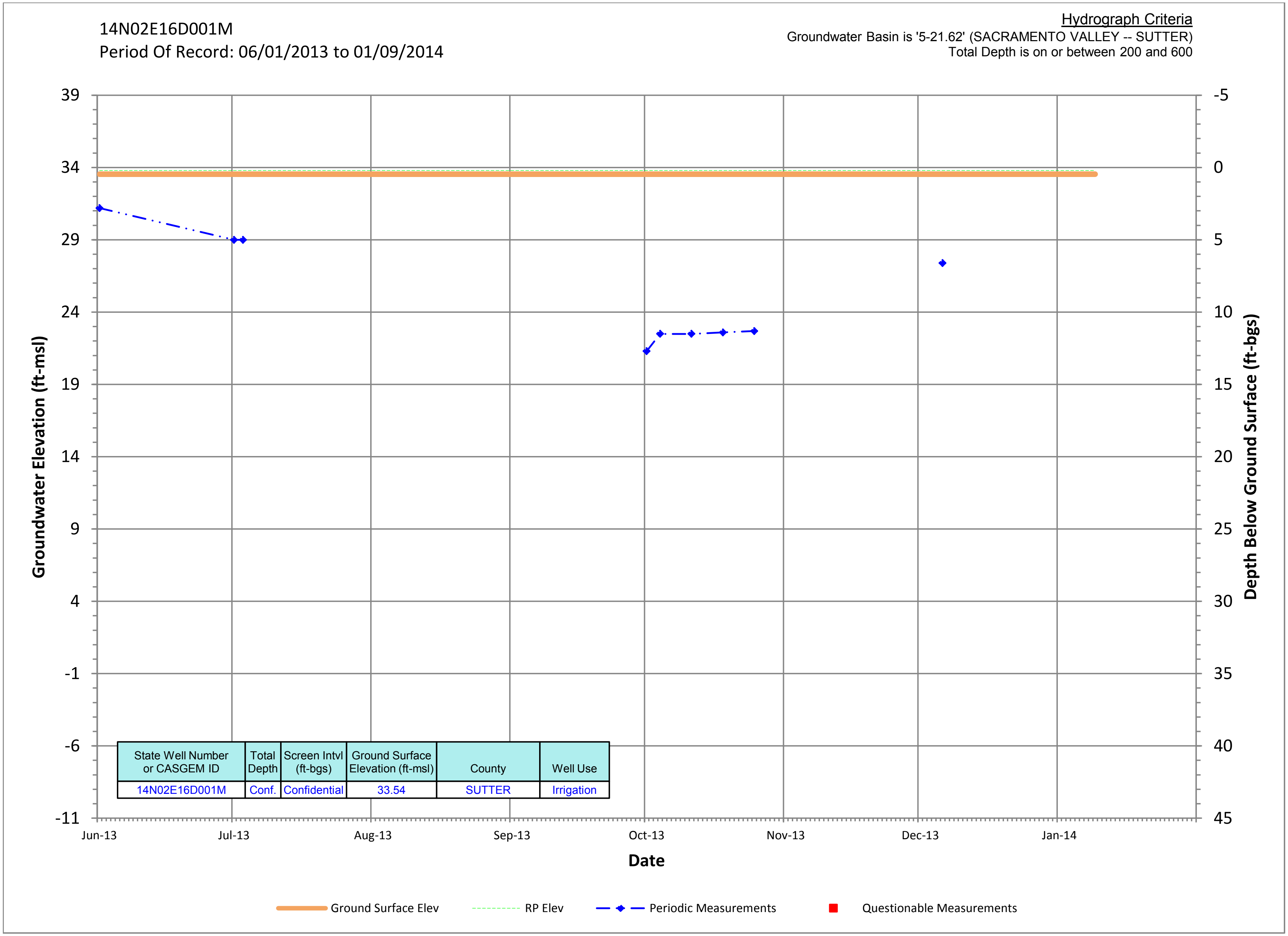
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E05R001M	Conf.	Confidential	36.49	SUTTER	Irrigation

14N02E08Q001M
Period Of Record: 06/01/2013 to 01/09/2014

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



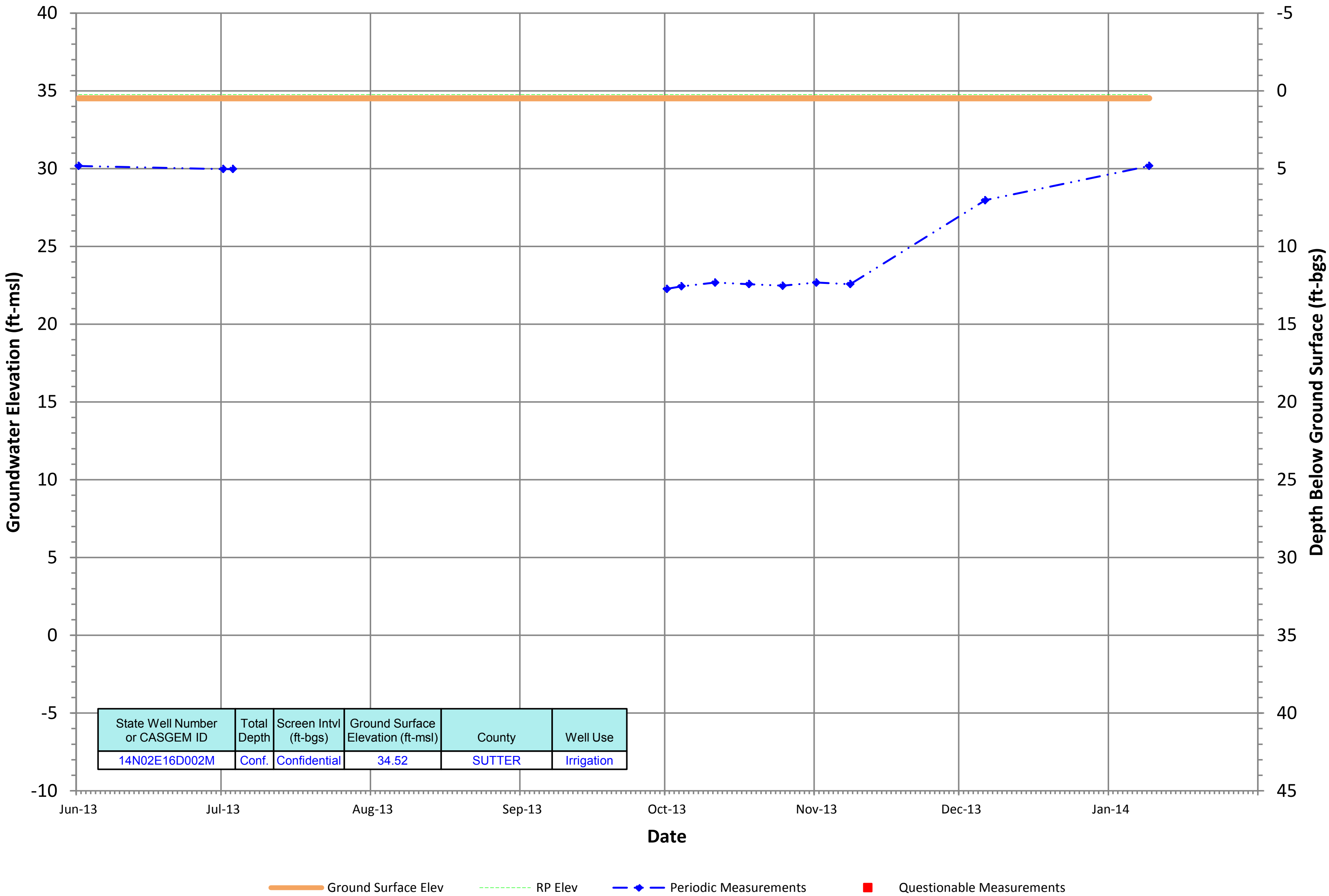
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E08Q001M	Conf.	Confidential	34.86	SUTTER	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E16D001M	Conf.	Confidential	33.54	SUTTER	Irrigation

14N02E16D002M
Period Of Record: 06/01/2013 to 01/09/2014

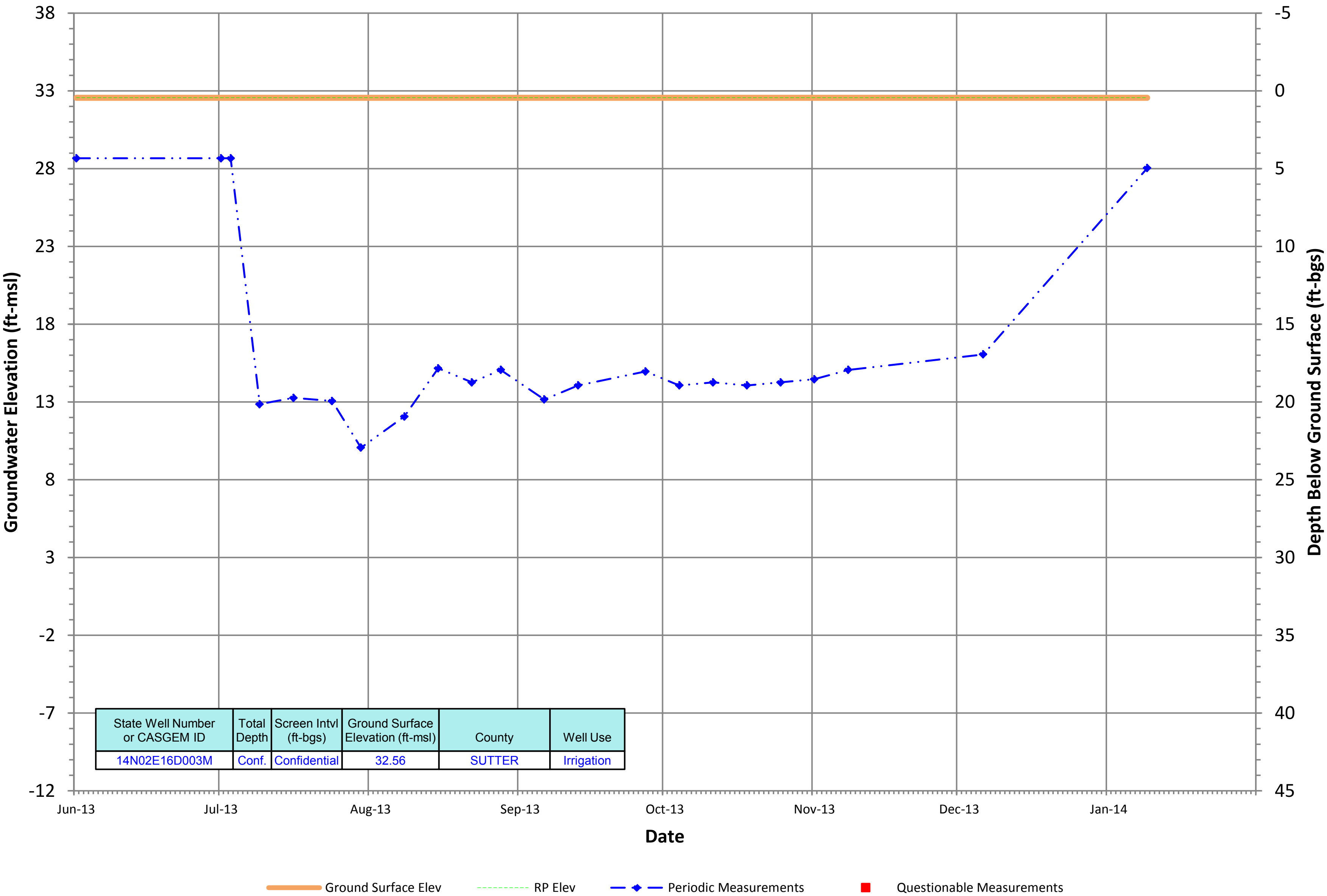
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



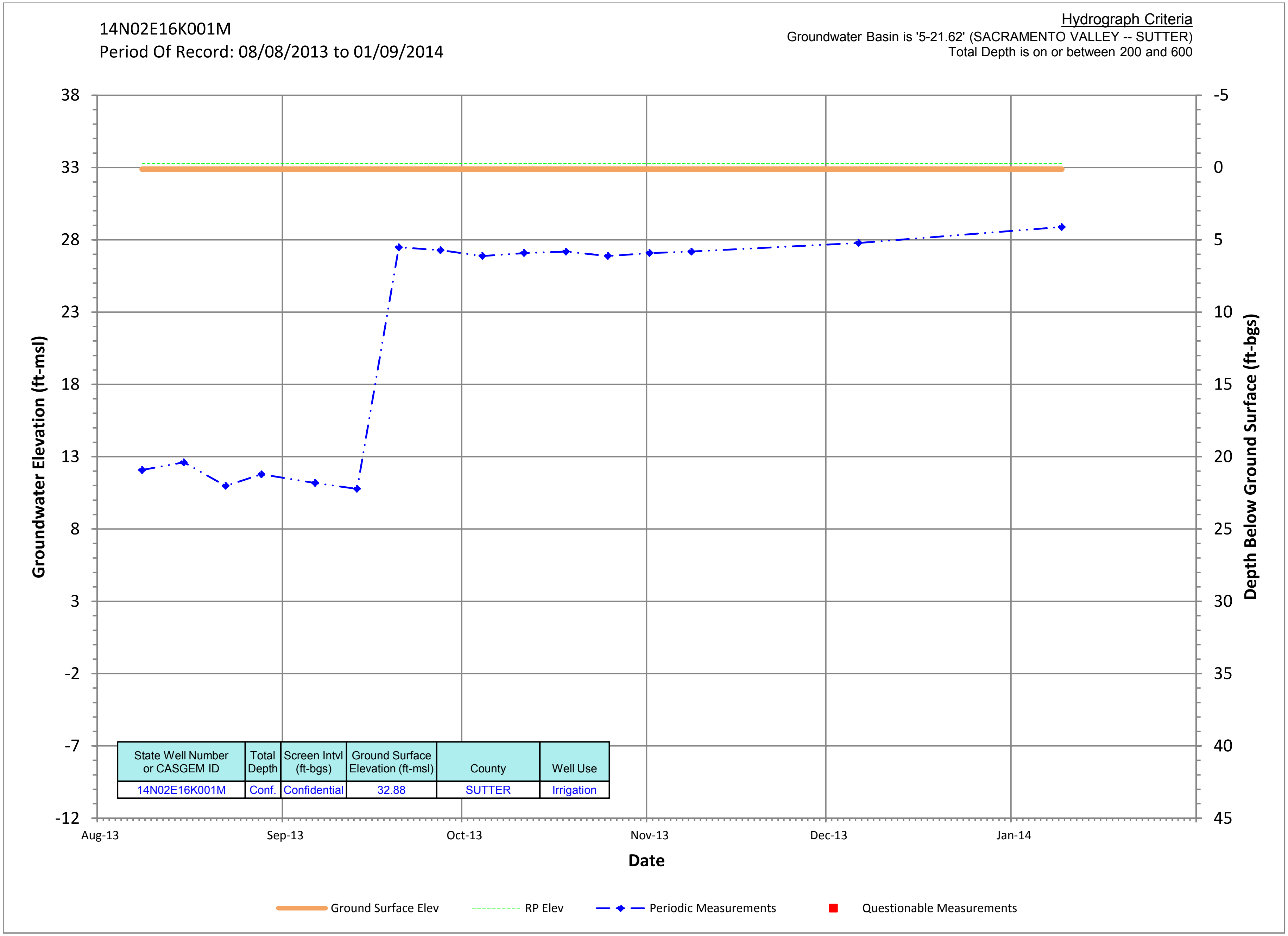
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E16D002M	Conf.	Confidential	34.52	SUTTER	Irrigation

14N02E16D003M
Period Of Record: 06/01/2013 to 01/09/2014

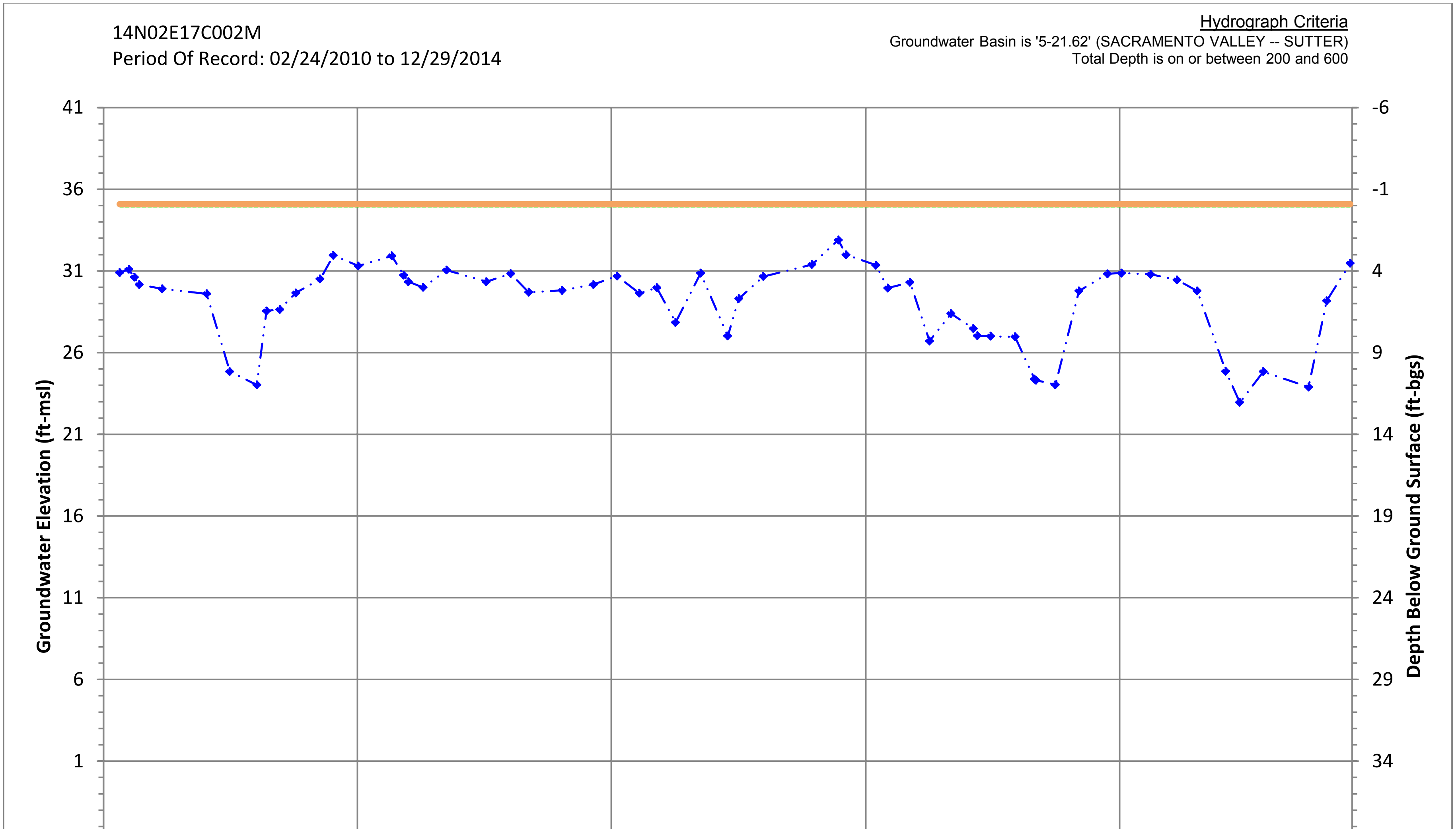
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E16D003M	Conf.	Confidential	32.56	SUTTER	Irrigation



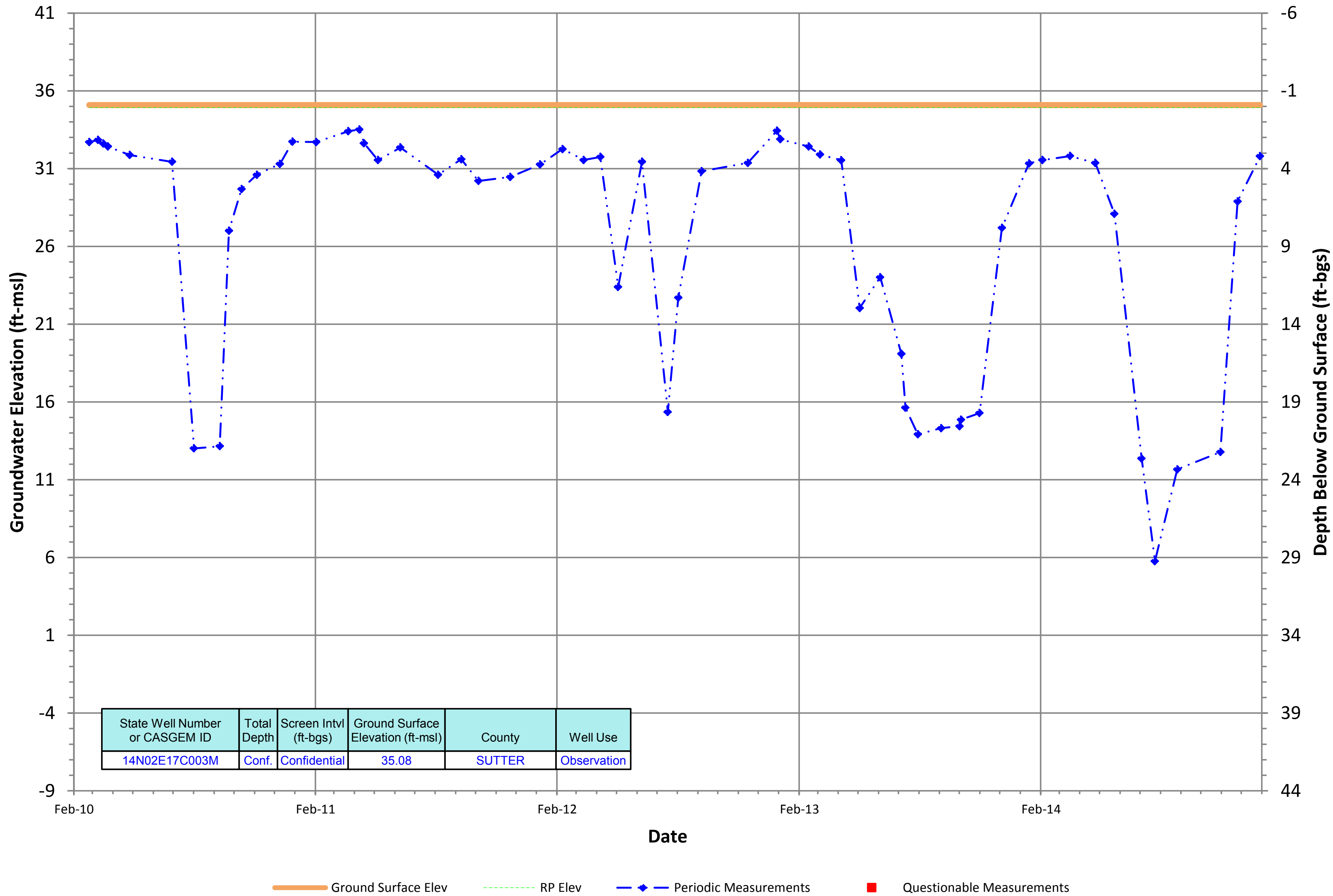
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E16K001M	Conf.	Confidential	32.88	SUTTER	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E17C002M	Conf.	Confidential	35.08	SUTTER	Observation

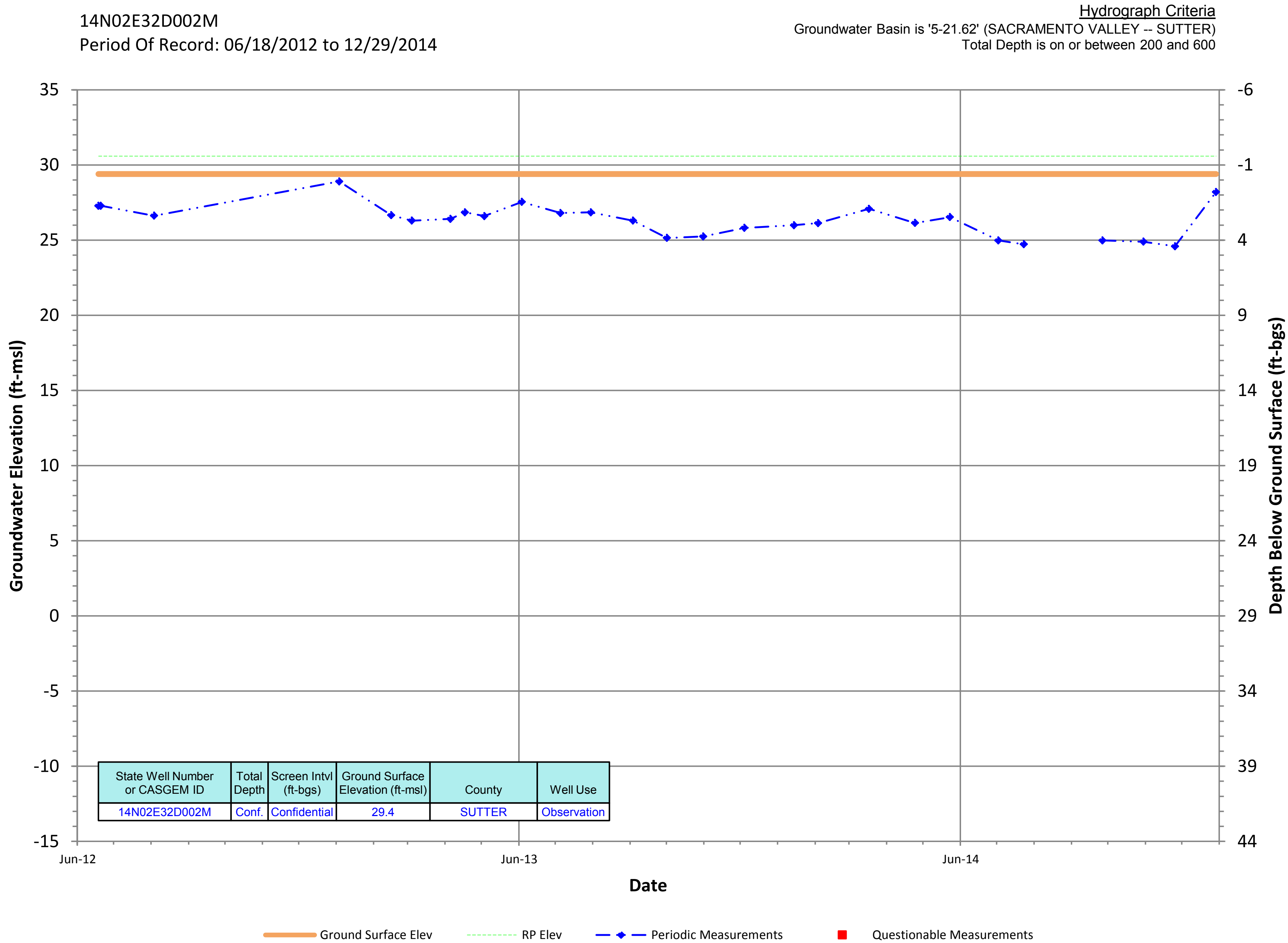
14N02E17C003M
Period Of Record: 02/24/2010 to 12/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E17C003M	Conf.	Confidential	35.08	SUTTER	Observation

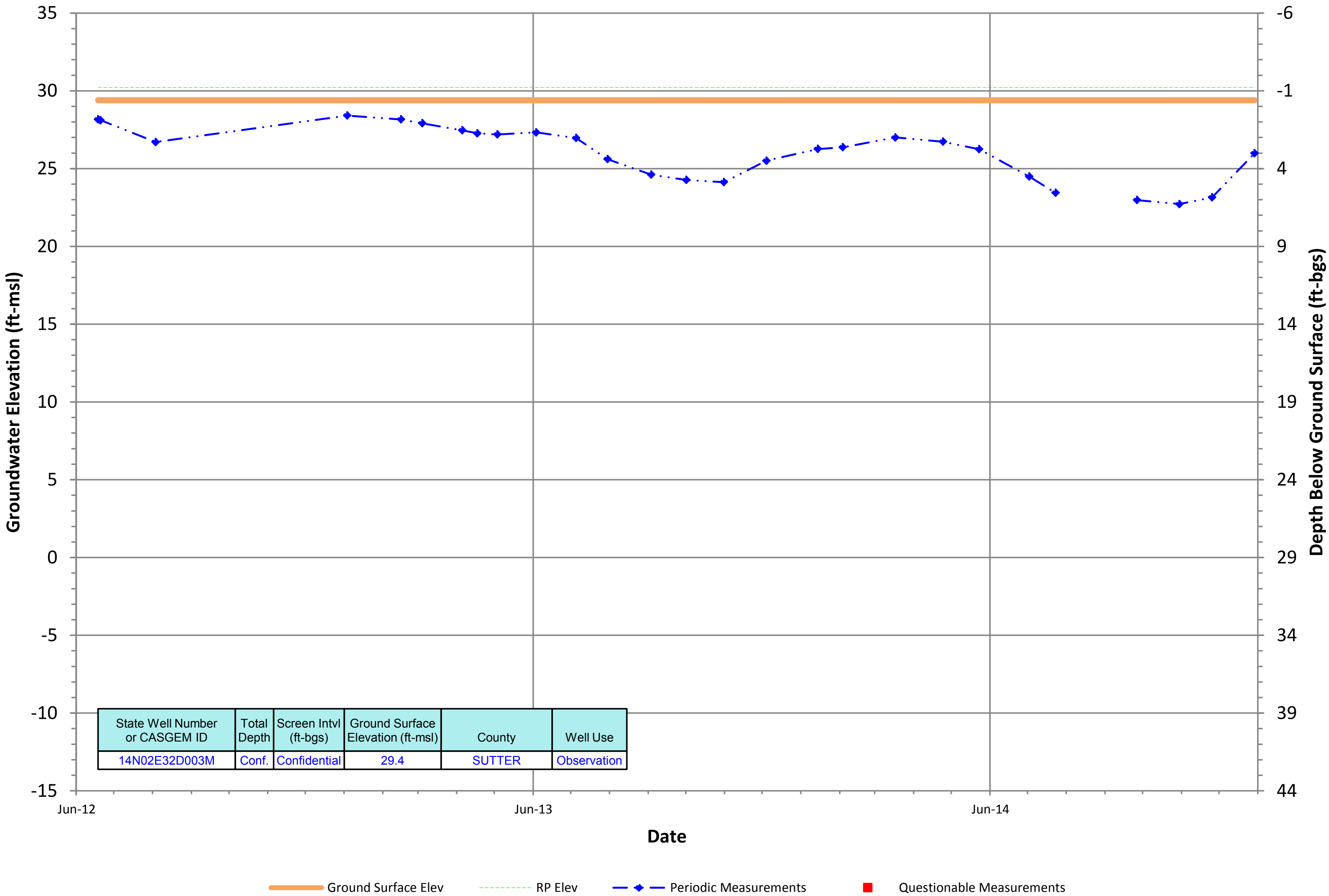
14N02E32D002M
Period Of Record: 06/18/2012 to 12/29/2014



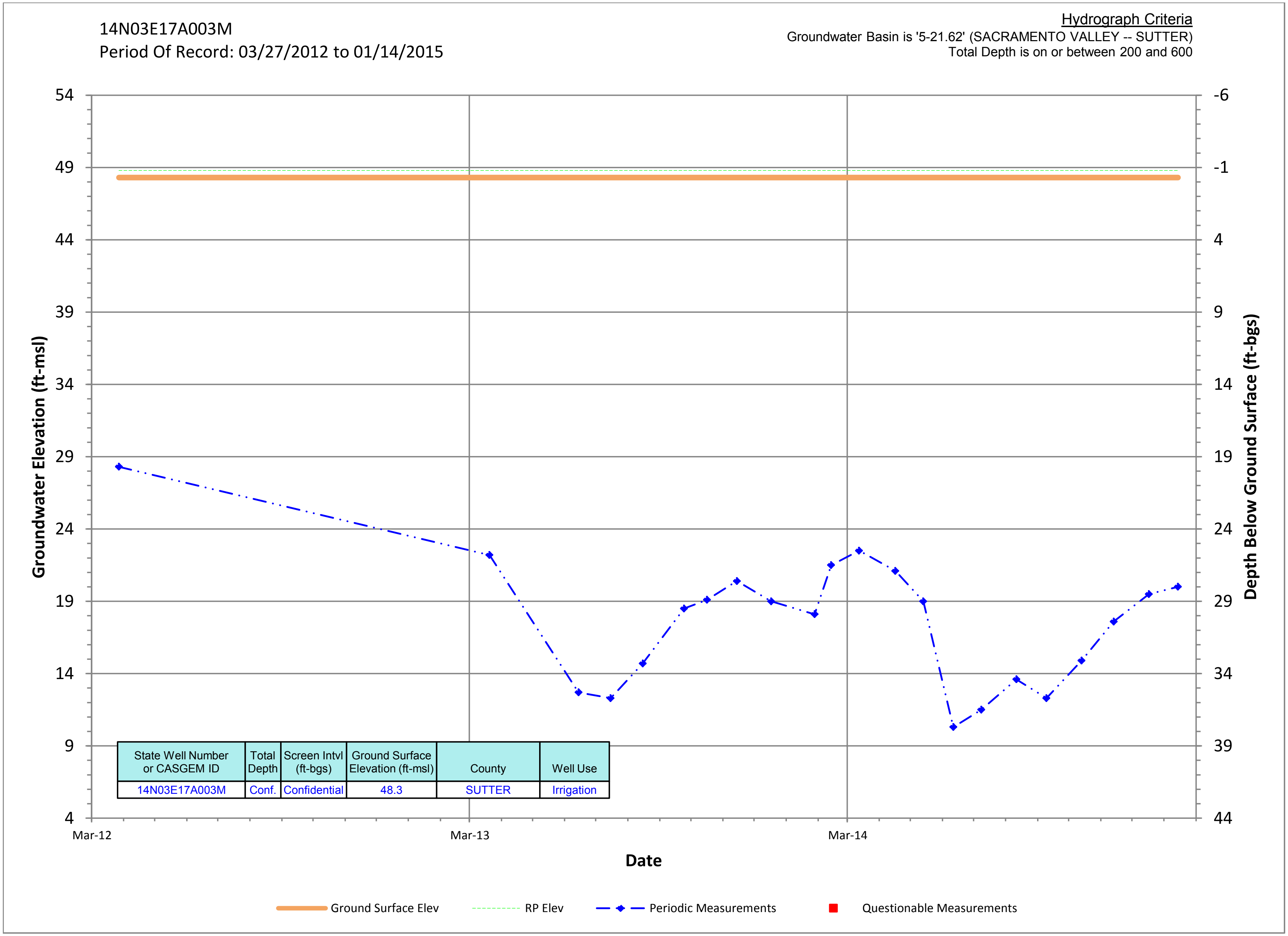
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E32D002M	Conf.	Confidential	29.4	SUTTER	Observation

14N02E32D003M
Period Of Record: 06/18/2012 to 12/29/2014

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



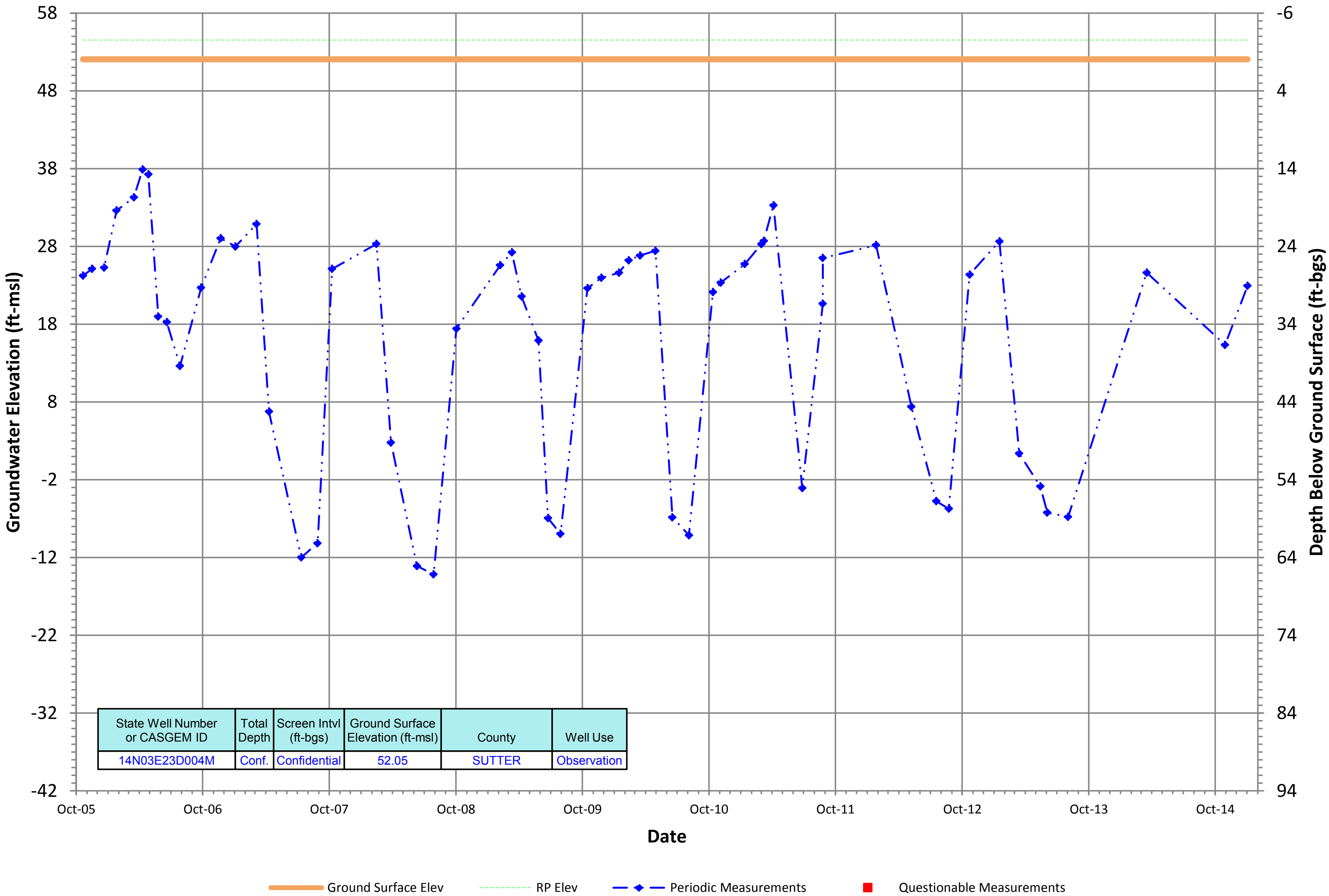
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E32D003M	Conf.	Confidential	29.4	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03E17A003M	Conf.	Confidential	48.3	SUTTER	Irrigation

14N03E23D004M
Period Of Record: 10/20/2005 to 01/02/2015

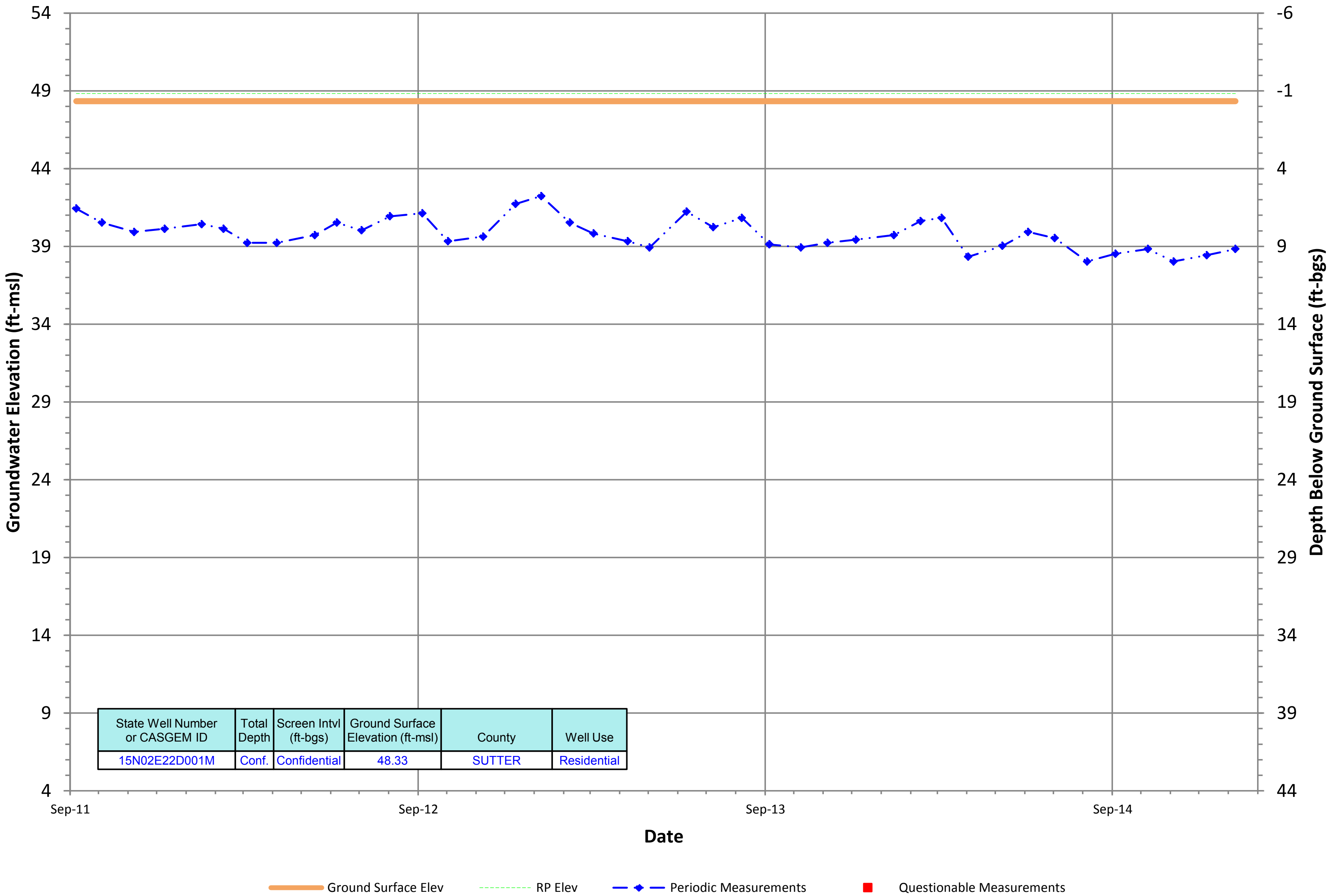
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



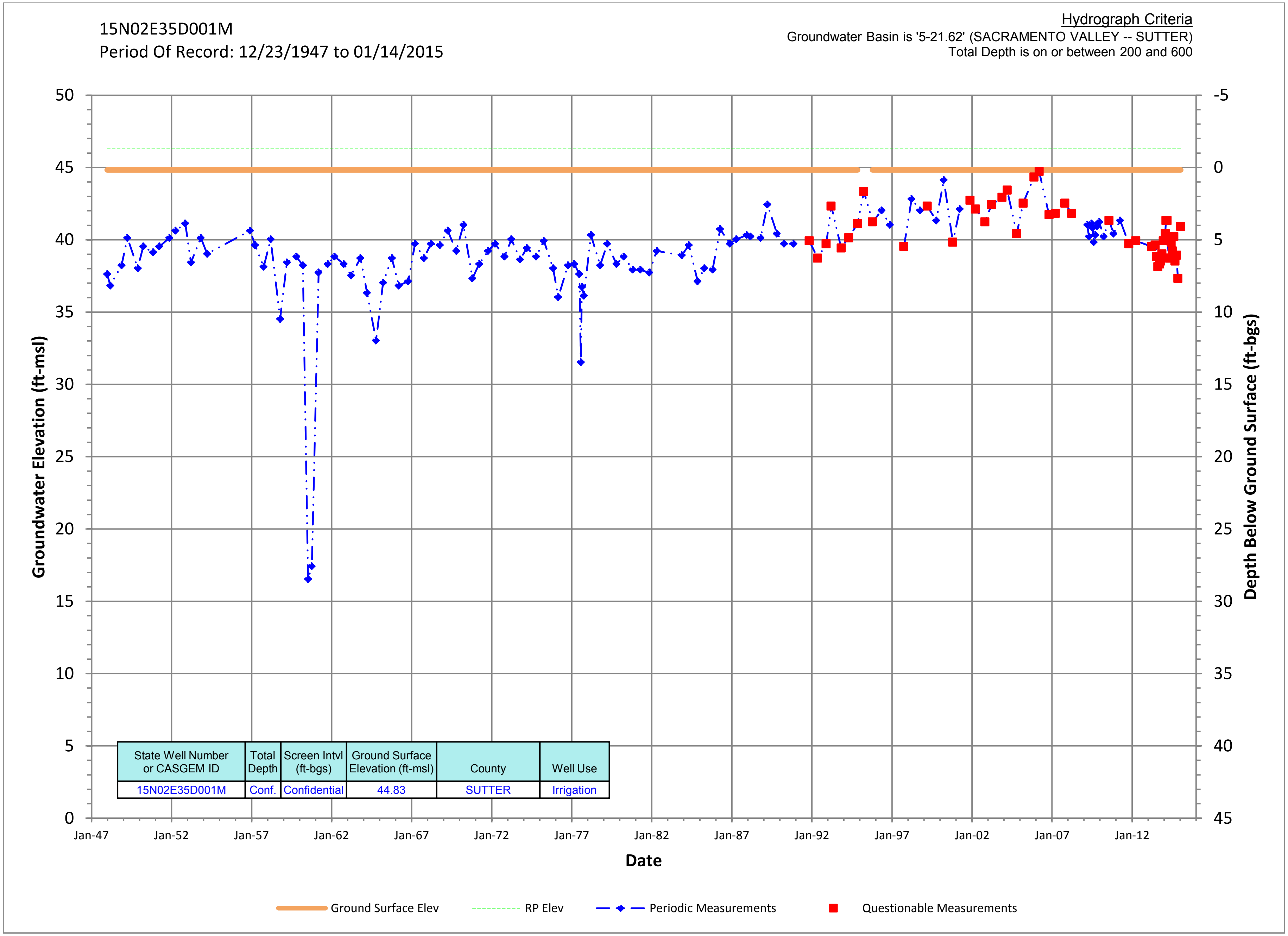
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03E23D004M	Conf.	Confidential	52.05	SUTTER	Observation

15N02E22D001M
Period Of Record: 09/07/2011 to 01/08/2015

Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N02E22D001M	Conf.	Confidential	48.33	SUTTER	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
15N02E35D001M	Conf.	Confidential	44.83	SUTTER	Irrigation

Deep Groundwater Monitoring Well Hydrographs- Sutter Subbasin

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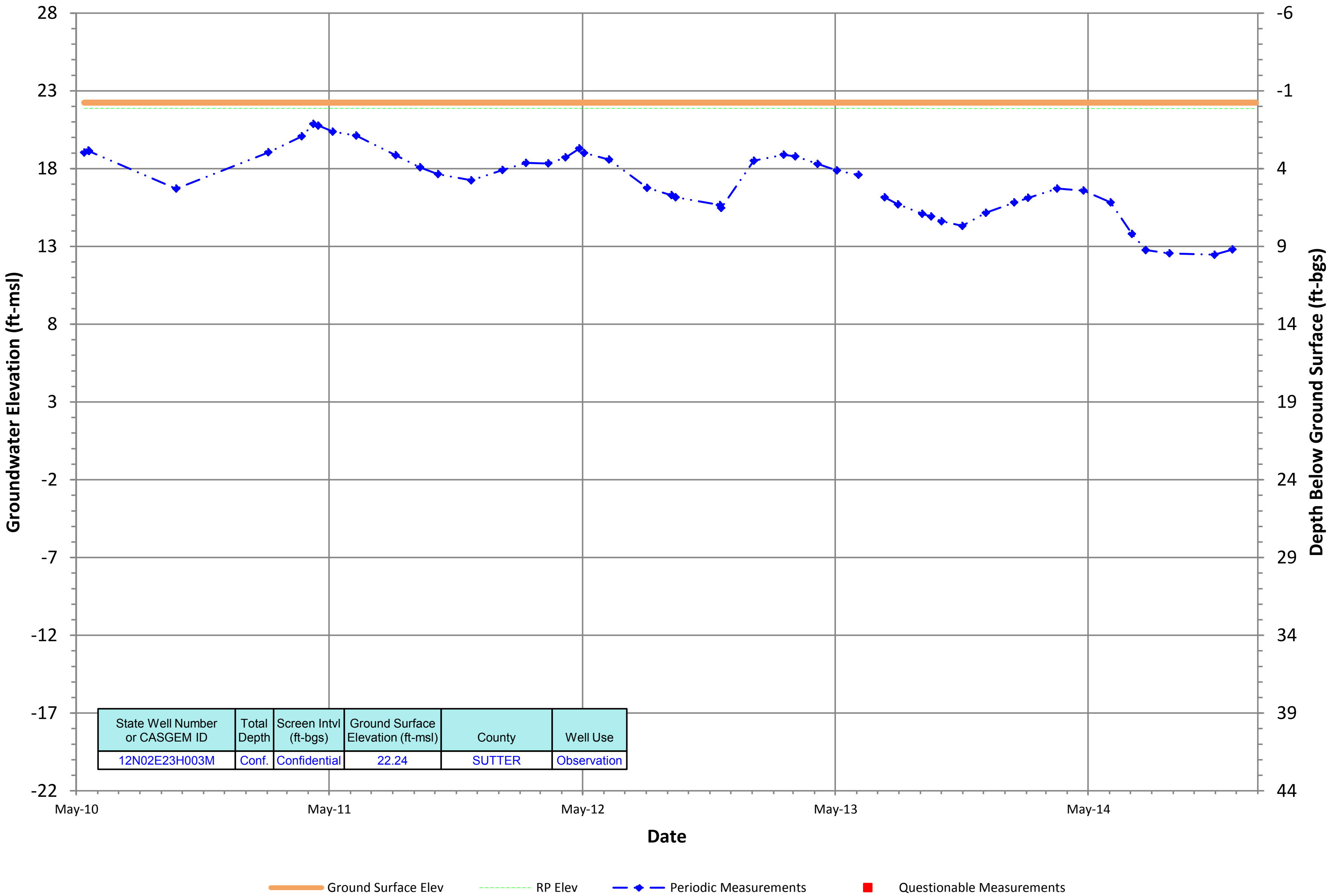
12N02E23H003M
Period Of Record: 05/12/2010 to 12/29/2014

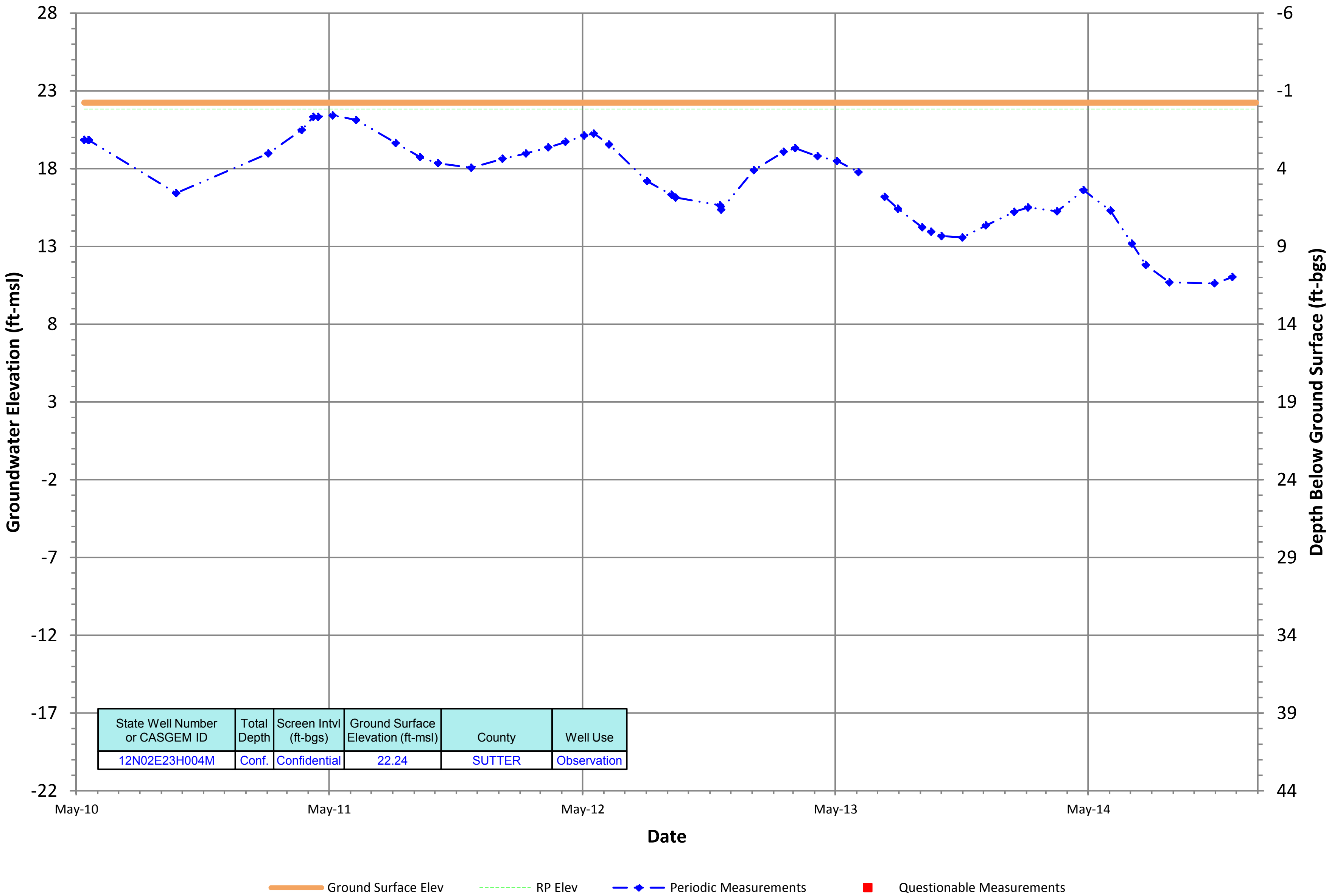
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E23H003M	Conf.	Confidential	22.24	SUTTER	Observation

12N02E23H004M
Period Of Record: 05/12/2010 to 12/29/2014

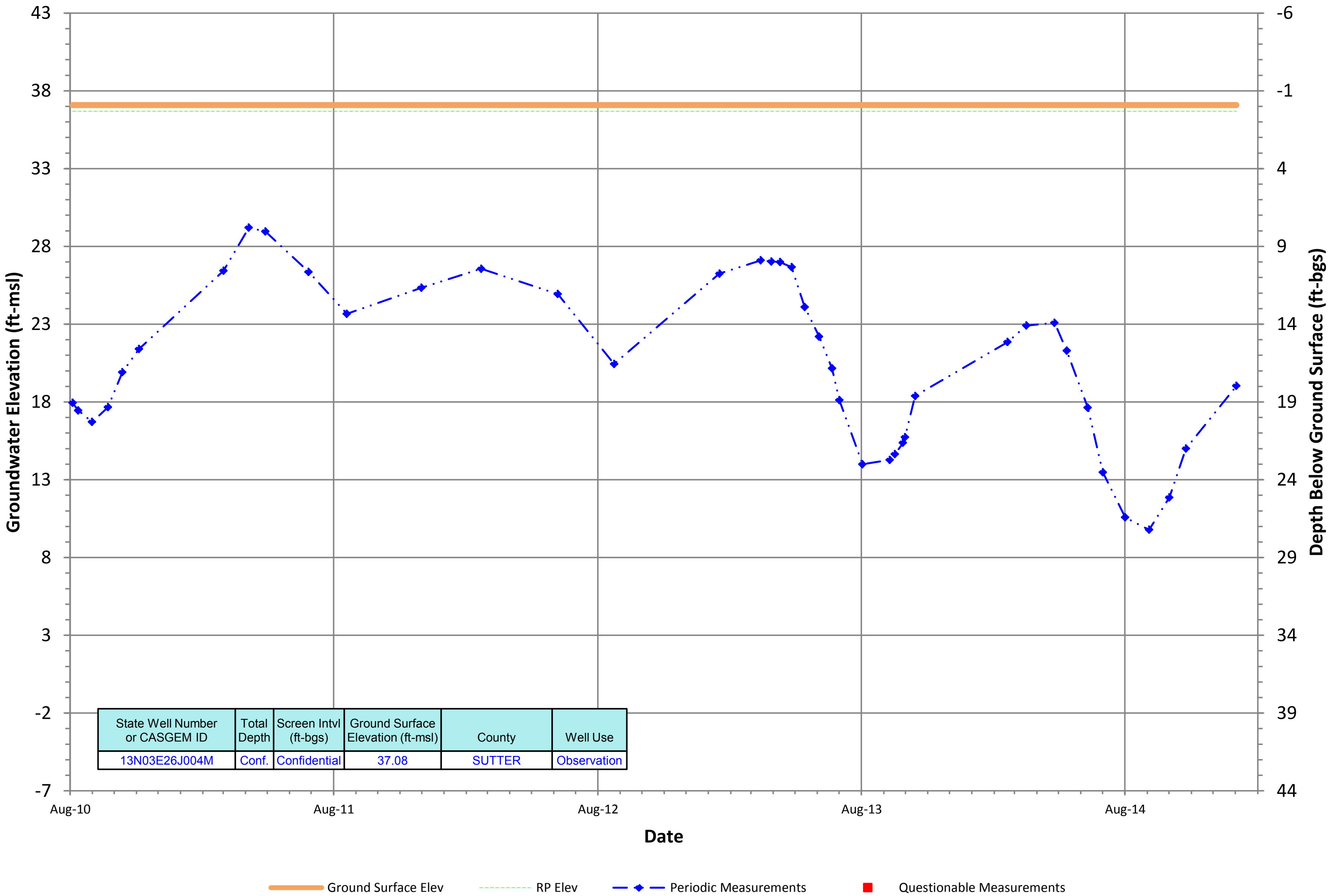
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
12N02E23H004M	Conf.	Confidential	22.24	SUTTER	Observation

13N03E26J004M
Period Of Record: 08/04/2010 to 01/02/2015

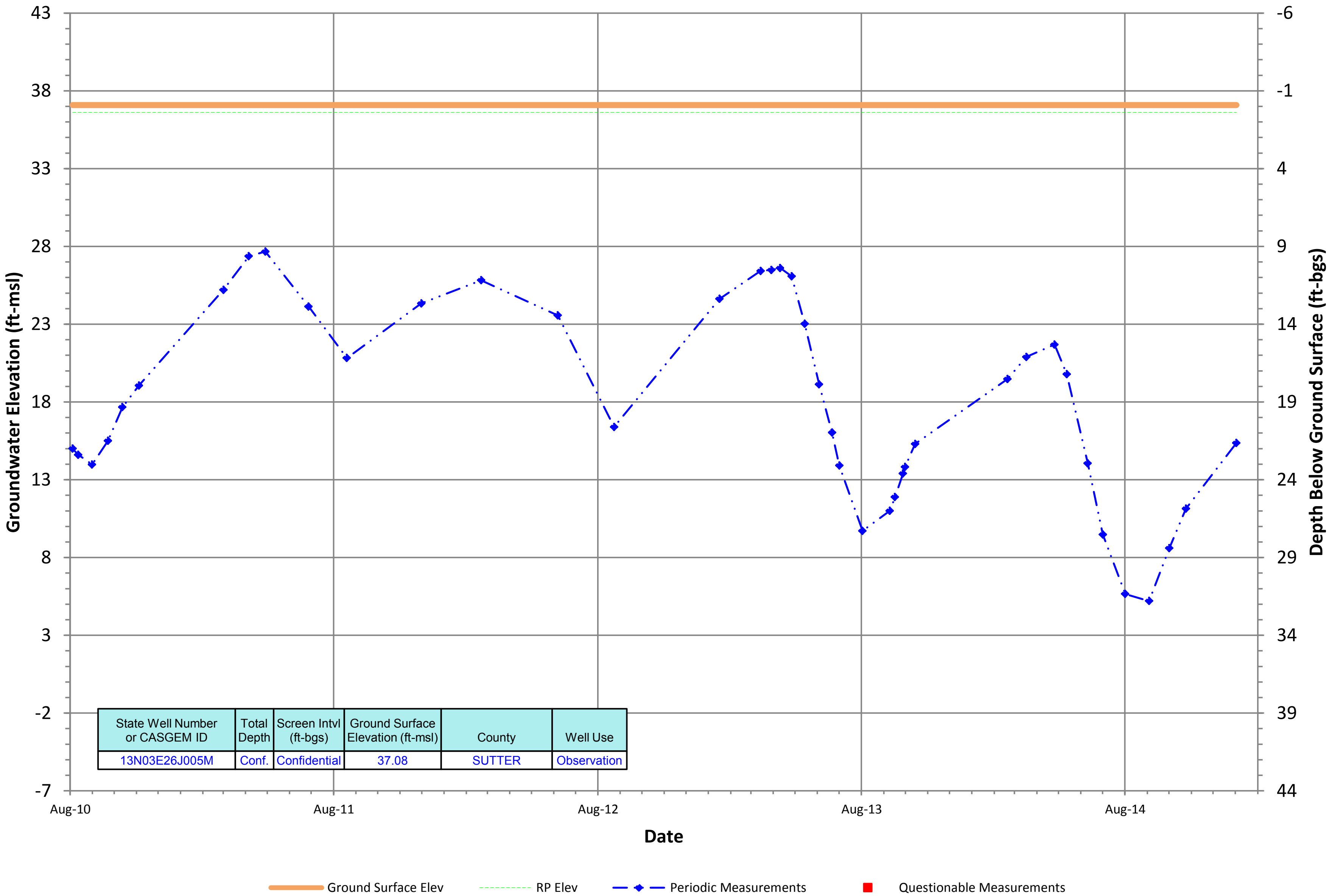
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E26J004M	Conf.	Confidential	37.08	SUTTER	Observation

13N03E26J005M
Period Of Record: 08/04/2010 to 01/02/2015

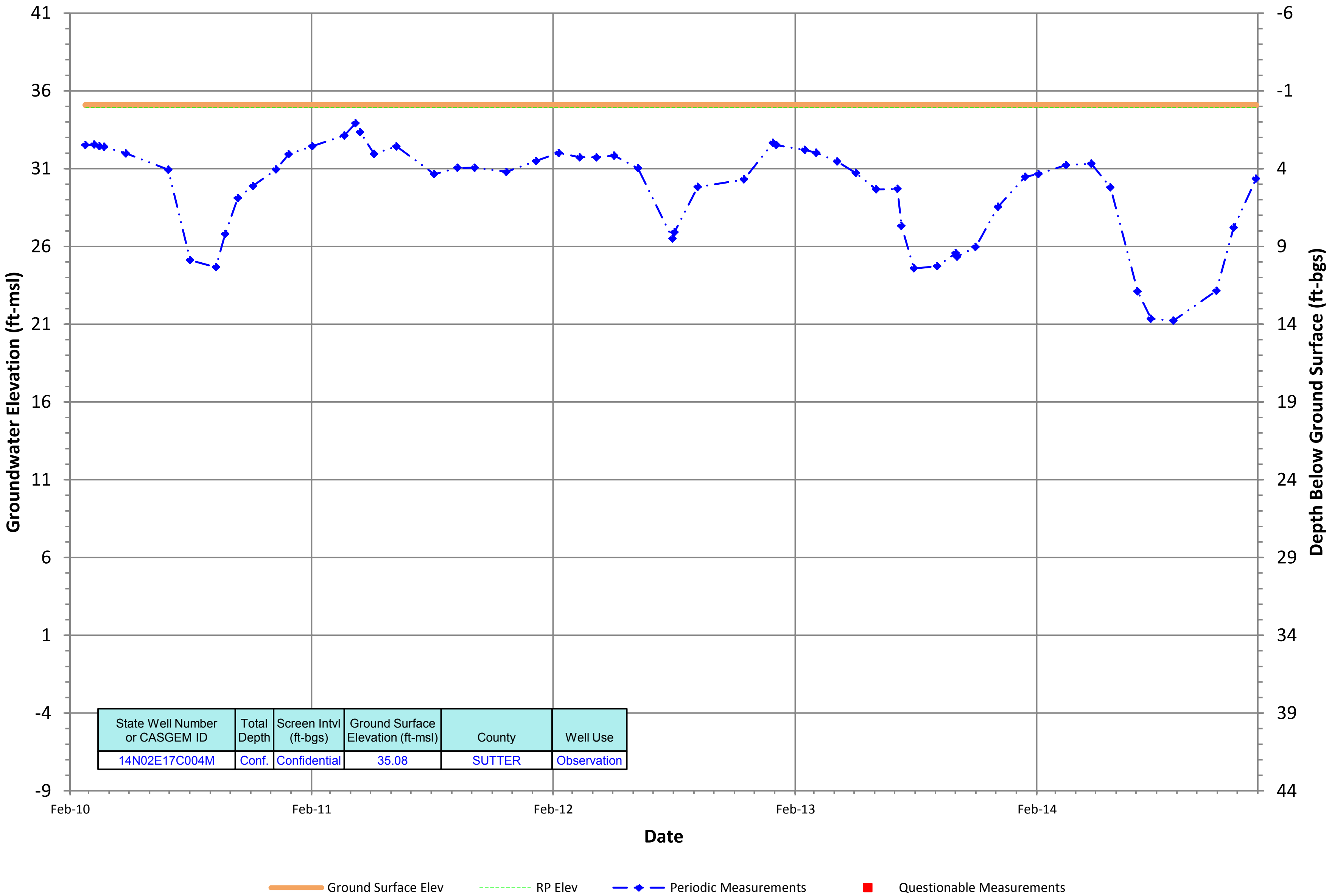
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is at or greater than 600



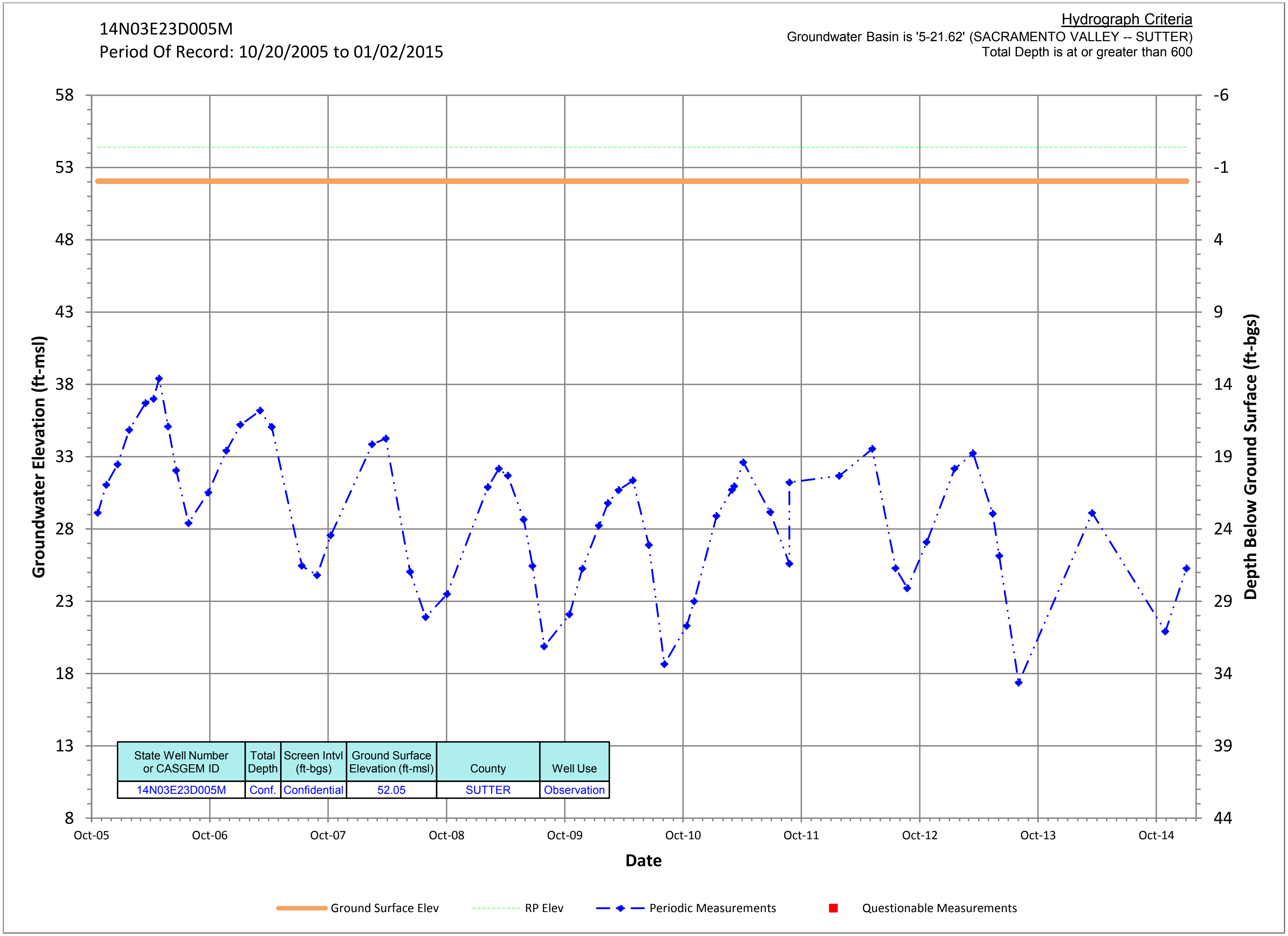
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
13N03E26J005M	Conf.	Confidential	37.08	SUTTER	Observation

14N02E17C004M
Period Of Record: 02/24/2010 to 12/29/2014

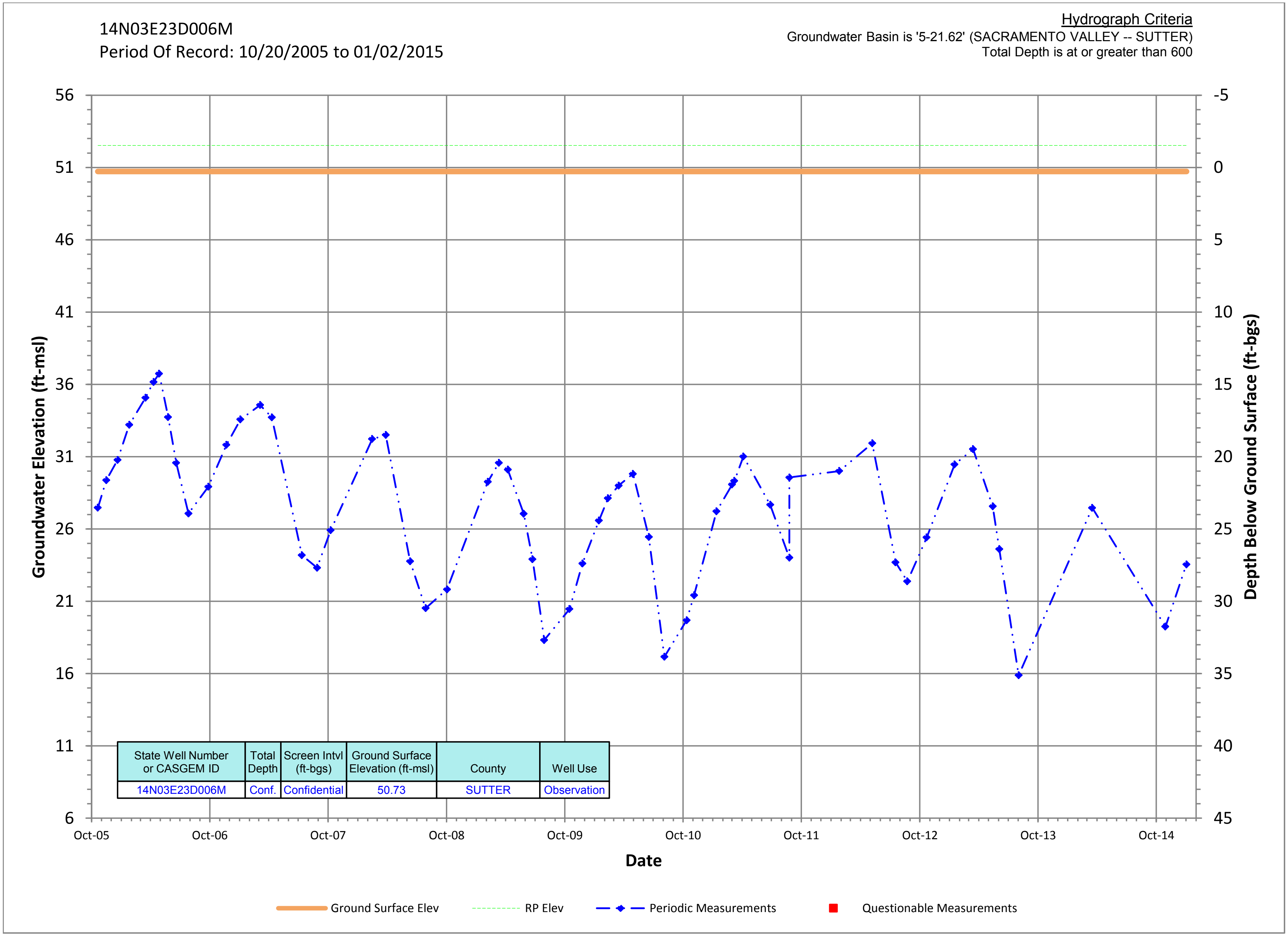
Hydrograph Criteria
Groundwater Basin is '5-21.62' (SACRAMENTO VALLEY -- SUTTER)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N02E17C004M	Conf.	Confidential	35.08	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03E23D005M	Conf.	Confidential	52.05	SUTTER	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
14N03E23D006M	Conf.	Confidential	50.73	SUTTER	Observation

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Shallow Groundwater Monitoring Well Hydrographs- West Butte Subbasin

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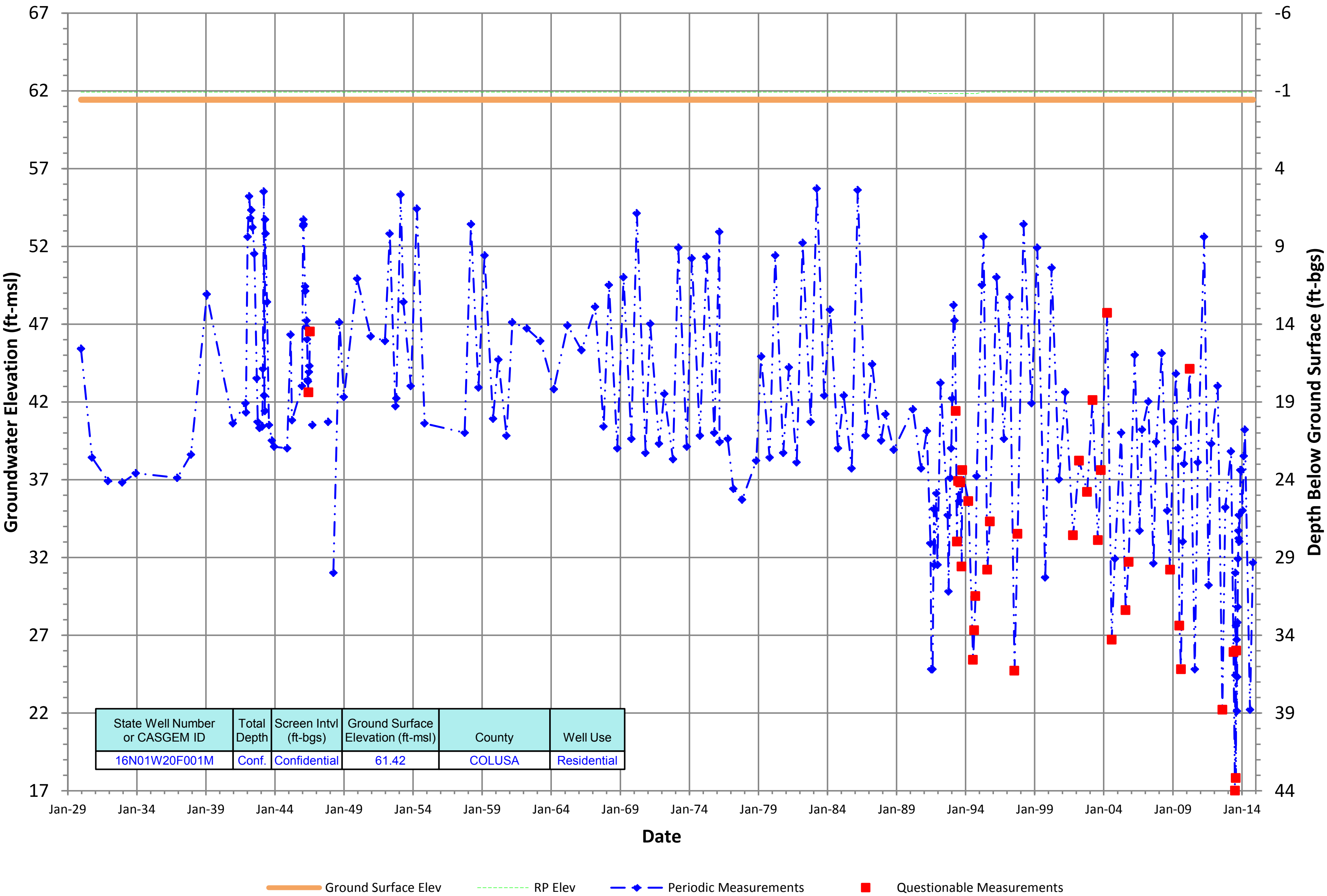
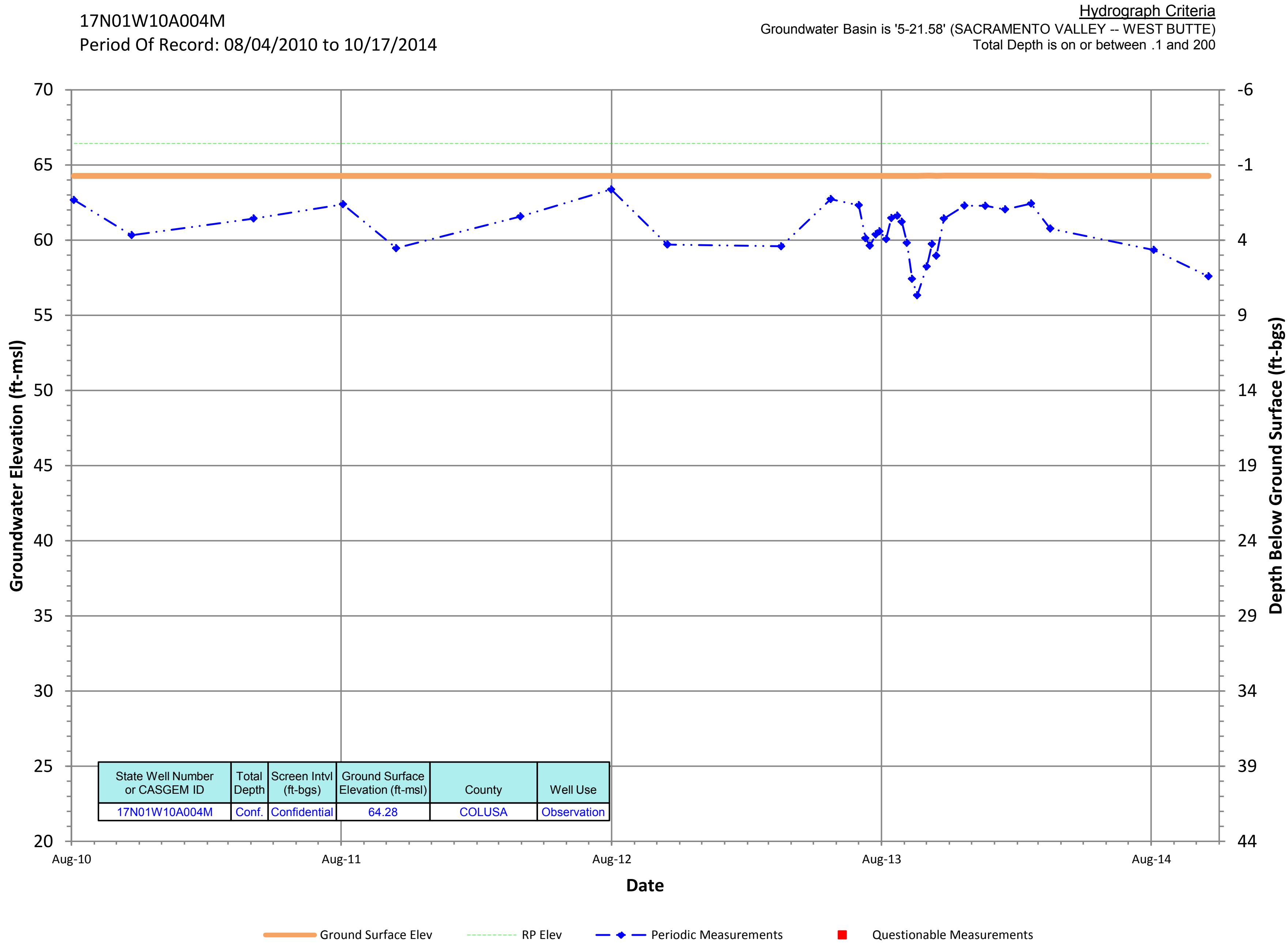
16N01W20F001M
Period Of Record: 12/17/1929 to 10/17/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200

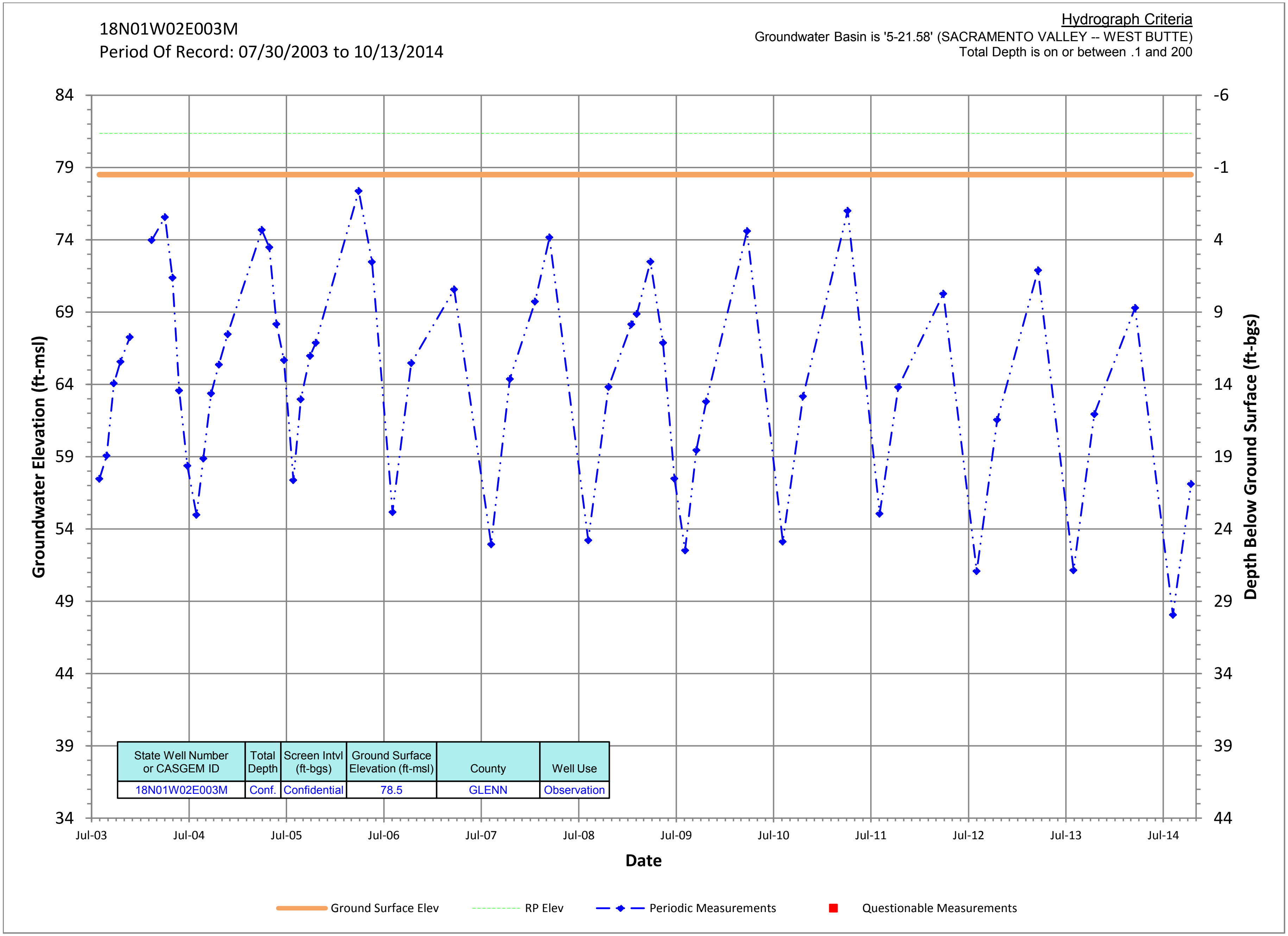


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N01W20F001M	Conf.	Confidential	61.42	COLUSA	Residential

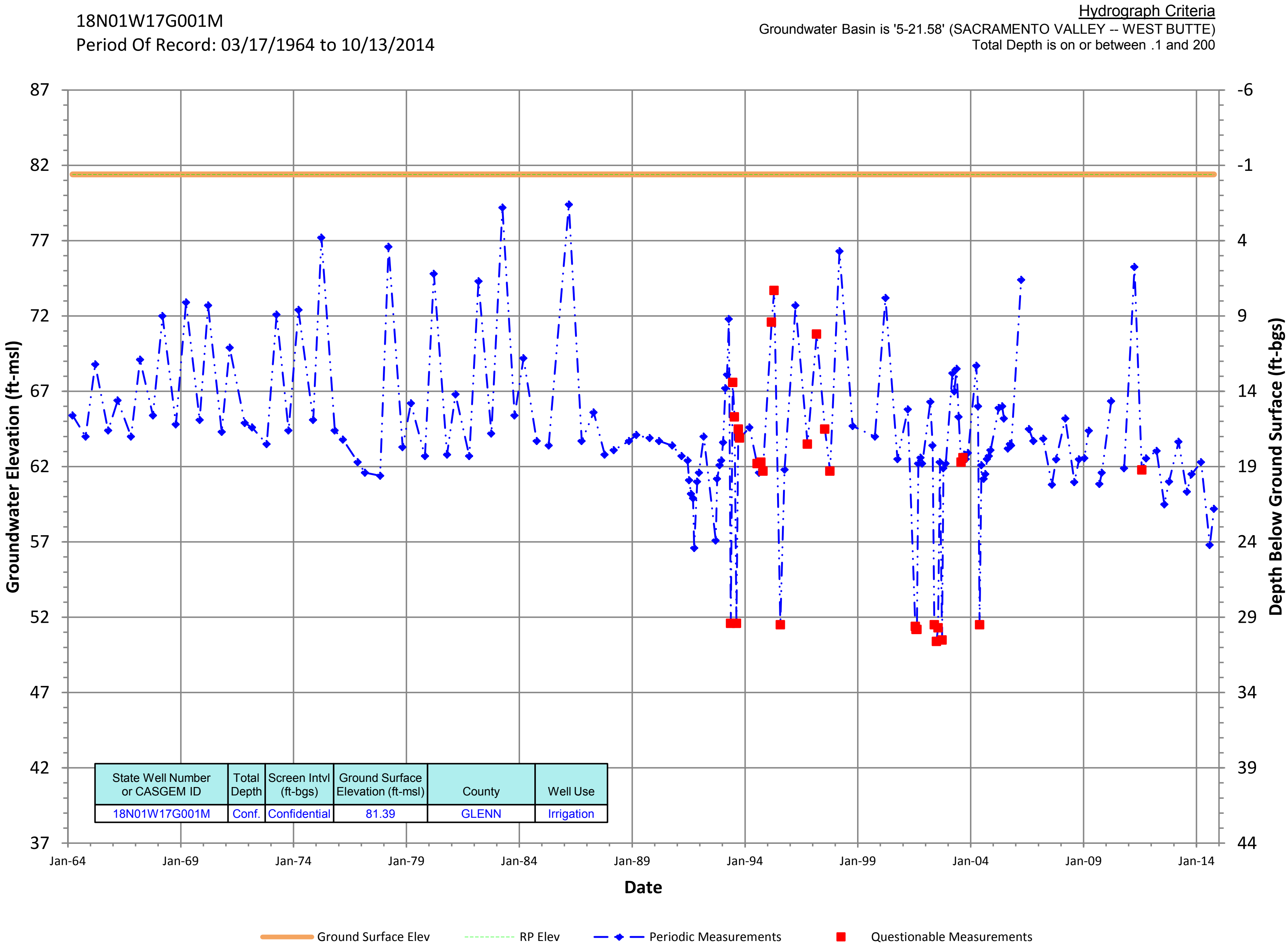
17N01W10A004M
Period Of Record: 08/04/2010 to 10/17/2014



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01W10A004M	Conf.	Confidential	64.28	COLUSA	Observation



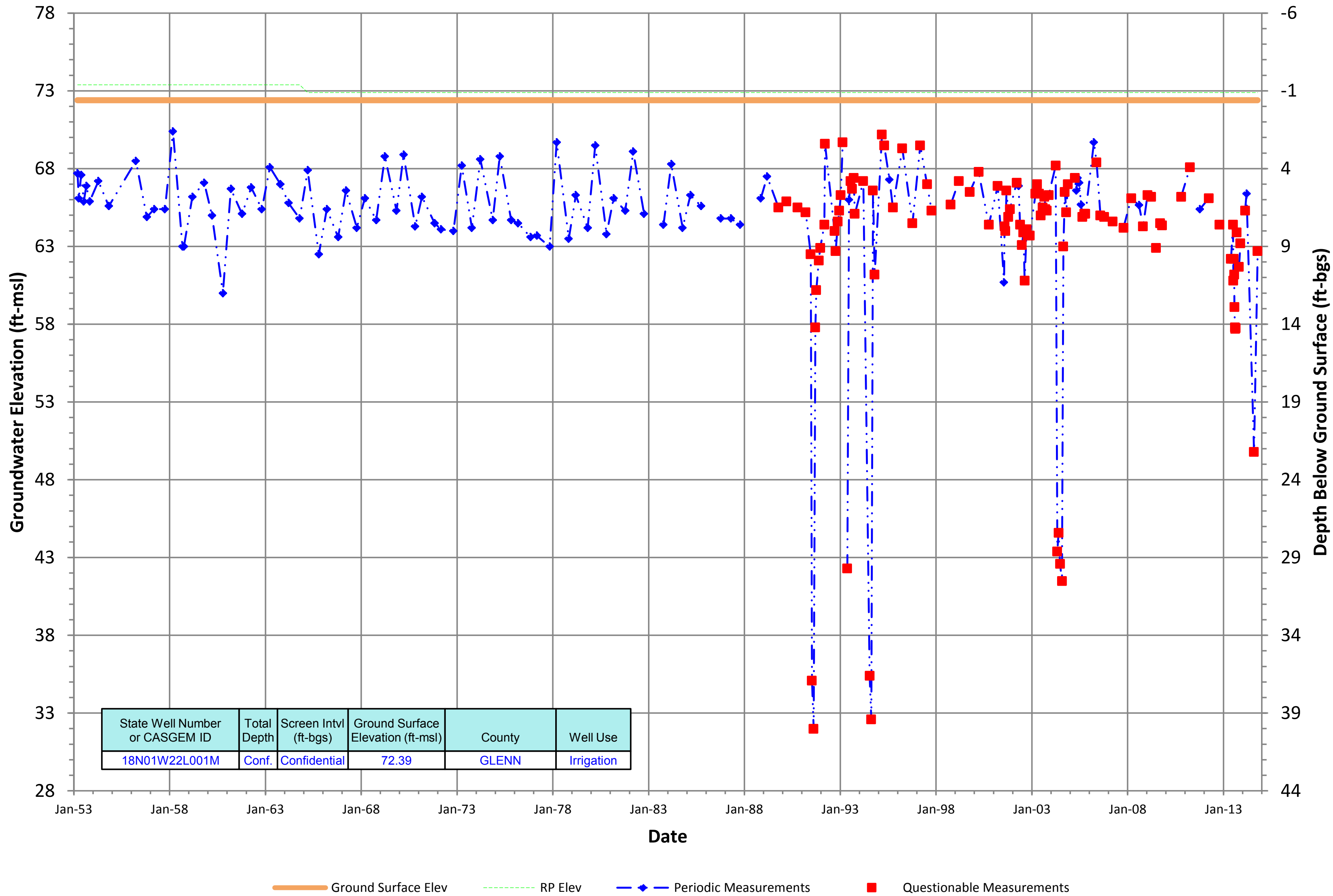
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01W02E003M	Conf.	Confidential	78.5	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01W17G001M	Conf.	Confidential	81.39	GLENN	Irrigation

18N01W22L001M
Period Of Record: 03/11/1953 to 10/13/2014

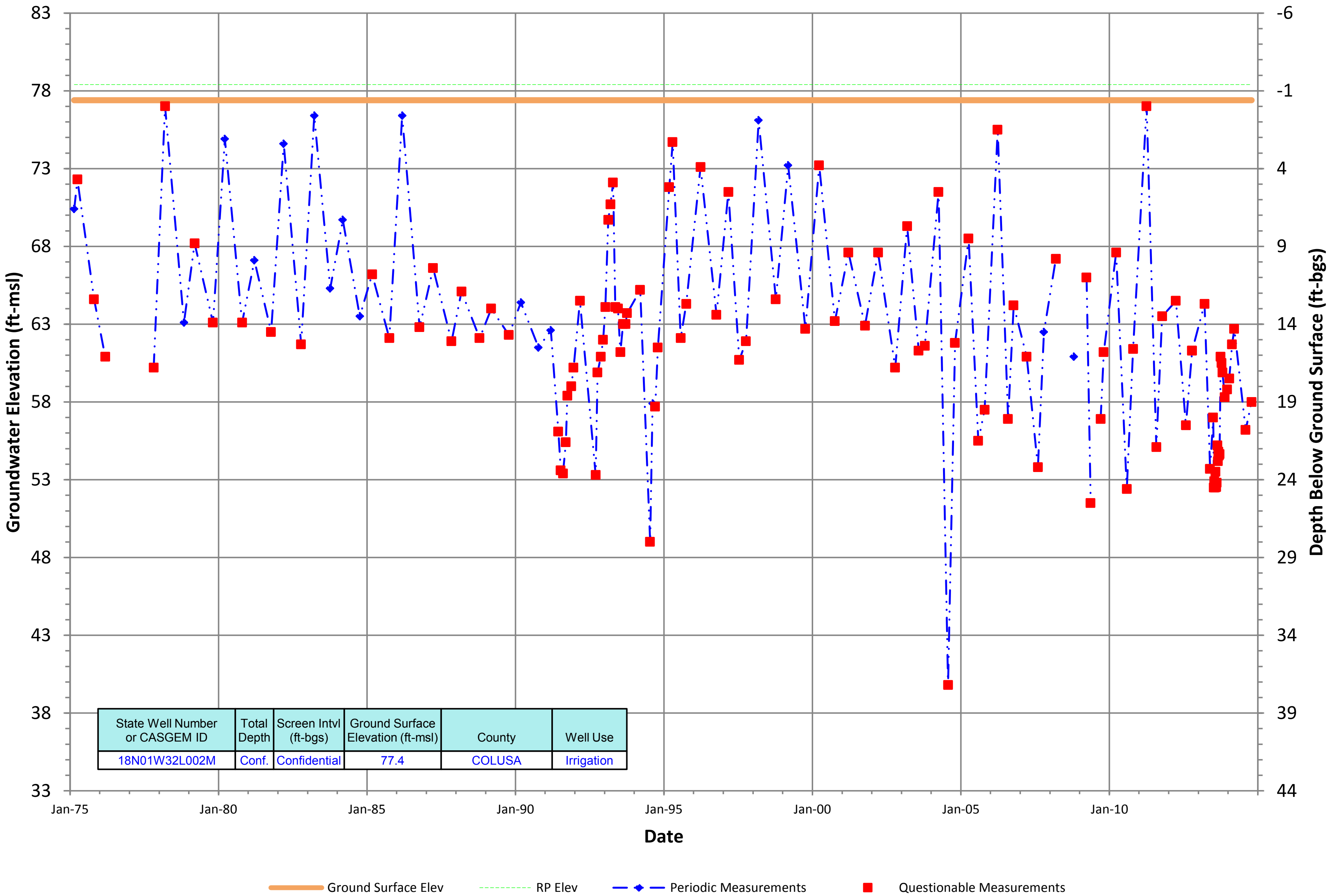
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



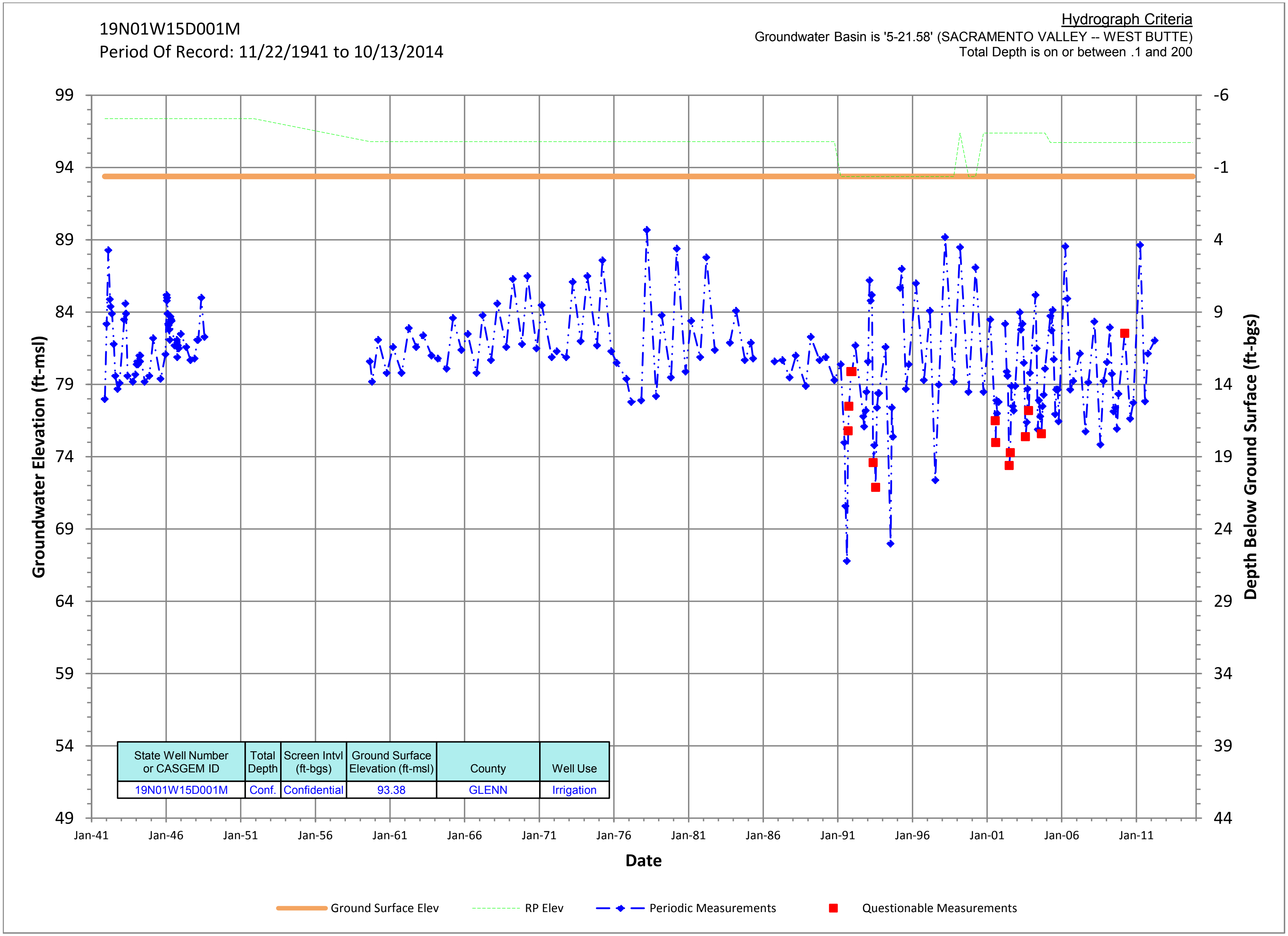
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01W22L001M	Conf.	Confidential	72.39	GLENN	Irrigation

18N01W32L002M
Period Of Record: 02/20/1975 to 10/17/2014

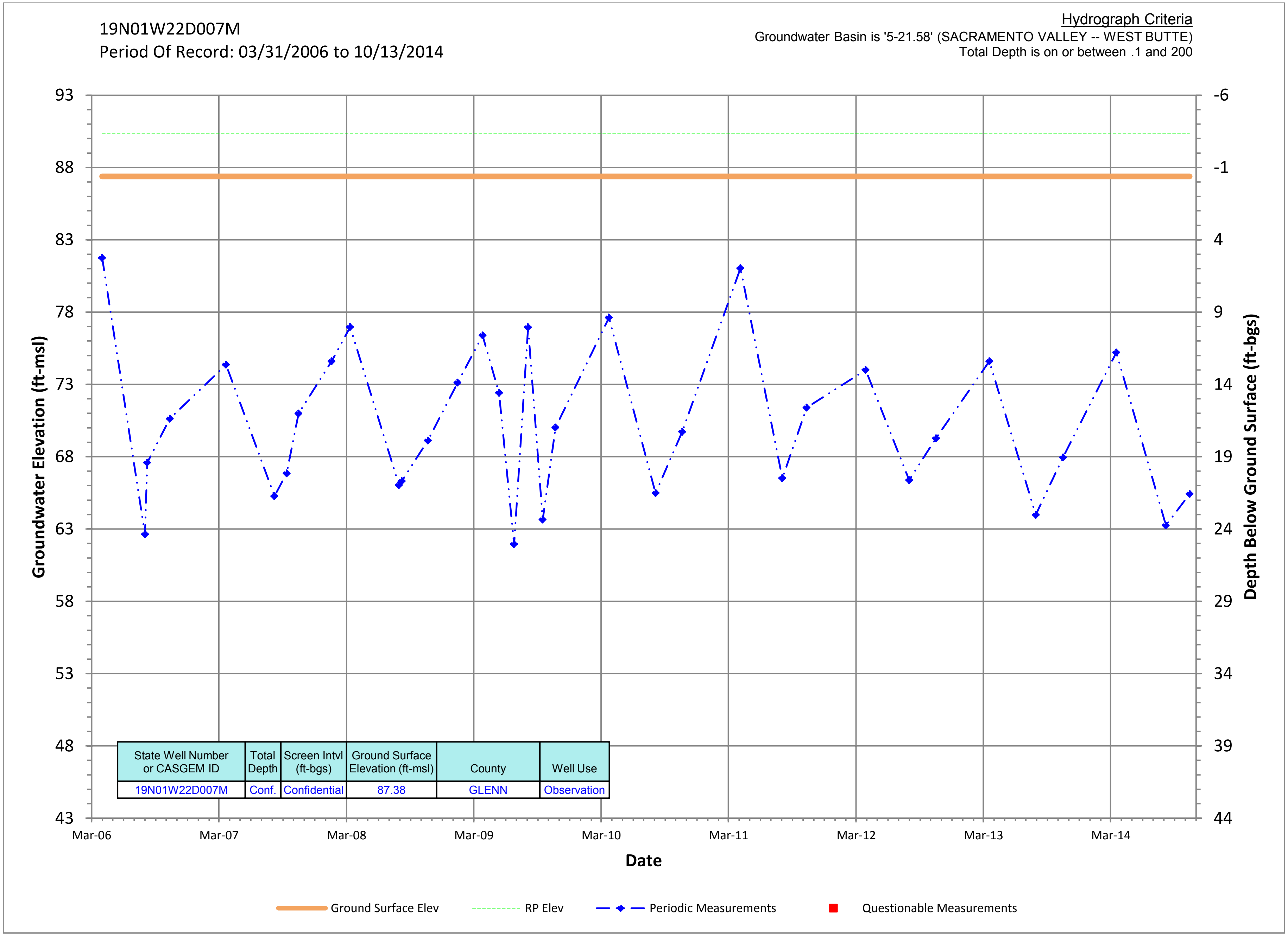
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



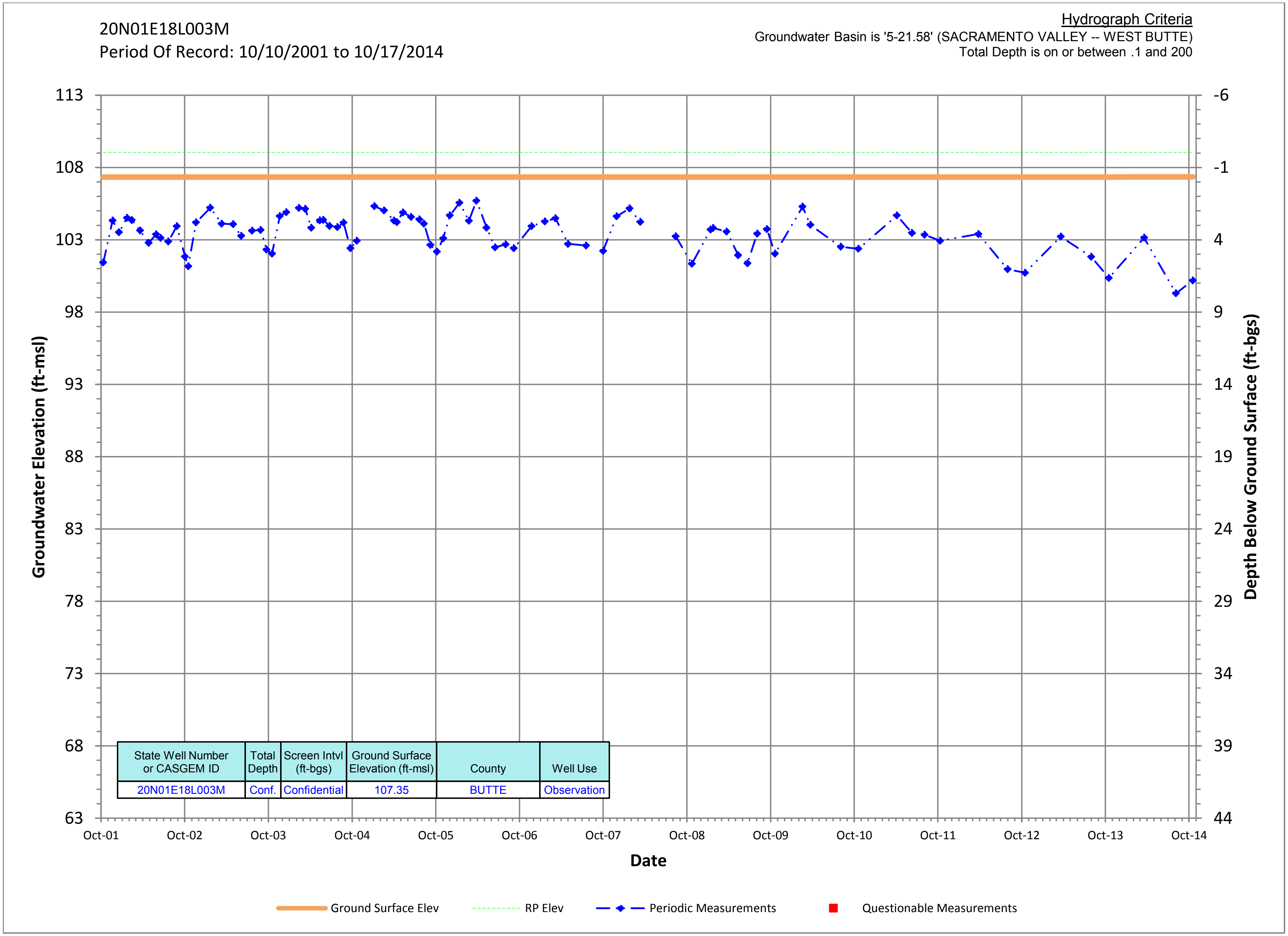
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01W32L002M	Conf.	Confidential	77.4	COLUSA	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W15D001M	Conf.	Confidential	93.38	GLENN	Irrigation



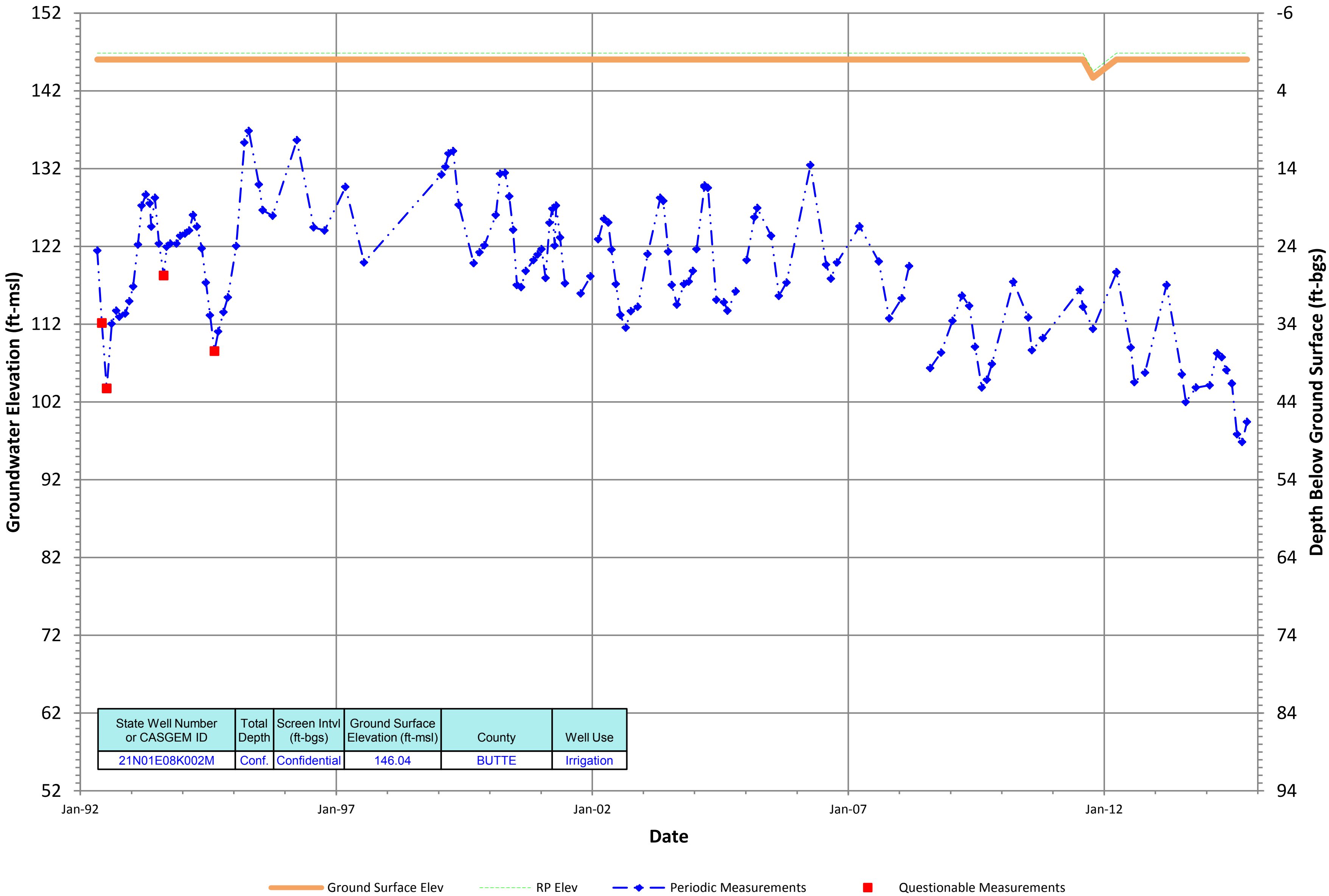
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W22D007M	Conf.	Confidential	87.38	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01E18L003M	Conf.	Confidential	107.35	BUTTE	Observation

21N01E08K002M
Period Of Record: 05/01/1992 to 10/16/2014

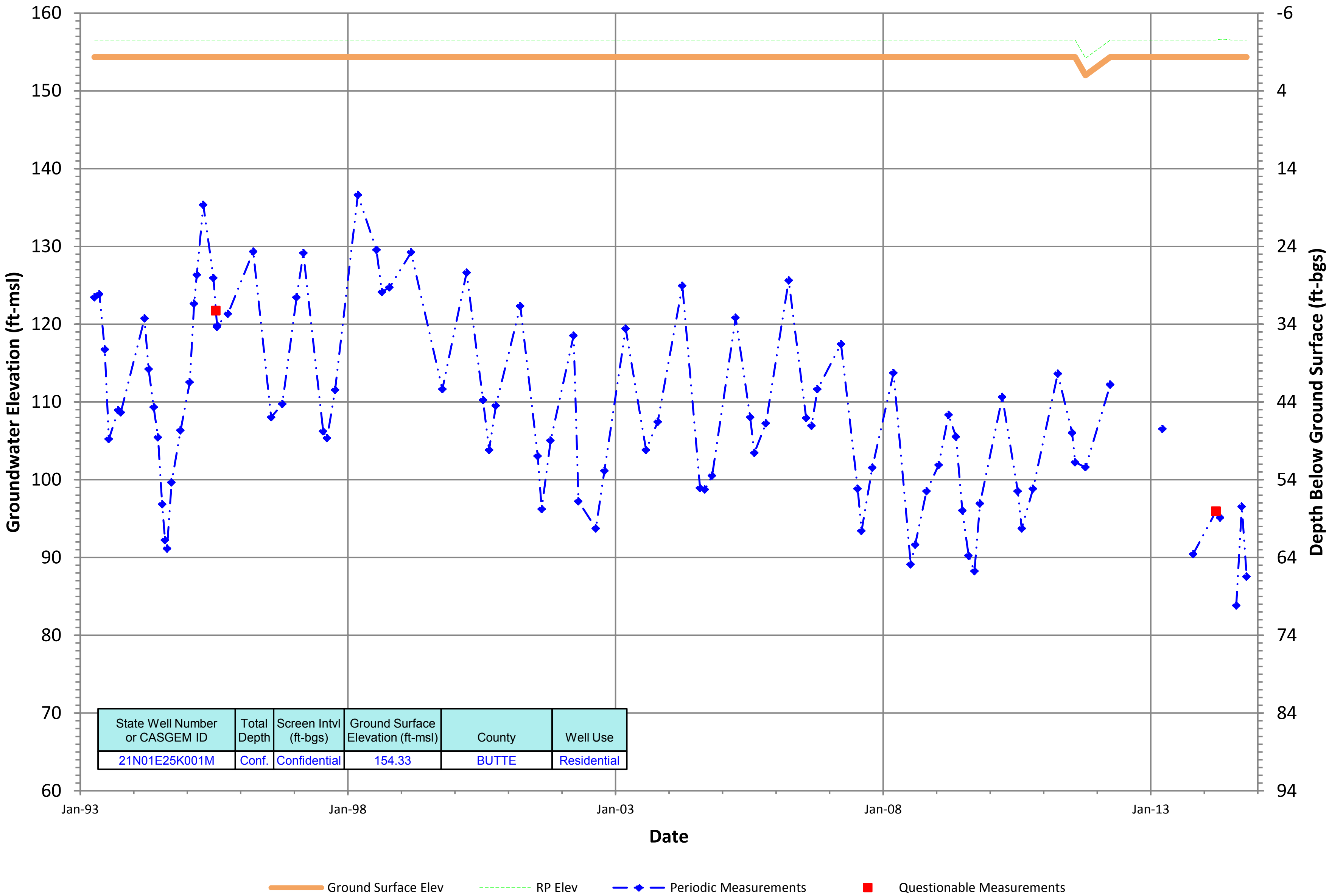
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E08K002M	Conf.	Confidential	146.04	BUTTE	Irrigation

21N01E25K001M
Period Of Record: 04/08/1993 to 10/16/2014

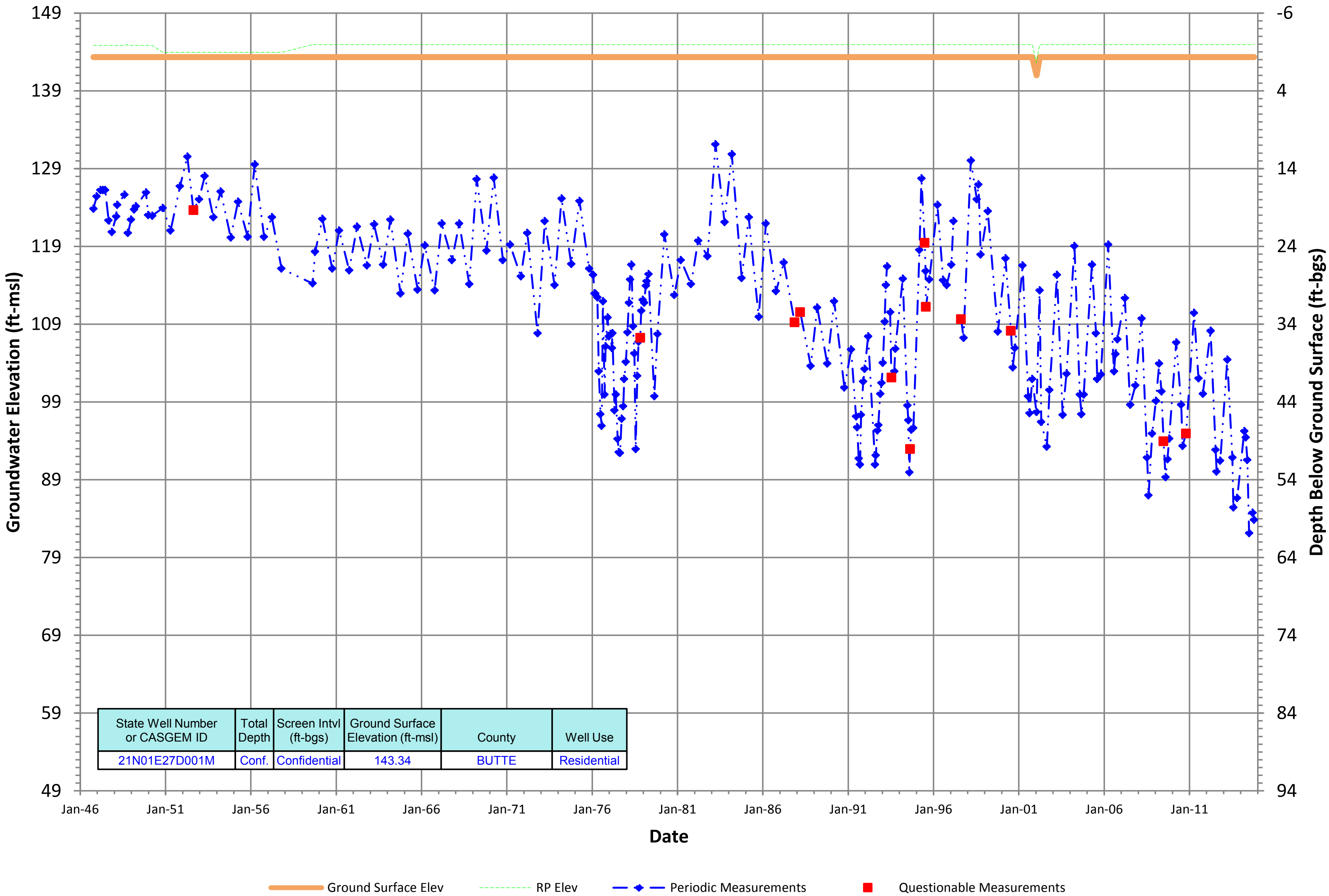
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E25K001M	Conf.	Confidential	154.33	BUTTE	Residential

21N01E27D001M
Period Of Record: 10/09/1946 to 10/15/2014

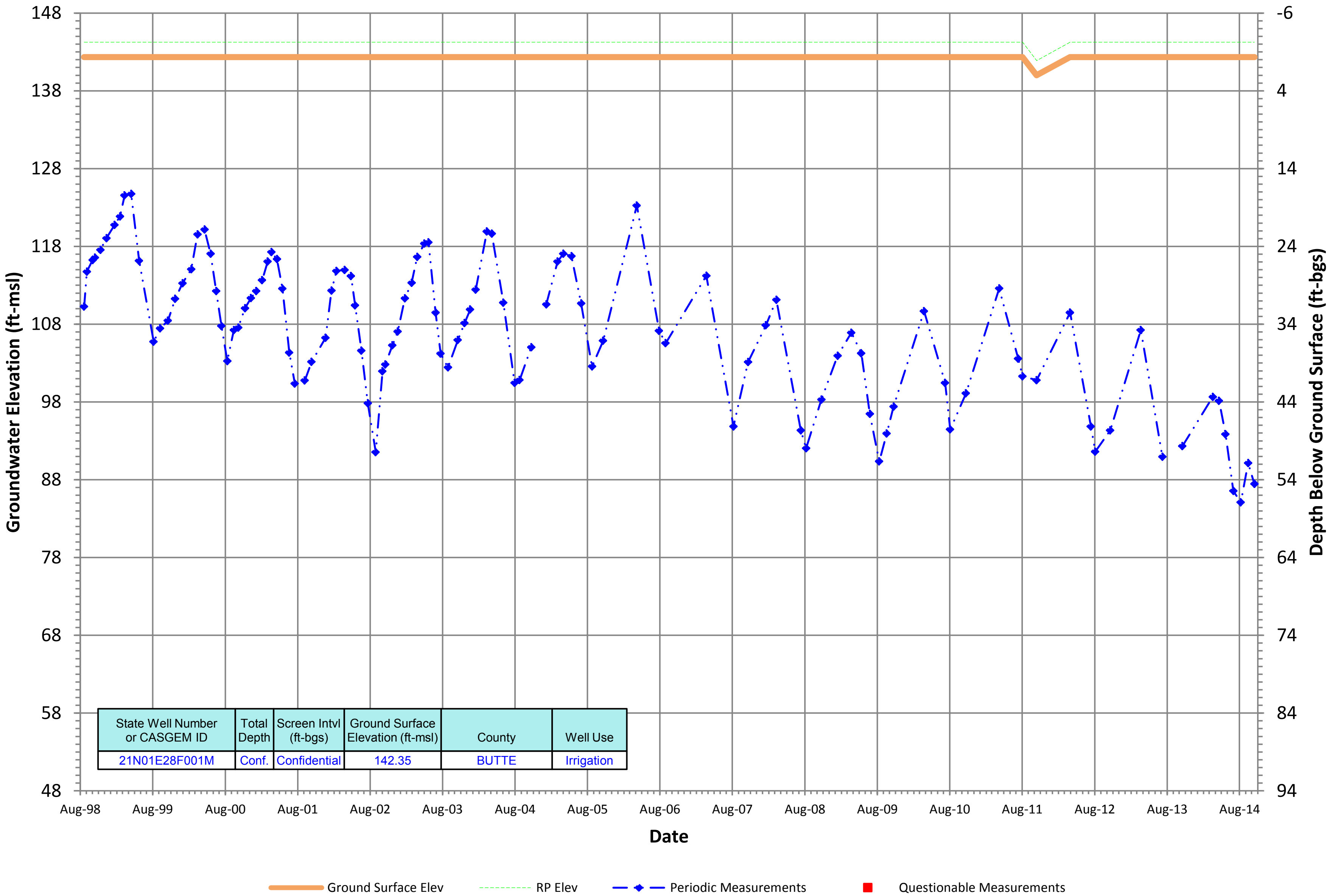
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E27D001M	Conf.	Confidential	143.34	BUTTE	Residential

21N01E28F001M
Period Of Record: 08/20/1998 to 10/15/2014

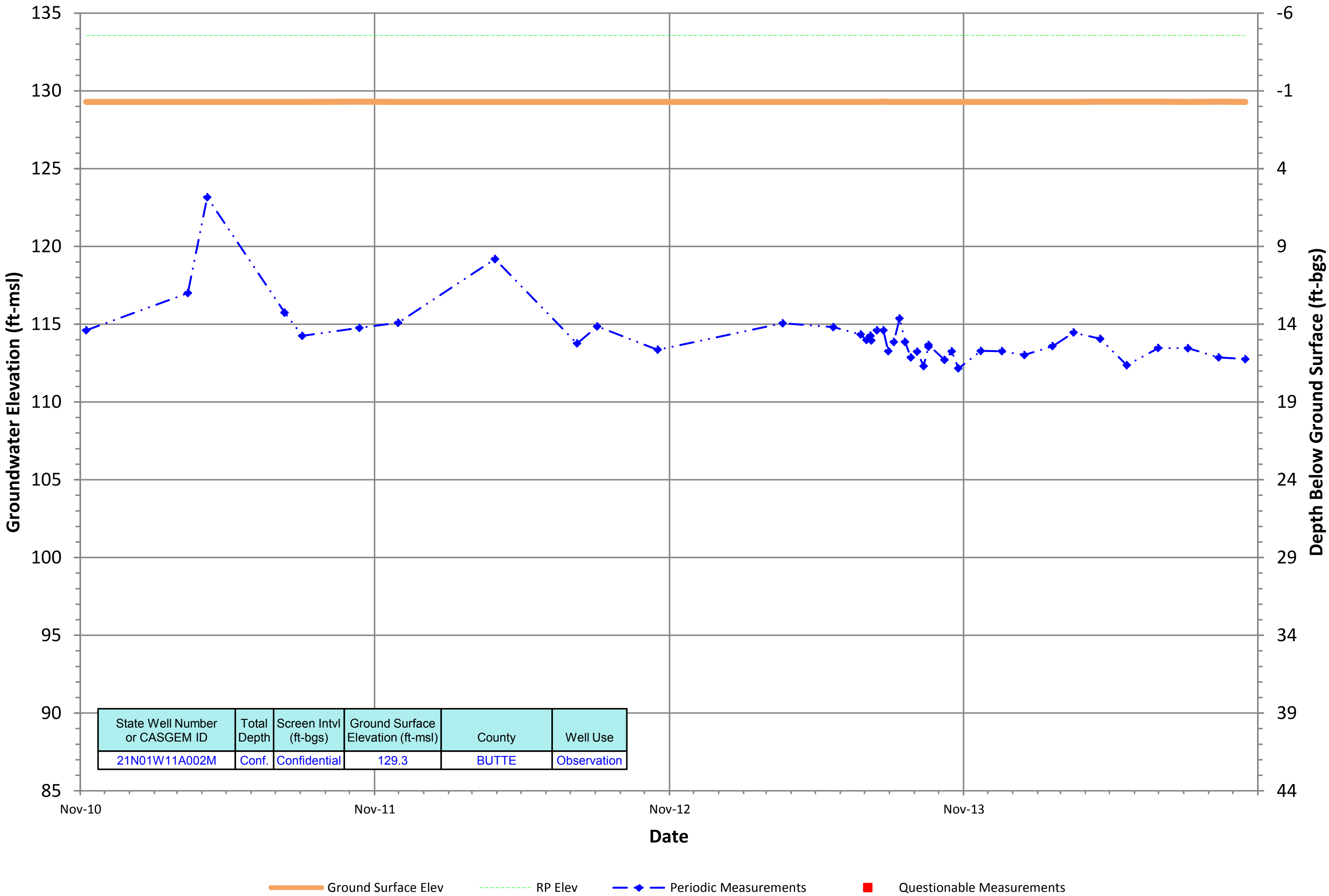
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



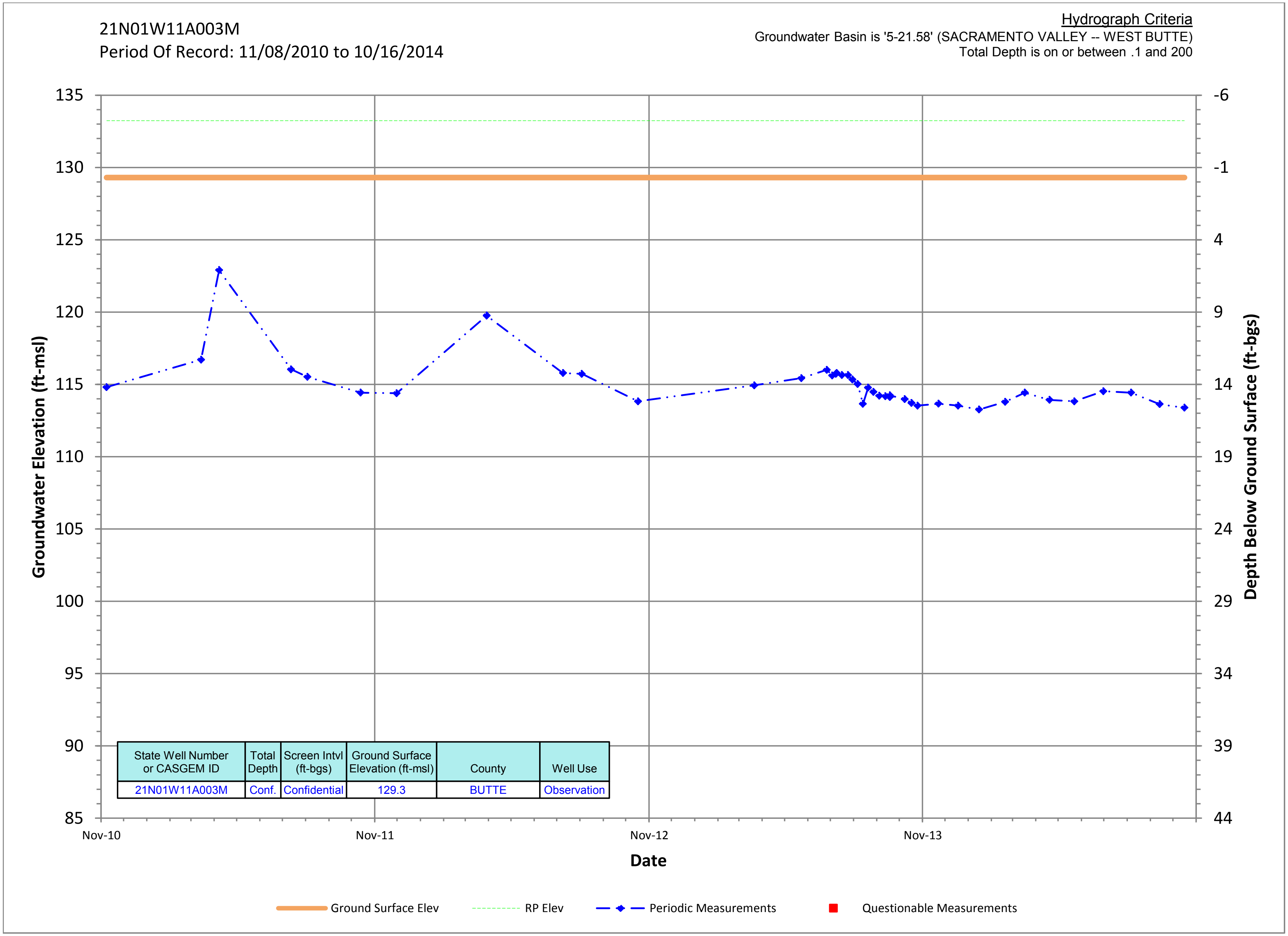
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E28F001M	Conf.	Confidential	142.35	BUTTE	Irrigation

21N01W11A002M
Period Of Record: 11/08/2010 to 10/16/2014

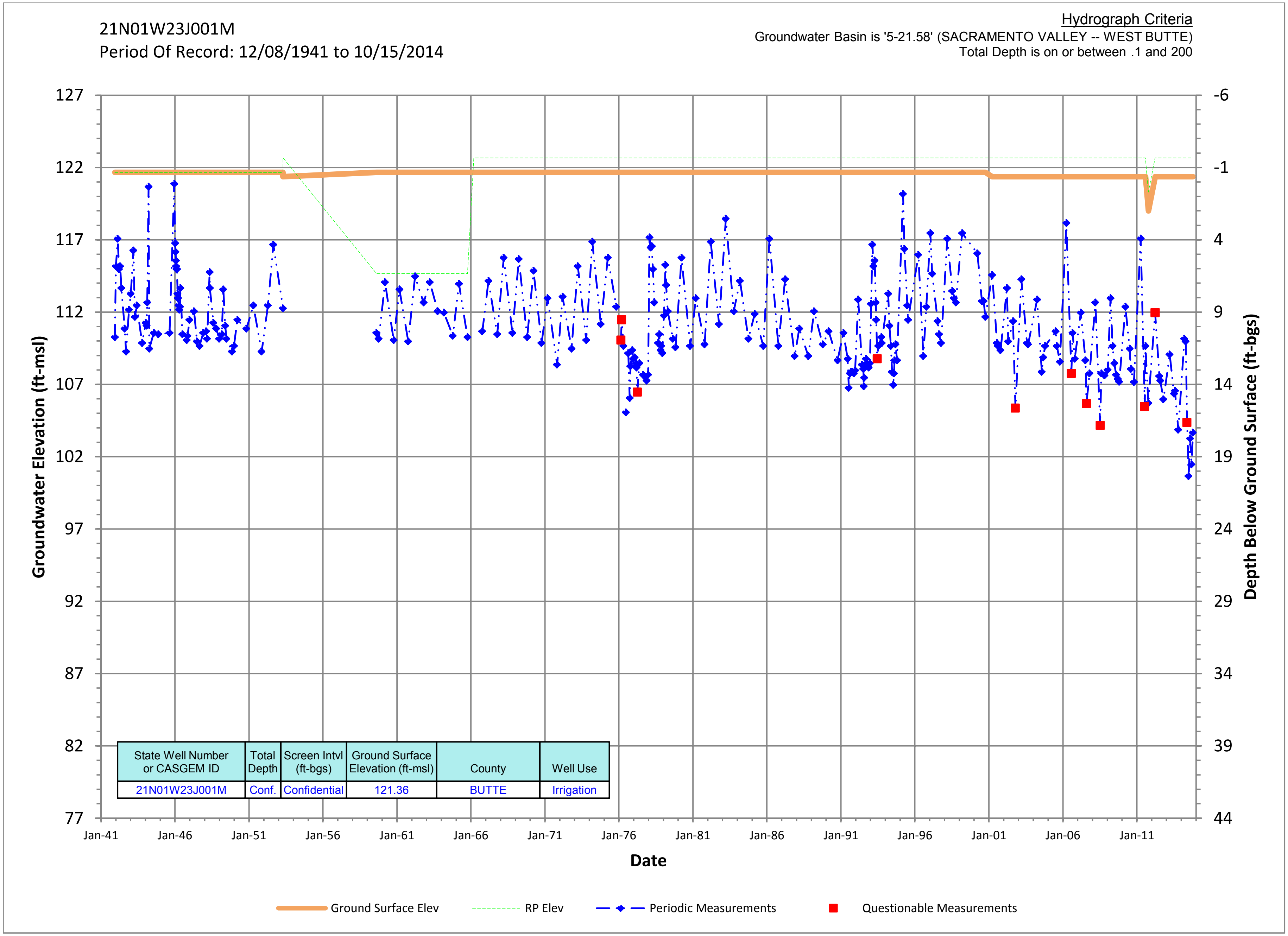
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W11A002M	Conf.	Confidential	129.3	BUTTE	Observation



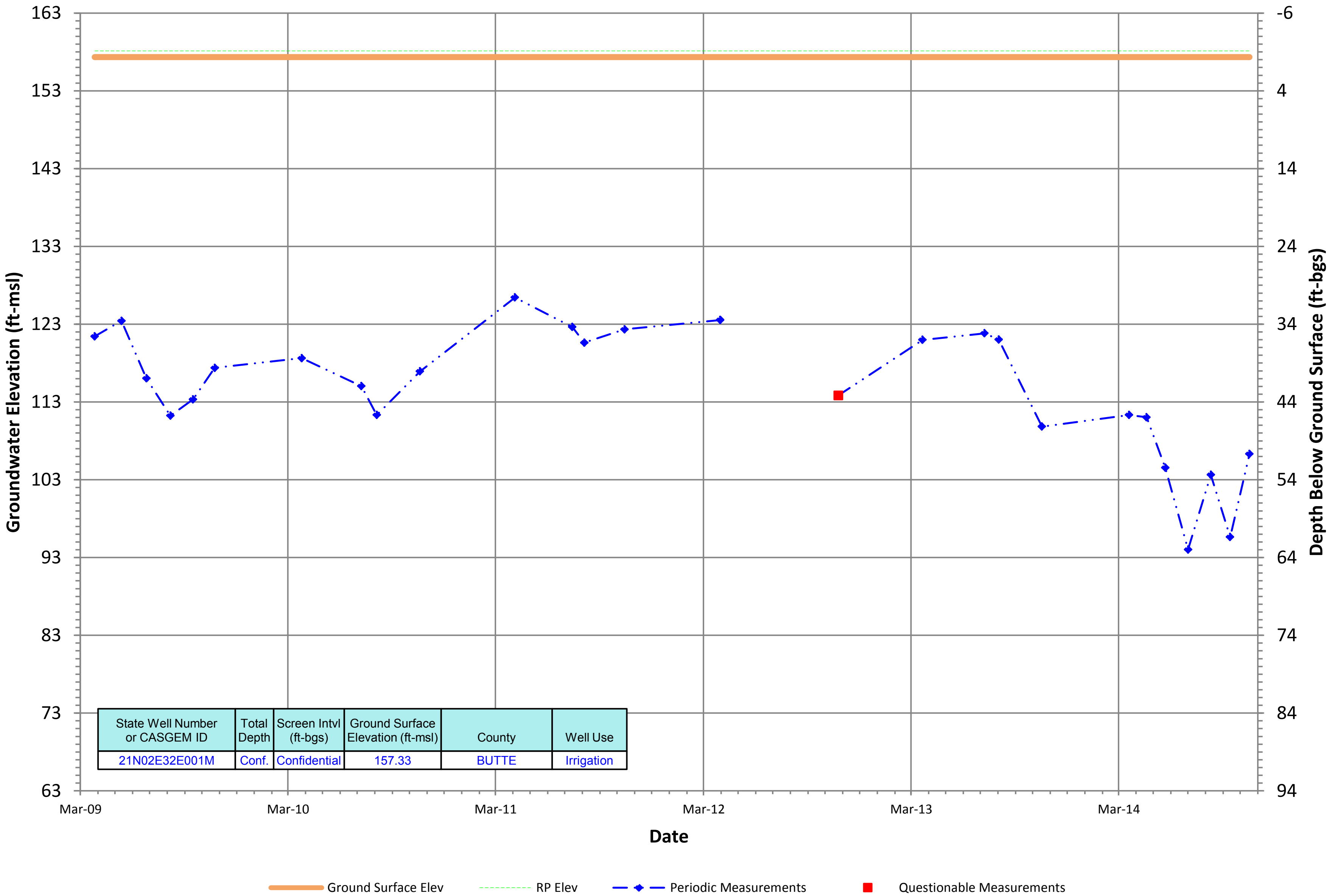
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W11A003M	Conf.	Confidential	129.3	BUTTE	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W23J001M	Conf.	Confidential	121.36	BUTTE	Irrigation

21N02E32E001M
Period Of Record: 03/26/2009 to 10/17/2014

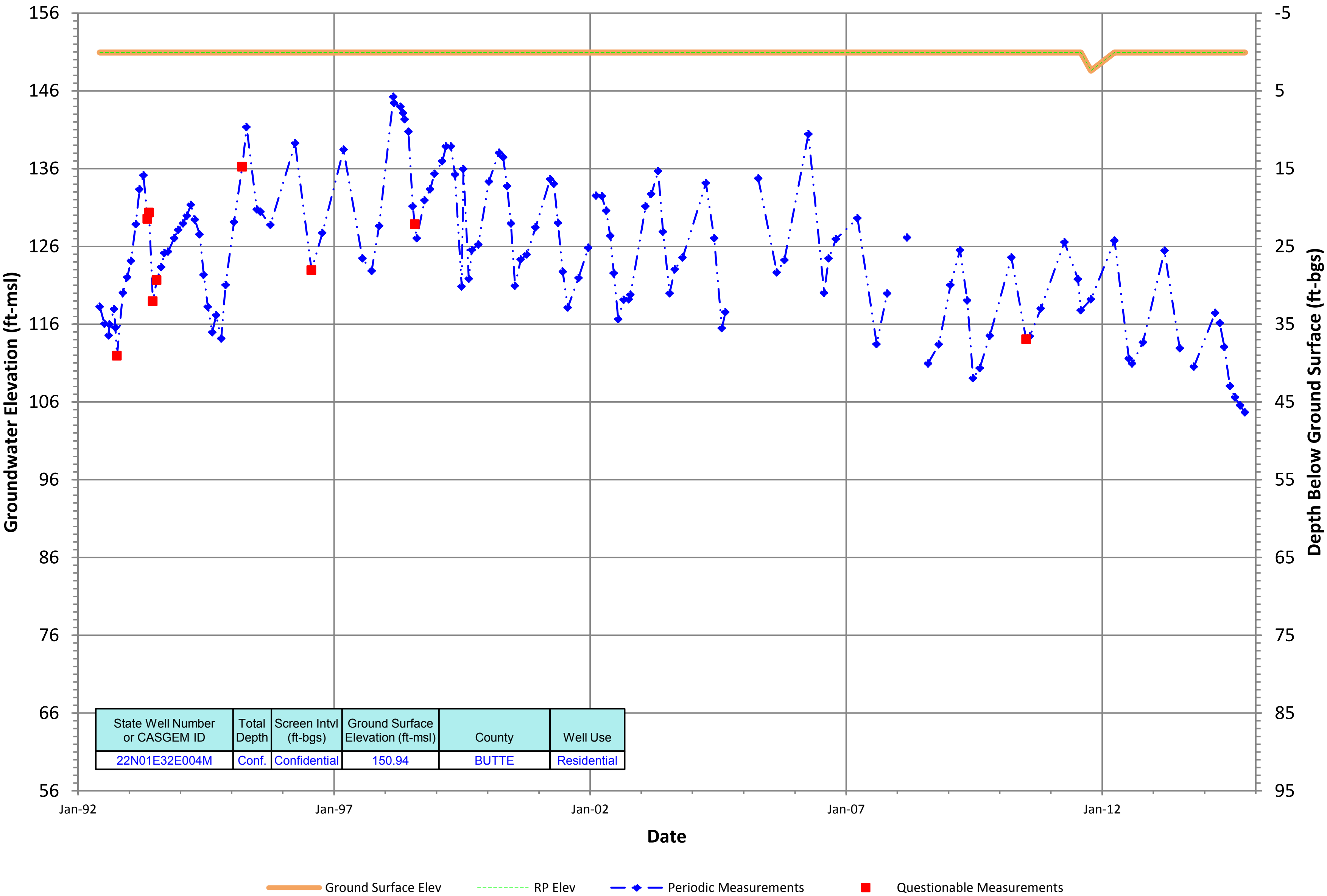
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E32E001M	Conf.	Confidential	157.33	BUTTE	Irrigation

22N01E32E004M
Period Of Record: 06/04/1992 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N01E32E004M	Conf.	Confidential	150.94	BUTTE	Residential

Intermediate Depth Groundwater Monitoring Well Hydrographs- West Butte Subbasin

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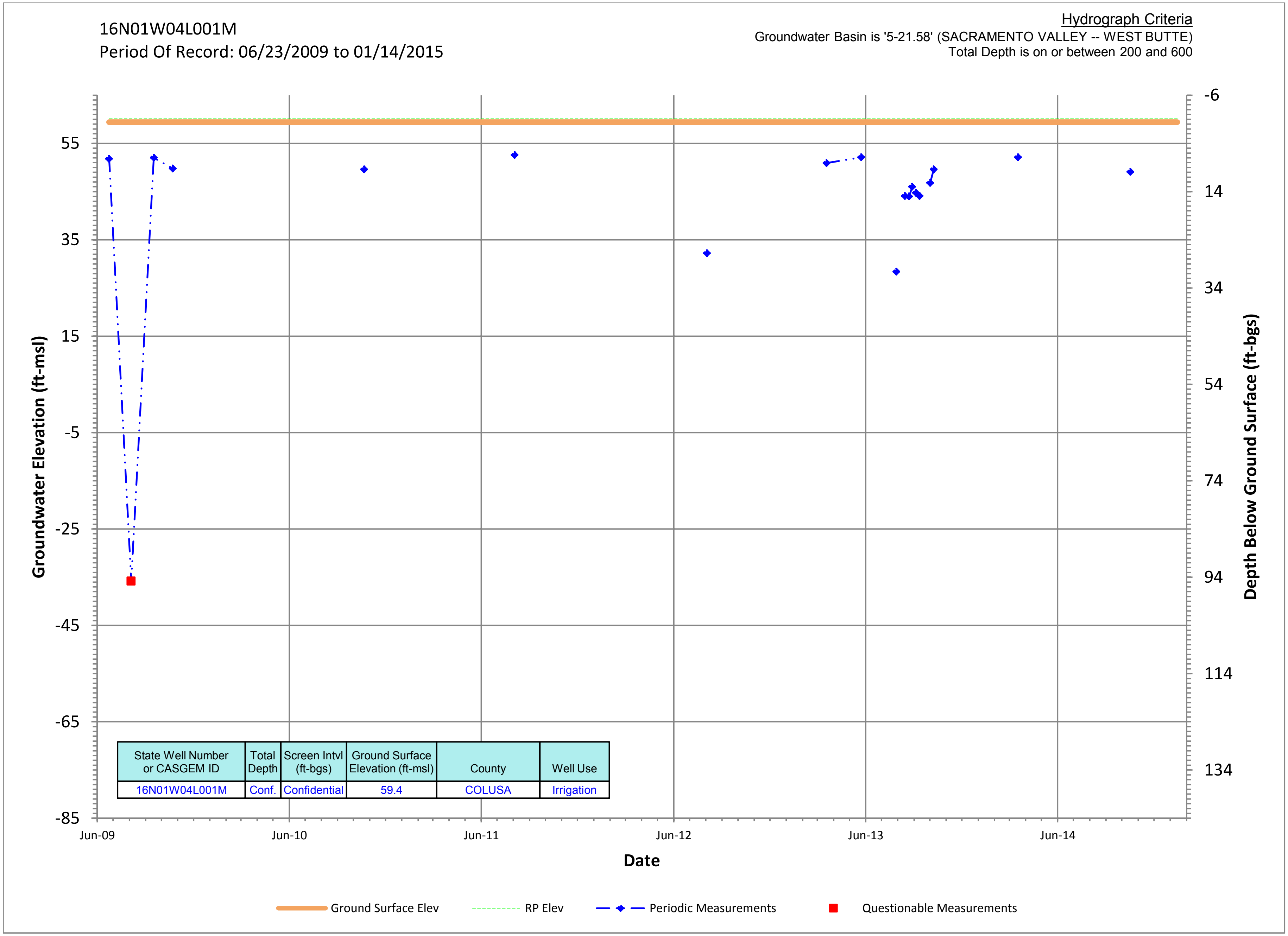
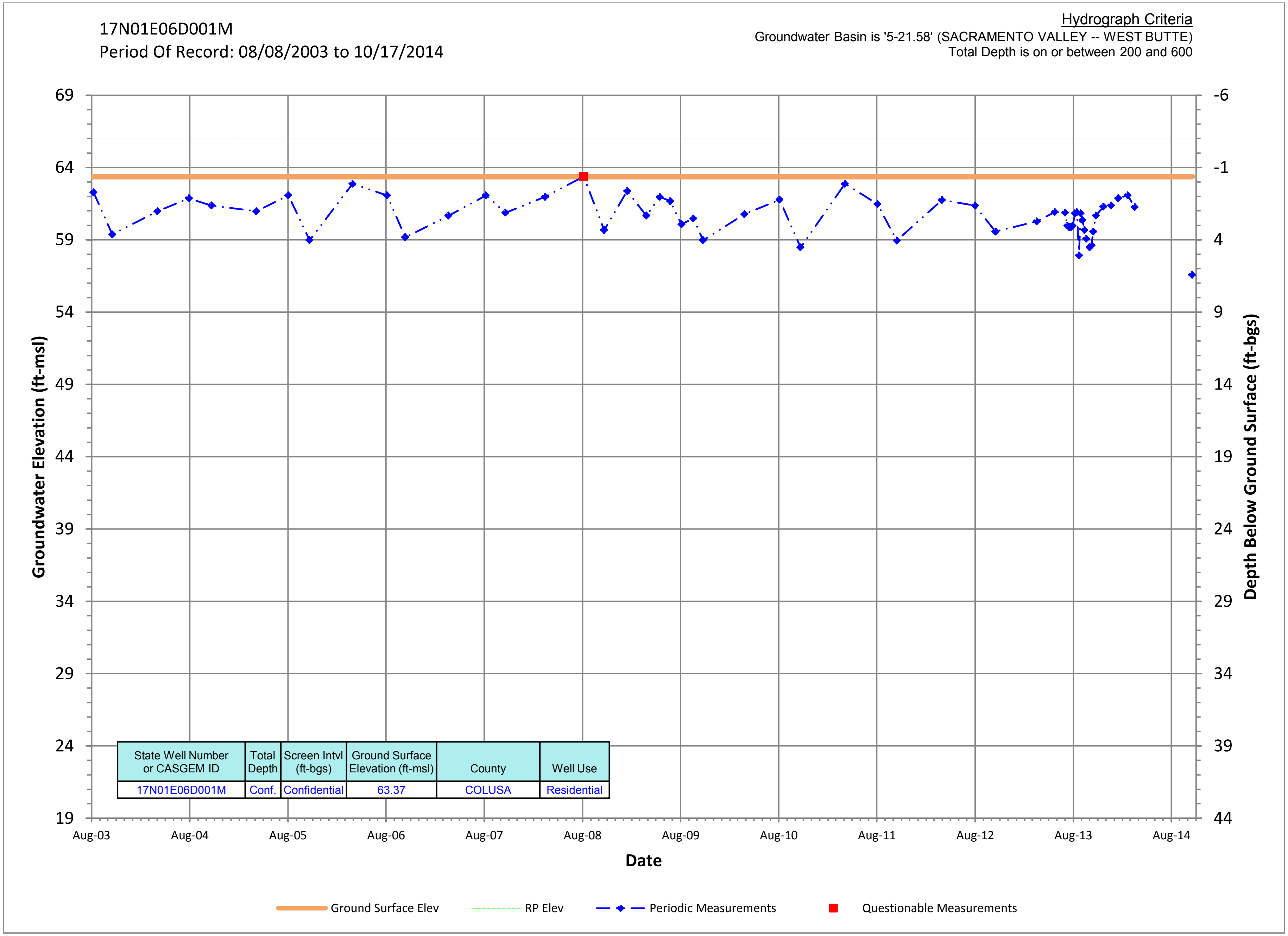
16N01W04L001M
Period Of Record: 06/23/2009 to 01/14/2015



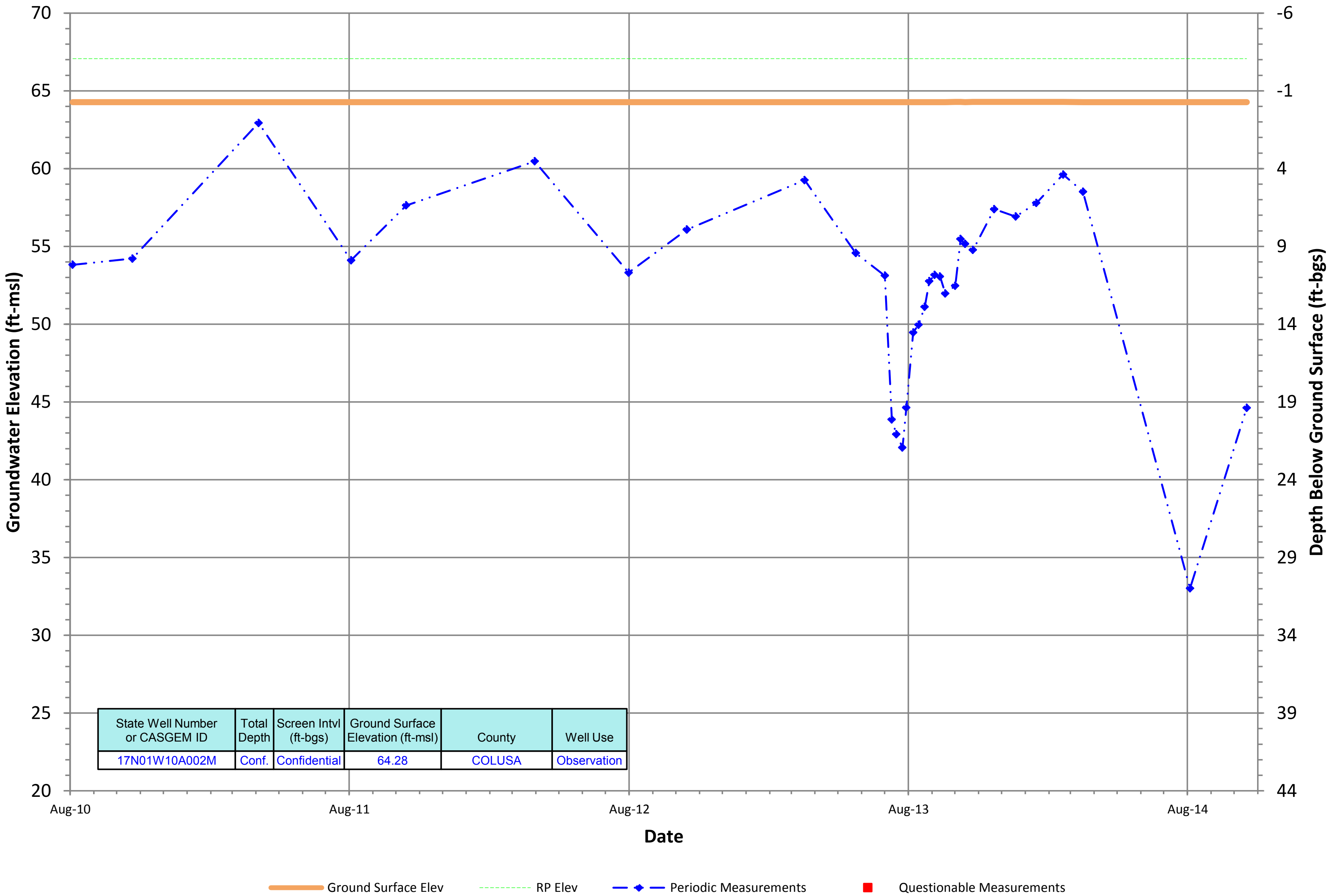
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
16N01W04L001M	Conf.	Confidential	59.4	COLUSA	Irrigation



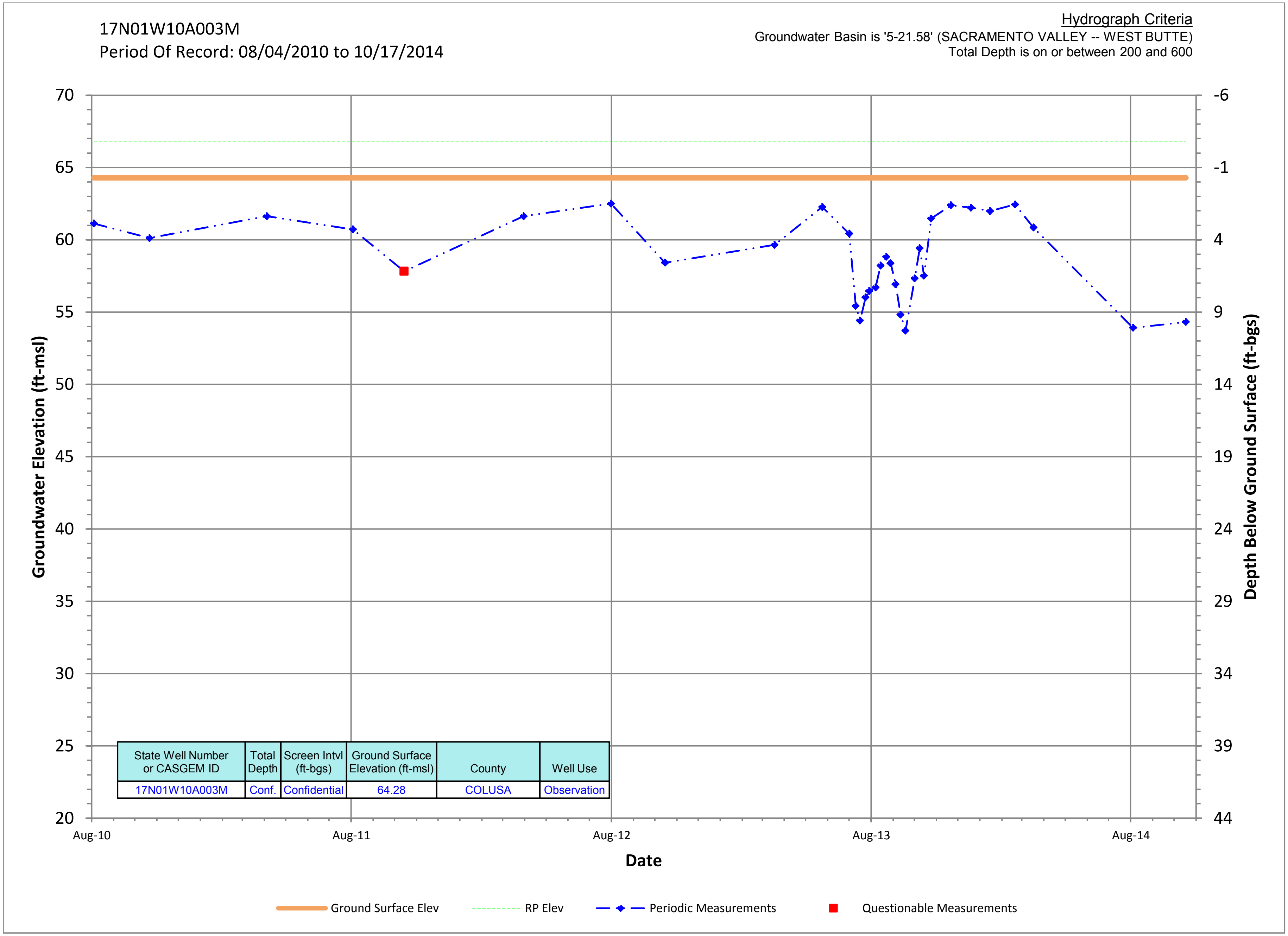
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01E06D001M	Conf.	Confidential	63.37	COLUSA	Residential

17N01W10A002M
Period Of Record: 08/04/2010 to 10/17/2014

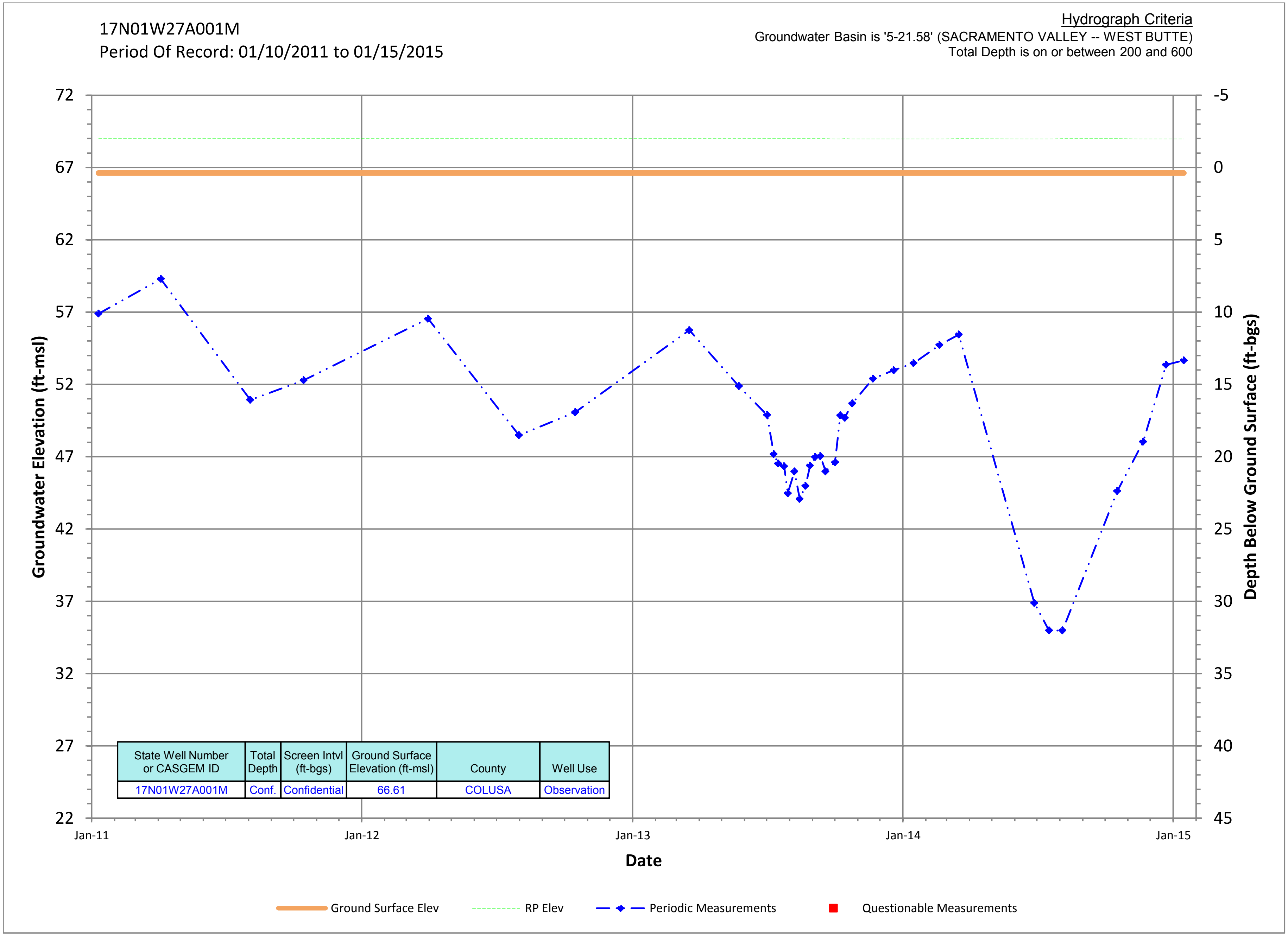
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01W10A002M	Conf.	Confidential	64.28	COLUSA	Observation



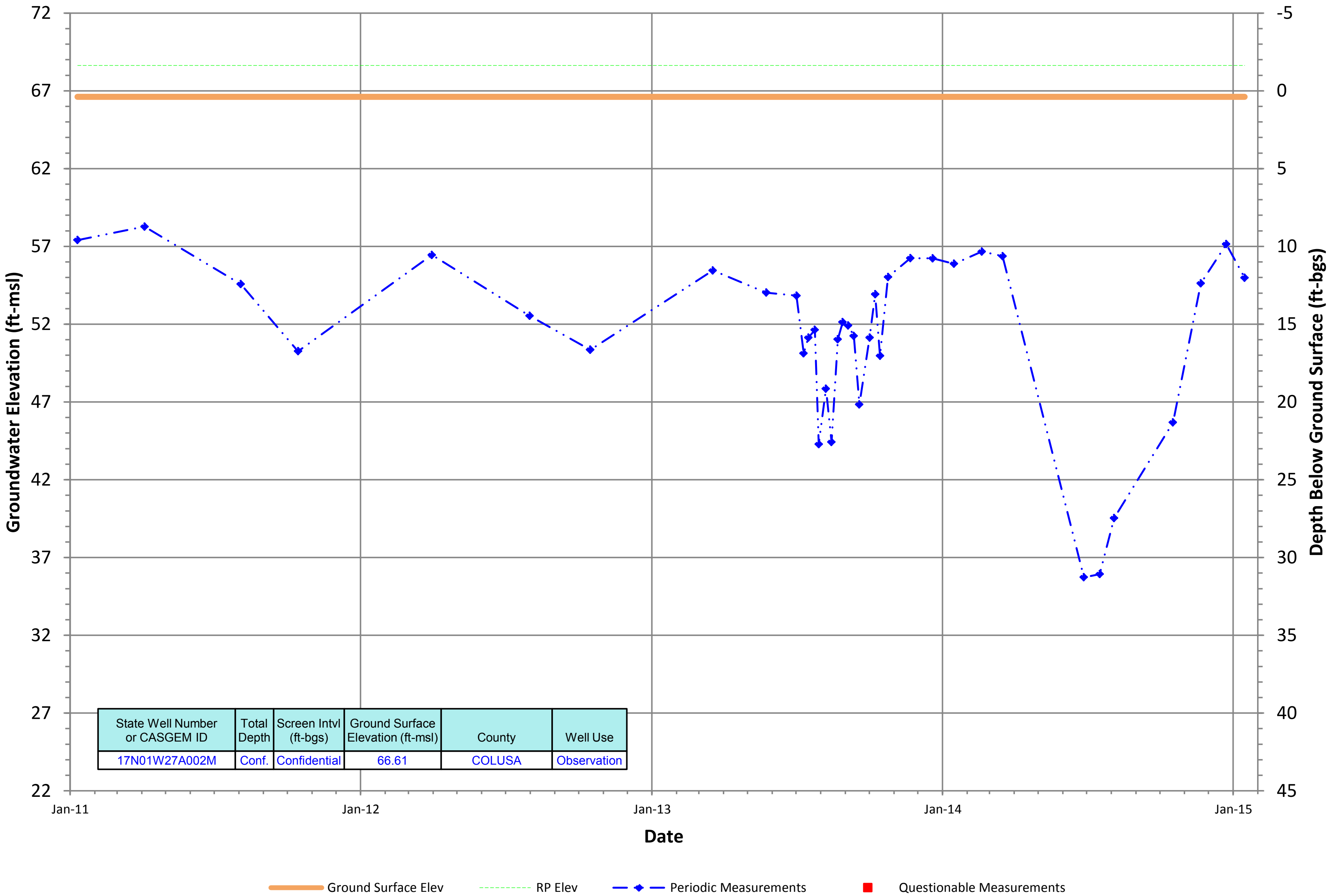
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01W10A003M	Conf.	Confidential	64.28	COLUSA	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01W27A001M	Conf.	Confidential	66.61	COLUSA	Observation

17N01W27A002M
Period Of Record: 01/10/2011 to 01/15/2015

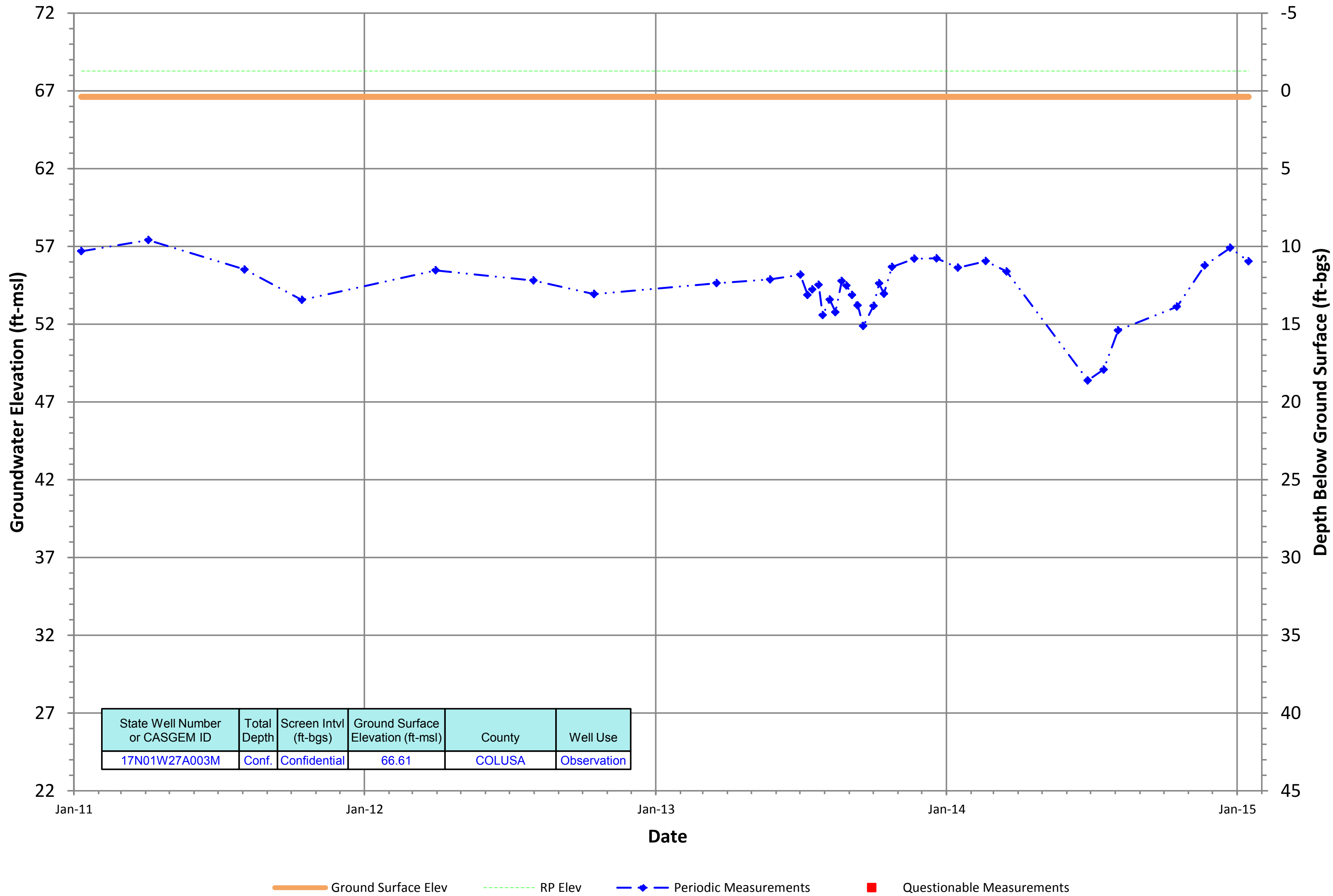
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



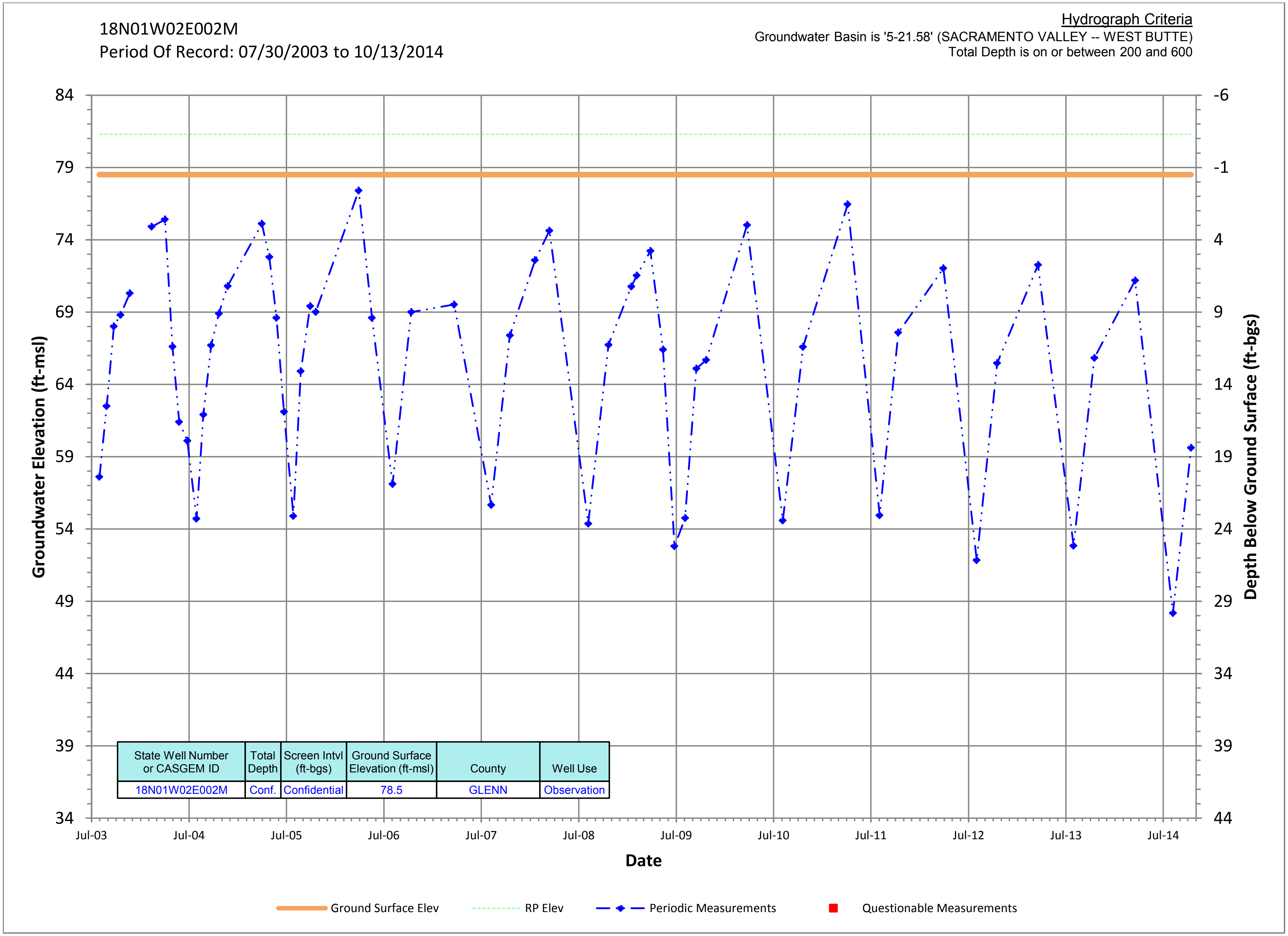
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01W27A002M	Conf.	Confidential	66.61	COLUSA	Observation

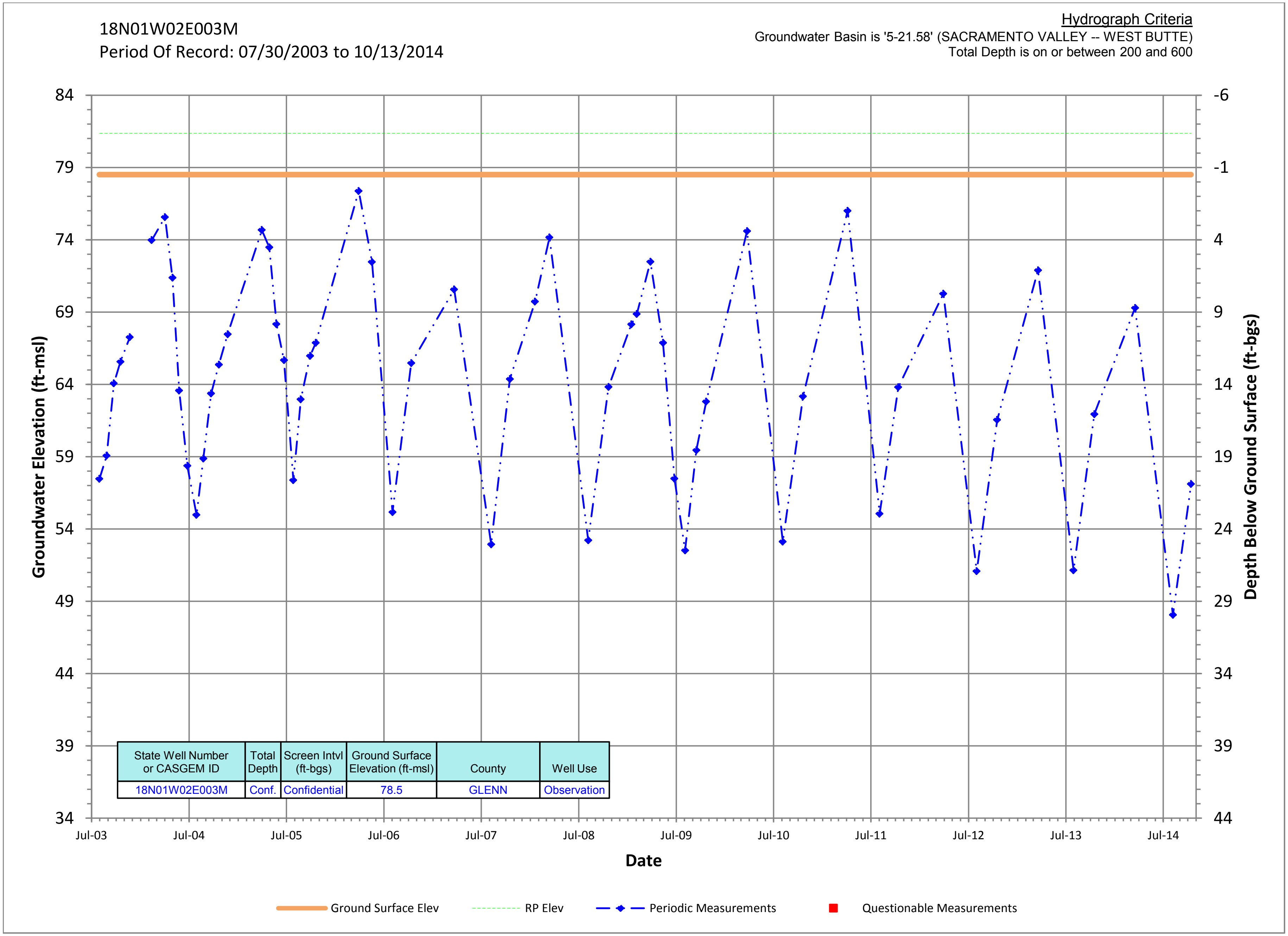
17N01W27A003M
Period Of Record: 01/10/2011 to 01/15/2015

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01W27A003M	Conf.	Confidential	66.61	COLUSA	Observation

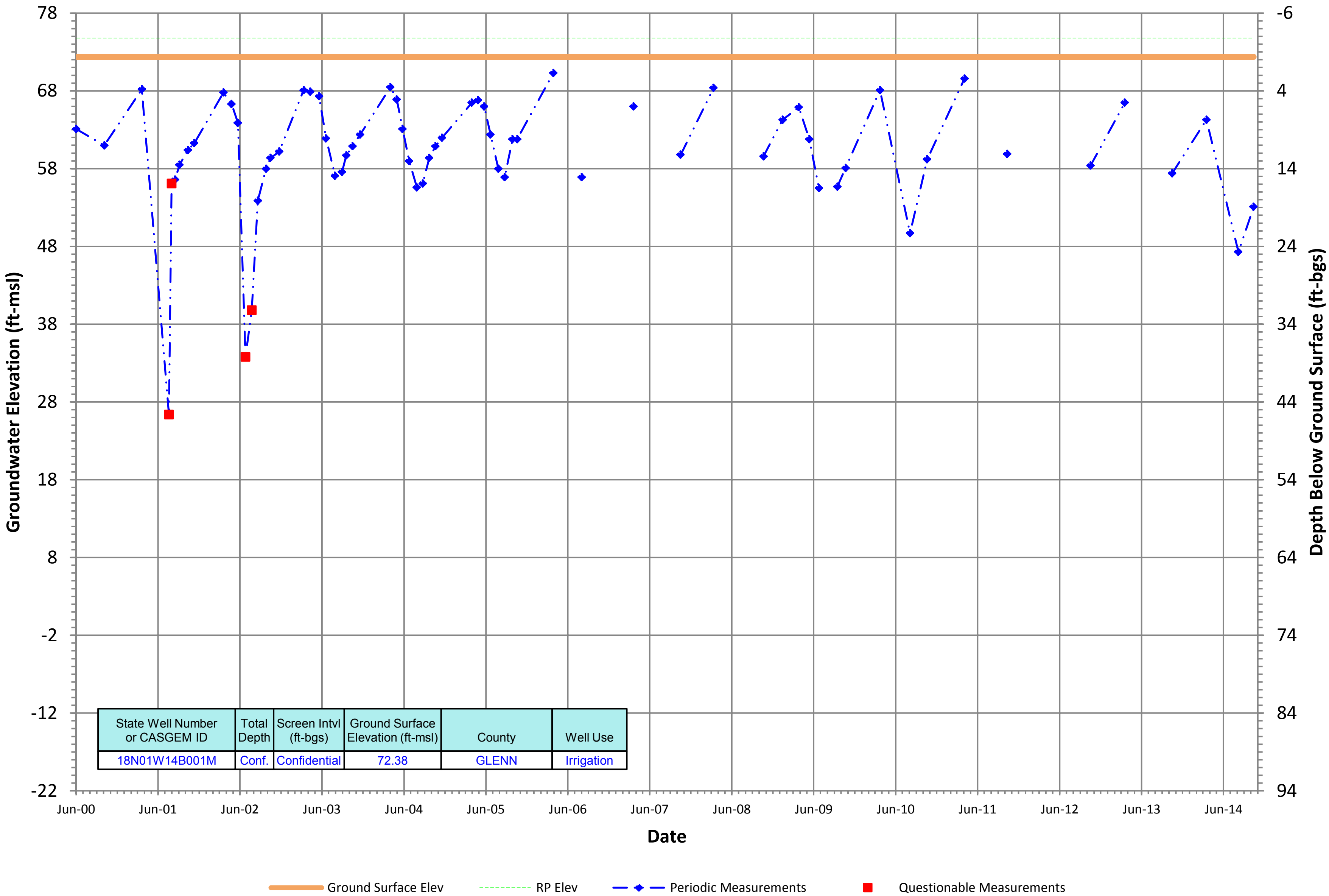

18N01W02E002M
Period Of Record: 07/30/2003 to 10/13/2014
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
84
79
74
69
64
59
54
49
44
39
34
-6
-1
4
9
14
19
24
29
34
39
44
Jul-03
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
Jul-11
Jul-12
Jul-13
Jul-14
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
18N01W02E002M
Conf.
Confidential
78.5
GLENN
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements



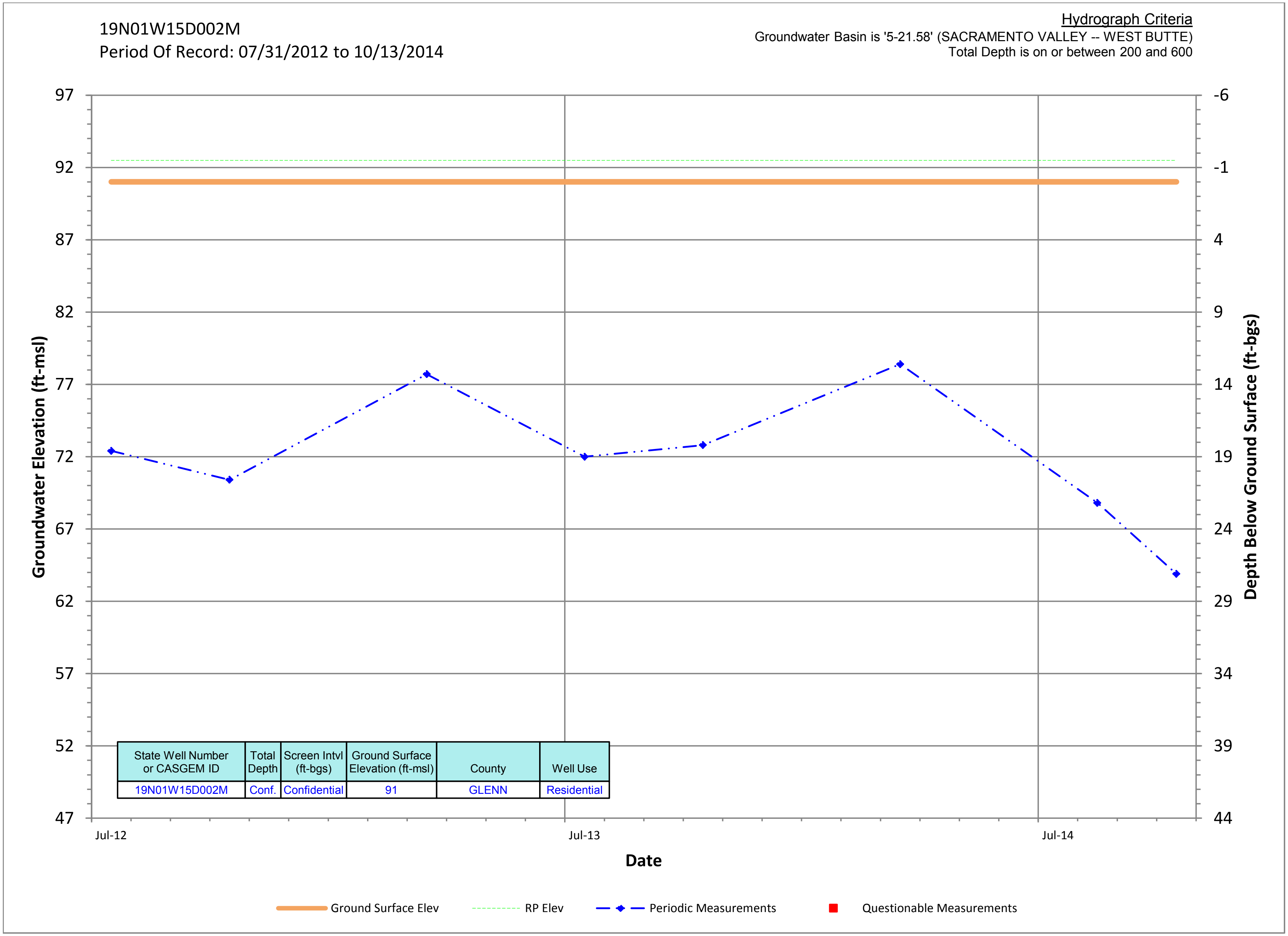
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01W02E003M	Conf.	Confidential	78.5	GLENN	Observation

18N01W14B001M
Period Of Record: 06/01/2000 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01W14B001M	Conf.	Confidential	72.38	GLENN	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W15D002M	Conf.	Confidential	91	GLENN	Residential

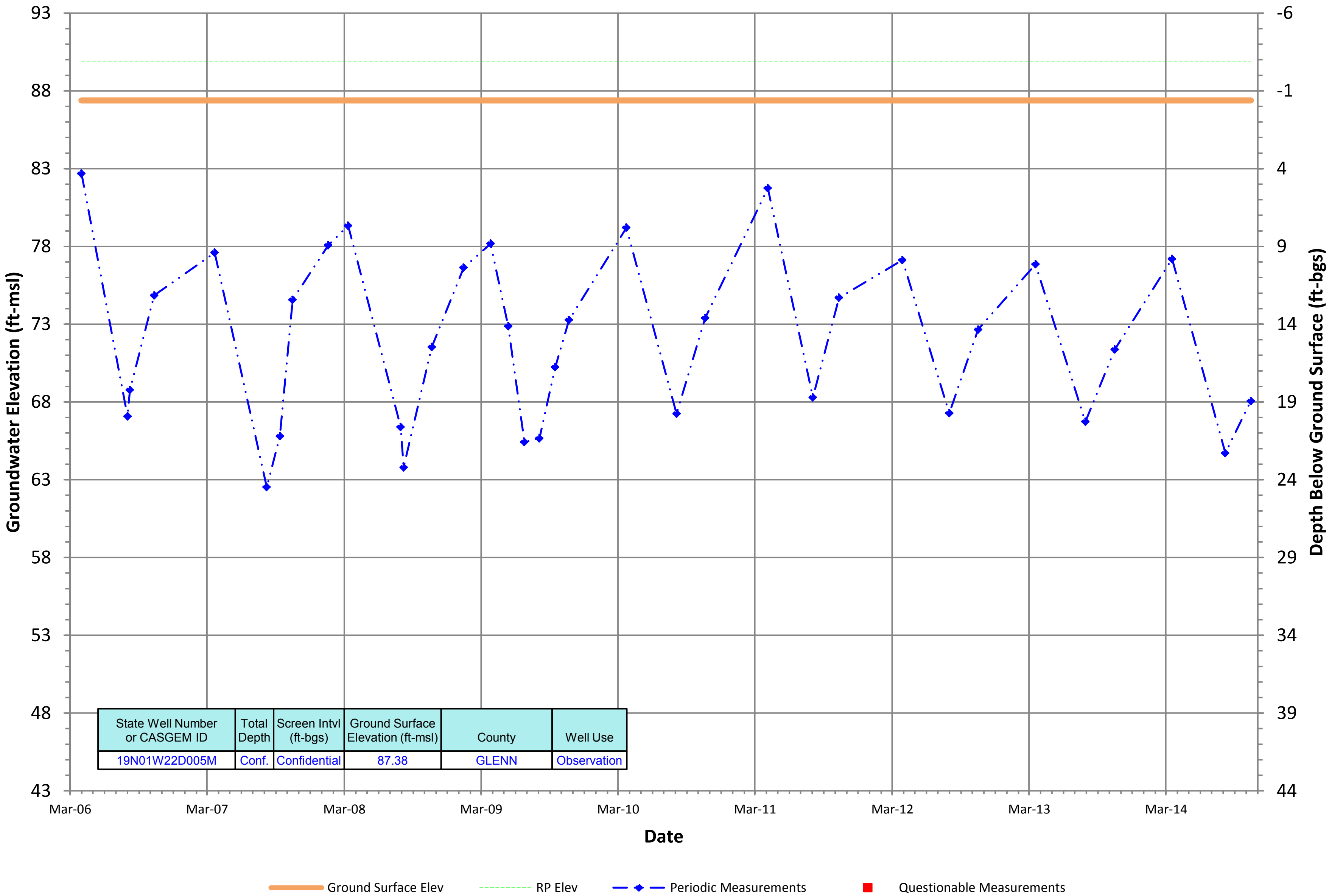
19N01W22D005M

Period Of Record: 03/31/2006 to 10/13/2014

Hydrograph Criteria

Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)

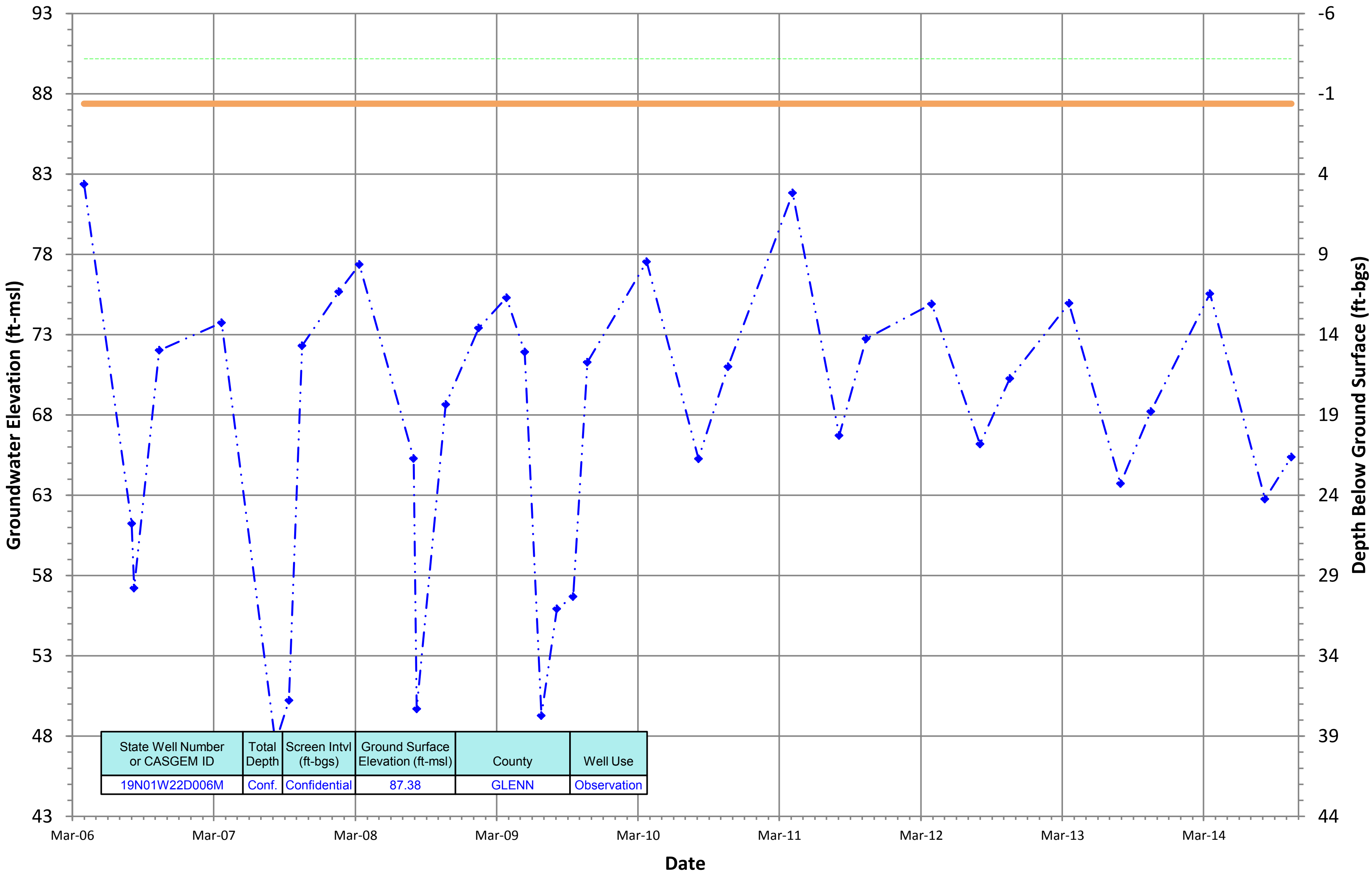
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W22D005M	Conf.	Confidential	87.38	GLENN	Observation

19N01W22D006M
Period Of Record: 03/31/2006 to 10/13/2014

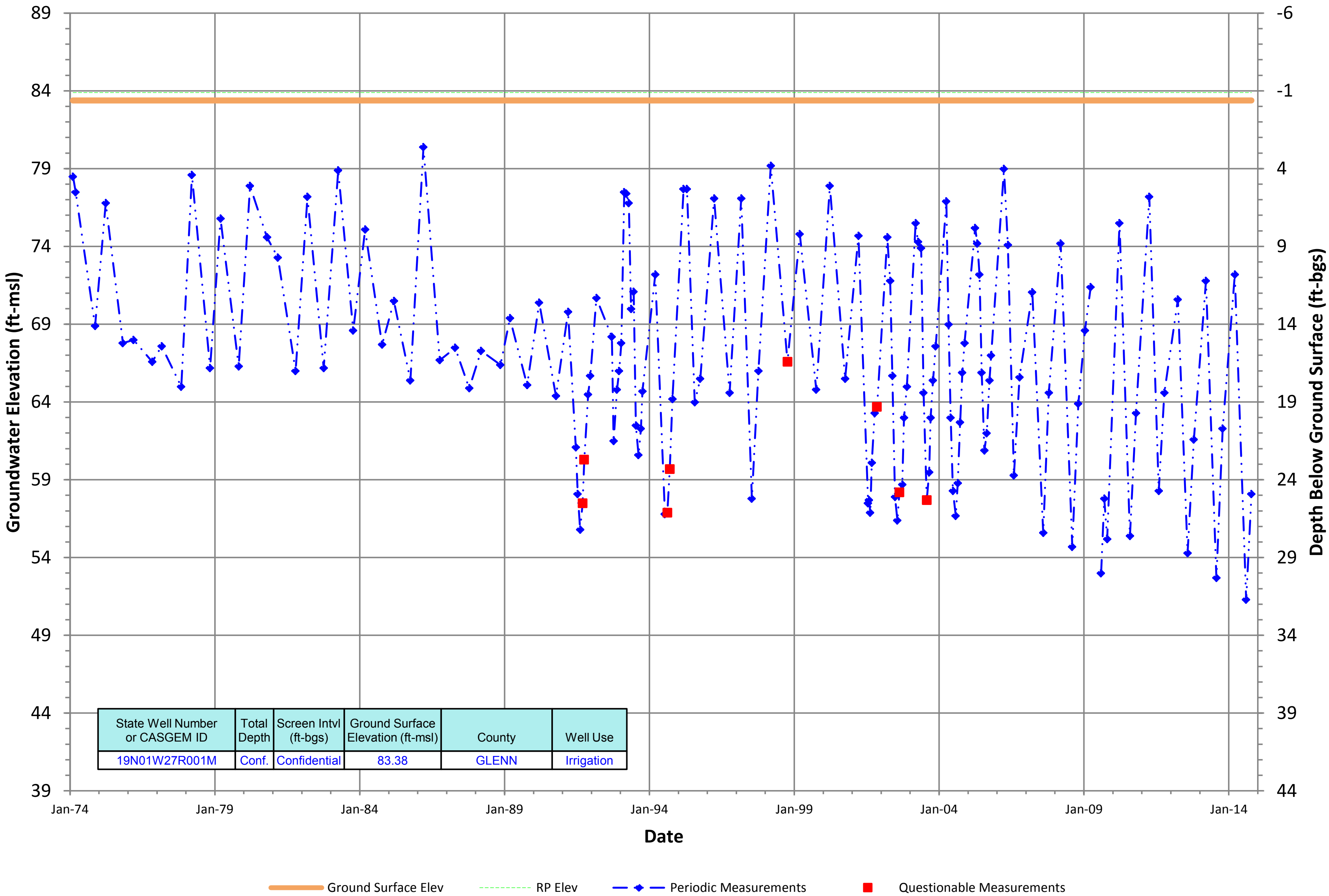
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W22D006M	Conf.	Confidential	87.38	GLENN	Observation

19N01W27R001M
Period Of Record: 02/06/1974 to 10/13/2014

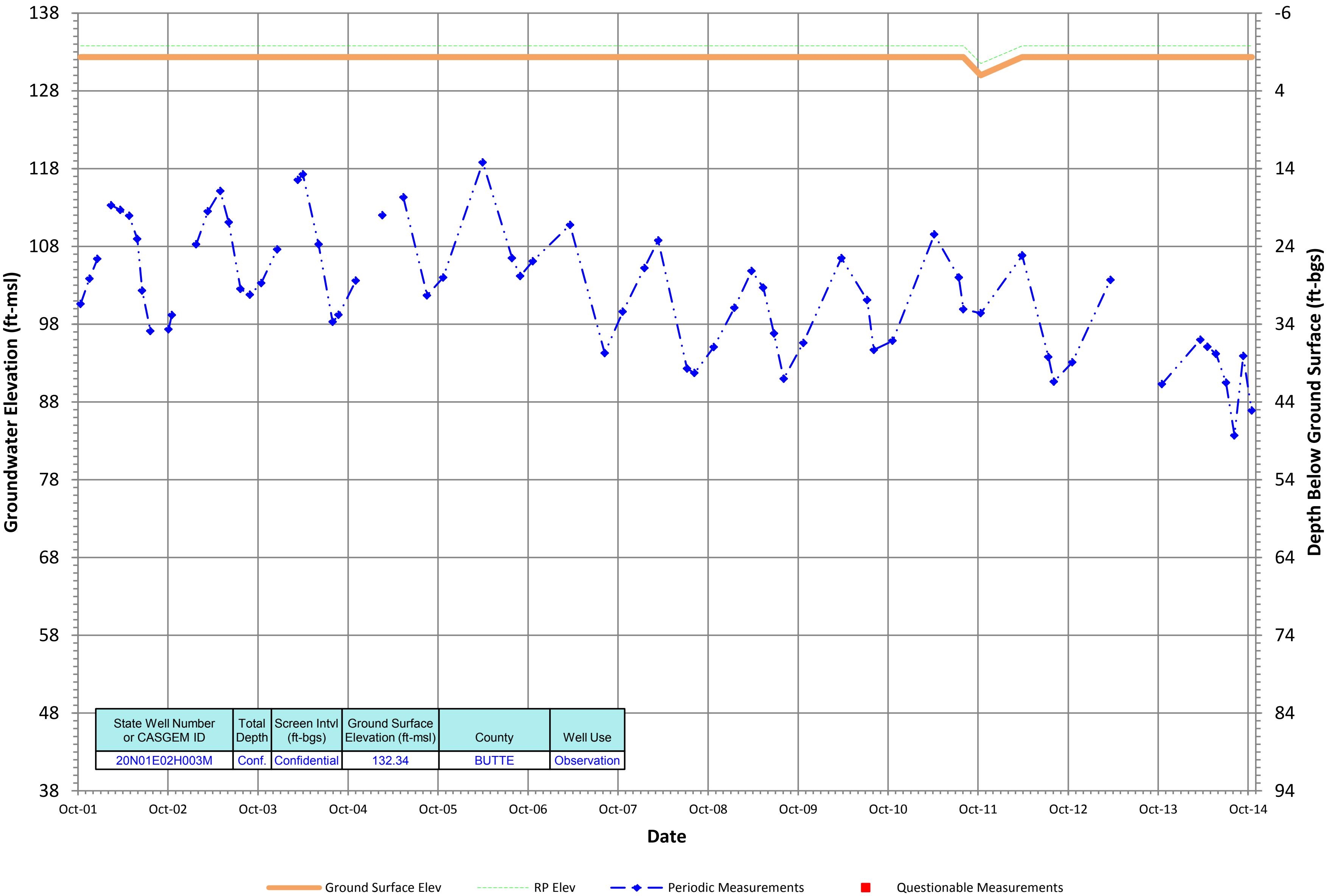
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W27R001M	Conf.	Confidential	83.38	GLENN	Irrigation

20N01E02H003M
Period Of Record: 10/11/2001 to 10/15/2014

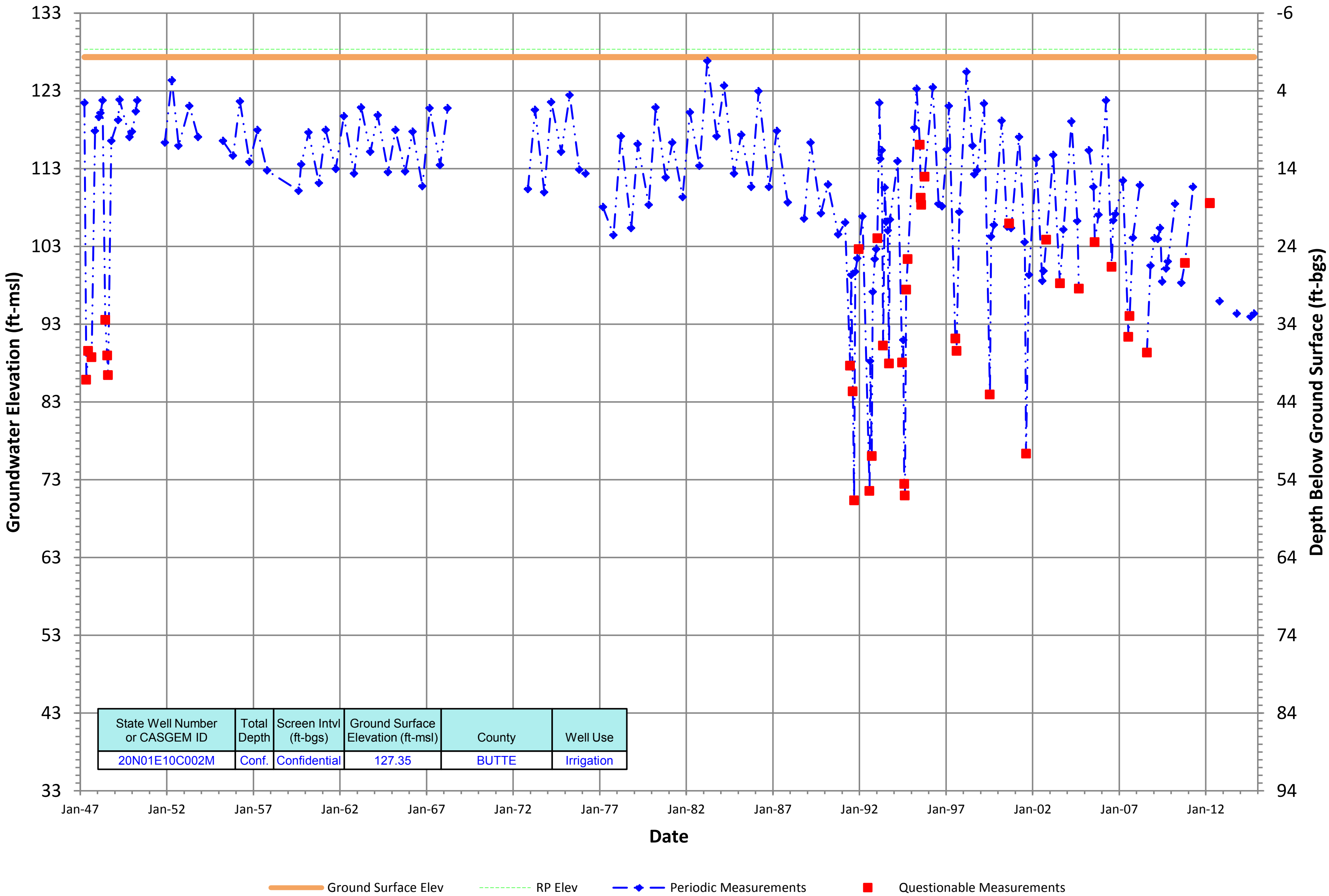
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01E02H003M	Conf.	Confidential	132.34	BUTTE	Observation

20N01E10C002M
Period Of Record: 03/31/1947 to 10/15/2014

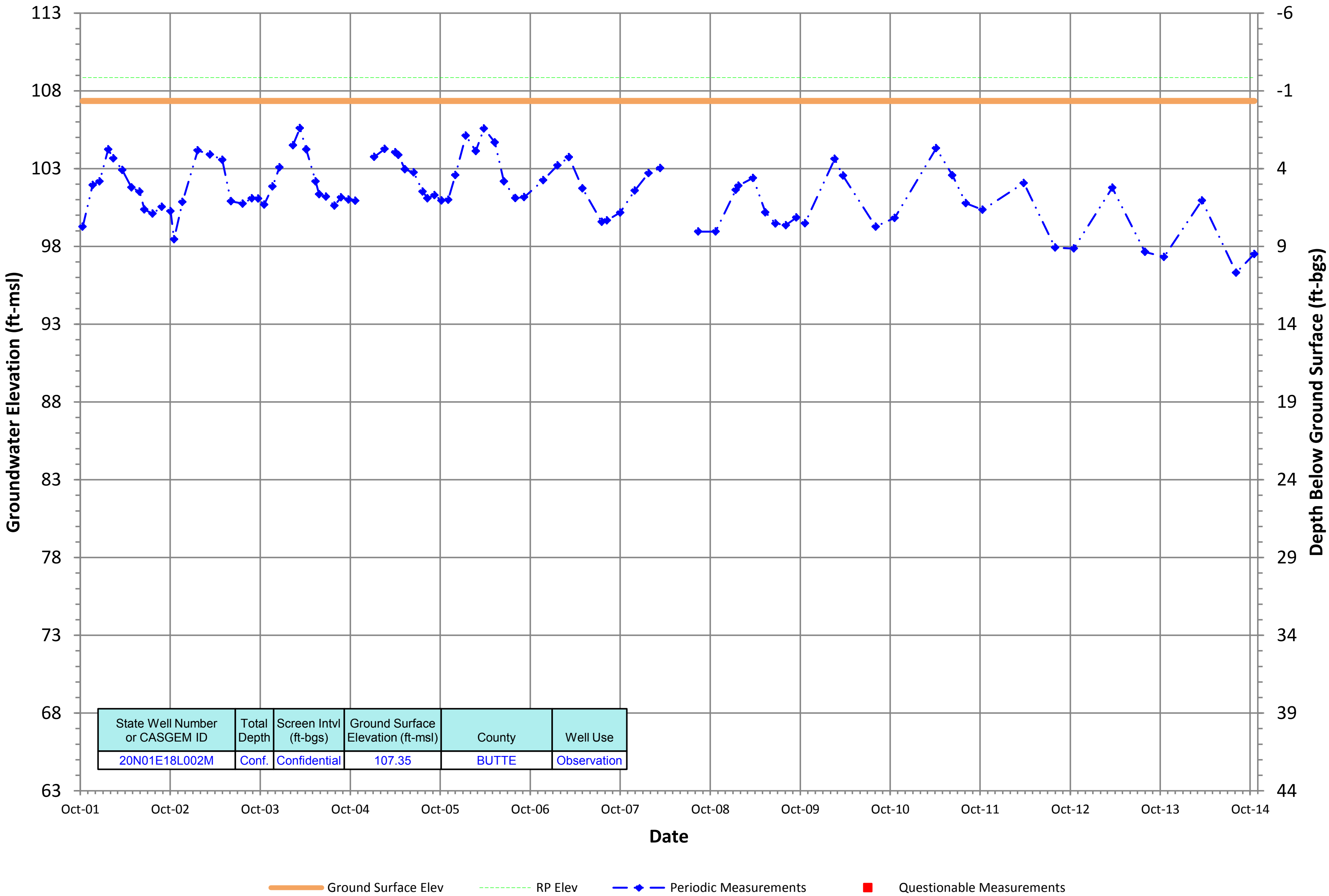
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01E10C002M	Conf.	Confidential	127.35	BUTTE	Irrigation

20N01E18L002M
Period Of Record: 10/10/2001 to 10/17/2014

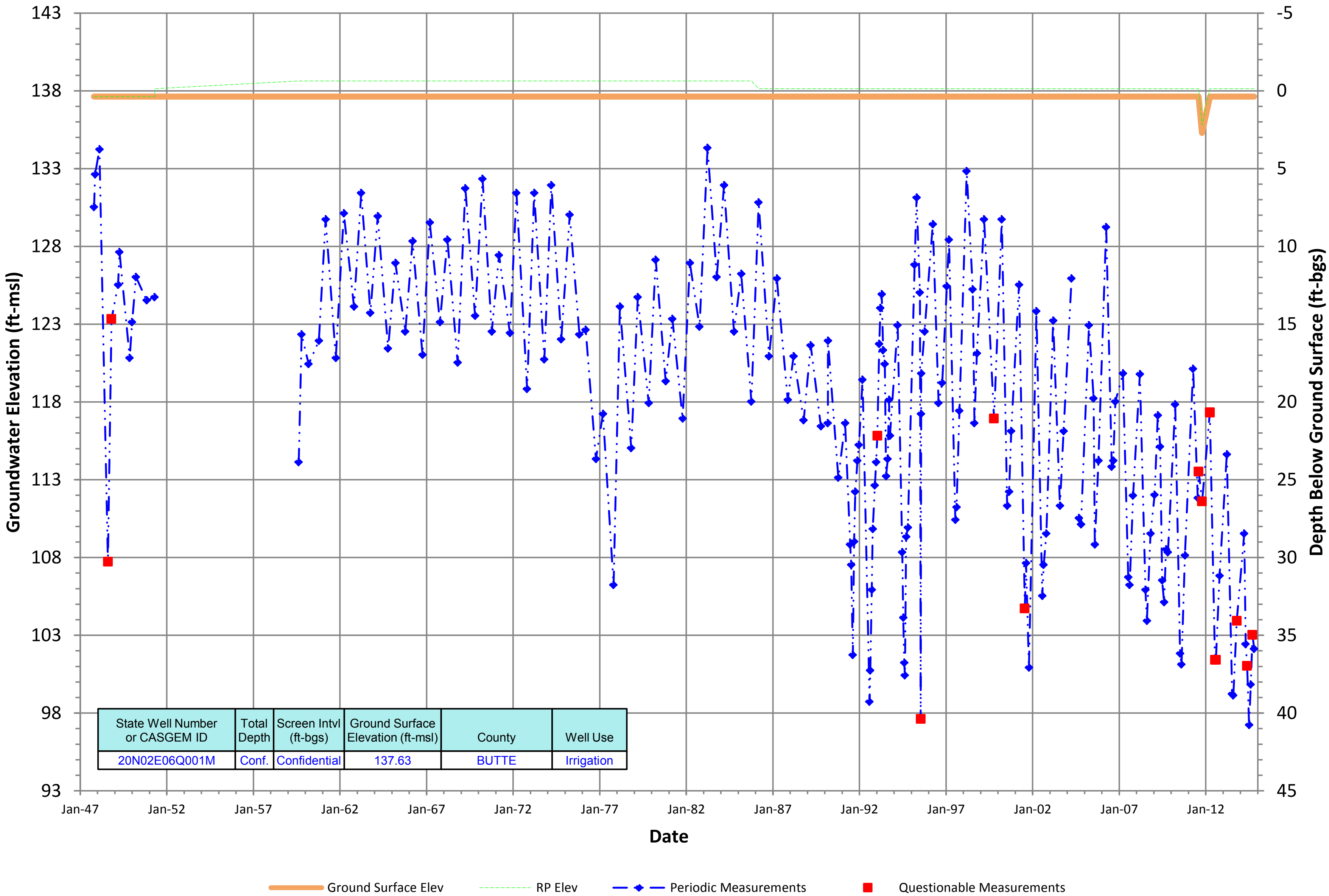
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



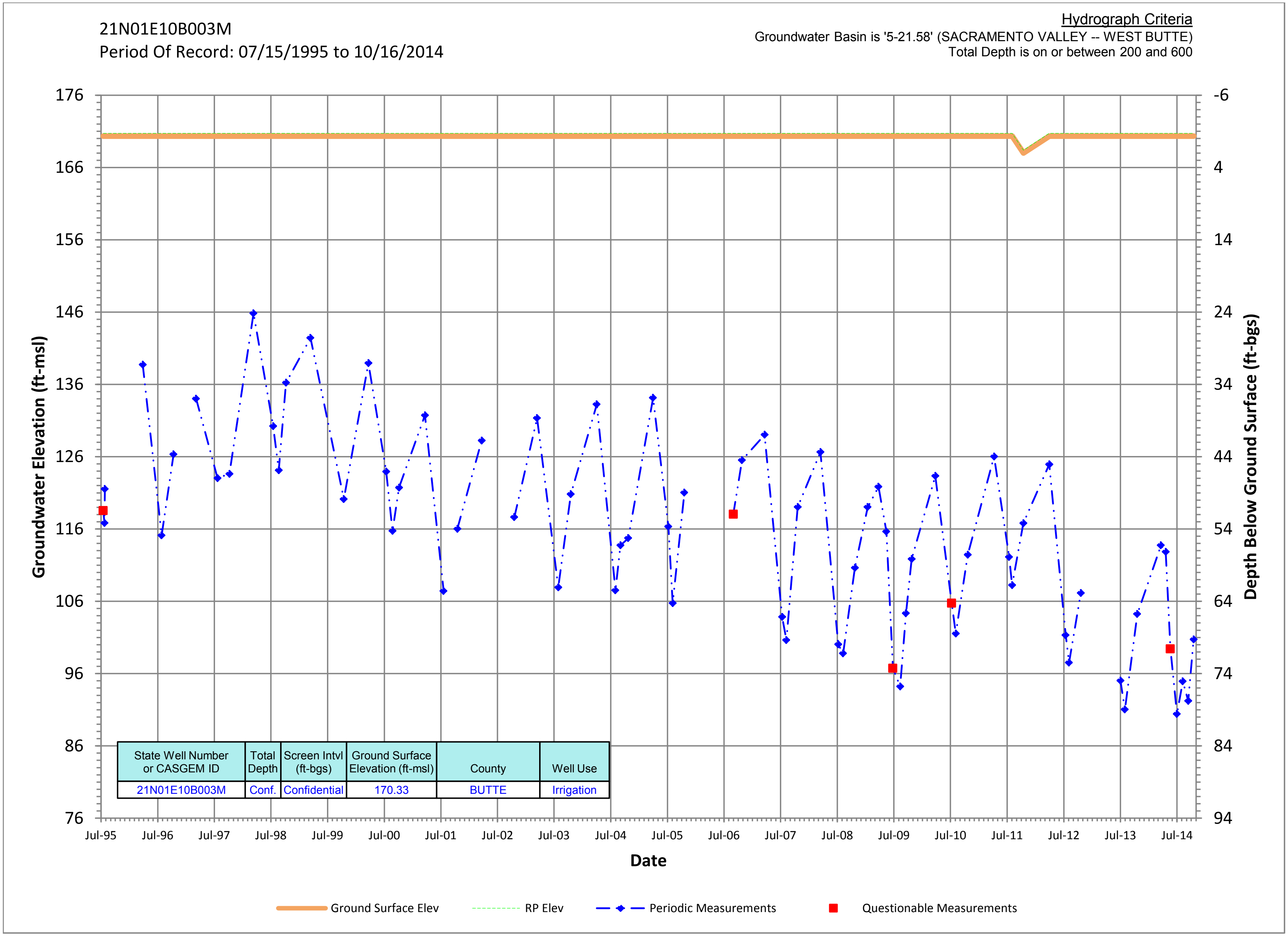
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01E18L002M	Conf.	Confidential	107.35	BUTTE	Observation

20N02E06Q001M
Period Of Record: 10/17/1947 to 10/15/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



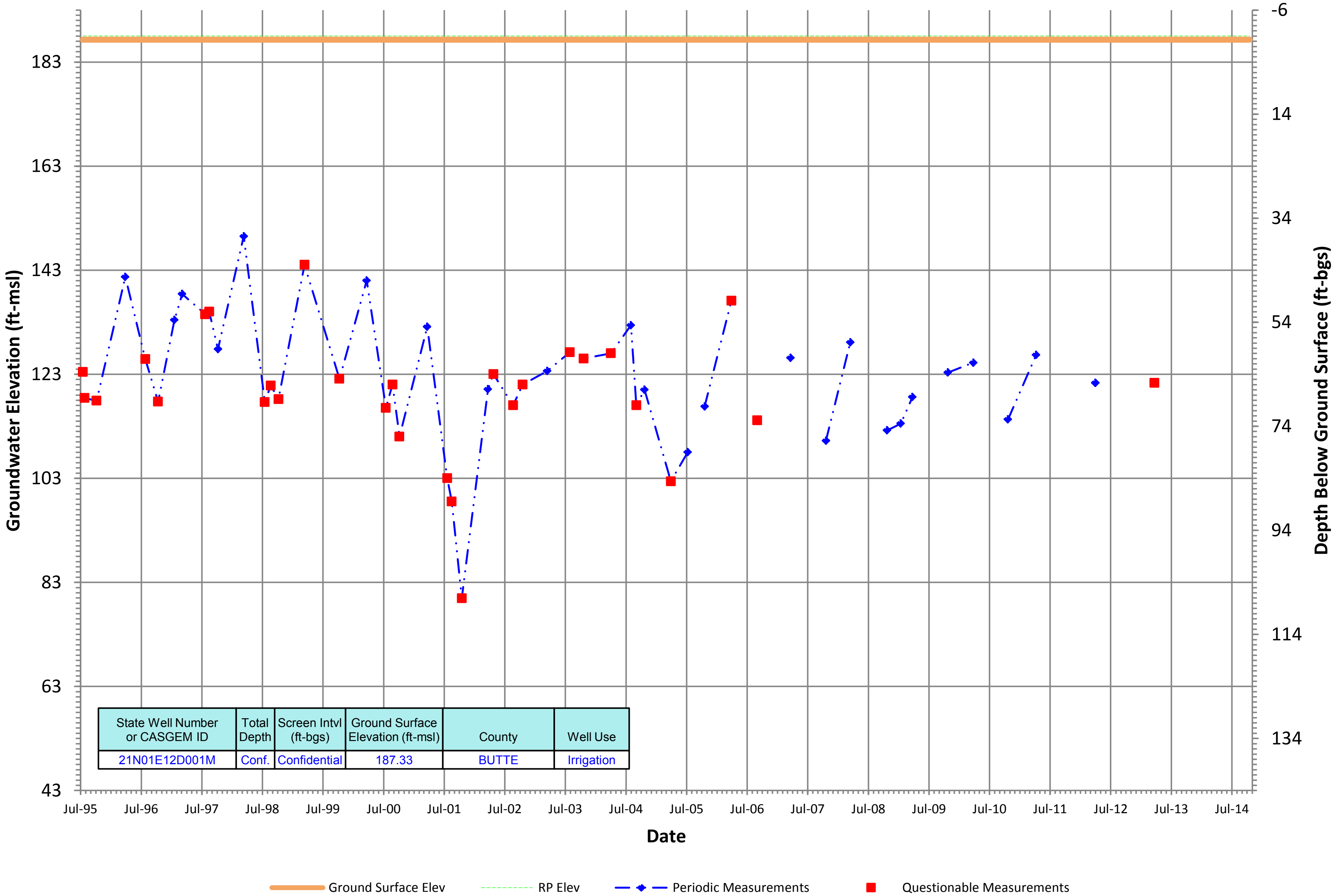
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N02E06Q001M	Conf.	Confidential	137.63	BUTTE	Irrigation



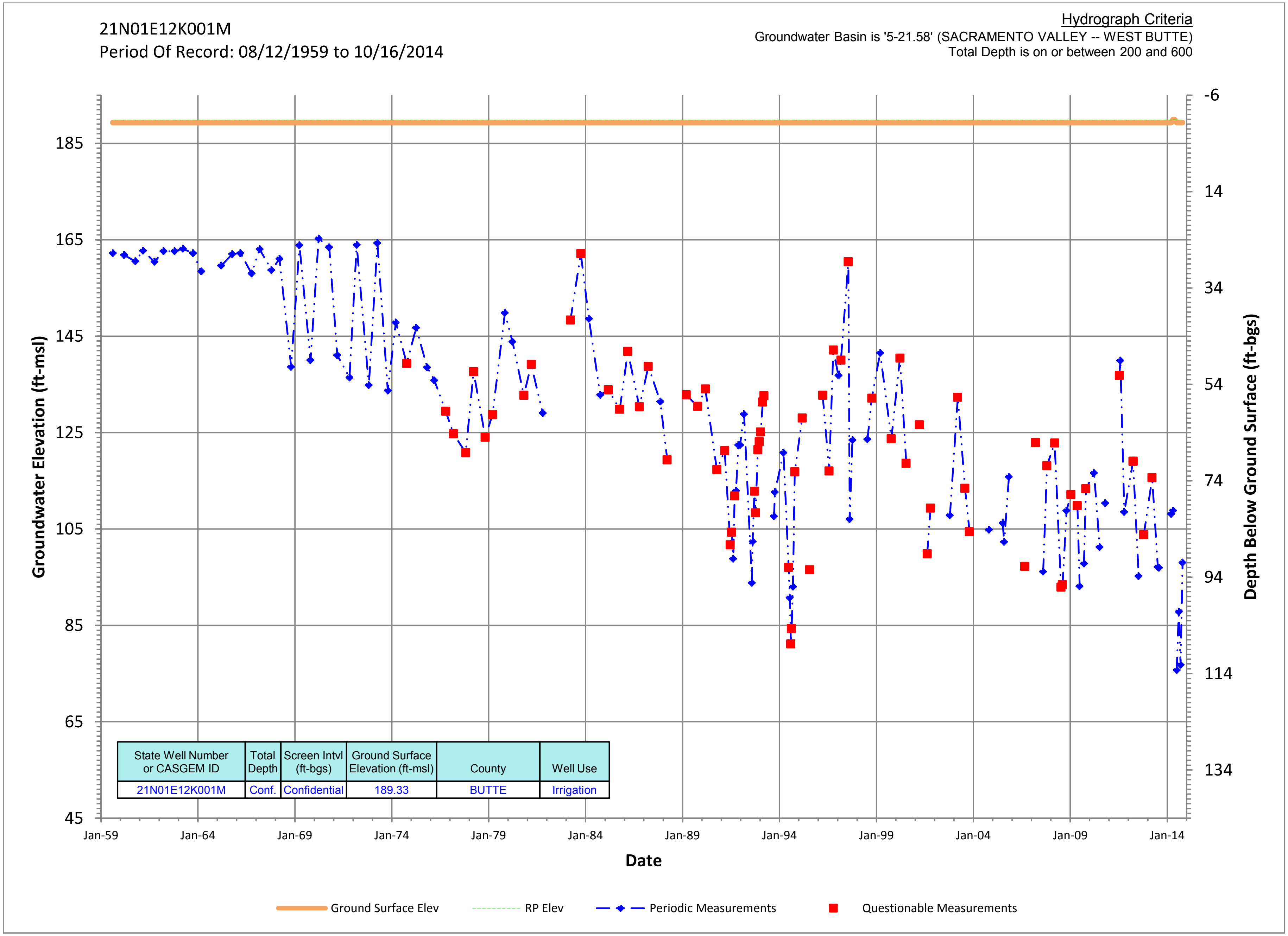
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E10B003M	Conf.	Confidential	170.33	BUTTE	Irrigation

21N01E12D001M
Period Of Record: 07/15/1995 to 10/16/2014

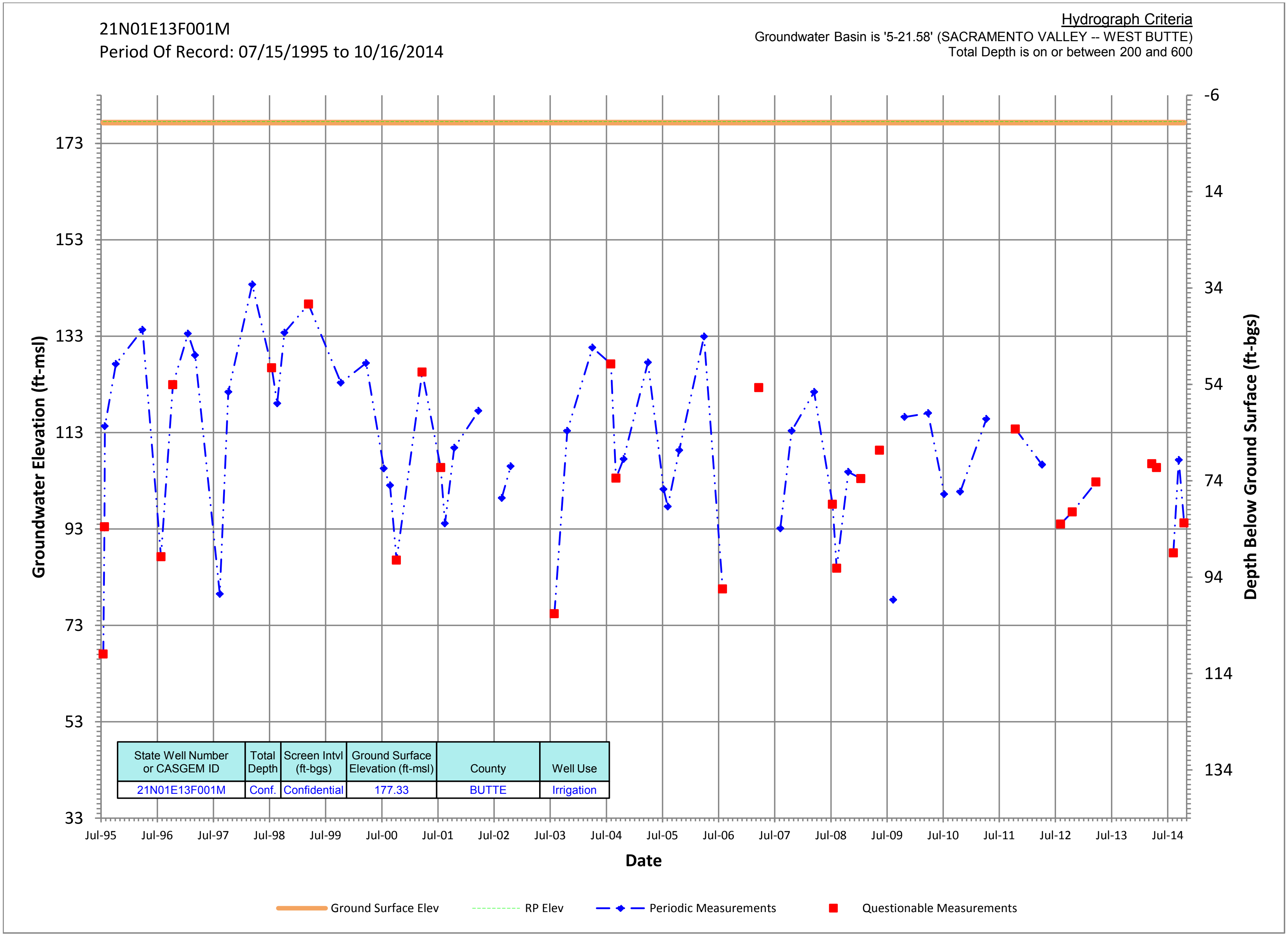
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E12D001M	Conf.	Confidential	187.33	BUTTE	Irrigation



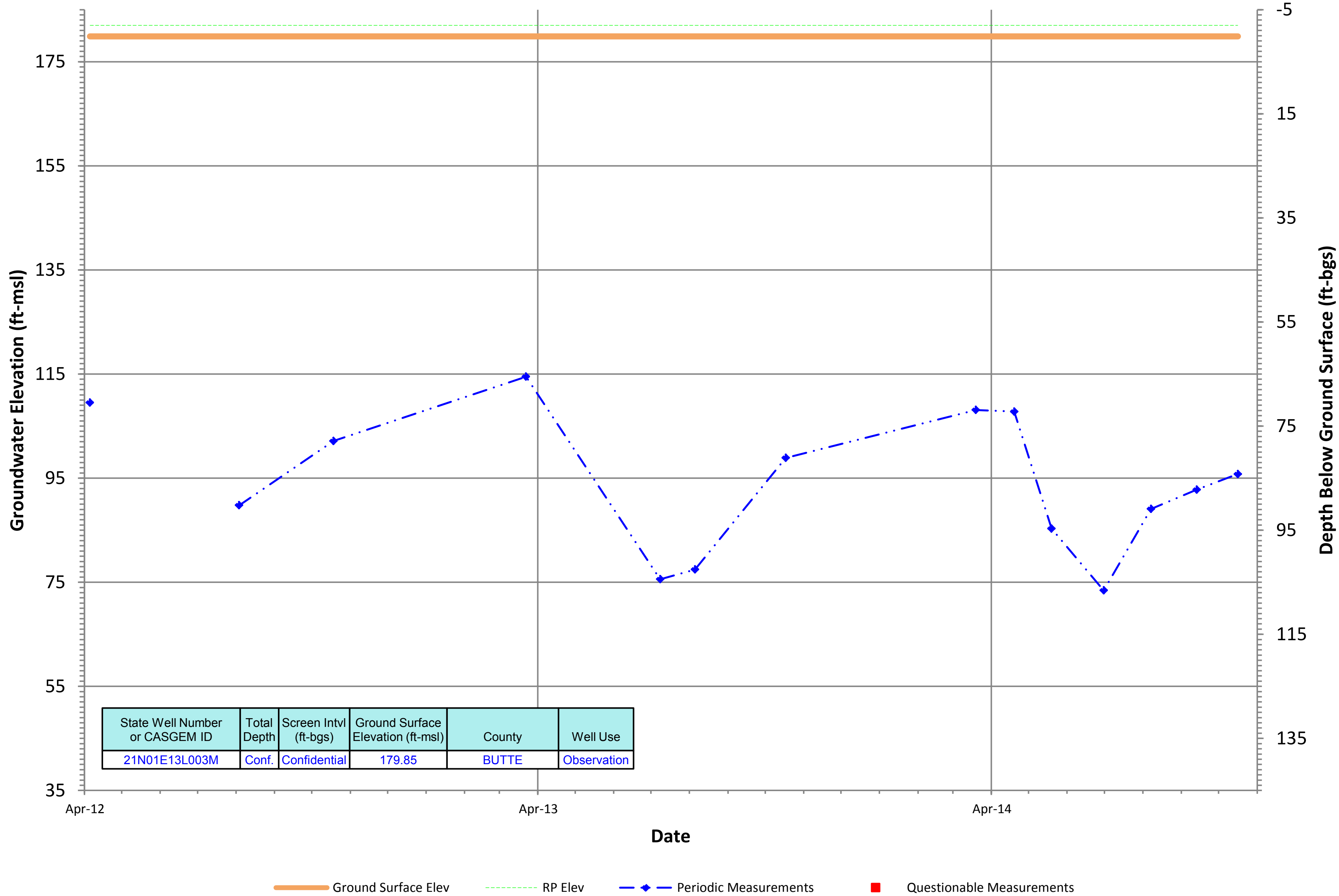
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E12K001M	Conf.	Confidential	189.33	BUTTE	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E13F001M	Conf.	Confidential	177.33	BUTTE	Irrigation

21N01E13L003M
Period Of Record: 04/05/2012 to 10/16/2014

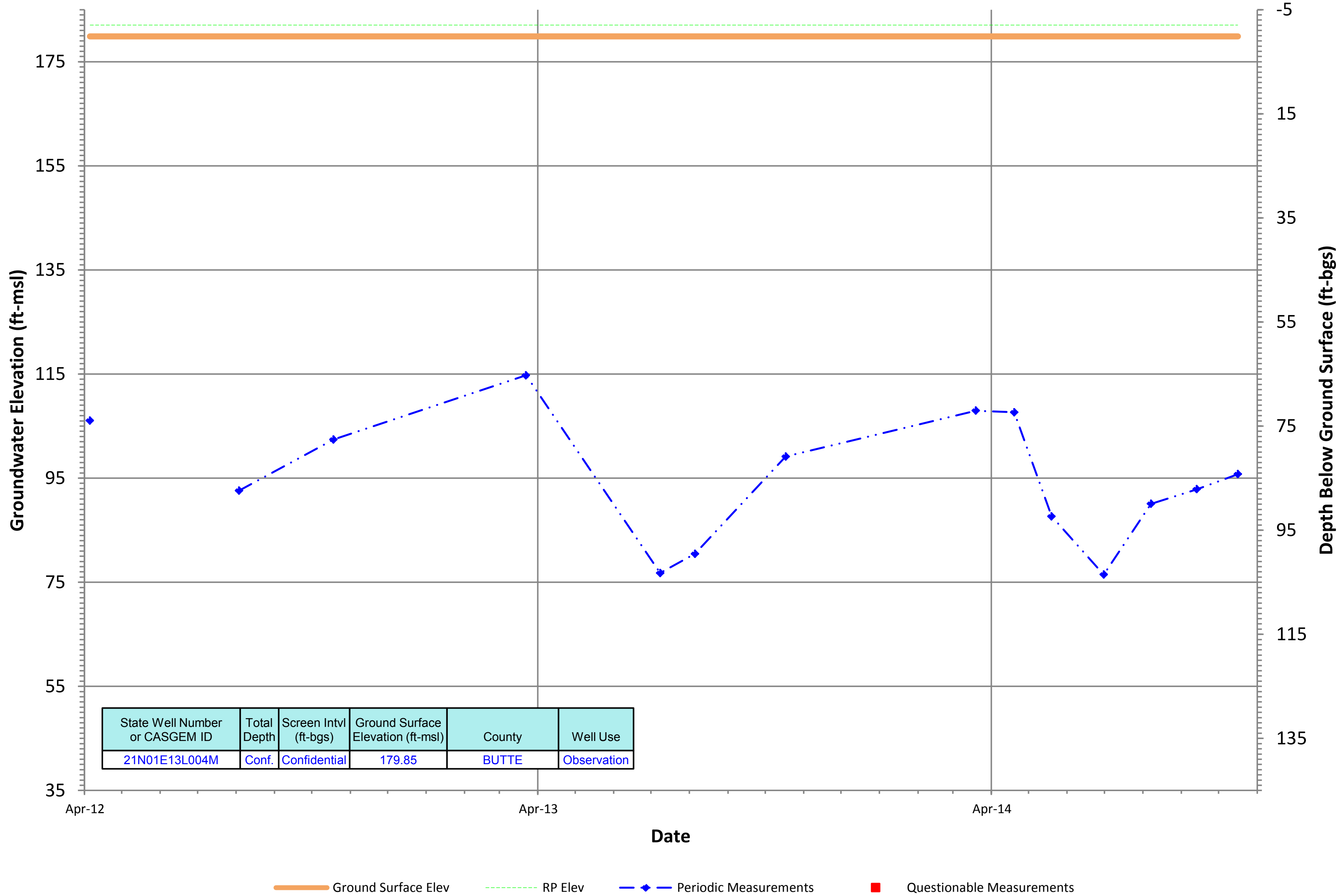
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E13L003M	Conf.	Confidential	179.85	BUTTE	Observation

21N01E13L004M
Period Of Record: 04/05/2012 to 10/16/2014

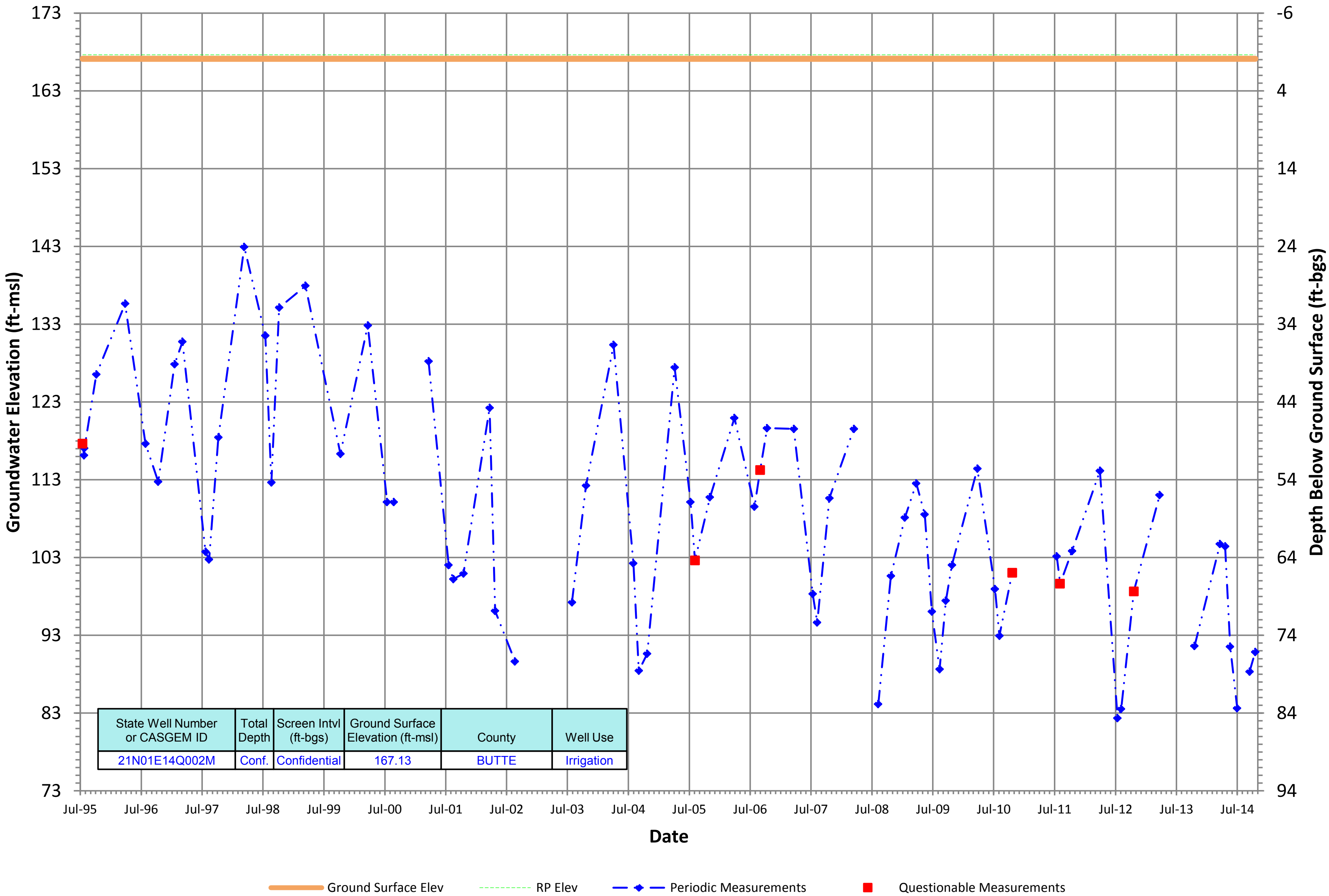
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



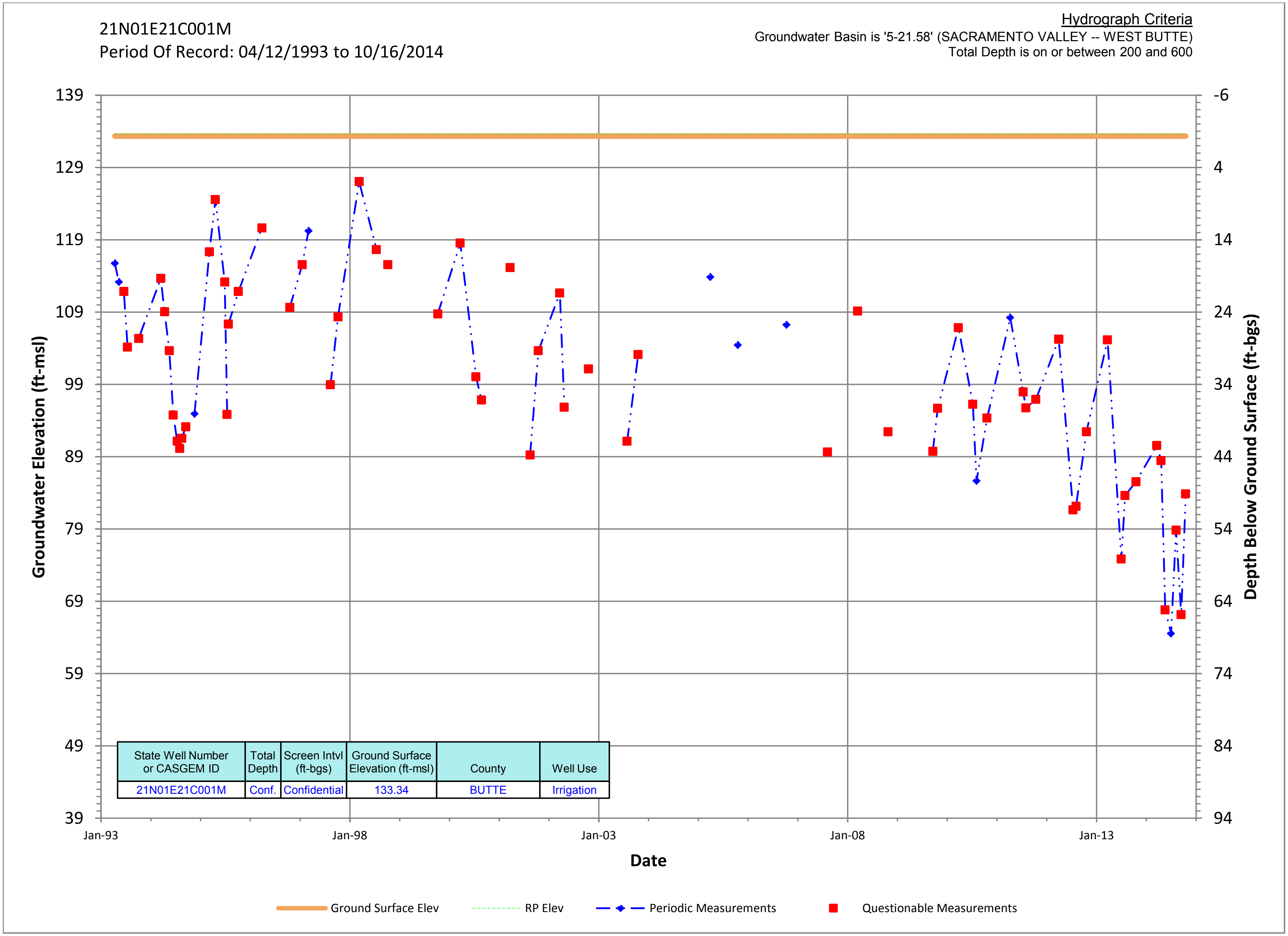
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E13L004M	Conf.	Confidential	179.85	BUTTE	Observation

21N01E14Q002M
Period Of Record: 07/15/1995 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



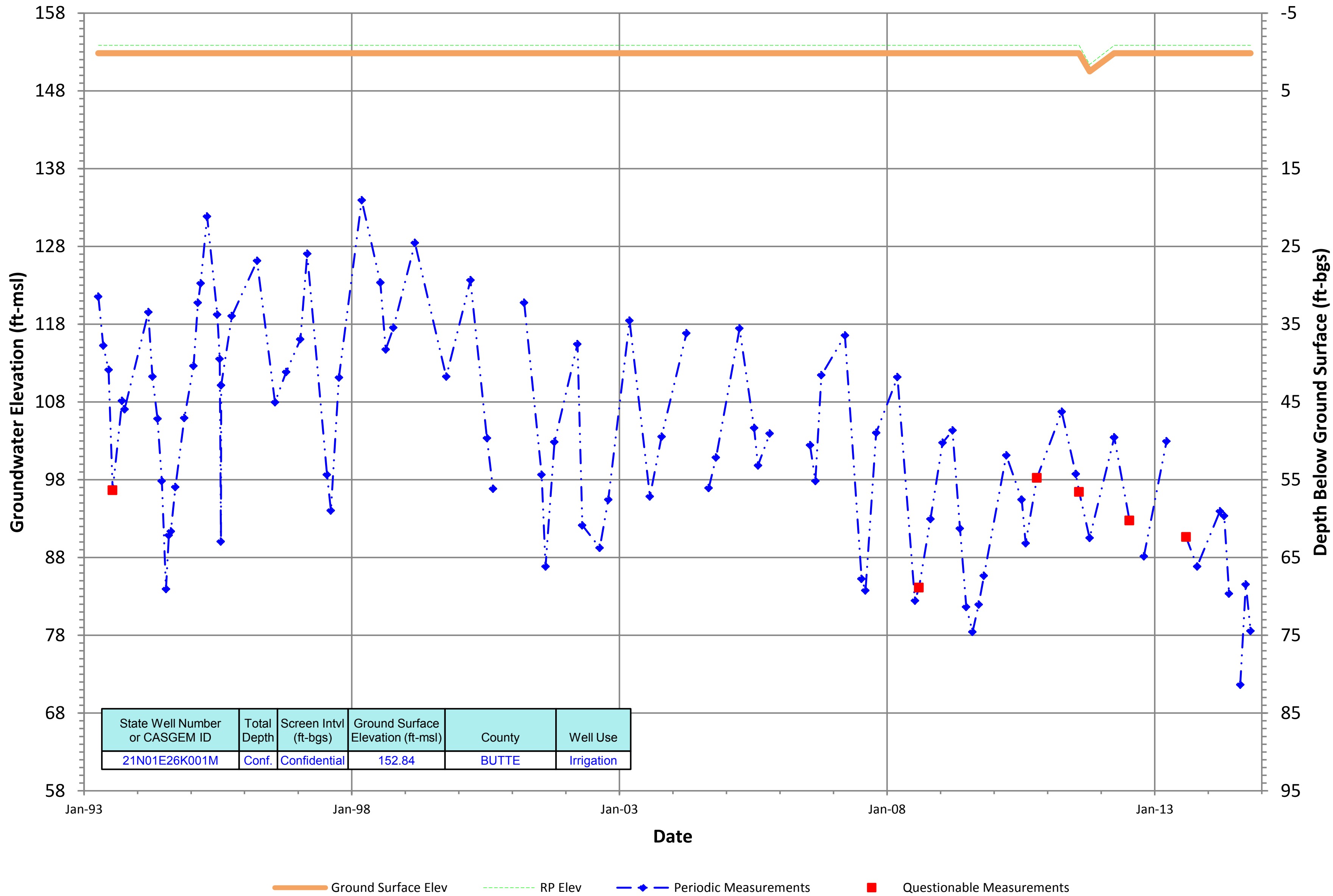
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E14Q002M	Conf.	Confidential	167.13	BUTTE	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E21C001M	Conf.	Confidential	133.34	BUTTE	Irrigation

21N01E26K001M
Period Of Record: 04/08/1993 to 10/16/2014

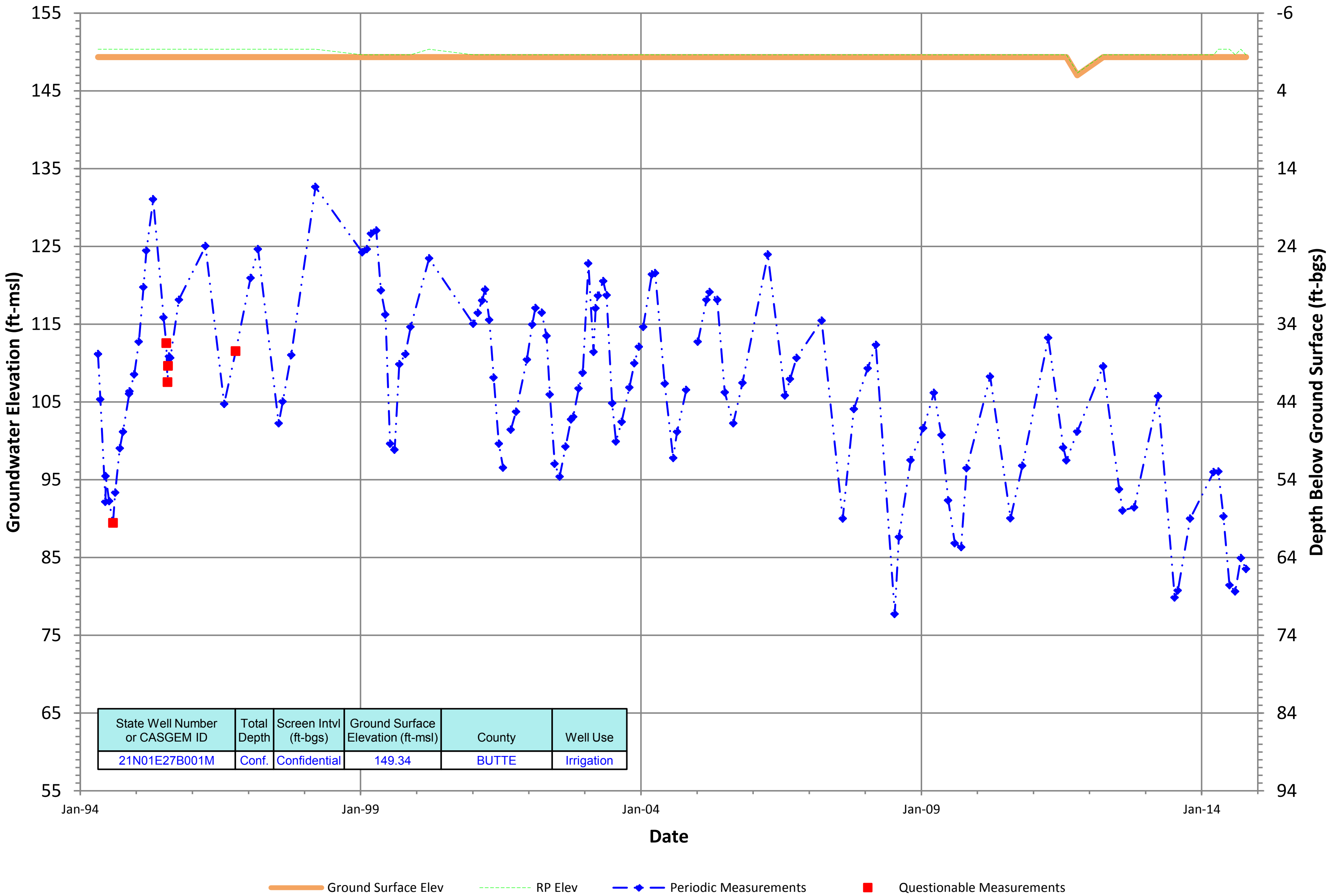
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E26K001M	Conf.	Confidential	152.84	BUTTE	Irrigation

21N01E27B001M
Period Of Record: 04/26/1994 to 10/16/2014

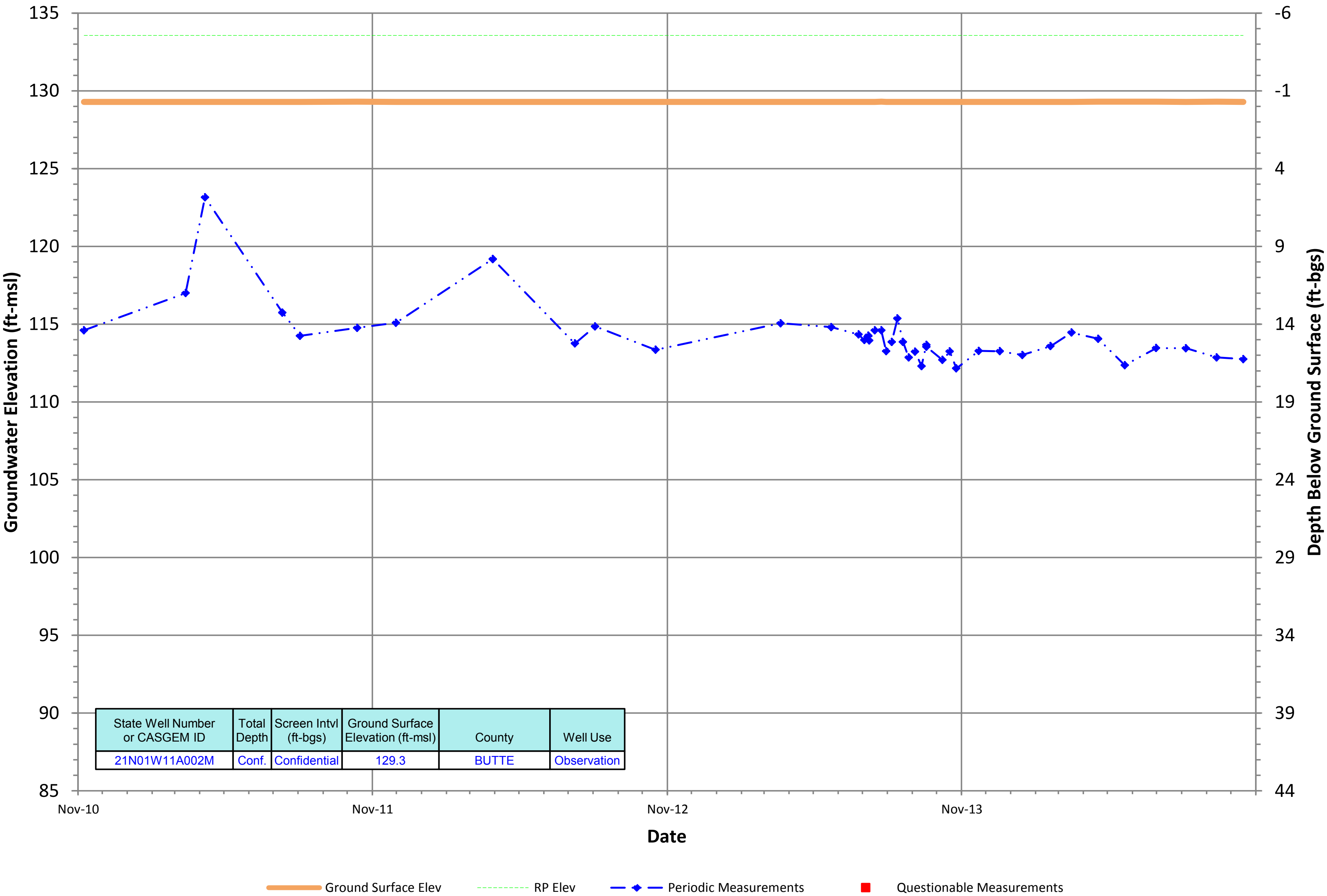
<u>Hydrograph Criteria</u>
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E27B001M	Conf.	Confidential	149.34	BUTTE	Irrigation

21N01W11A002M
Period Of Record: 11/08/2010 to 10/16/2014

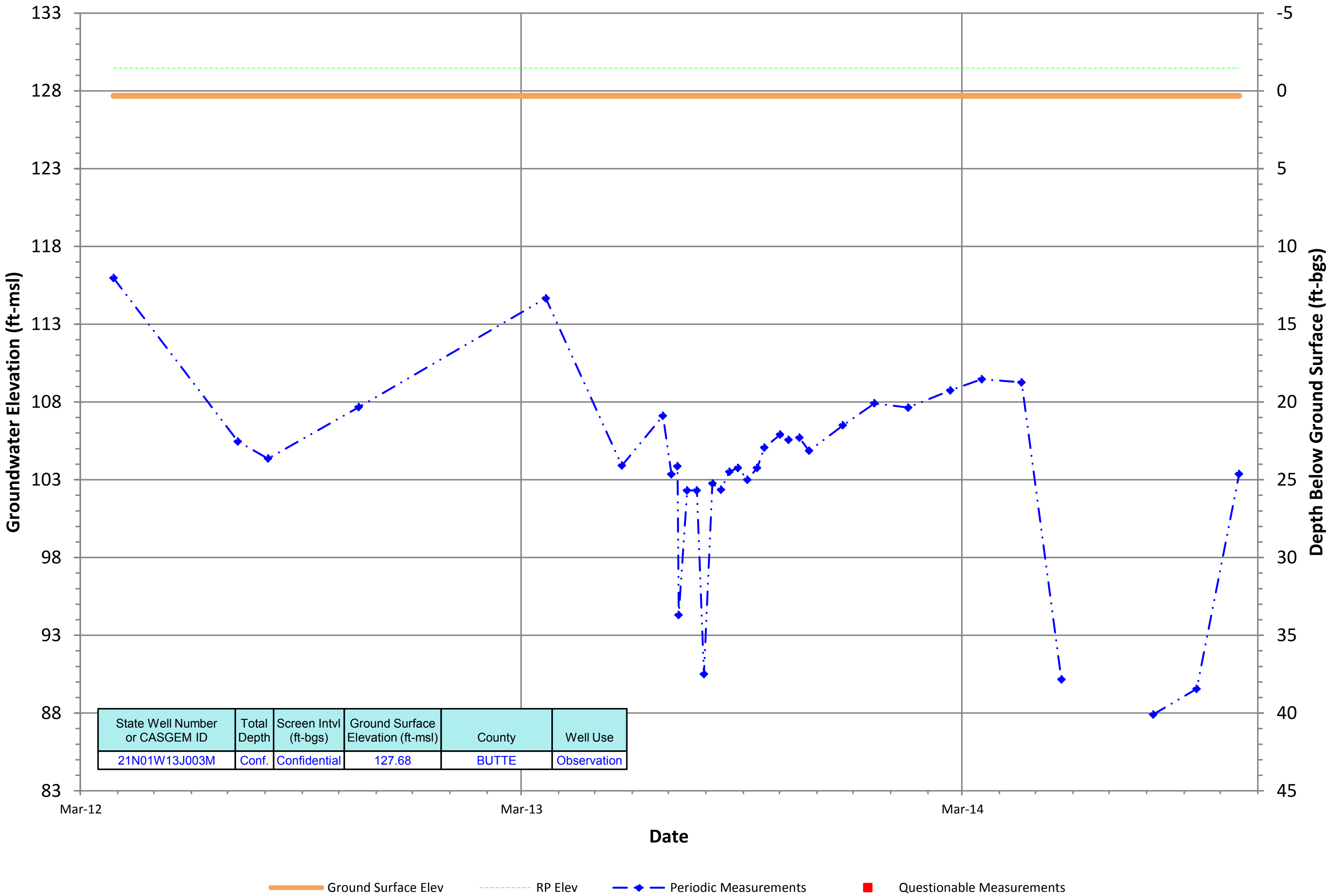
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W11A002M	Conf.	Confidential	129.3	BUTTE	Observation

21N01W13J003M
Period Of Record: 03/28/2012 to 10/16/2014

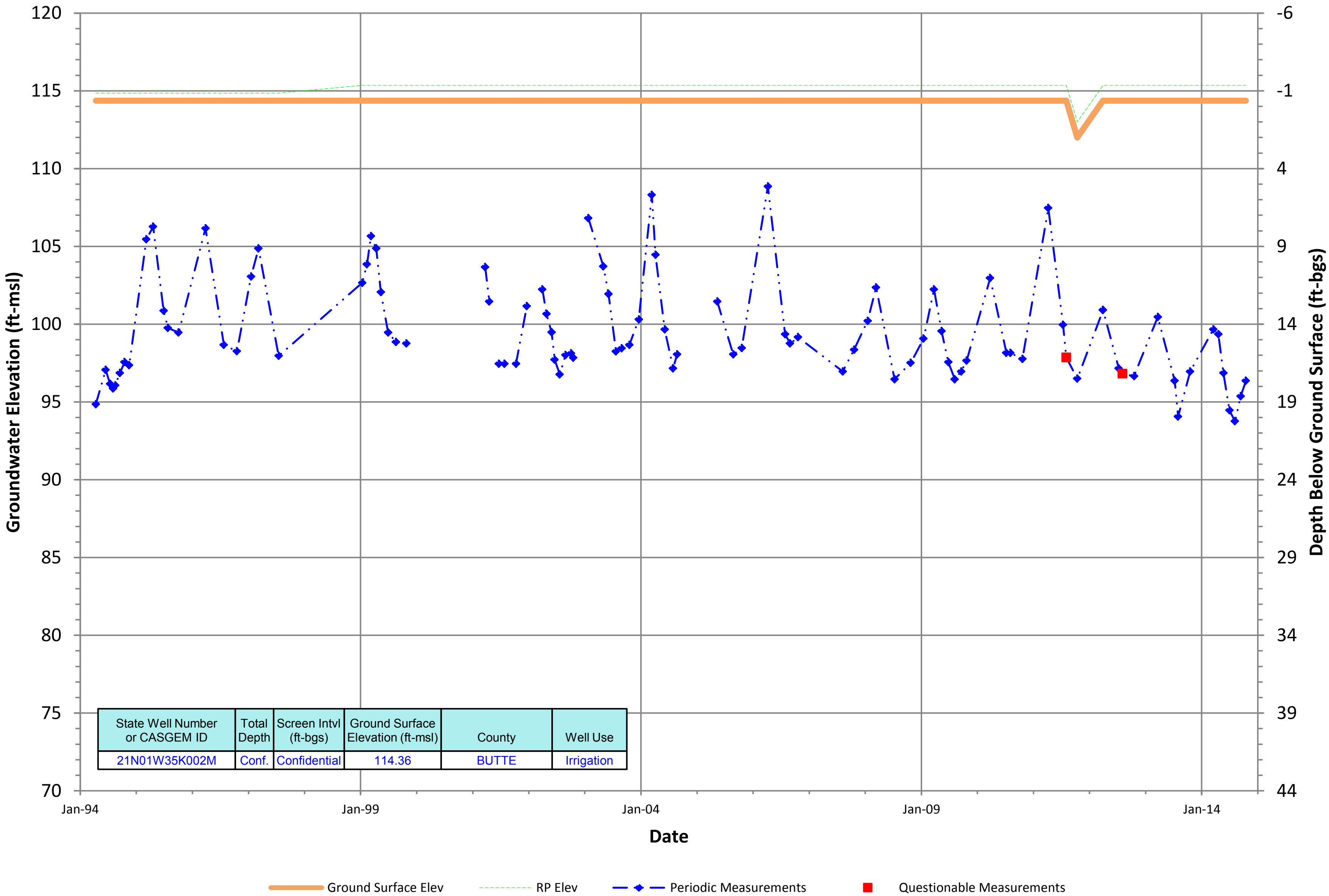
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W13J003M	Conf.	Confidential	127.68	BUTTE	Observation

21N01W35K002M
Period Of Record: 04/12/1994 to 10/15/2014

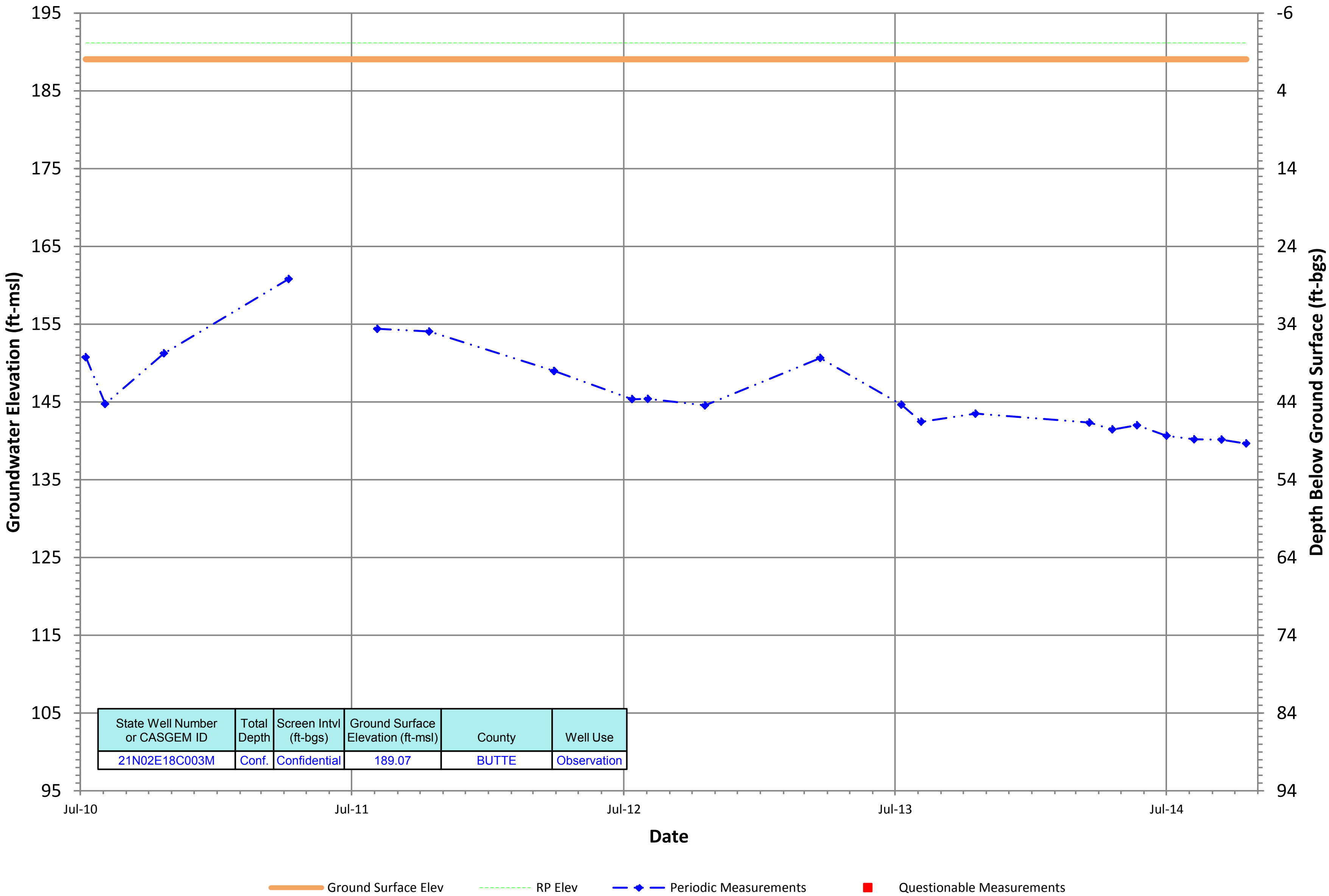
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



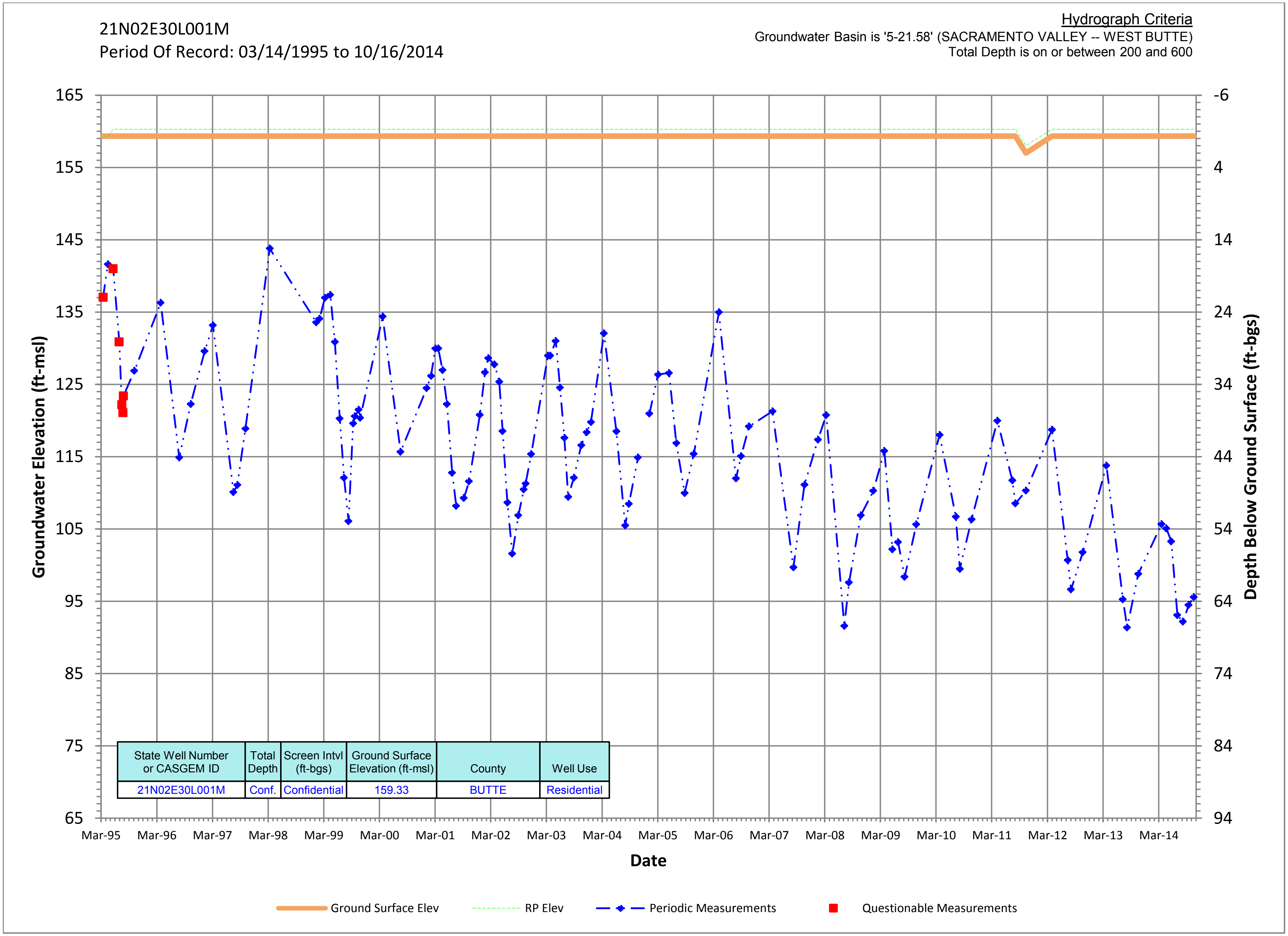
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W35K002M	Conf.	Confidential	114.36	BUTTE	Irrigation

21N02E18C003M
Period Of Record: 07/08/2010 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



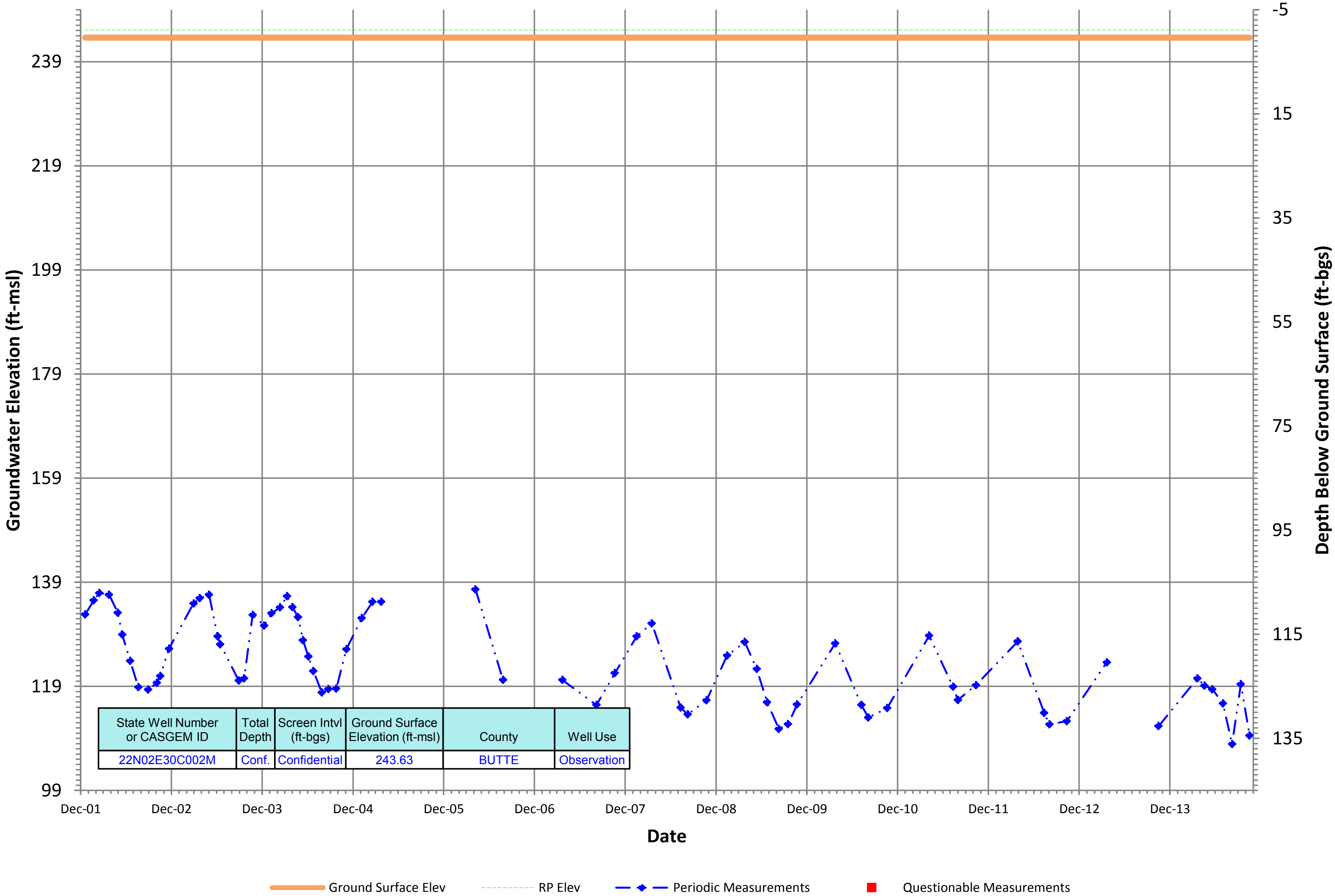
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E18C003M	Conf.	Confidential	189.07	BUTTE	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E30L001M	Conf.	Confidential	159.33	BUTTE	Residential

22N02E30C002M
Period Of Record: 12/19/2001 to 10/17/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N02E30C002M	Conf.	Confidential	243.63	BUTTE	Observation

Deep Groundwater Monitoring Well Hydrographs- West Butte Subbasin

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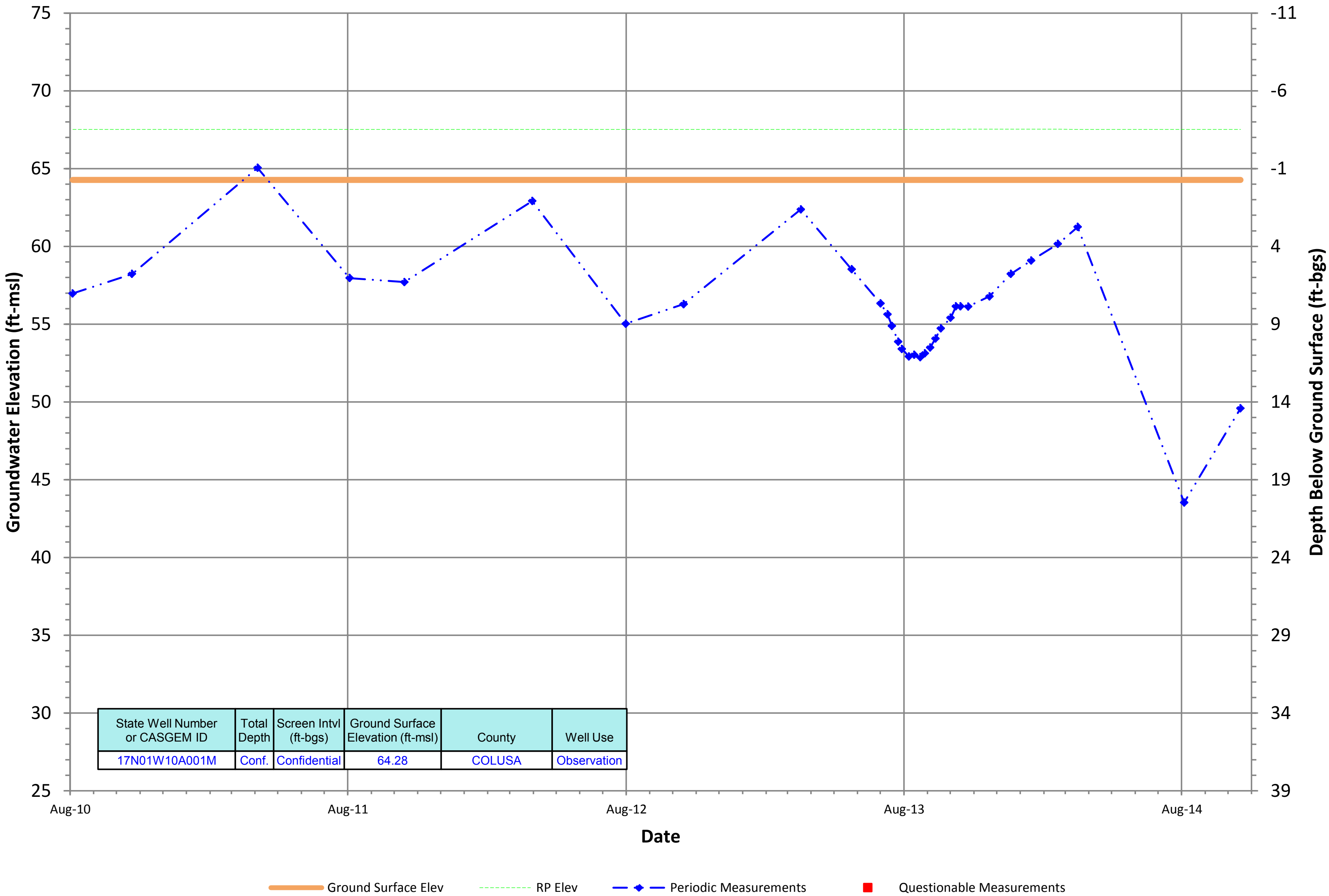
17N01W10A001M
Period Of Record: 08/04/2010 to 10/17/2014

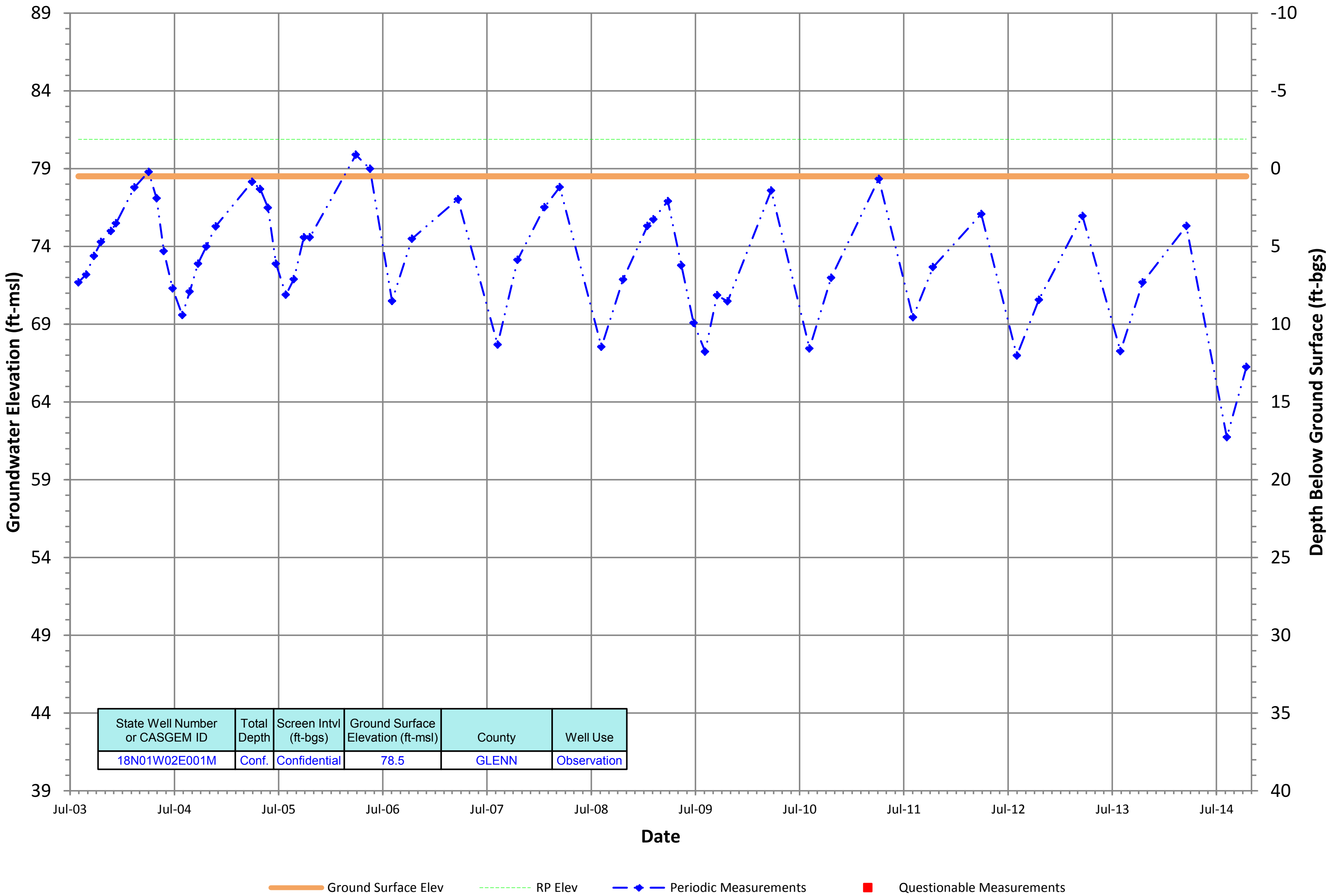
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



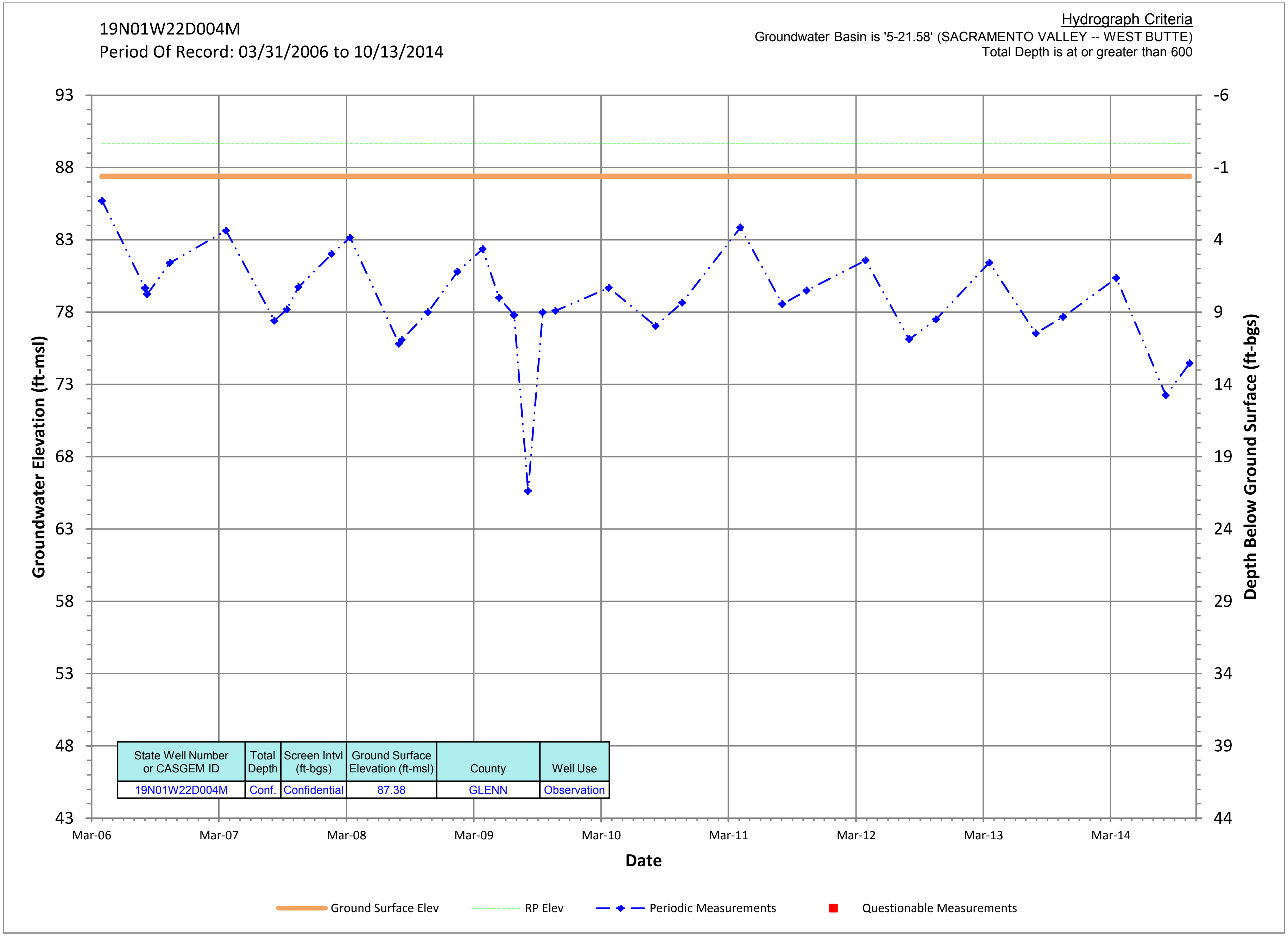
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
17N01W10A001M	Conf.	Confidential	64.28	COLUSA	Observation

18N01W02E001M
Period Of Record: 07/30/2003 to 10/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



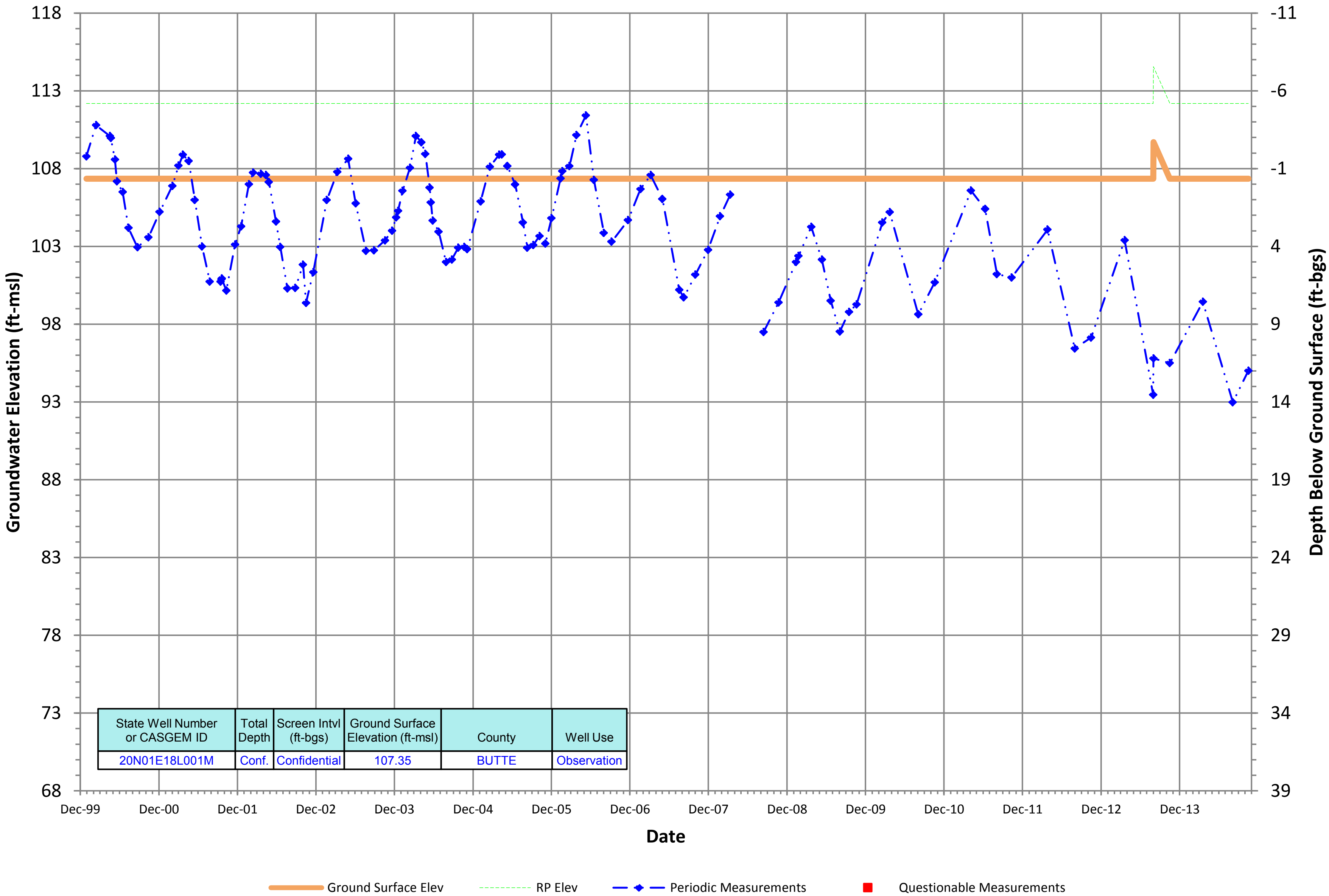
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
18N01W02E001M	Conf.	Confidential	78.5	GLENN	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
19N01W22D004M	Conf.	Confidential	87.38	GLENN	Observation

20N01E18L001M
Period Of Record: 12/29/1999 to 10/17/2014

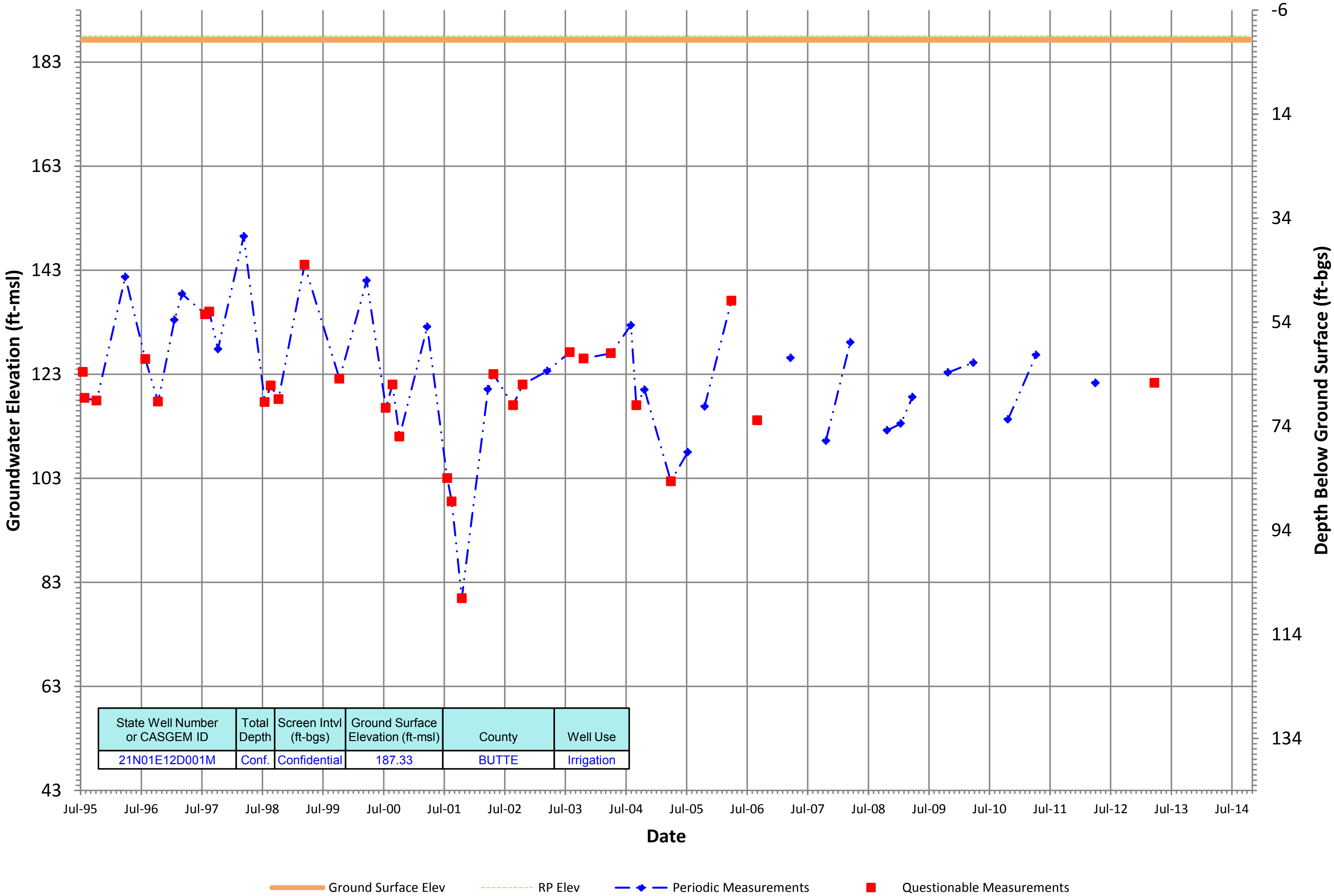
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
20N01E18L001M	Conf.	Confidential	107.35	BUTTE	Observation

21N01E12D001M
Period Of Record: 07/15/1995 to 10/16/2014

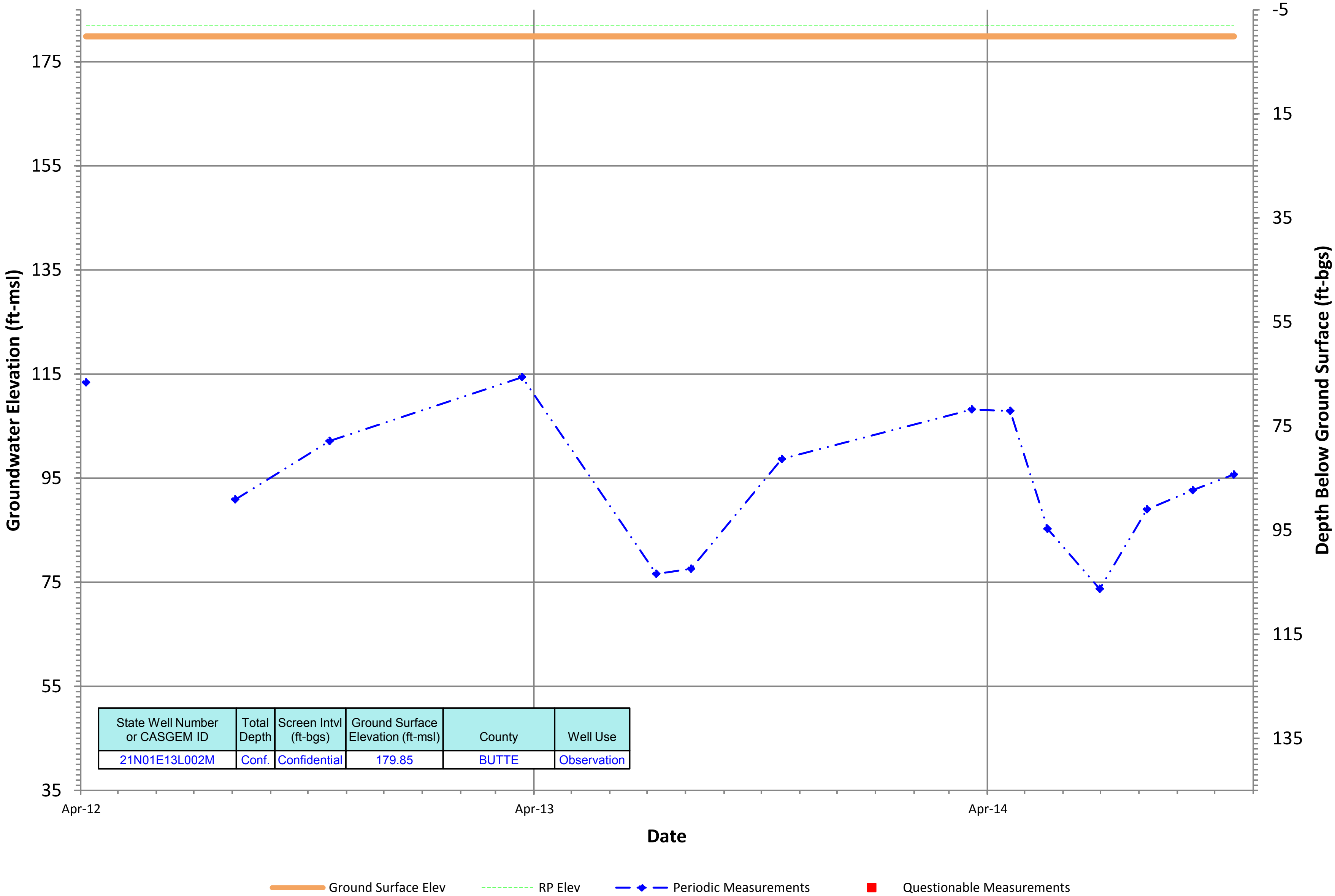
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E12D001M	Conf.	Confidential	187.33	BUTTE	Irrigation

21N01E13L002M
Period Of Record: 04/05/2012 to 10/16/2014

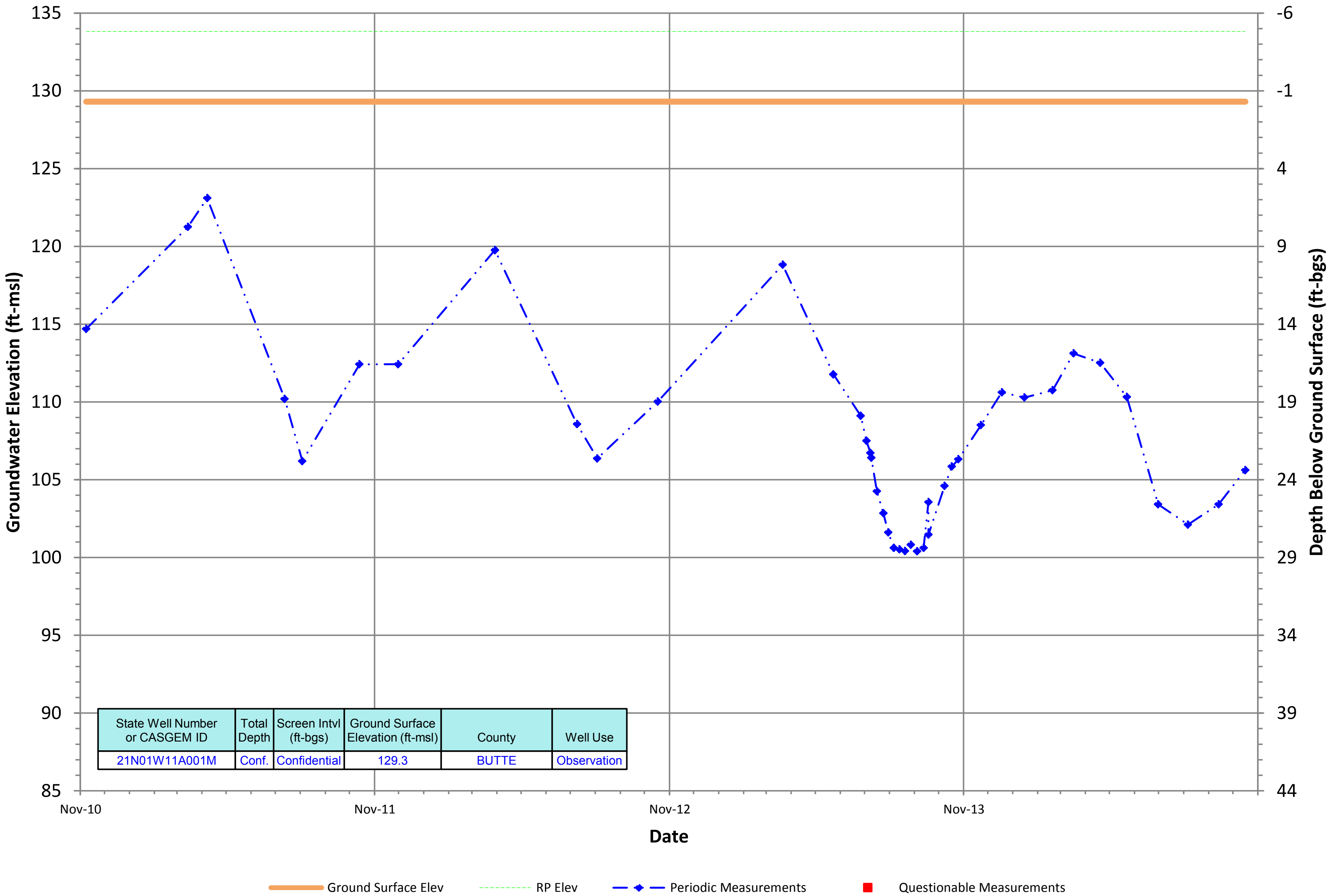
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



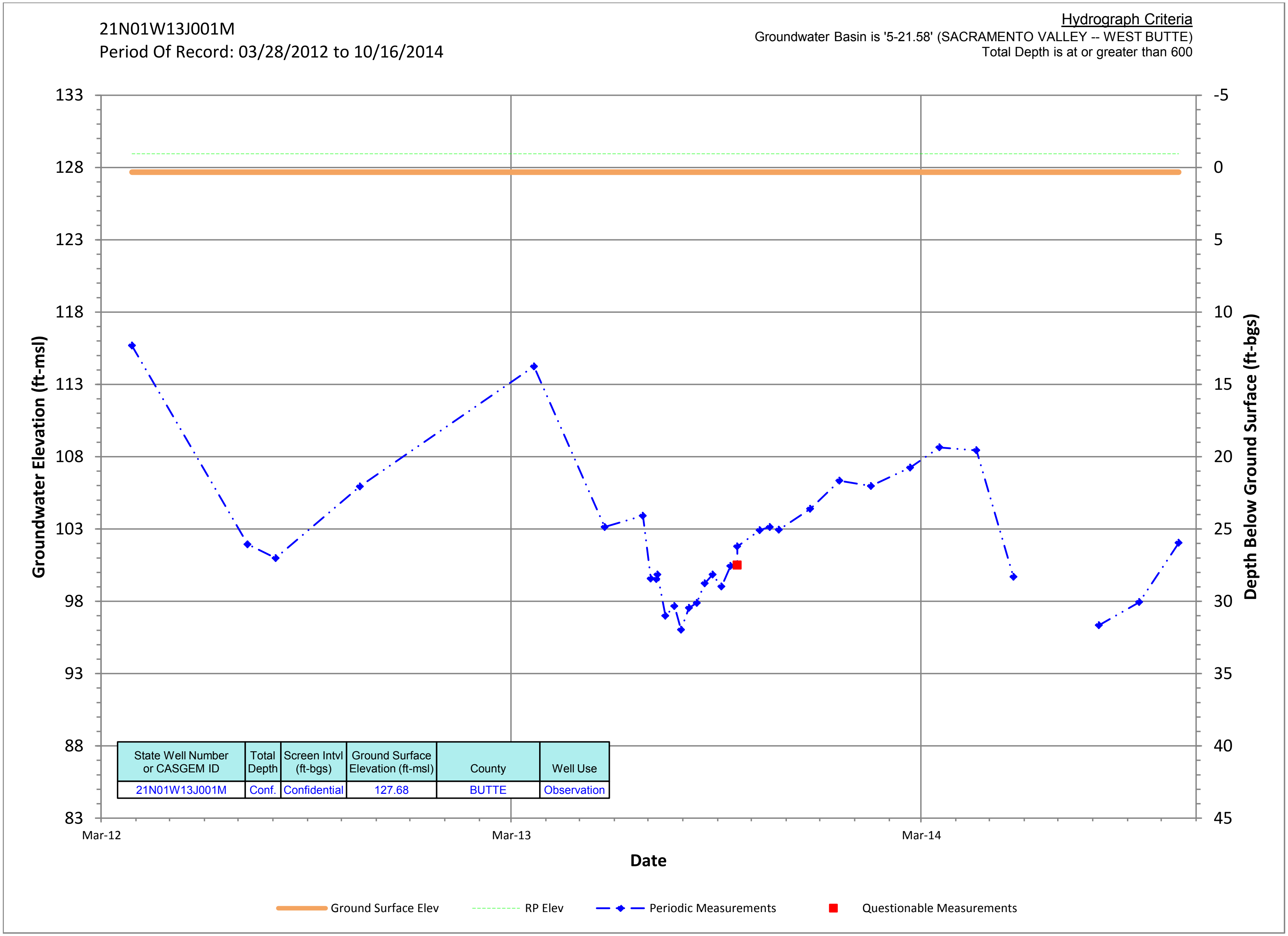
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01E13L002M	Conf.	Confidential	179.85	BUTTE	Observation

21N01W11A001M
Period Of Record: 11/08/2010 to 10/16/2014

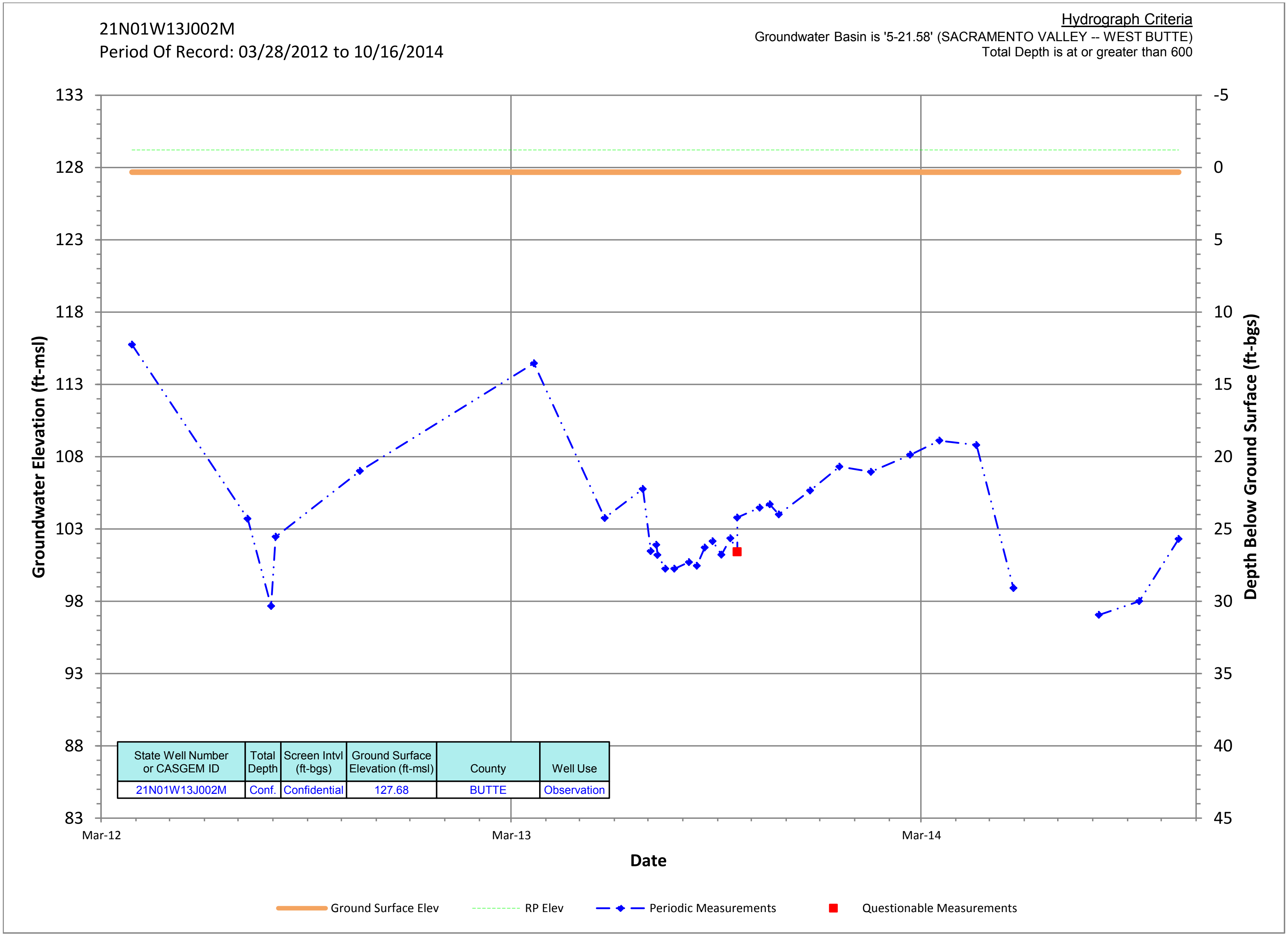
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



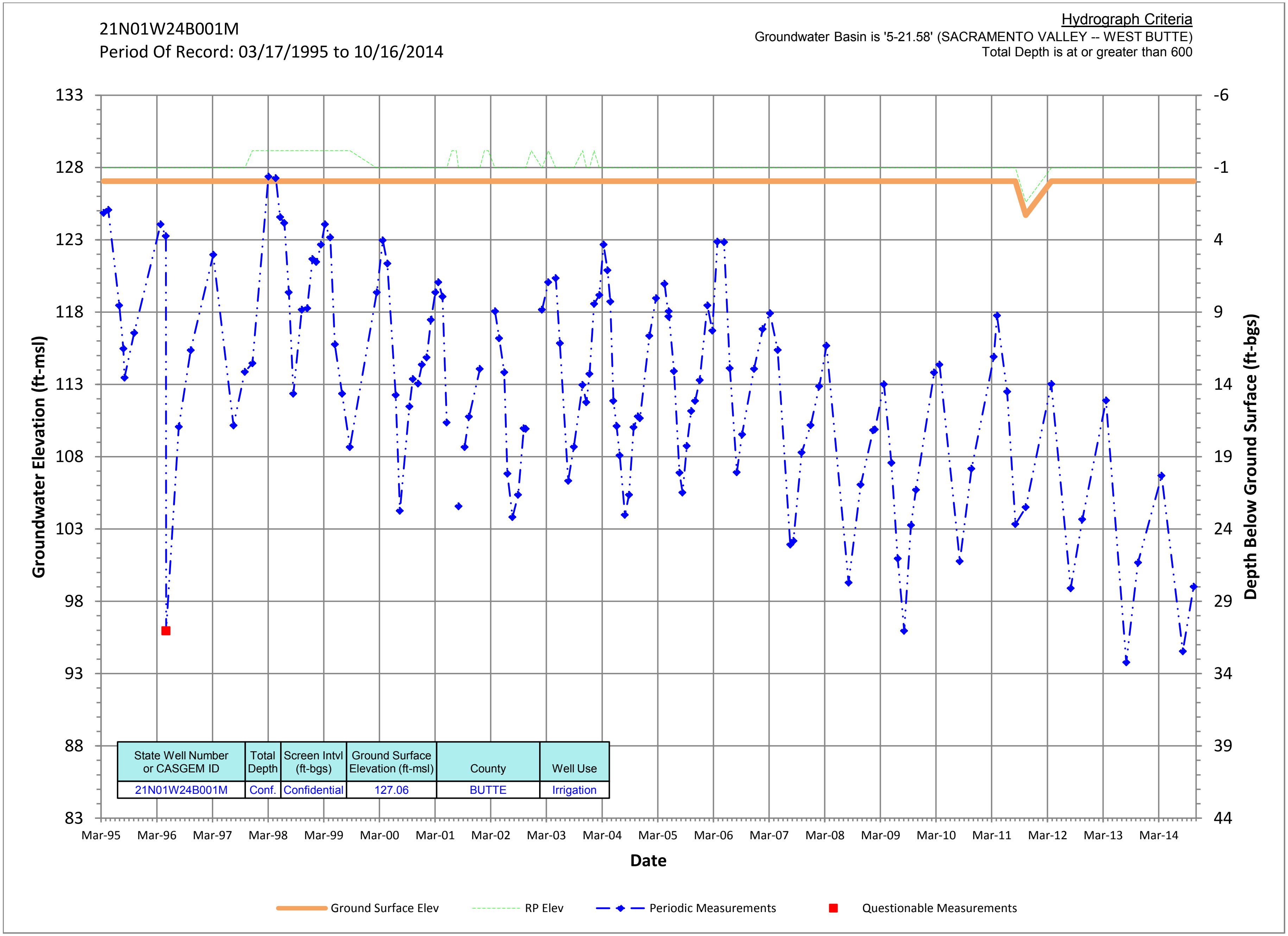
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W11A001M	Conf.	Confidential	129.3	BUTTE	Observation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W13J001M	Conf.	Confidential	127.68	BUTTE	Observation

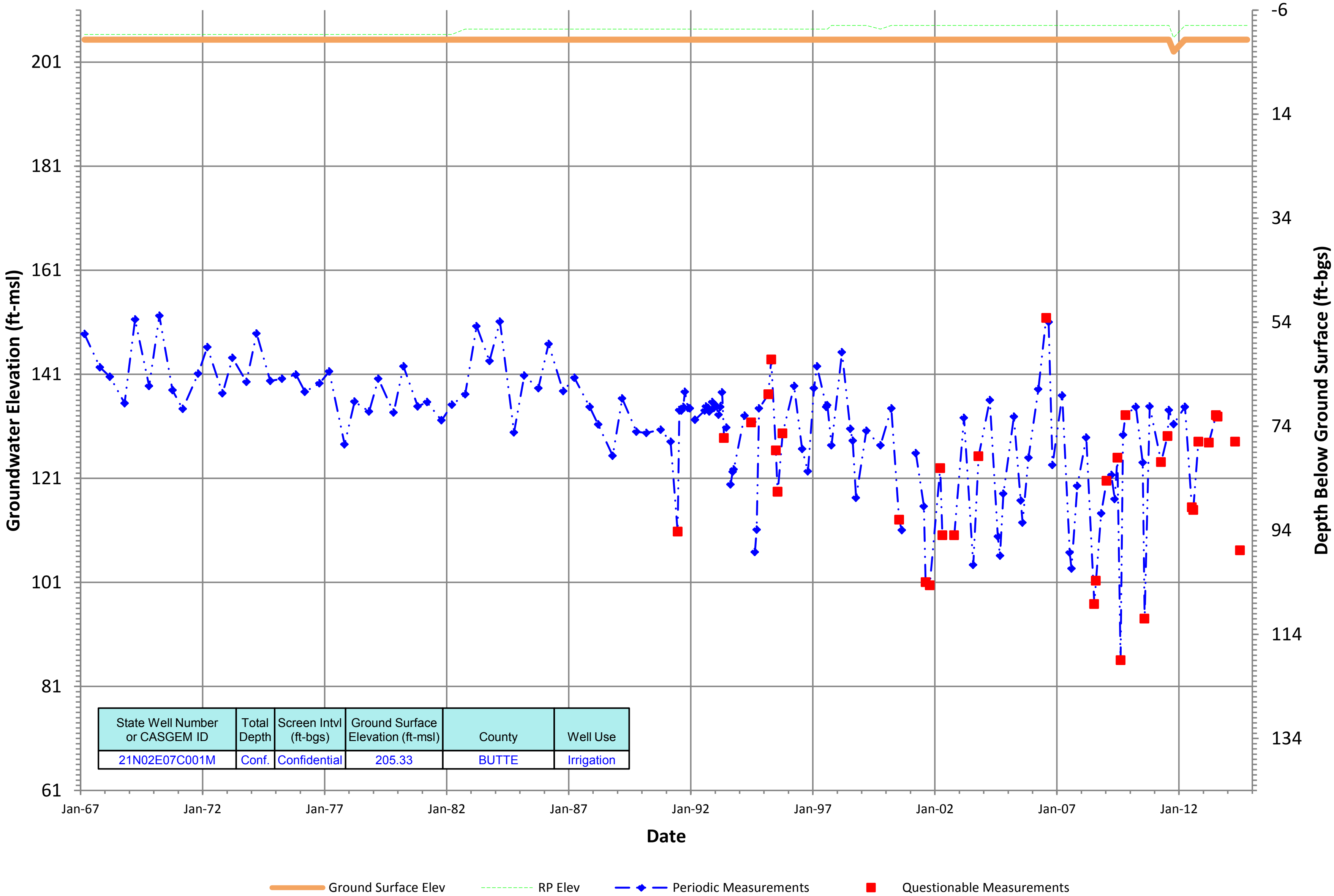


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N01W13J002M	Conf.	Confidential	127.68	BUTTE	Observation


21N01W24B001M
Period Of Record: 03/17/1995 to 10/16/2014
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
133
128
123
118
113
108
103
98
93
88
83
-6
-1
4
9
14
19
24
29
34
39
44
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Mar-08
Mar-09
Mar-10
Mar-11
Mar-12
Mar-13
Mar-14
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
21N01W24B001M
Conf.
Confidential
127.06
BUTTE
Irrigation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

21N02E07C001M
Period Of Record: 02/28/1967 to 10/16/2014

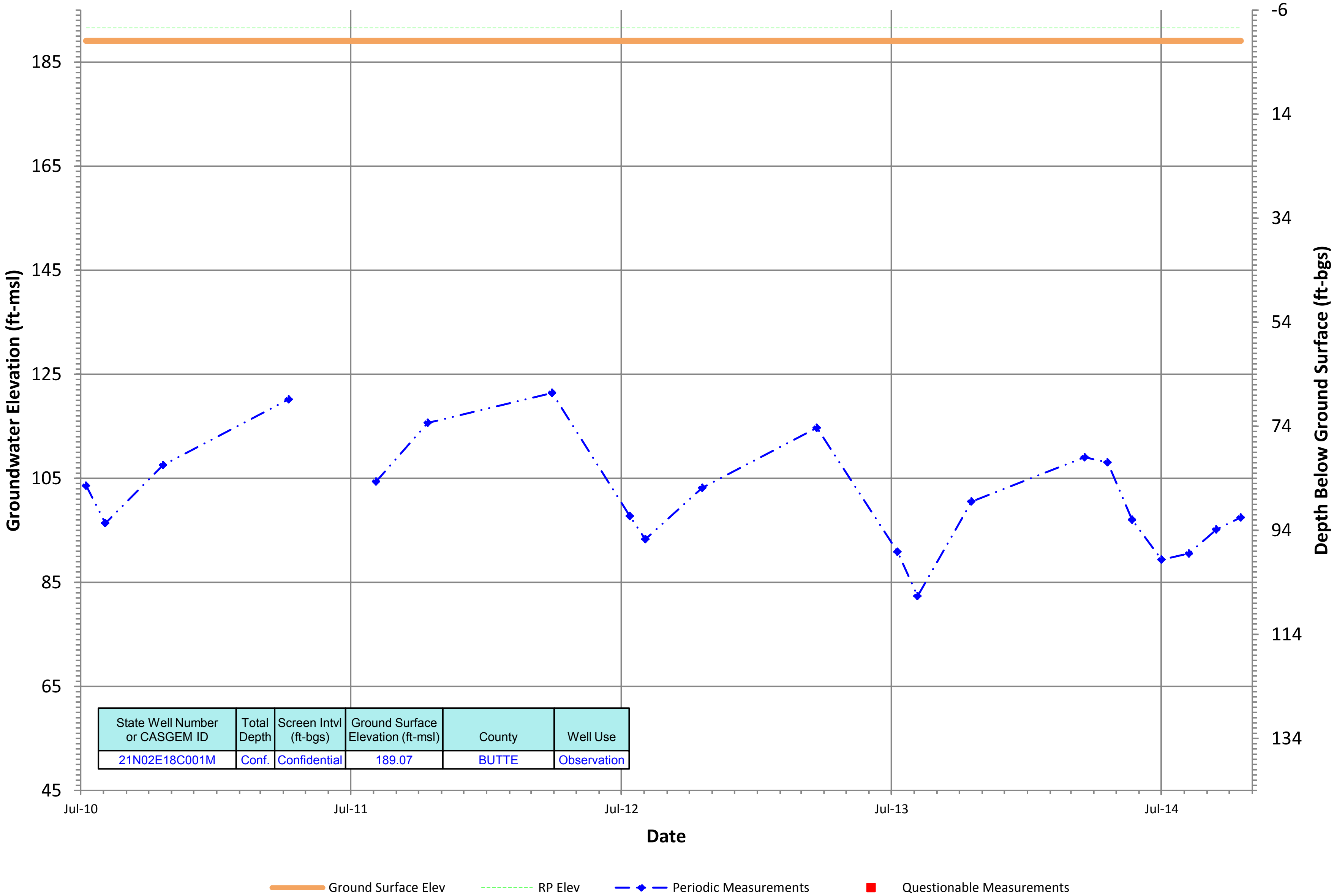
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



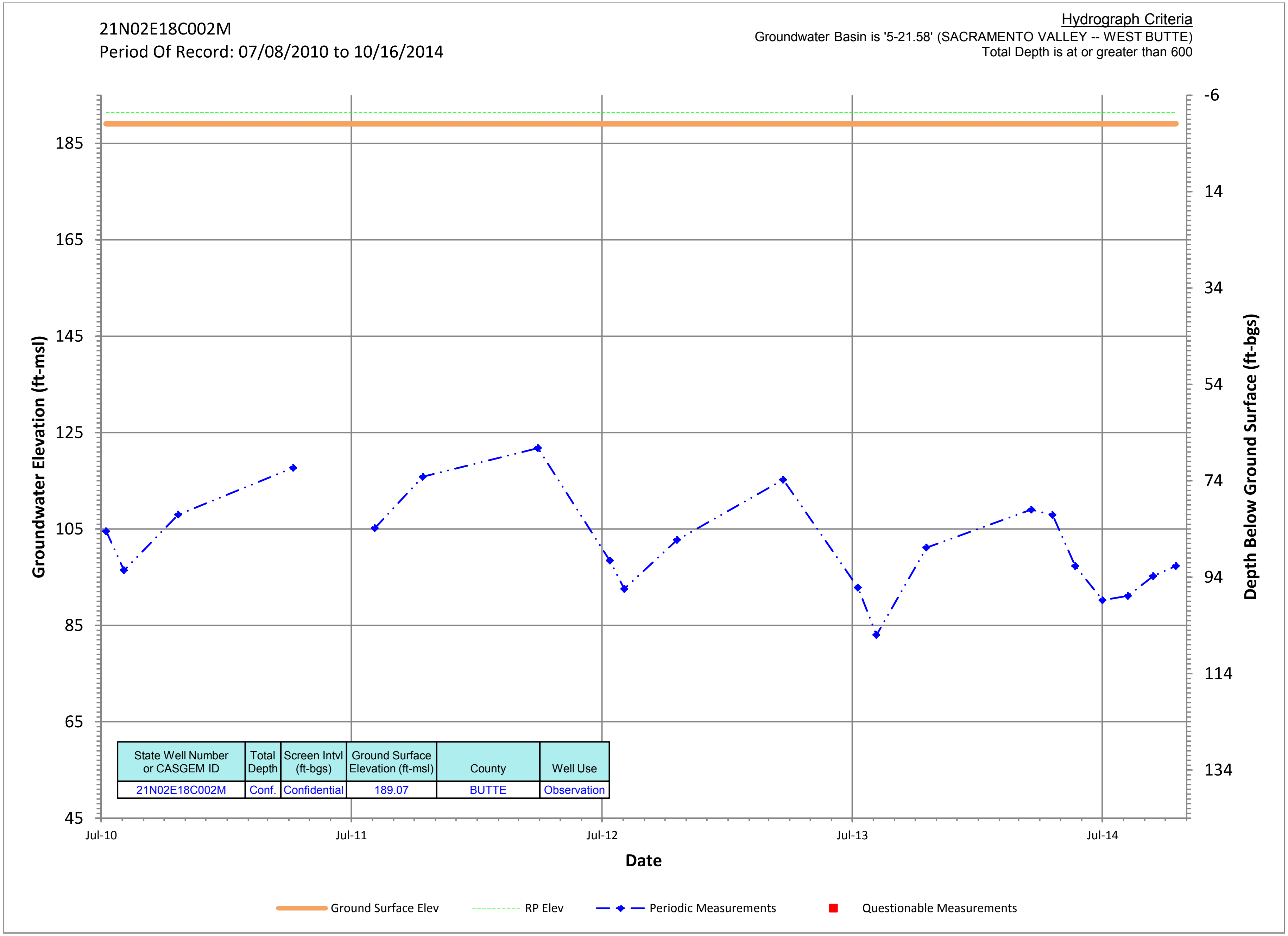
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E07C001M	Conf.	Confidential	205.33	BUTTE	Irrigation

21N02E18C001M
Period Of Record: 07/08/2010 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600

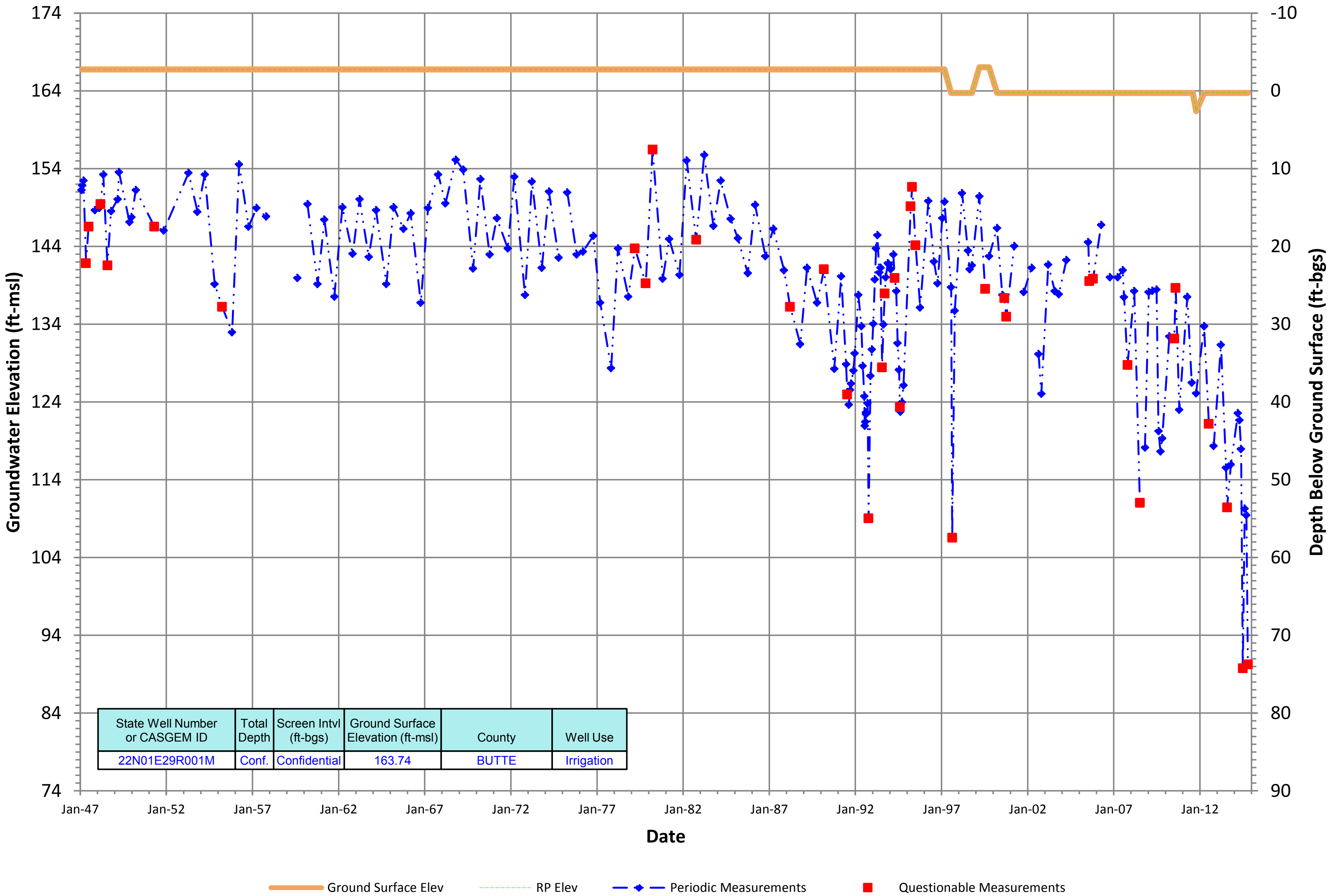


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
21N02E18C001M	Conf.	Confidential	189.07	BUTTE	Observation

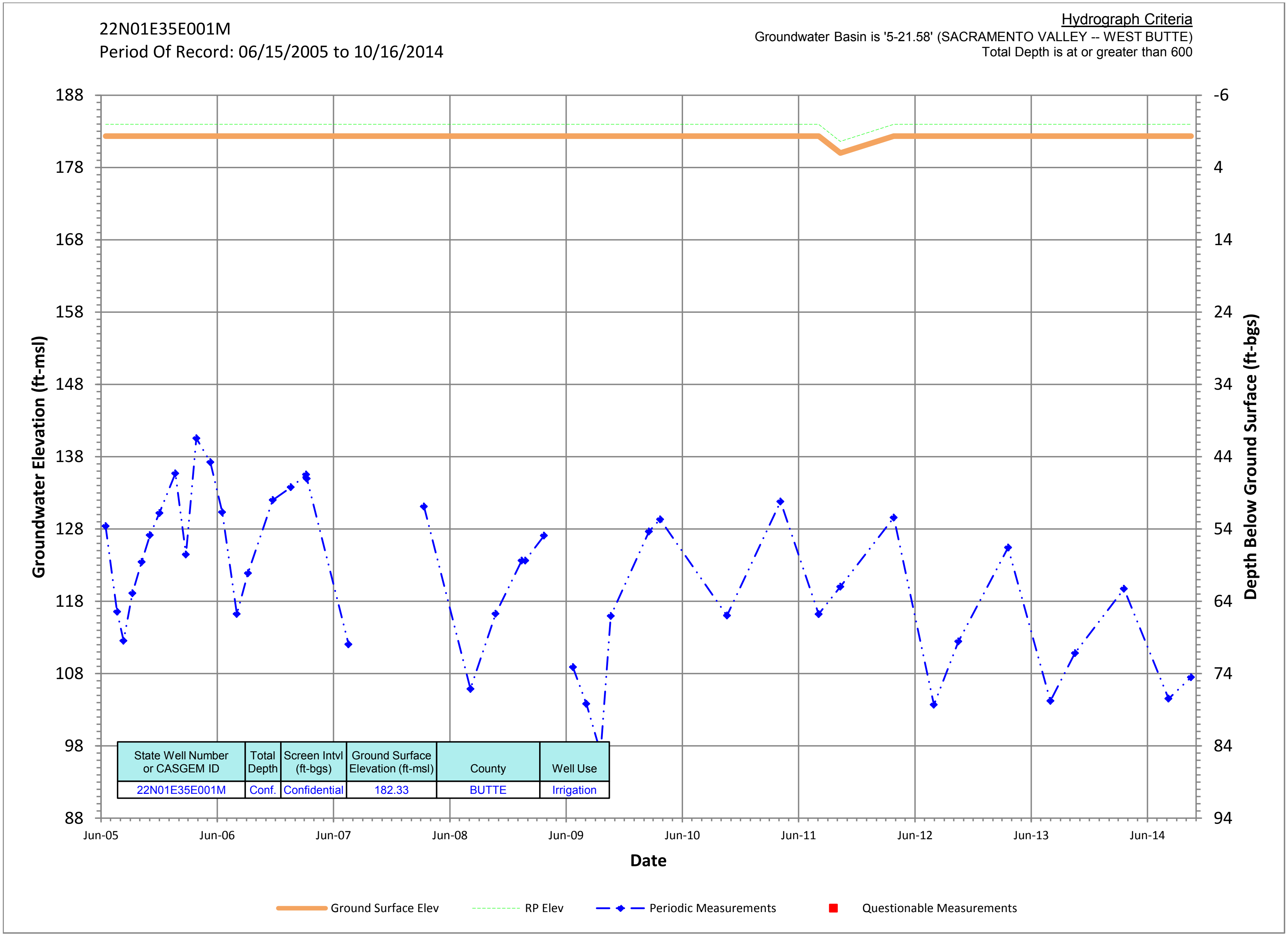

21N02E18C002M
Period Of Record: 07/08/2010 to 10/16/2014
Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600
Groundwater Elevation (ft-msl)
Depth Below Ground Surface (ft-bgs)
185
165
145
125
105
85
65
45
-6
14
34
54
74
94
114
134
Jul-10
Jul-11
Jul-12
Jul-13
Jul-14
Date
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
21N02E18C002M
Conf.
Confidential
189.07
BUTTE
Observation
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

22N01E29R001M
Period Of Record: 01/27/1947 to 10/16/2014

Hydrograph Criteria
Groundwater Basin is '5-21.58' (SACRAMENTO VALLEY -- WEST BUTTE)
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N01E29R001M	Conf.	Confidential	163.74	BUTTE	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
22N01E35E001M	Conf.	Confidential	182.33	BUTTE	Irrigation

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Shallow Groundwater Monitoring Well Hydrographs- Yolo Subbasin

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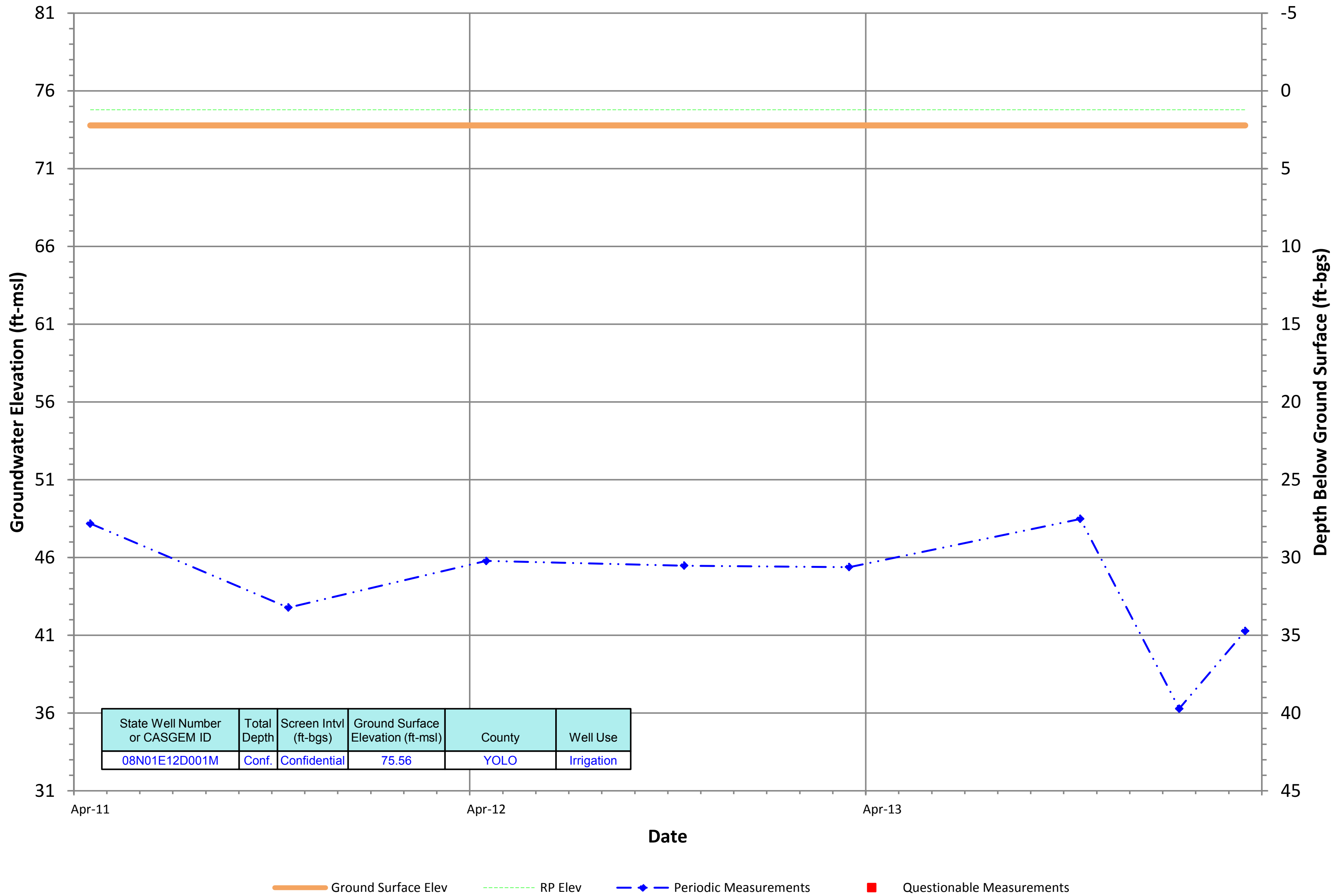
08N01E12D001M
Period Of Record: 04/22/2011 to 03/18/2014

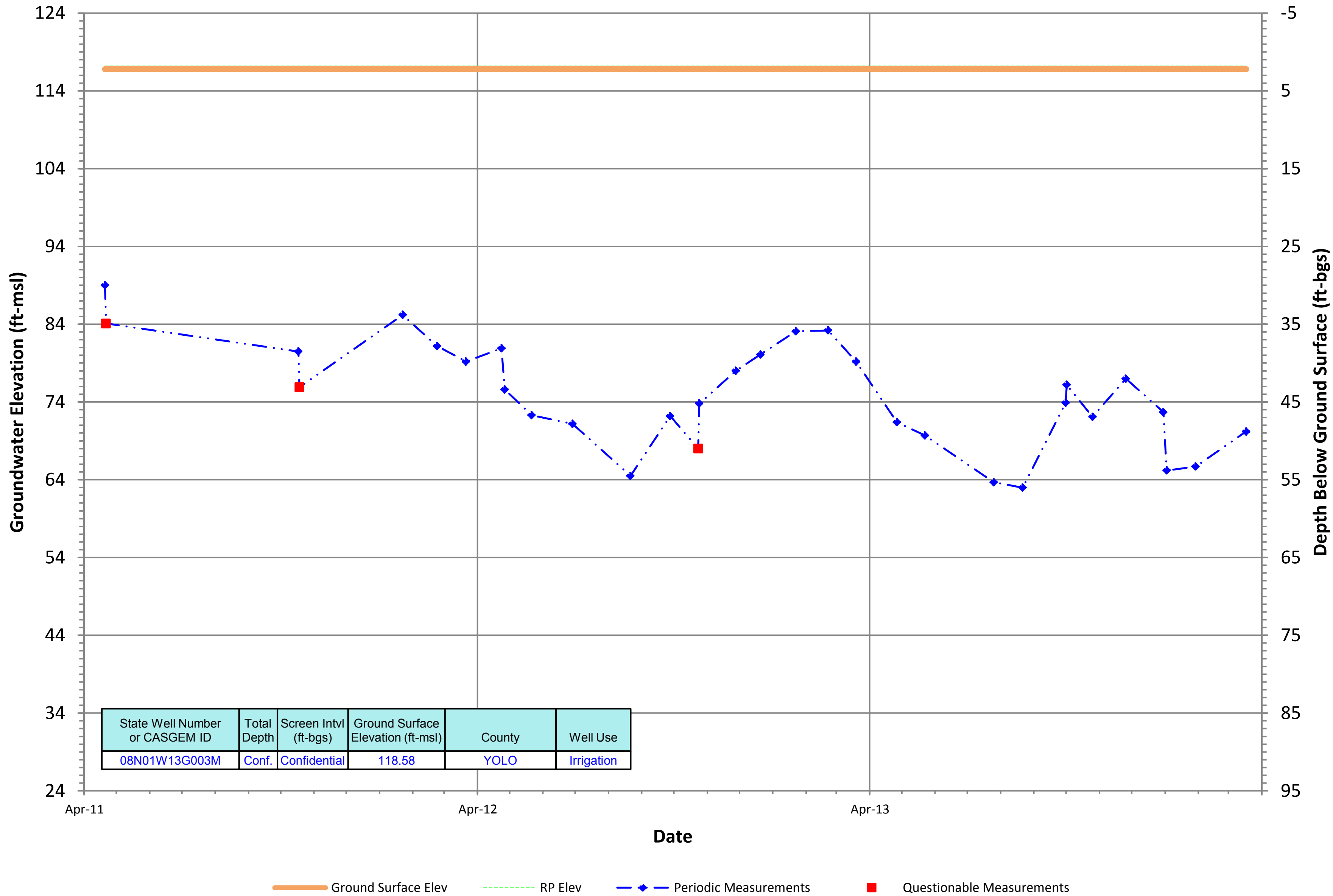
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E12D001M	Conf.	Confidential	75.56	YOLO	Irrigation

08N01W13G003M
Period Of Record: 04/20/2011 to 03/17/2014

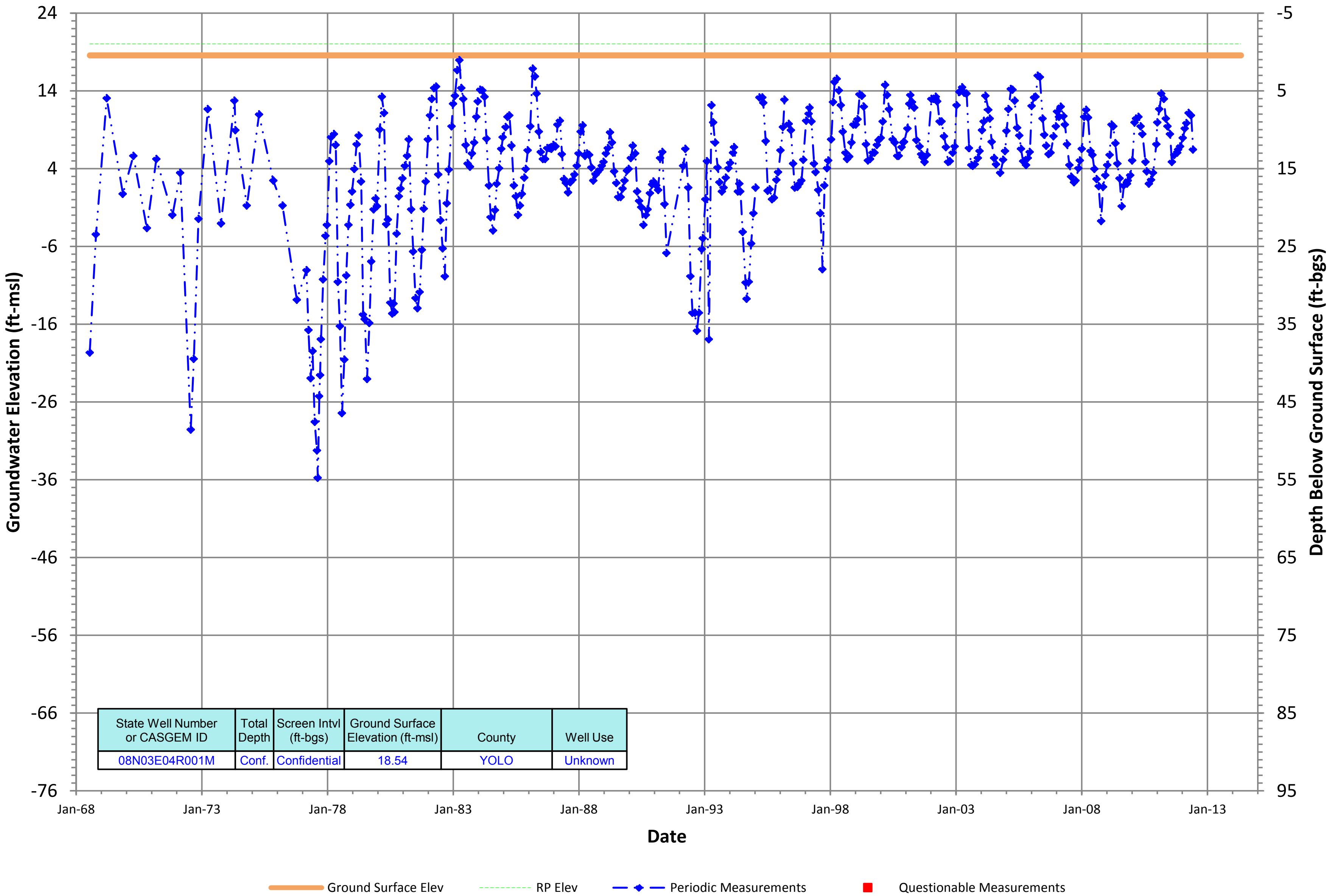
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



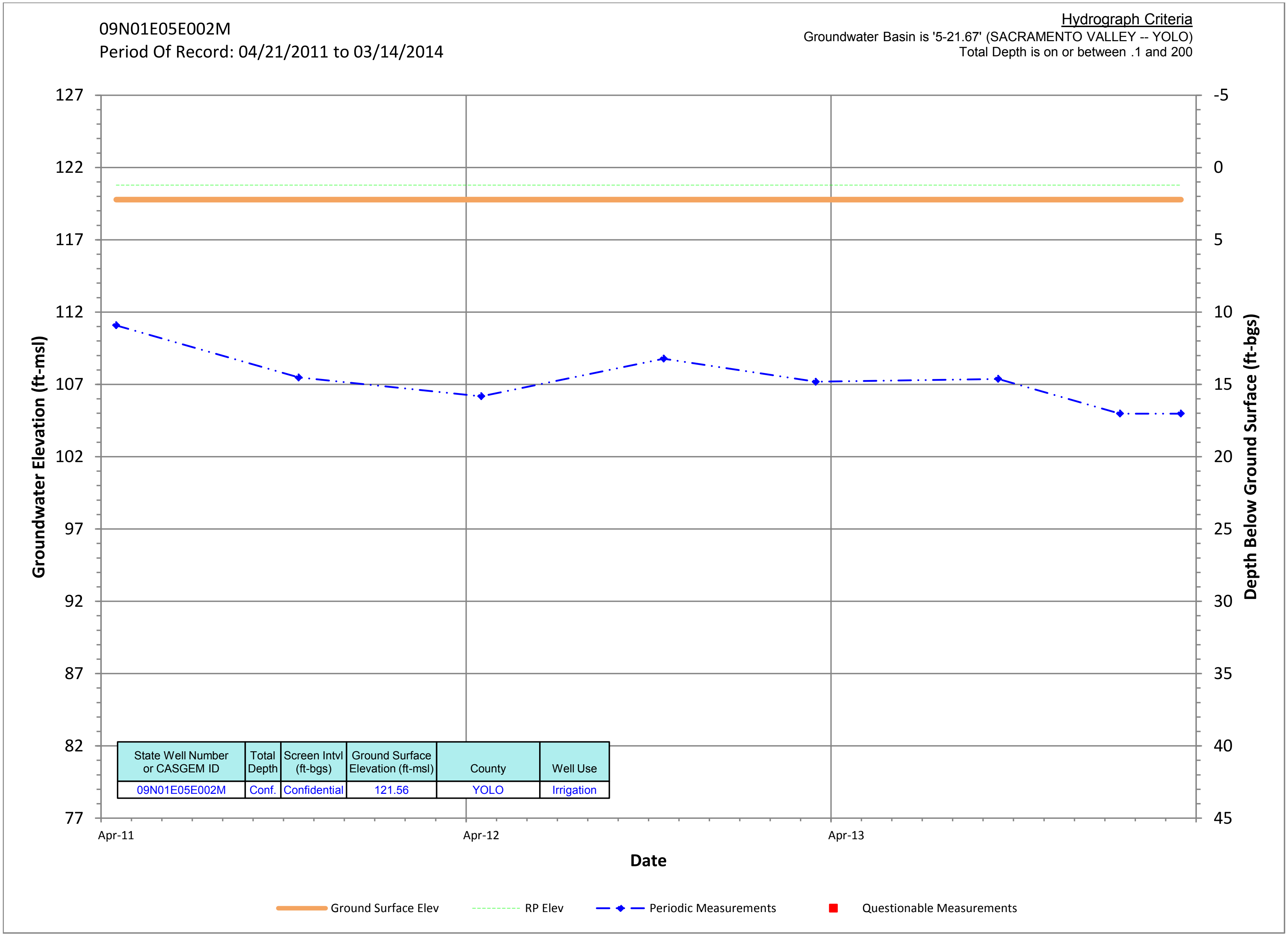
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W13G003M	Conf.	Confidential	118.58	YOLO	Irrigation

08N03E04R001M
Period Of Record: 07/16/1968 to 05/01/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



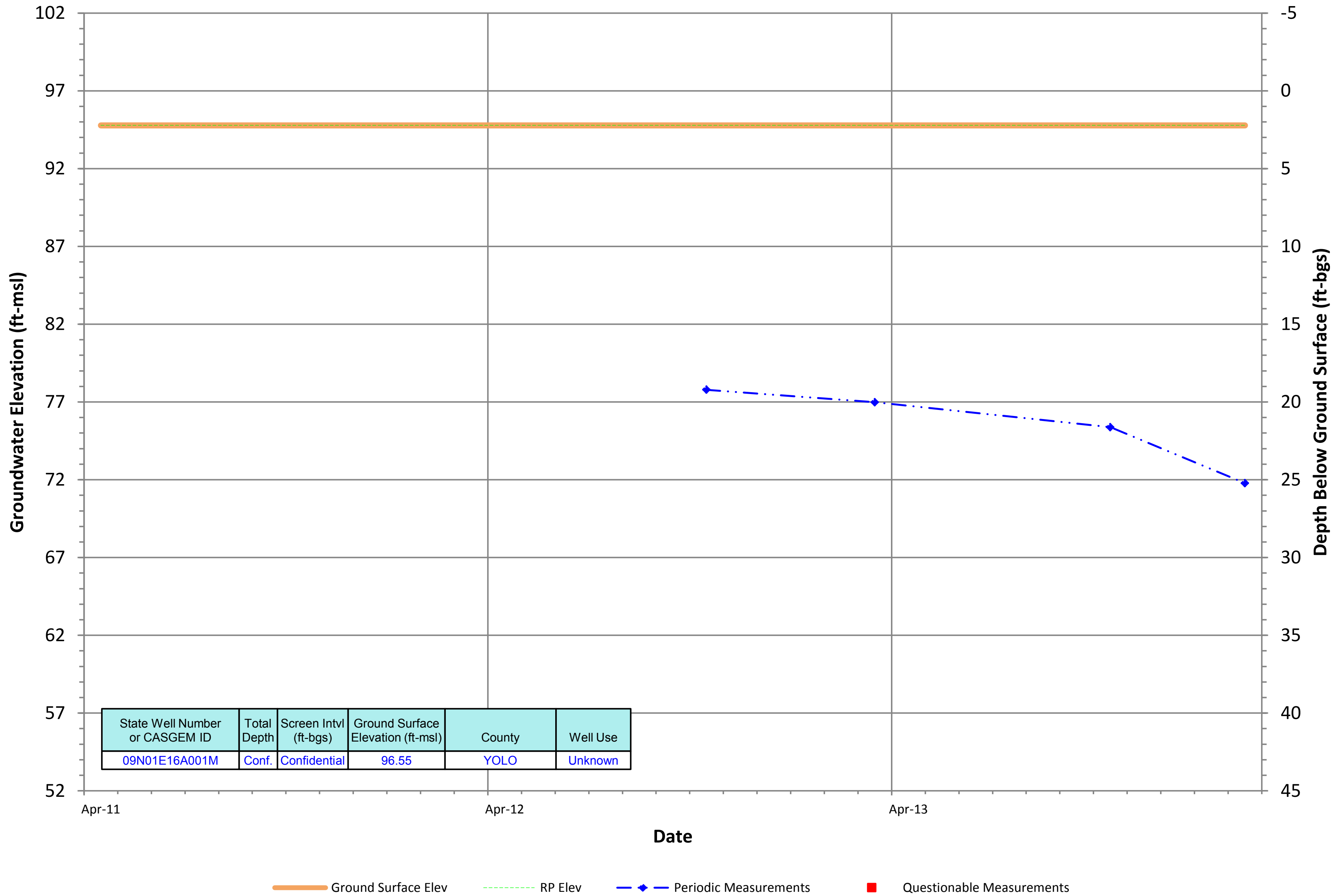
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N03E04R001M	Conf.	Confidential	18.54	YOLO	Unknown



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E05E002M	Conf.	Confidential	121.56	YOLO	Irrigation

09N01E16A001M
Period Of Record: 04/26/2011 to 02/05/2014

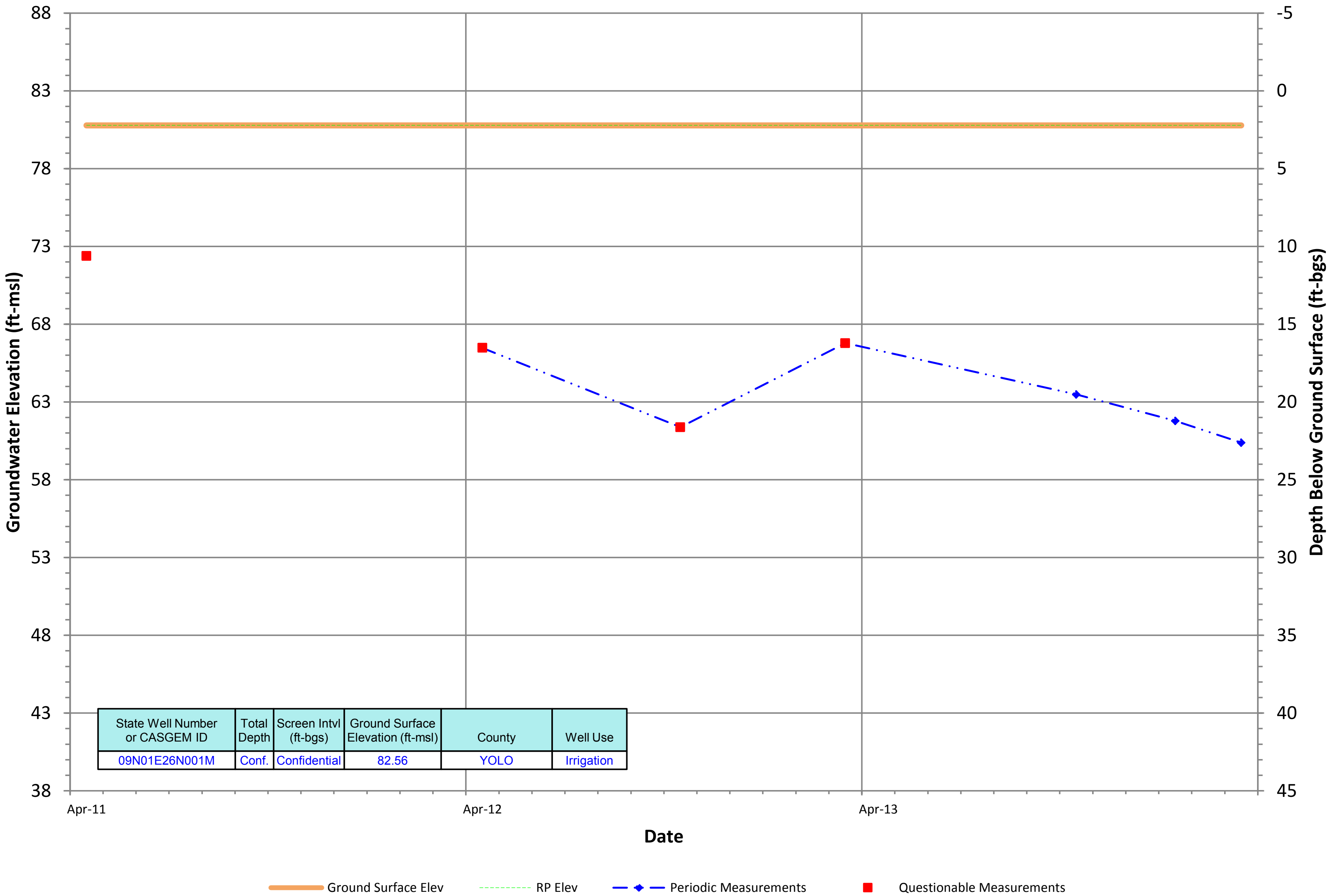
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E16A001M	Conf.	Confidential	96.55	YOLO	Unknown

09N01E26N001M
Period Of Record: 04/22/2011 to 03/18/2014

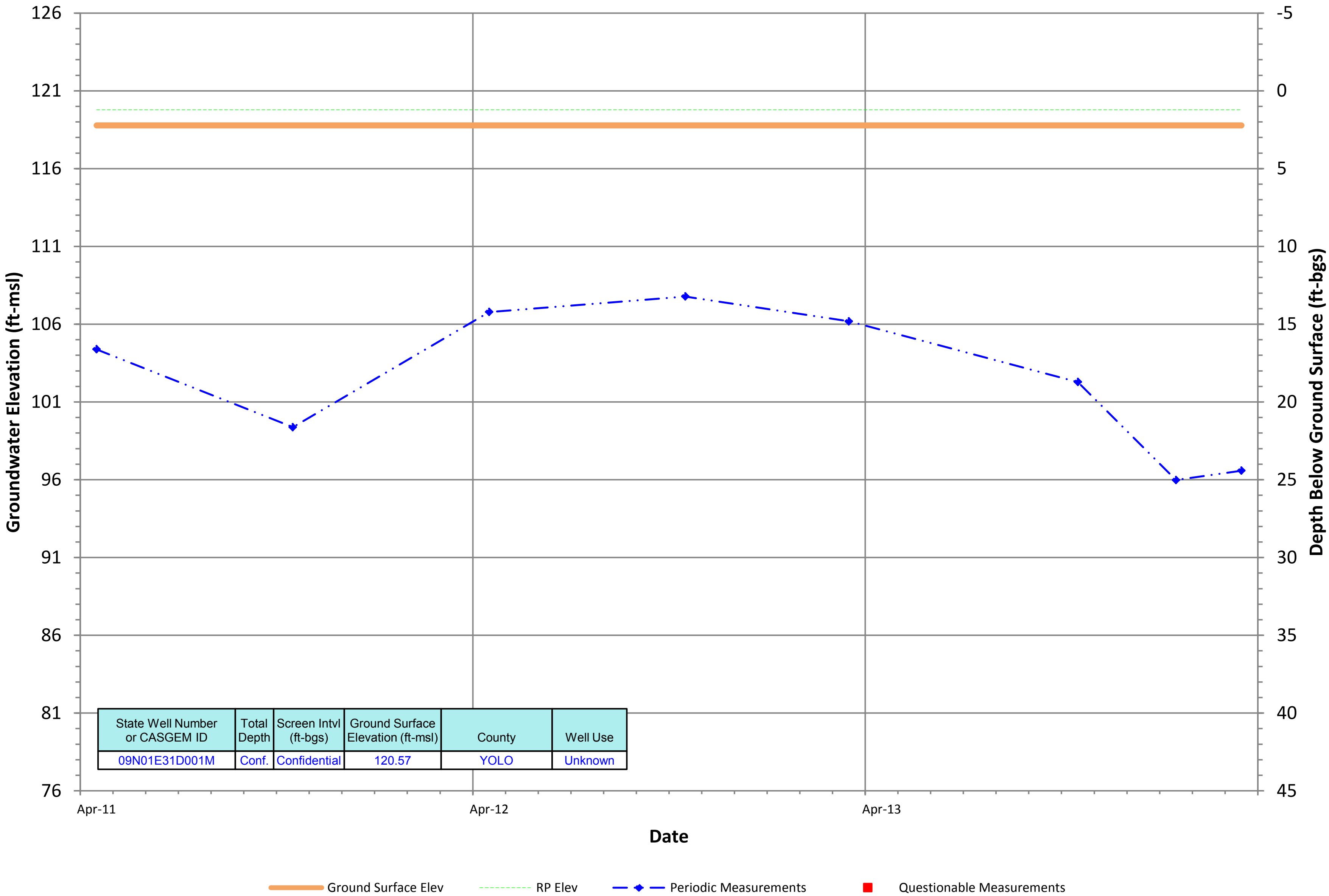
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E26N001M	Conf.	Confidential	82.56	YOLO	Irrigation

09N01E31D001M
Period Of Record: 04/21/2011 to 03/17/2014

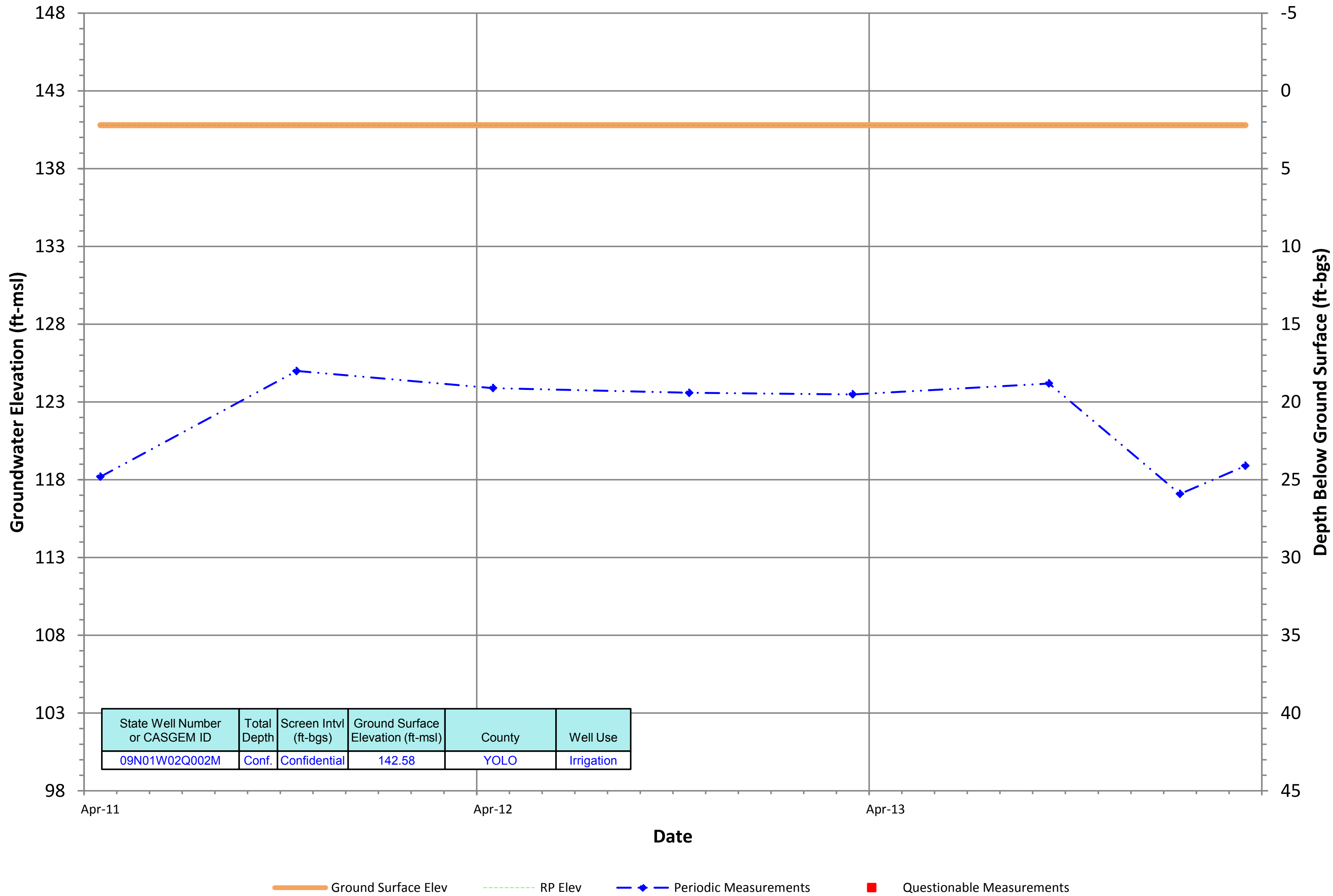
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



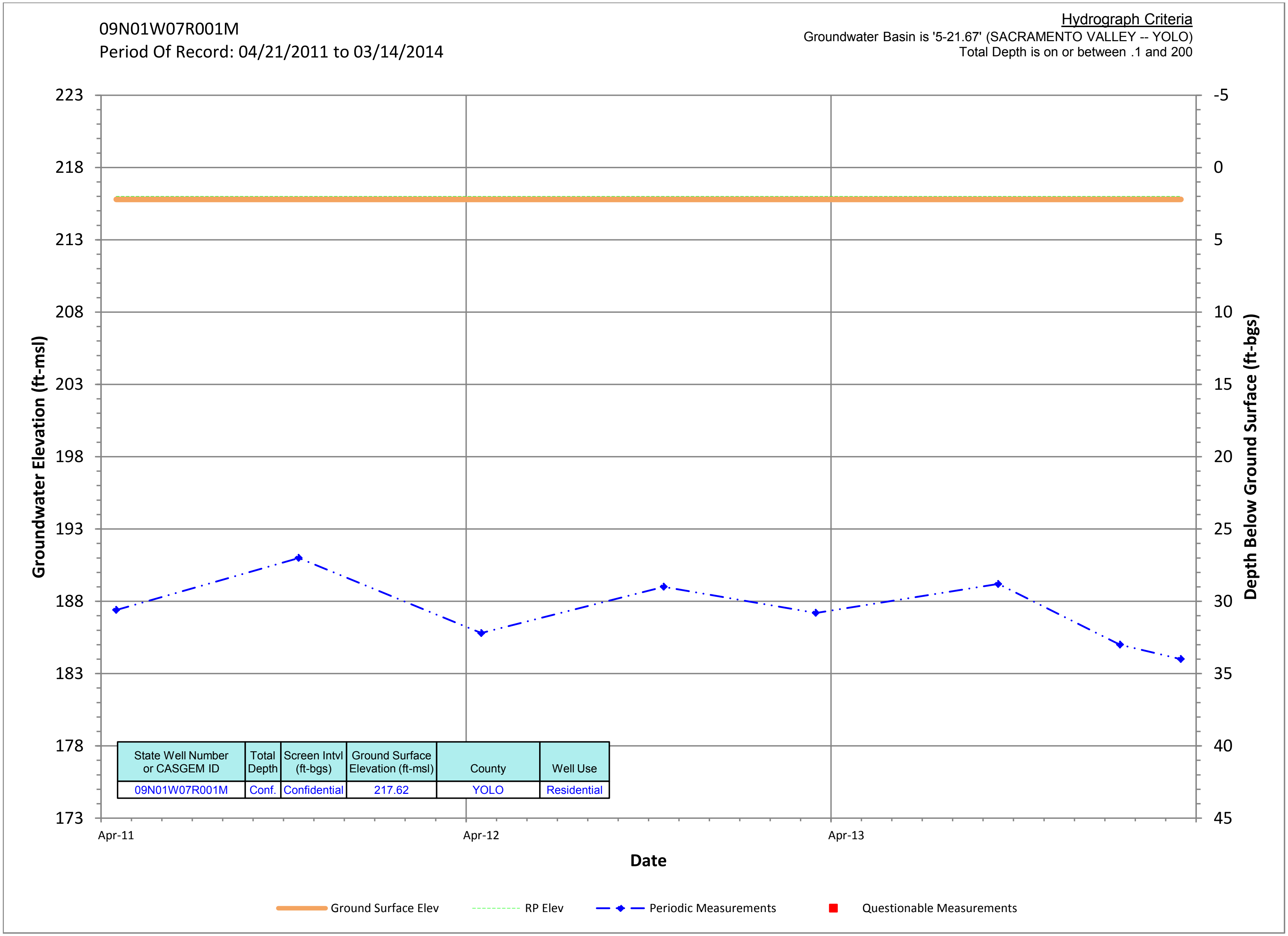
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E31D001M	Conf.	Confidential	120.57	YOLO	Unknown

09N01W02Q002M
Period Of Record: 04/21/2011 to 03/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



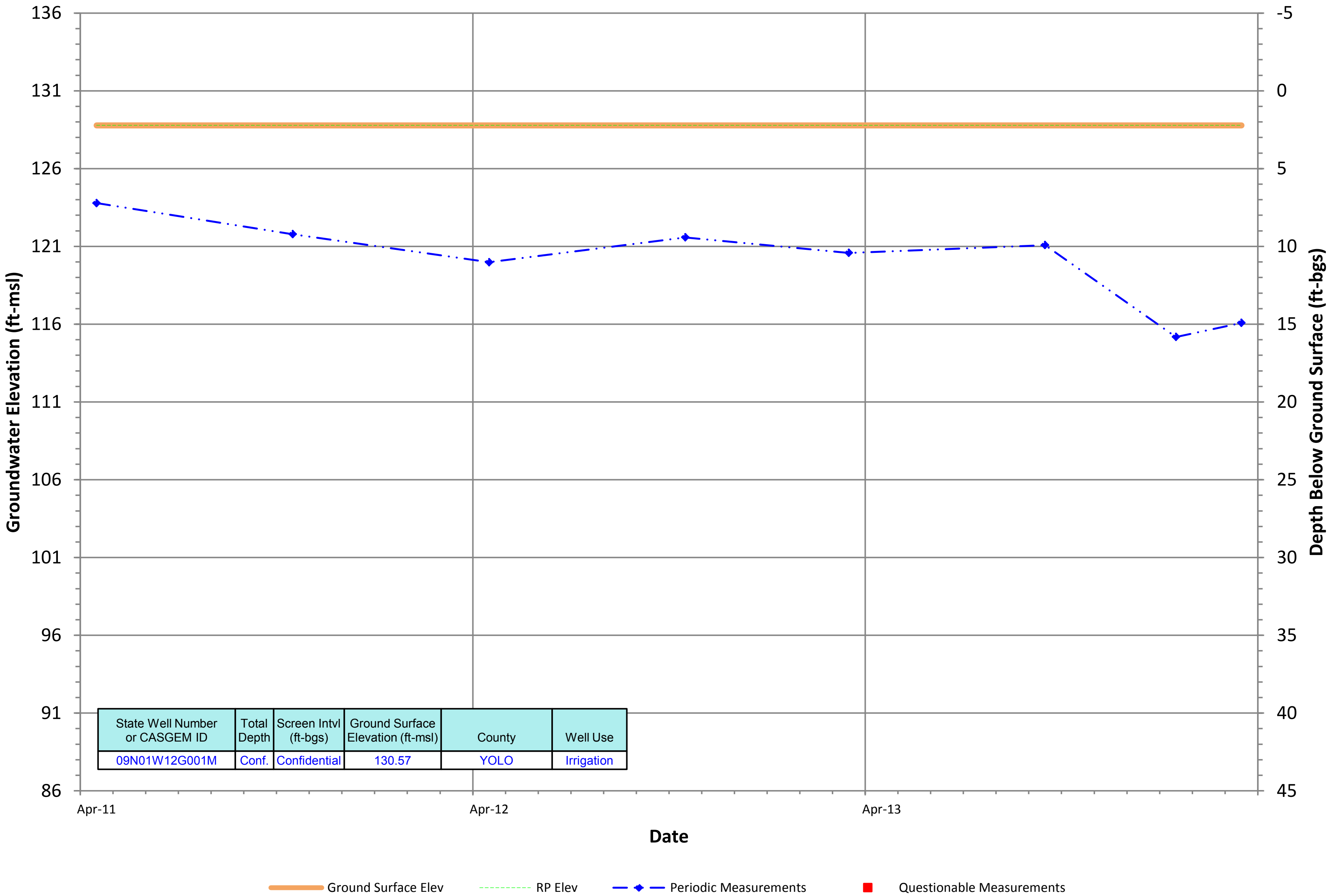
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W02Q002M	Conf.	Confidential	142.58	YOLO	Irrigation



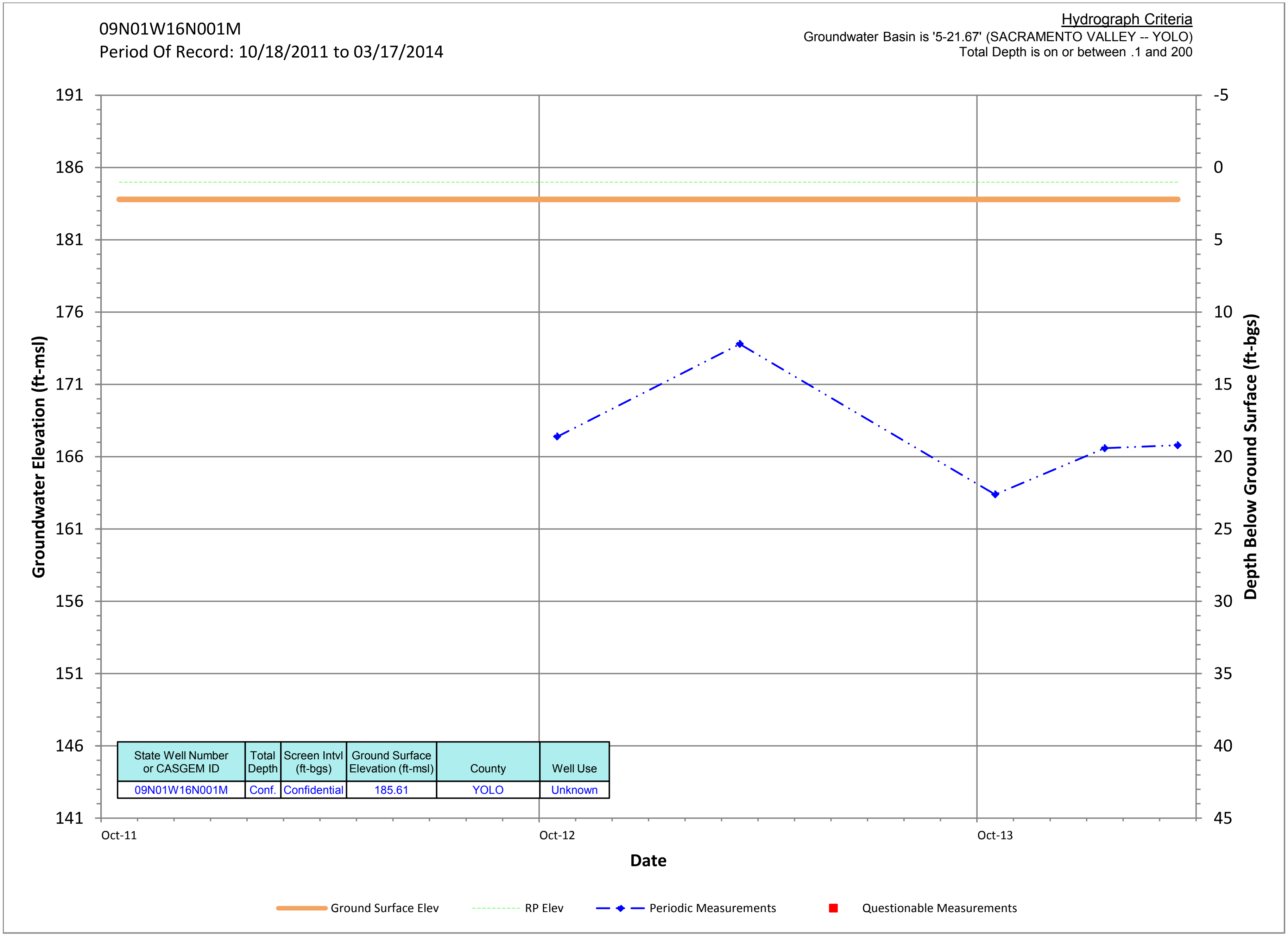
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W07R001M	Conf.	Confidential	217.62	YOLO	Residential

09N01W12G001M
Period Of Record: 04/21/2011 to 03/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



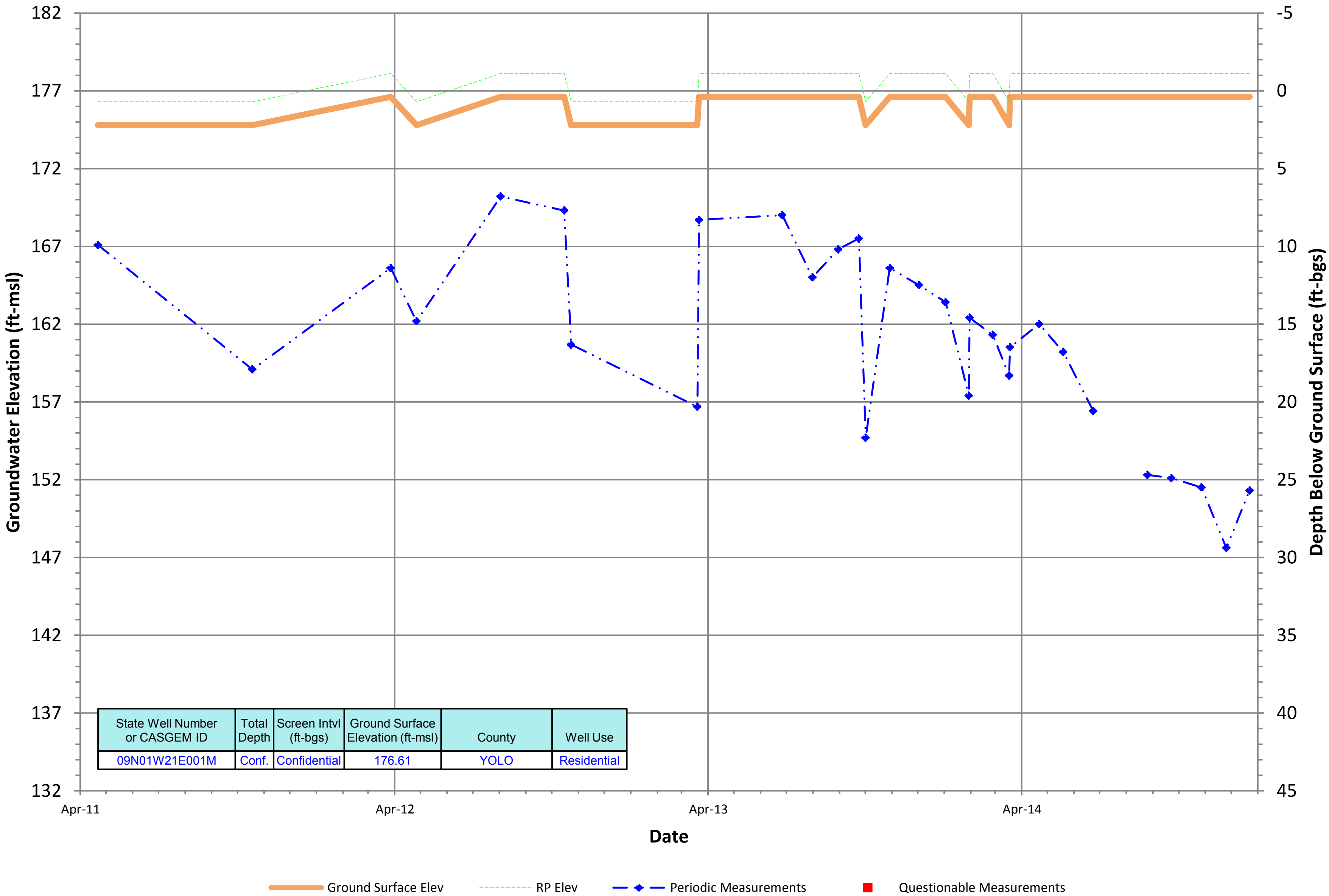
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W12G001M	Conf.	Confidential	130.57	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W16N001M	Conf.	Confidential	185.61	YOLO	Unknown

09N01W21E001M
Period Of Record: 04/21/2011 to 12/22/2014

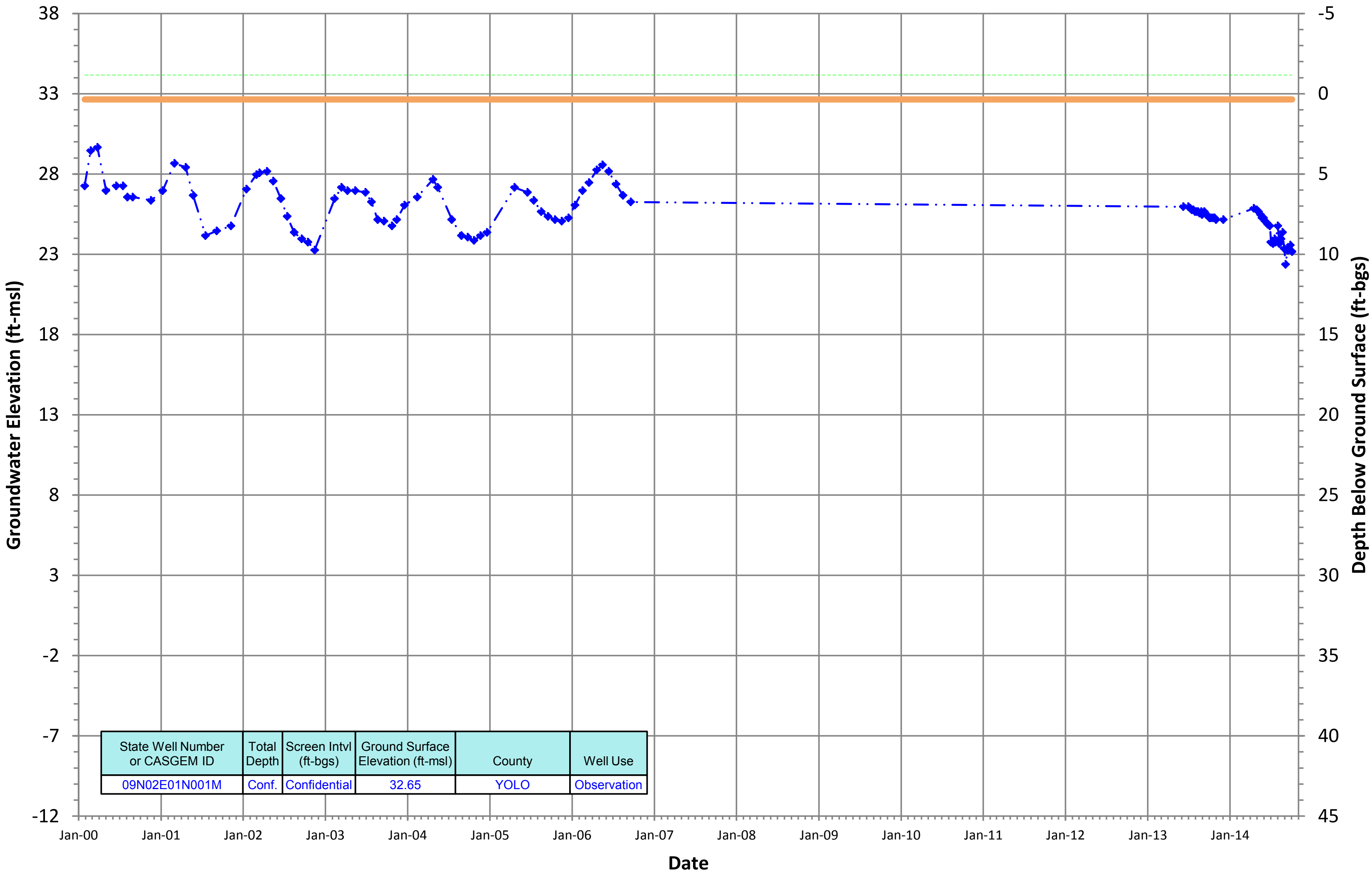
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



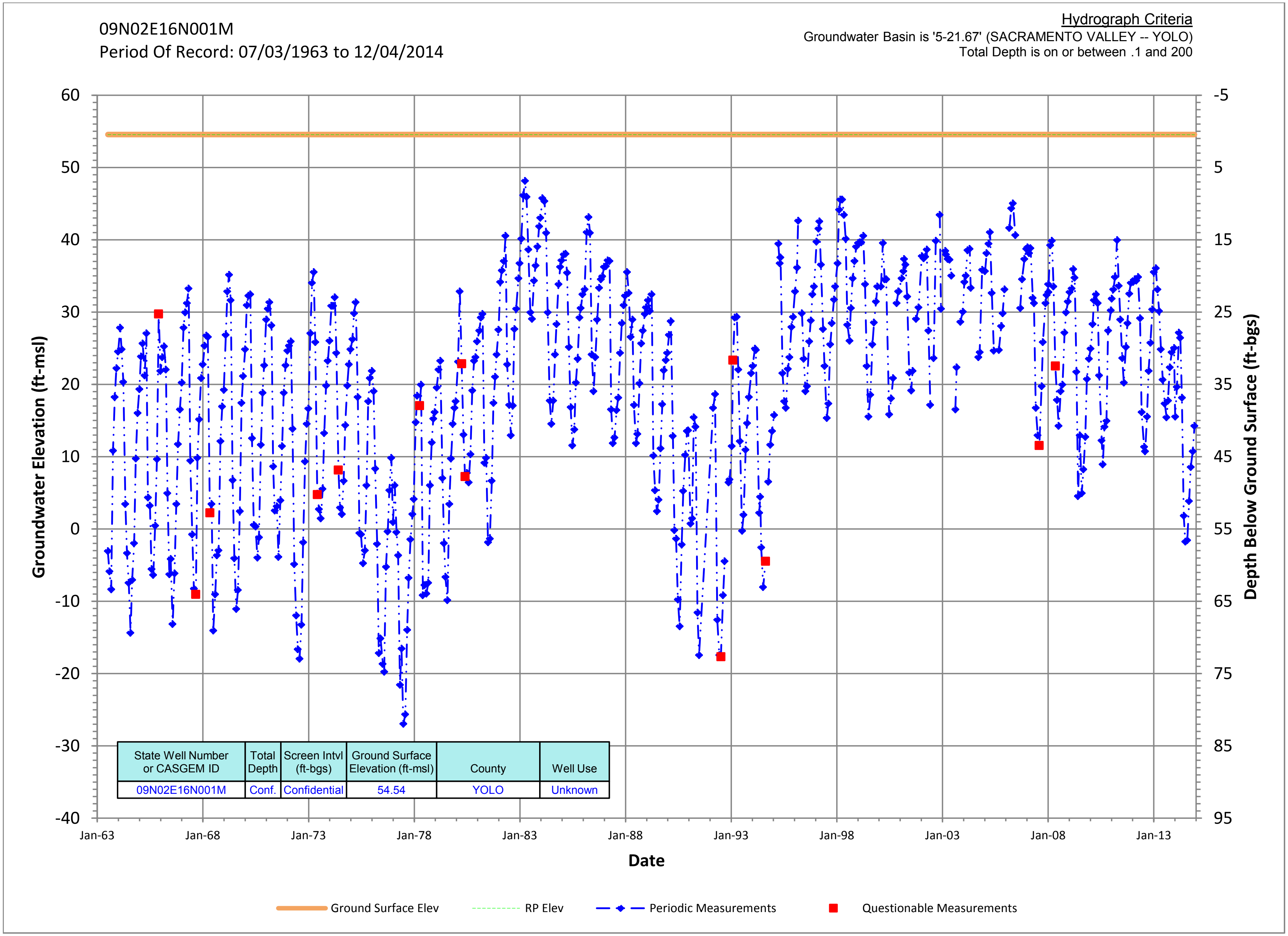
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W21E001M	Conf.	Confidential	176.61	YOLO	Residential

09N02E01N001M
Period Of Record: 01/27/2000 to 10/03/2014

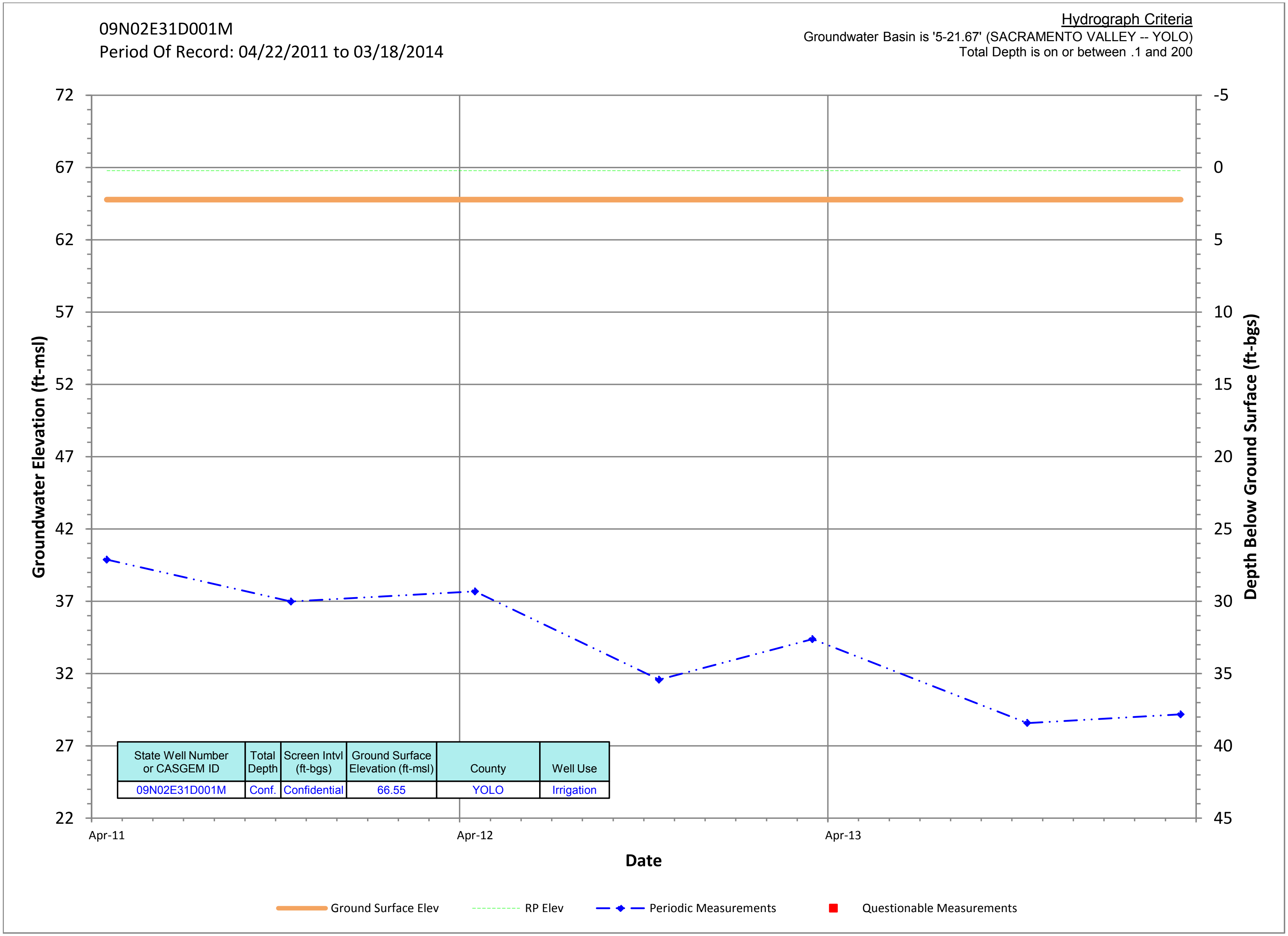
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E01N001M	Conf.	Confidential	32.65	YOLO	Observation



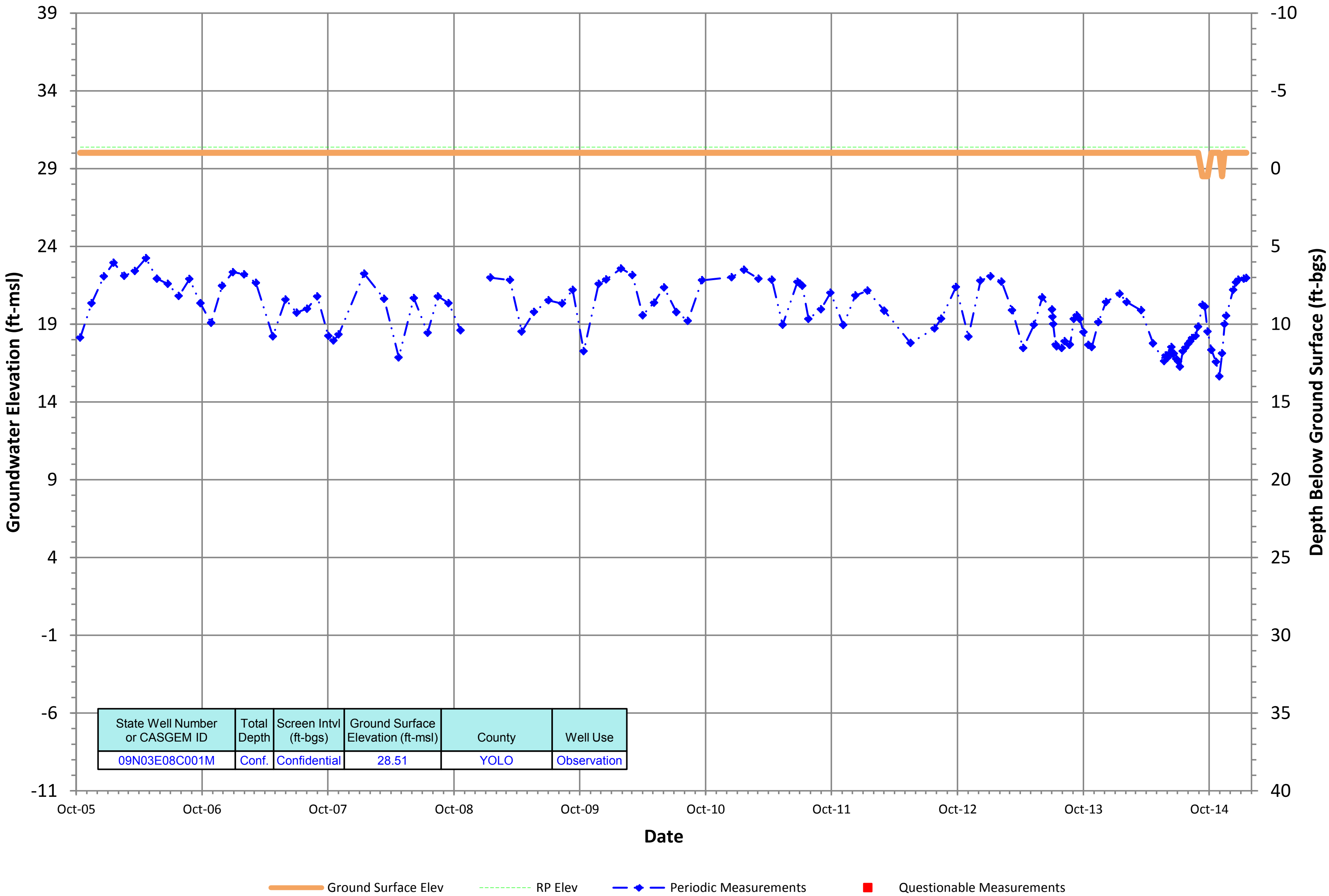
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E16N001M	Conf.	Confidential	54.54	YOLO	Unknown



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E31D001M	Conf.	Confidential	66.55	YOLO	Irrigation

09N03E08C001M
Period Of Record: 10/12/2005 to 01/16/2015

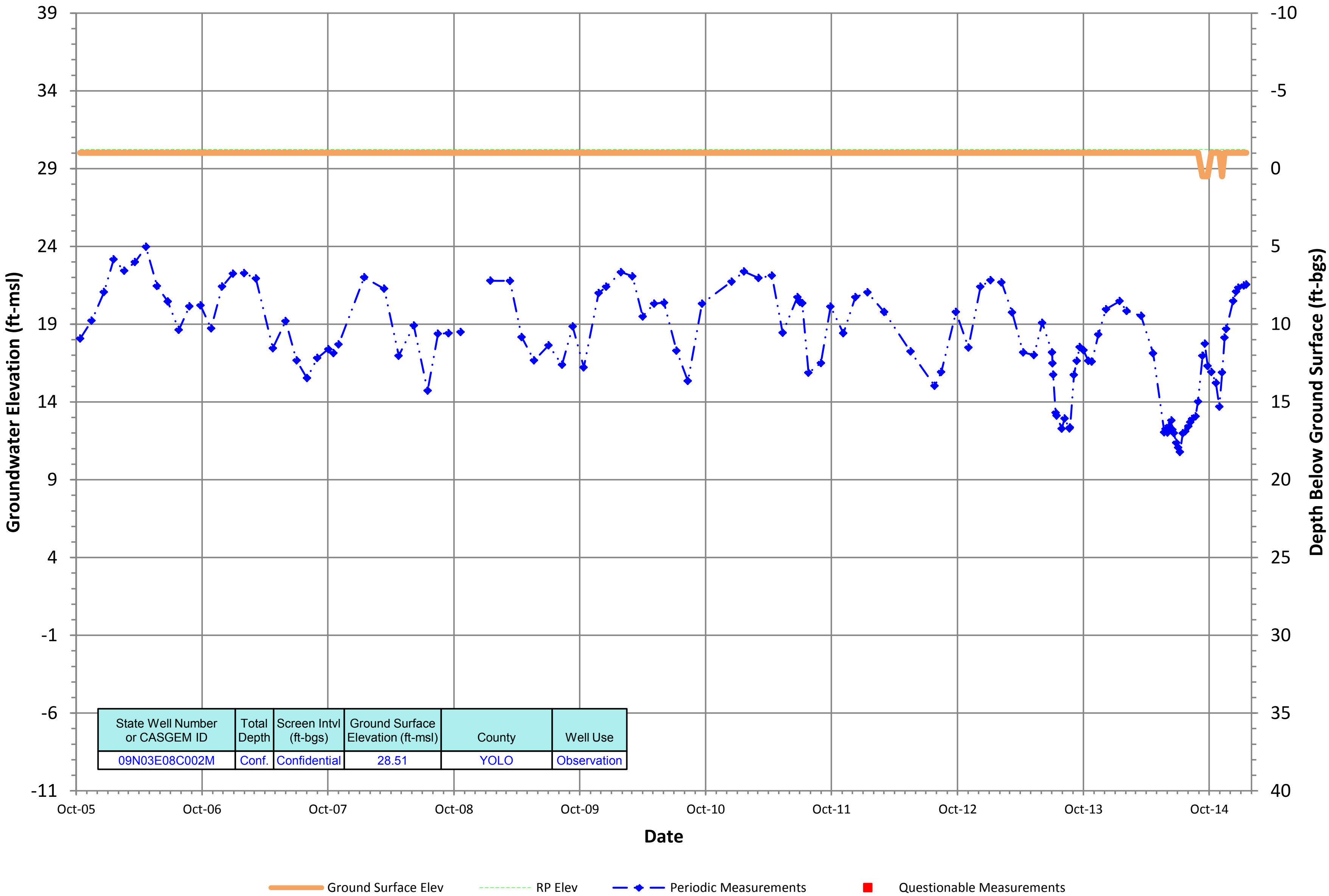
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E08C001M	Conf.	Confidential	28.51	YOLO	Observation

09N03E08C002M
Period Of Record: 10/12/2005 to 01/16/2015

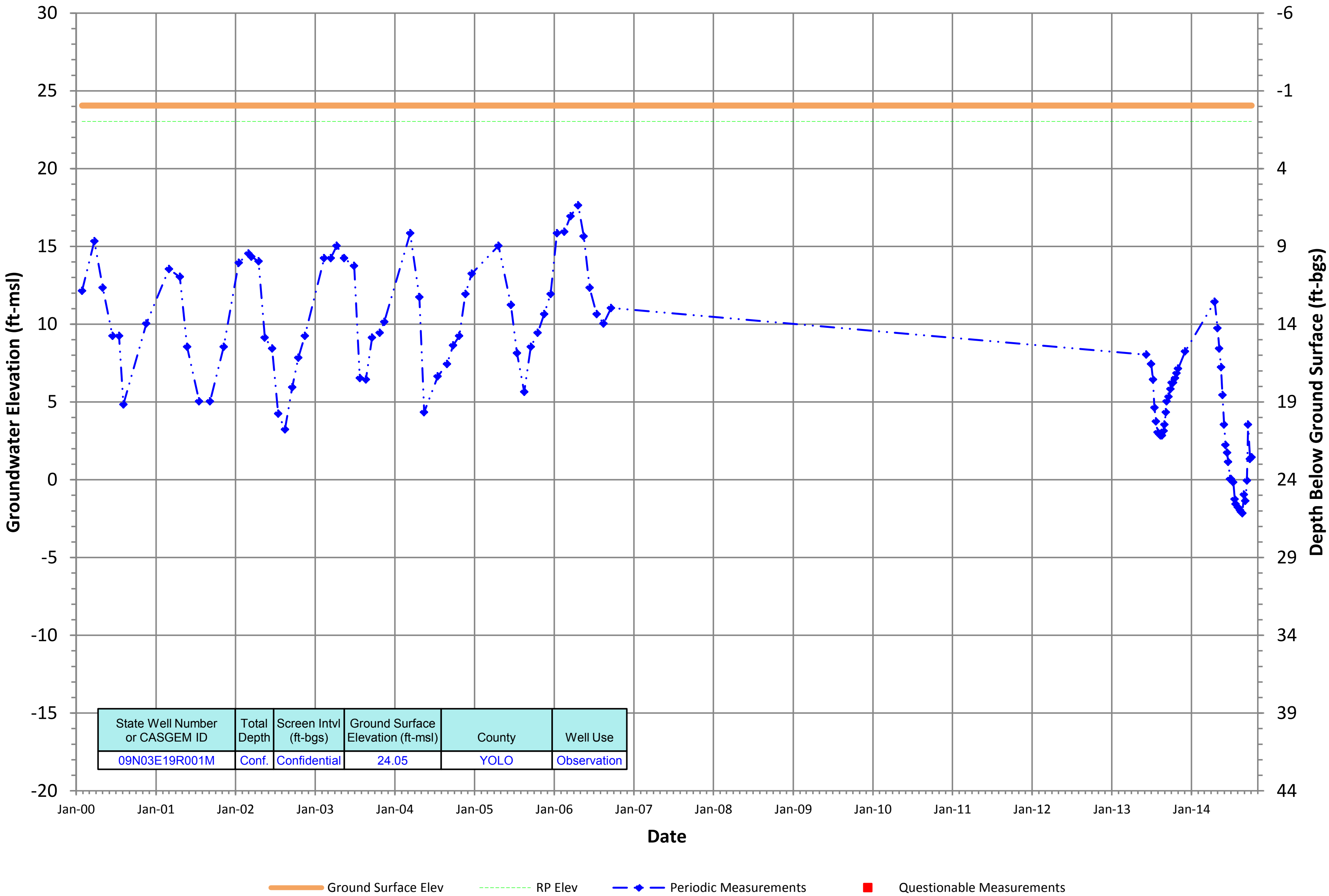
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E08C002M	Conf.	Confidential	28.51	YOLO	Observation

09N03E19R001M
Period Of Record: 01/27/2000 to 10/03/2014

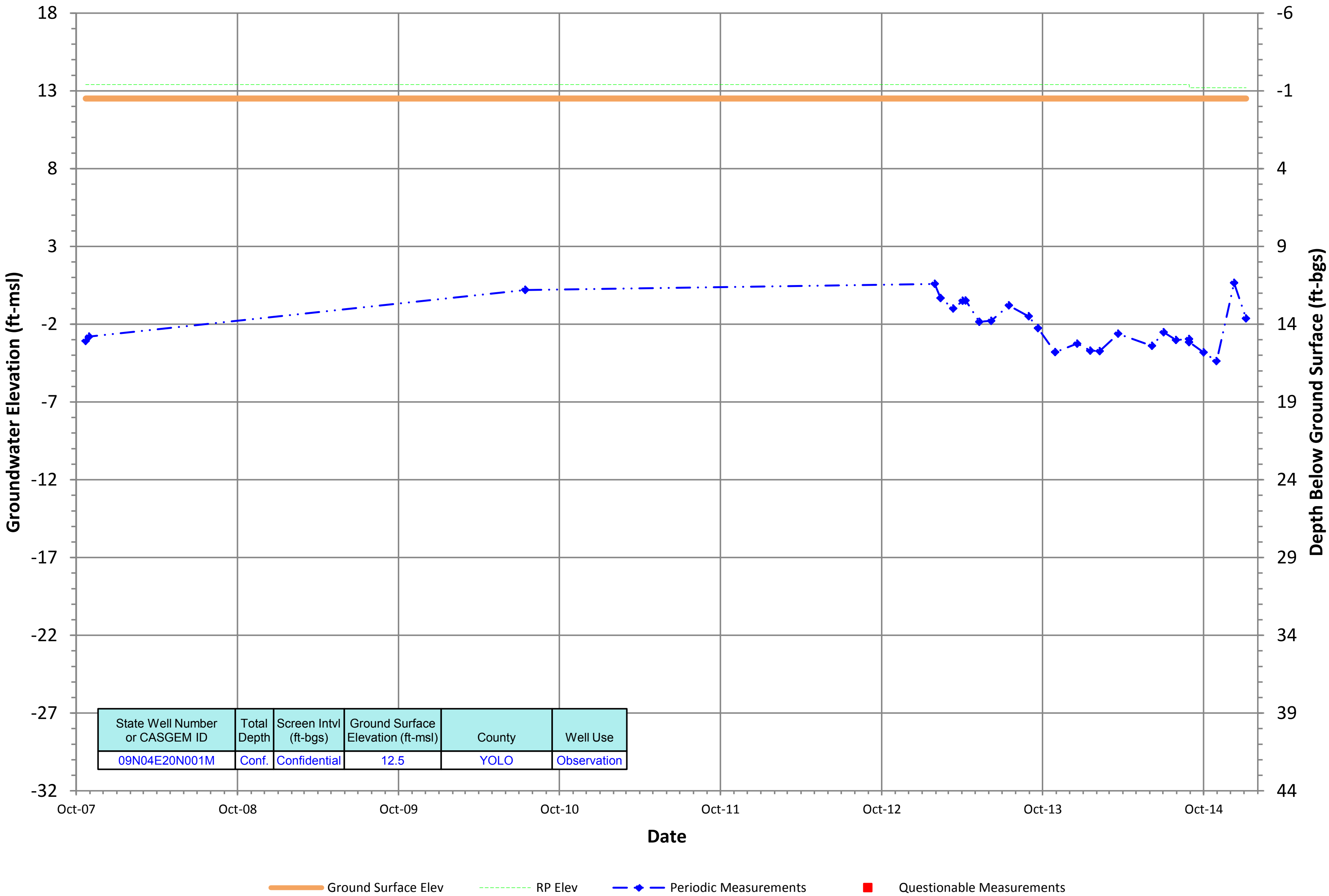
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E19R001M	Conf.	Confidential	24.05	YOLO	Observation

09N04E20N001M
Period Of Record: 10/22/2007 to 01/05/2015

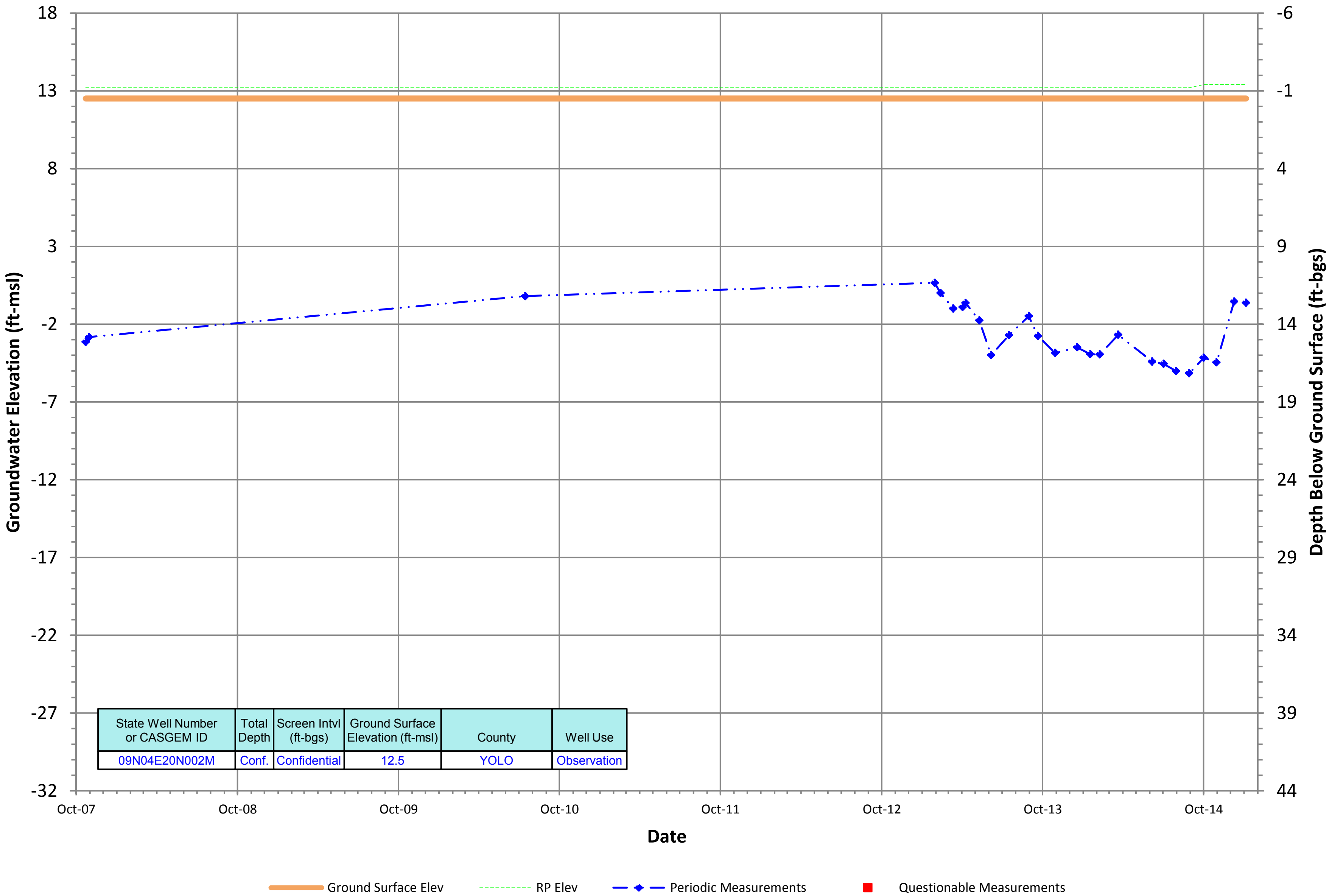
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N04E20N001M	Conf.	Confidential	12.5	YOLO	Observation

09N04E20N002M
Period Of Record: 10/22/2007 to 01/05/2015

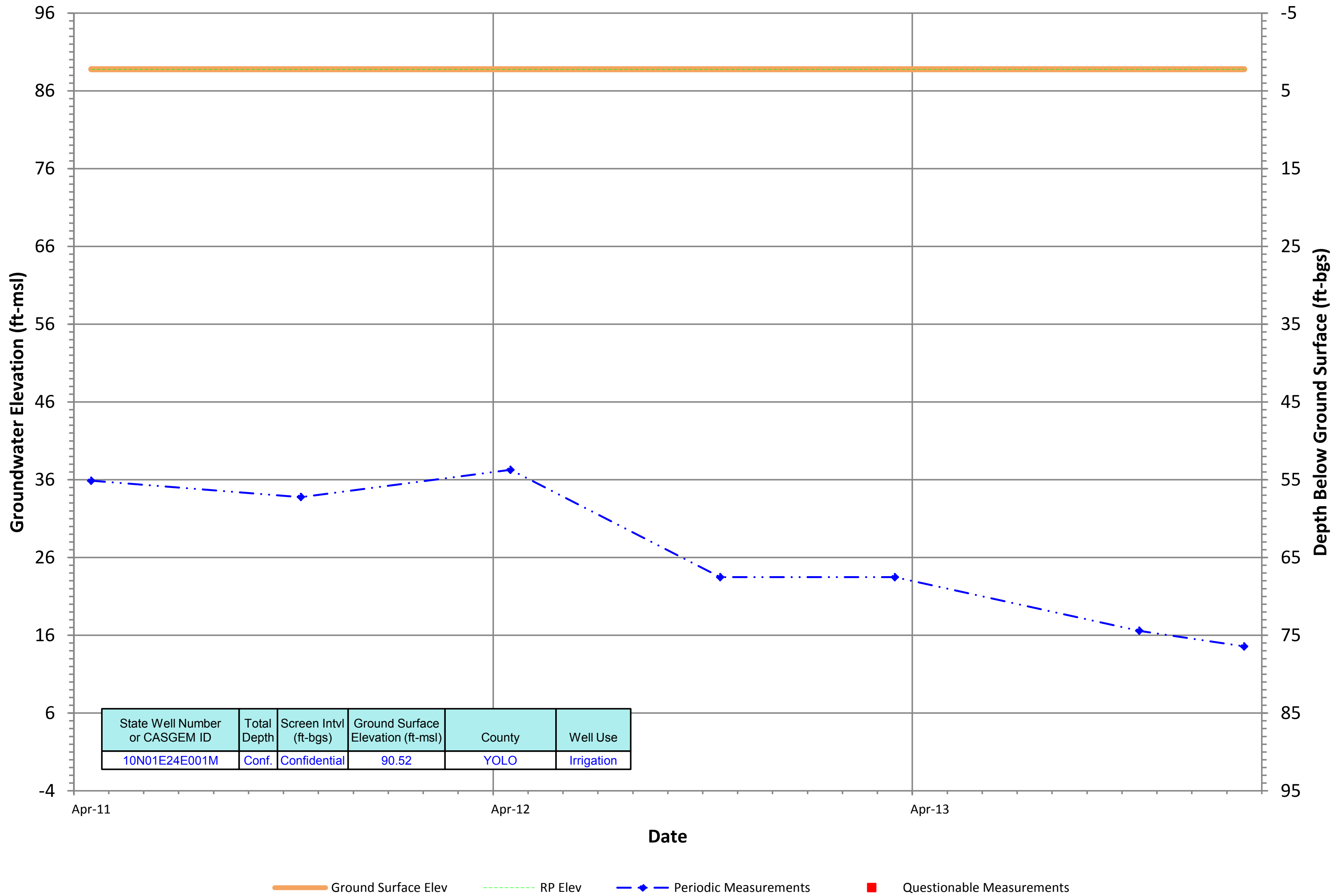
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N04E20N002M	Conf.	Confidential	12.5	YOLO	Observation

10N01E24E001M
Period Of Record: 04/22/2011 to 01/31/2014

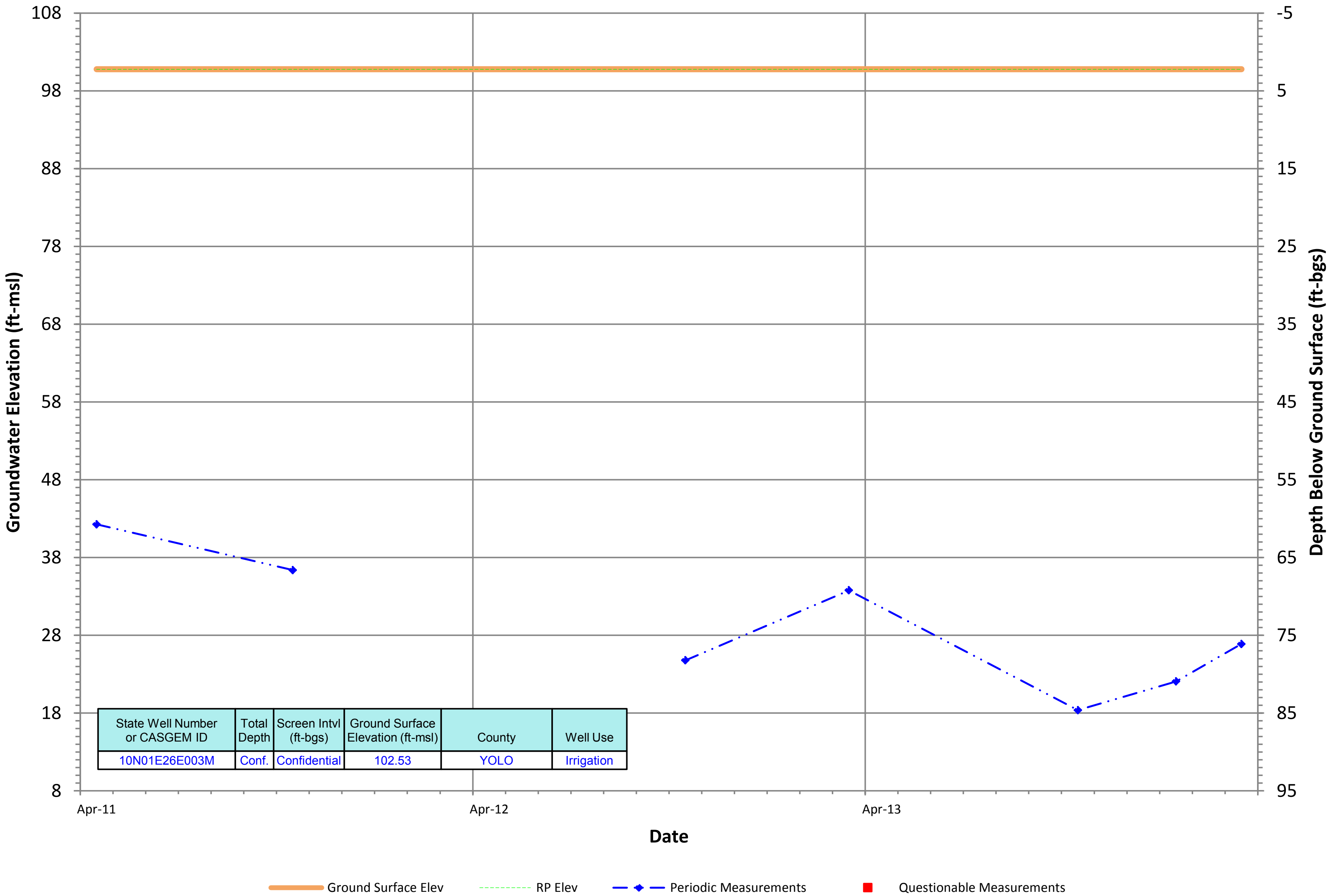
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E24E001M	Conf.	Confidential	90.52	YOLO	Irrigation

10N01E26E003M
Period Of Record: 04/22/2011 to 03/19/2014

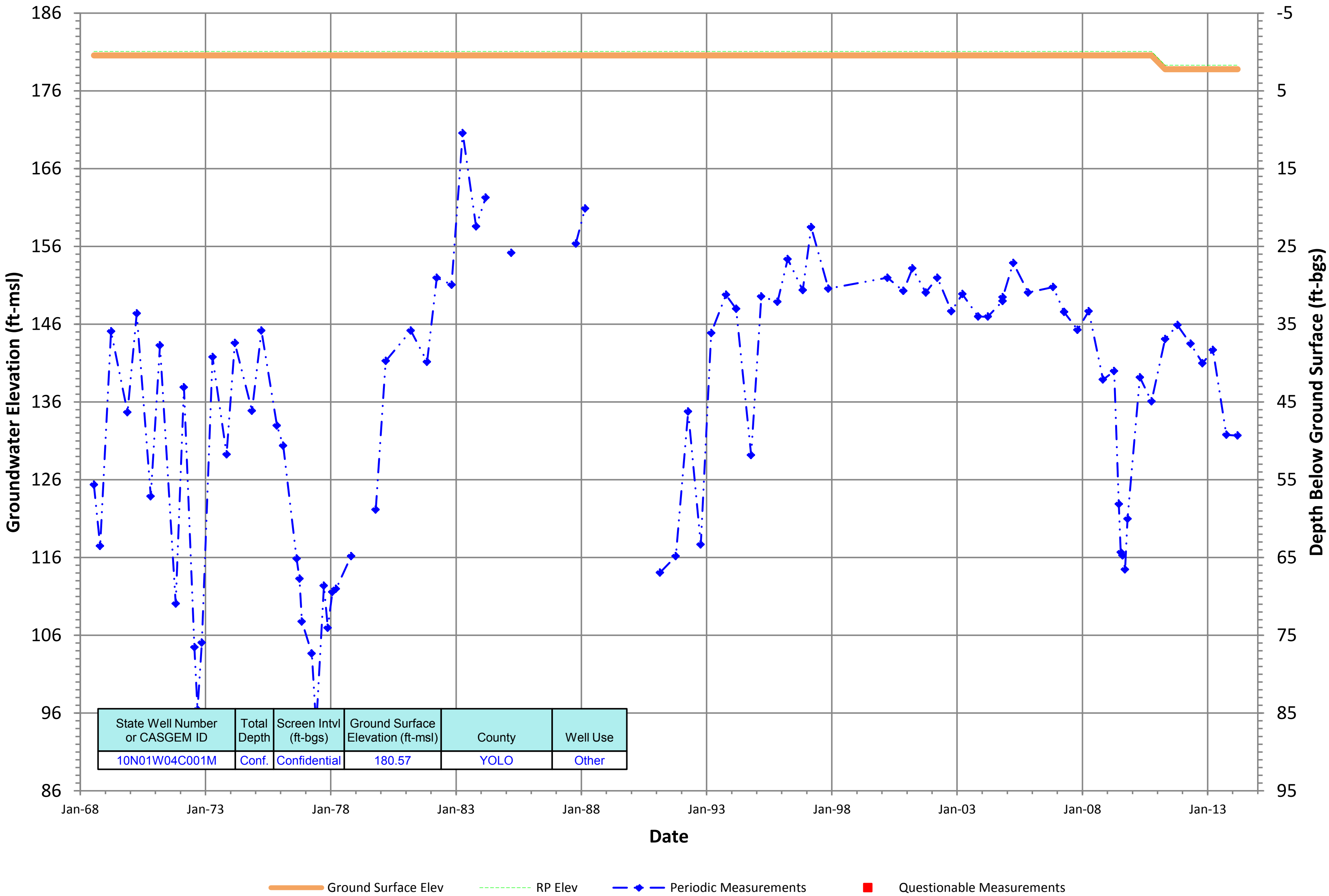
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



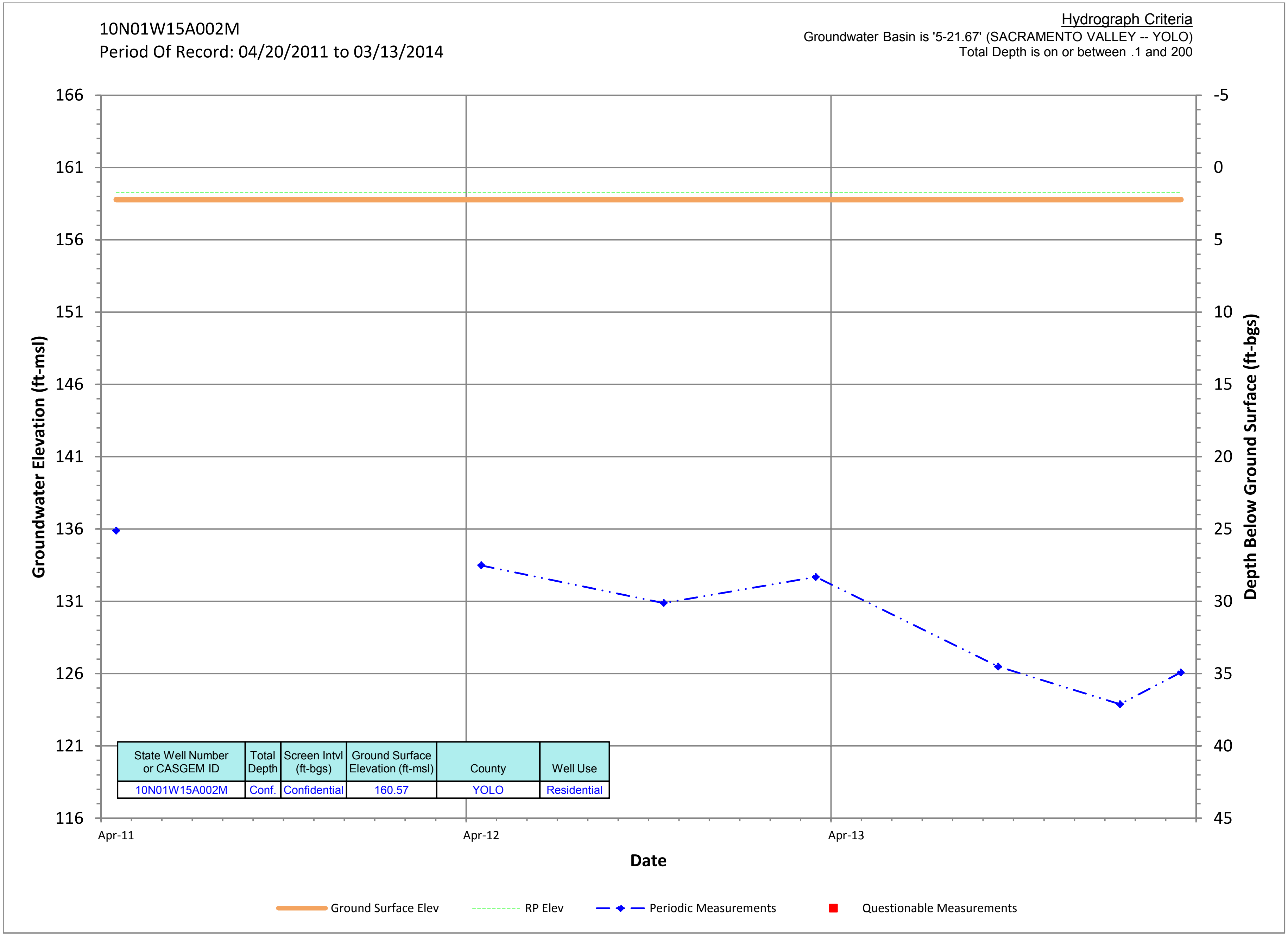
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E26E003M	Conf.	Confidential	102.53	YOLO	Irrigation

10N01W04C001M
Period Of Record: 07/18/1968 to 03/13/2014

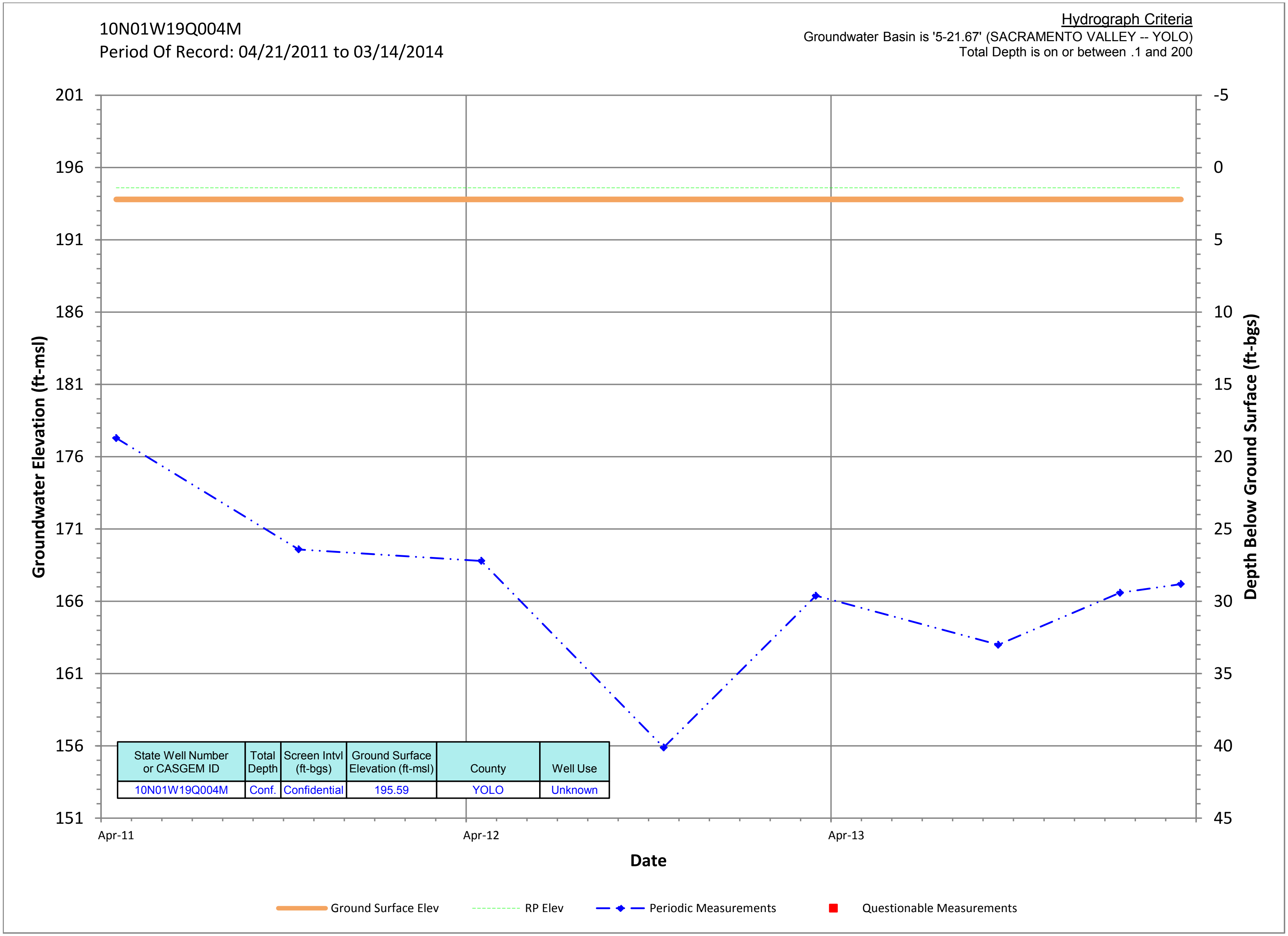
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W04C001M	Conf.	Confidential	180.57	YOLO	Other



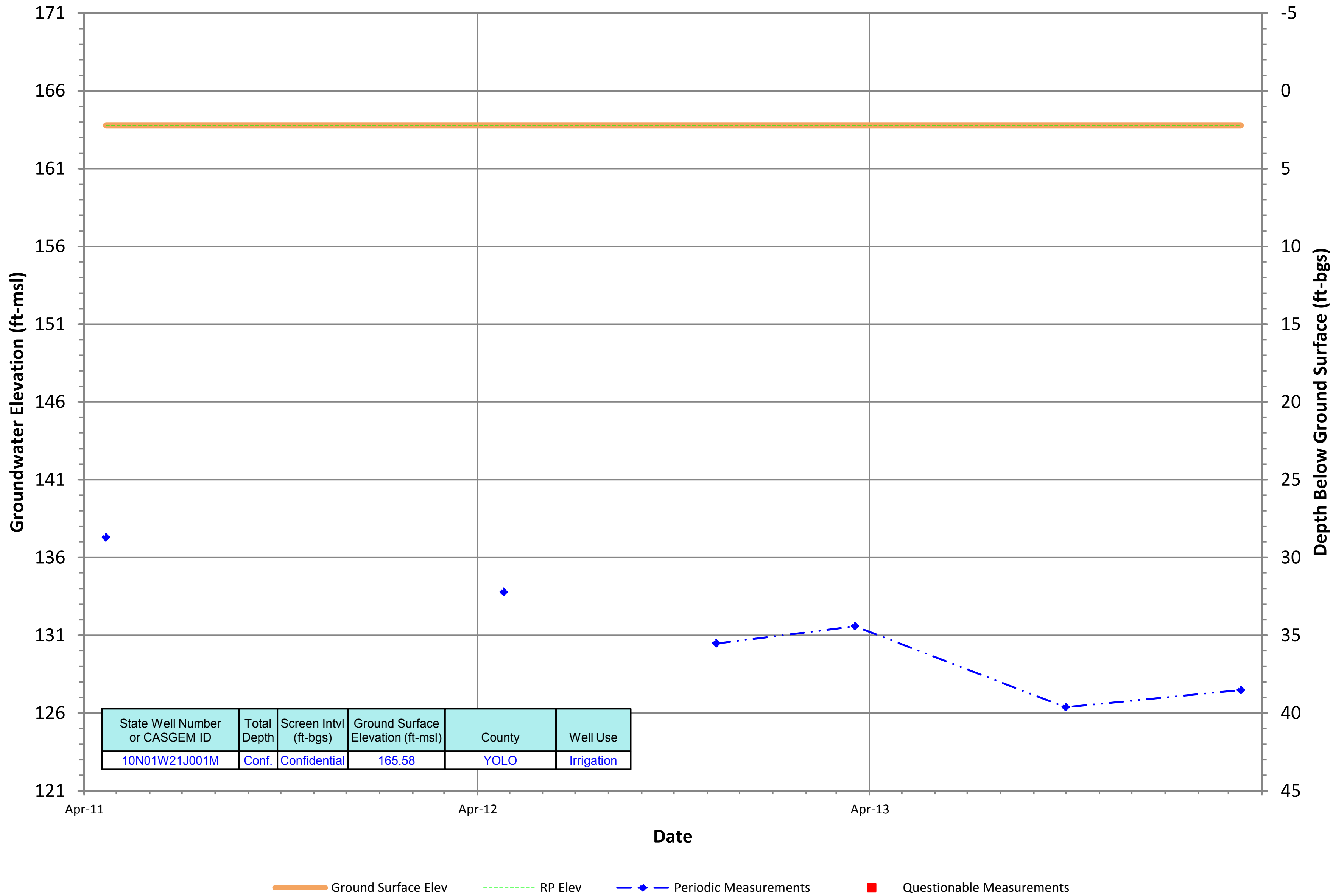
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W15A002M	Conf.	Confidential	160.57	YOLO	Residential



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W19Q004M	Conf.	Confidential	195.59	YOLO	Unknown

10N01W21J001M
Period Of Record: 04/21/2011 to 03/12/2014

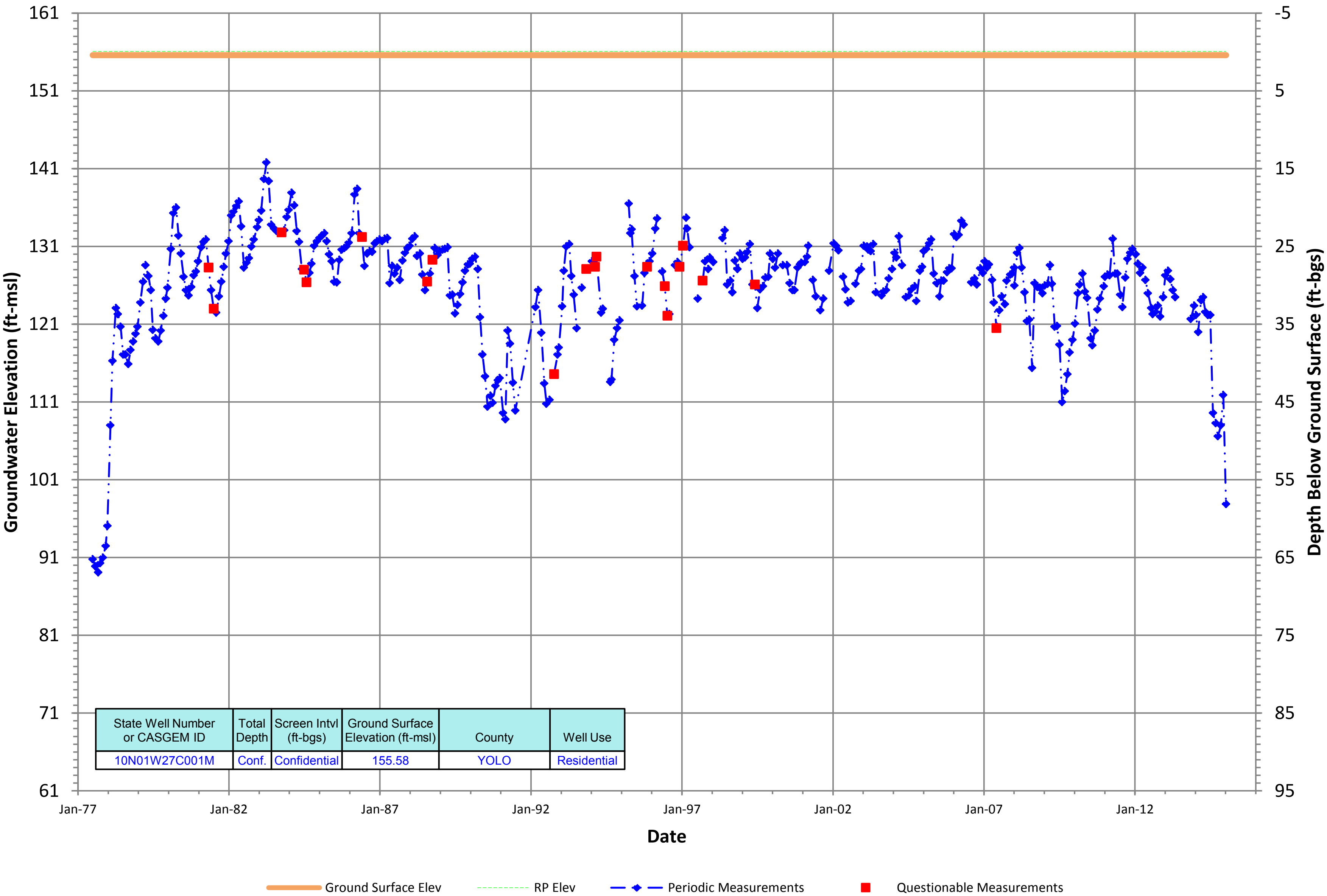
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W21J001M	Conf.	Confidential	165.58	YOLO	Irrigation

10N01W27C001M
Period Of Record: 06/27/1977 to 01/06/2015

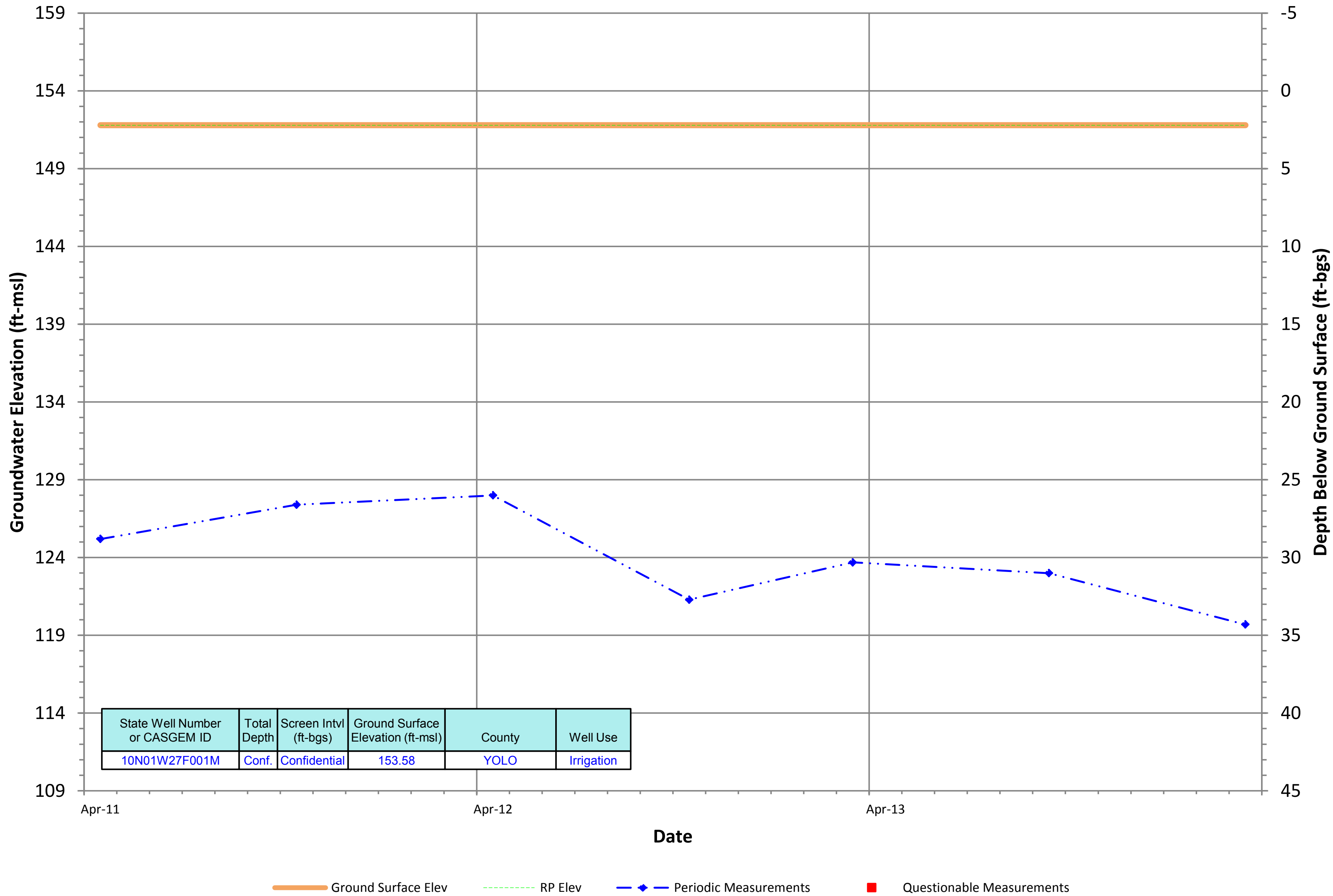
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W27C001M	Conf.	Confidential	155.58	YOLO	Residential

10N01W27F001M
Period Of Record: 04/21/2011 to 03/14/2014

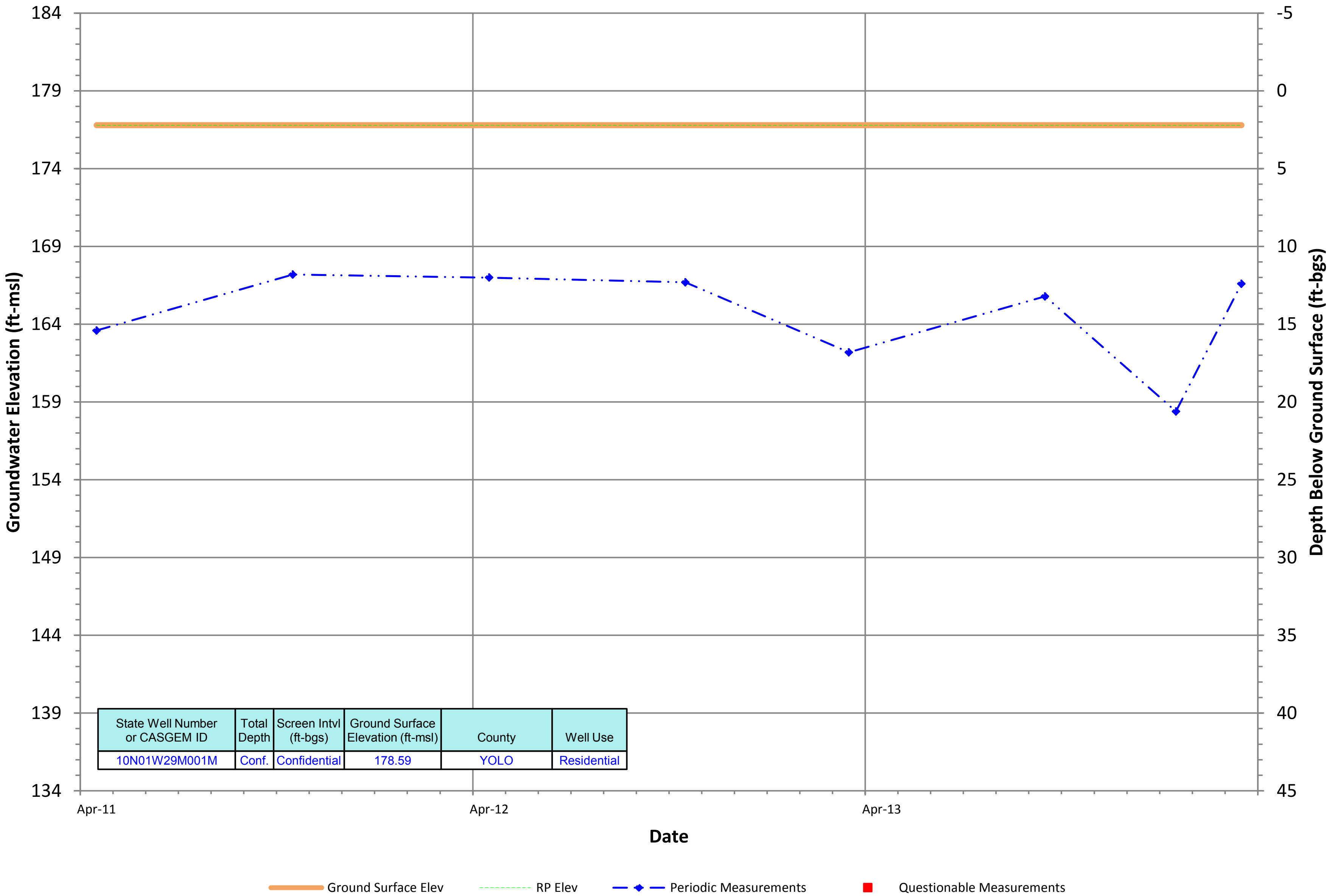
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W27F001M	Conf.	Confidential	153.58	YOLO	Irrigation

10N01W29M001M
Period Of Record: 04/21/2011 to 03/14/2014

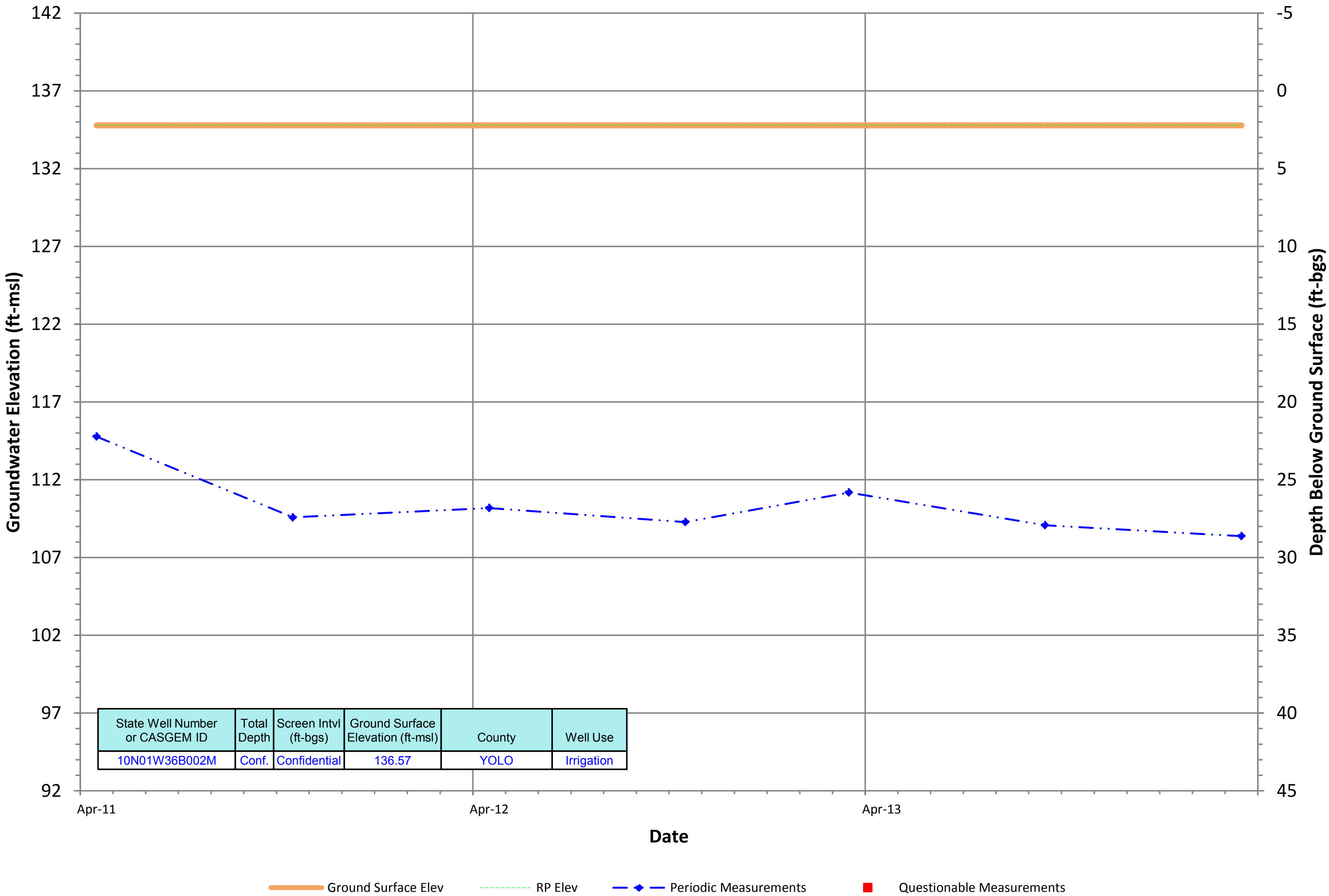
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



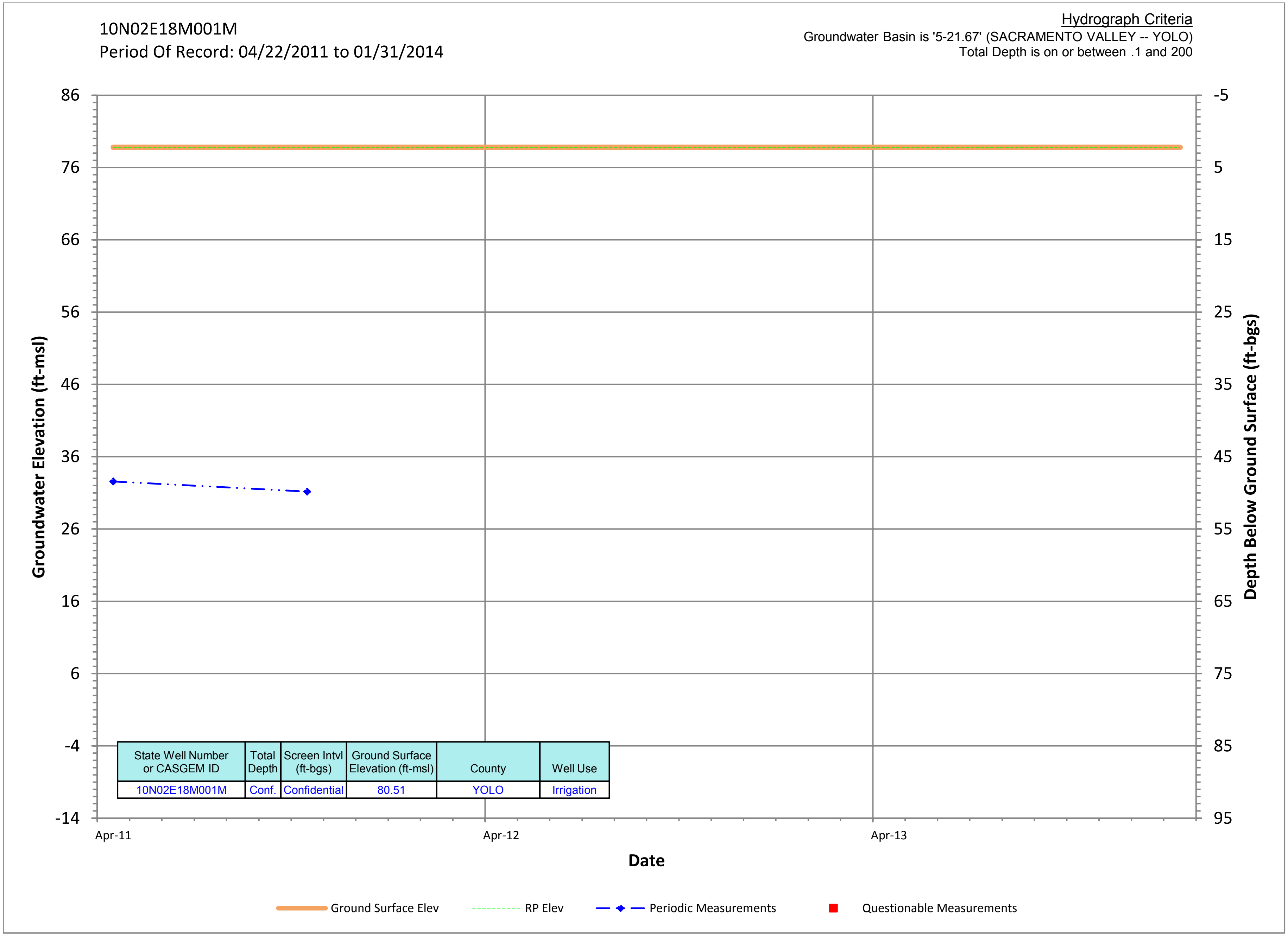
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W29M001M	Conf.	Confidential	178.59	YOLO	Residential

10N01W36B002M
Period Of Record: 04/21/2011 to 03/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



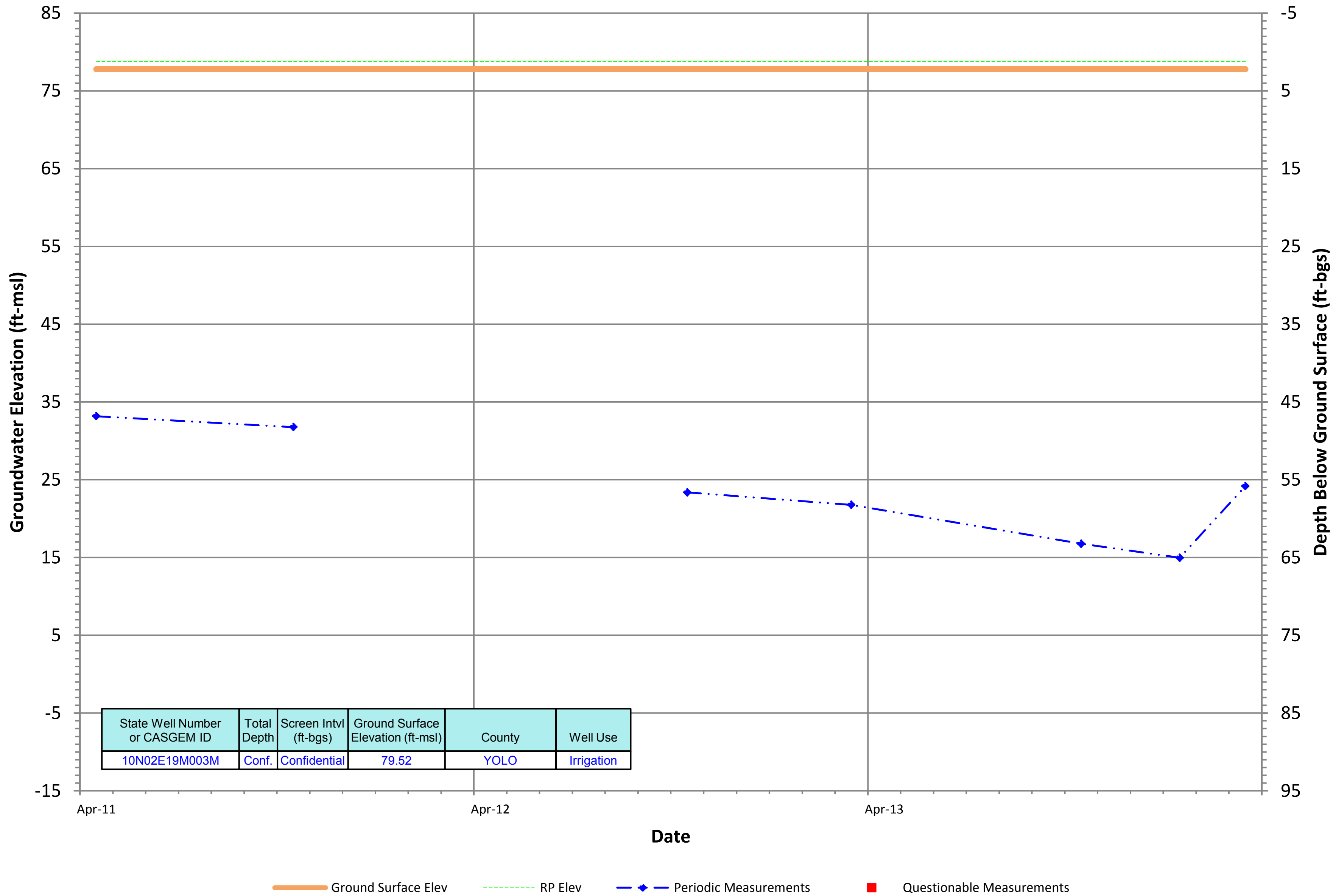
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W36B002M	Conf.	Confidential	136.57	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E18M001M	Conf.	Confidential	80.51	YOLO	Irrigation

10N02E19M003M
Period Of Record: 04/22/2011 to 03/19/2014

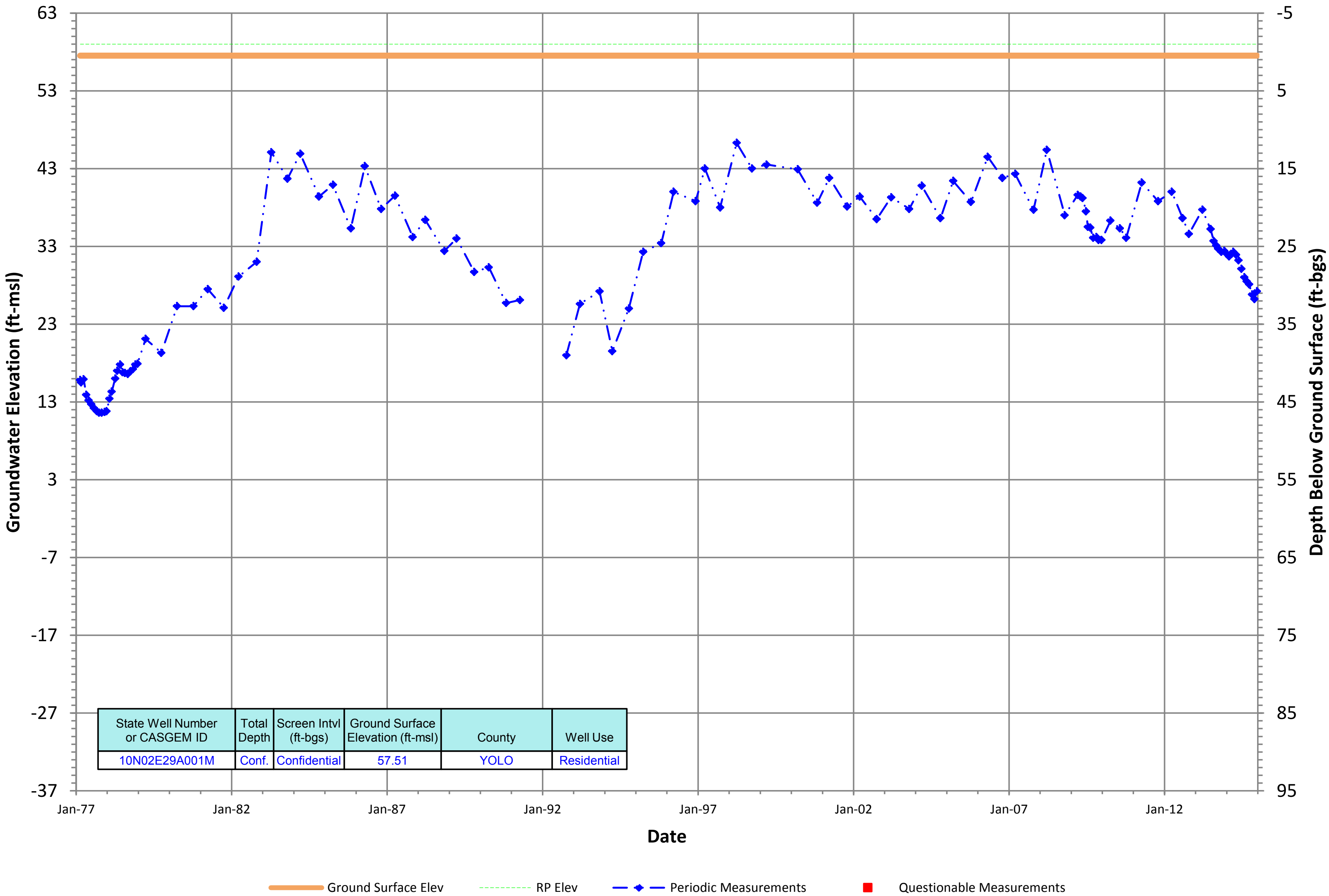
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E19M003M	Conf.	Confidential	79.52	YOLO	Irrigation

10N02E29A001M
Period Of Record: 02/16/1977 to 12/22/2014

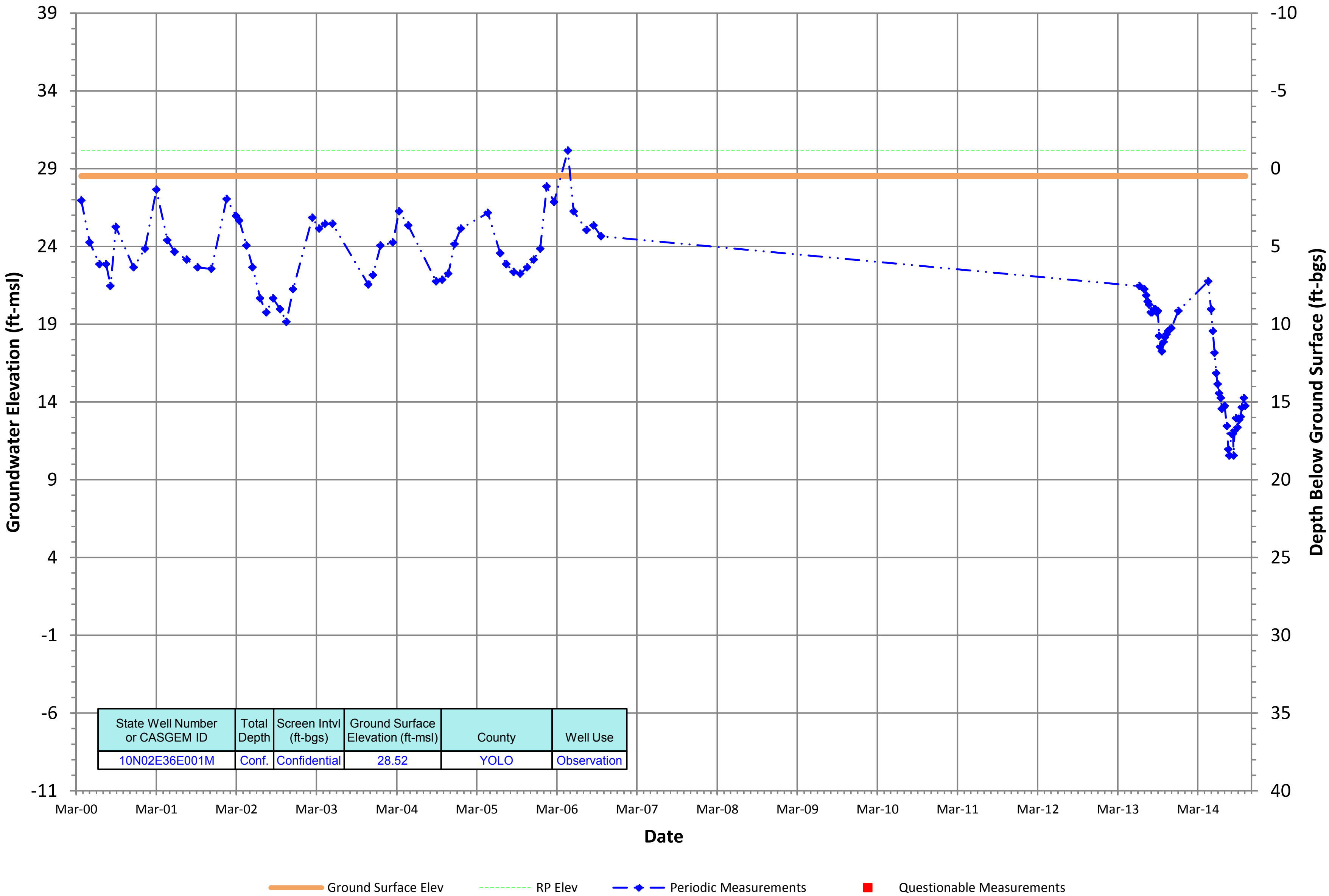
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E29A001M	Conf.	Confidential	57.51	YOLO	Residential

10N02E36E001M
Period Of Record: 03/24/2000 to 10/03/2014

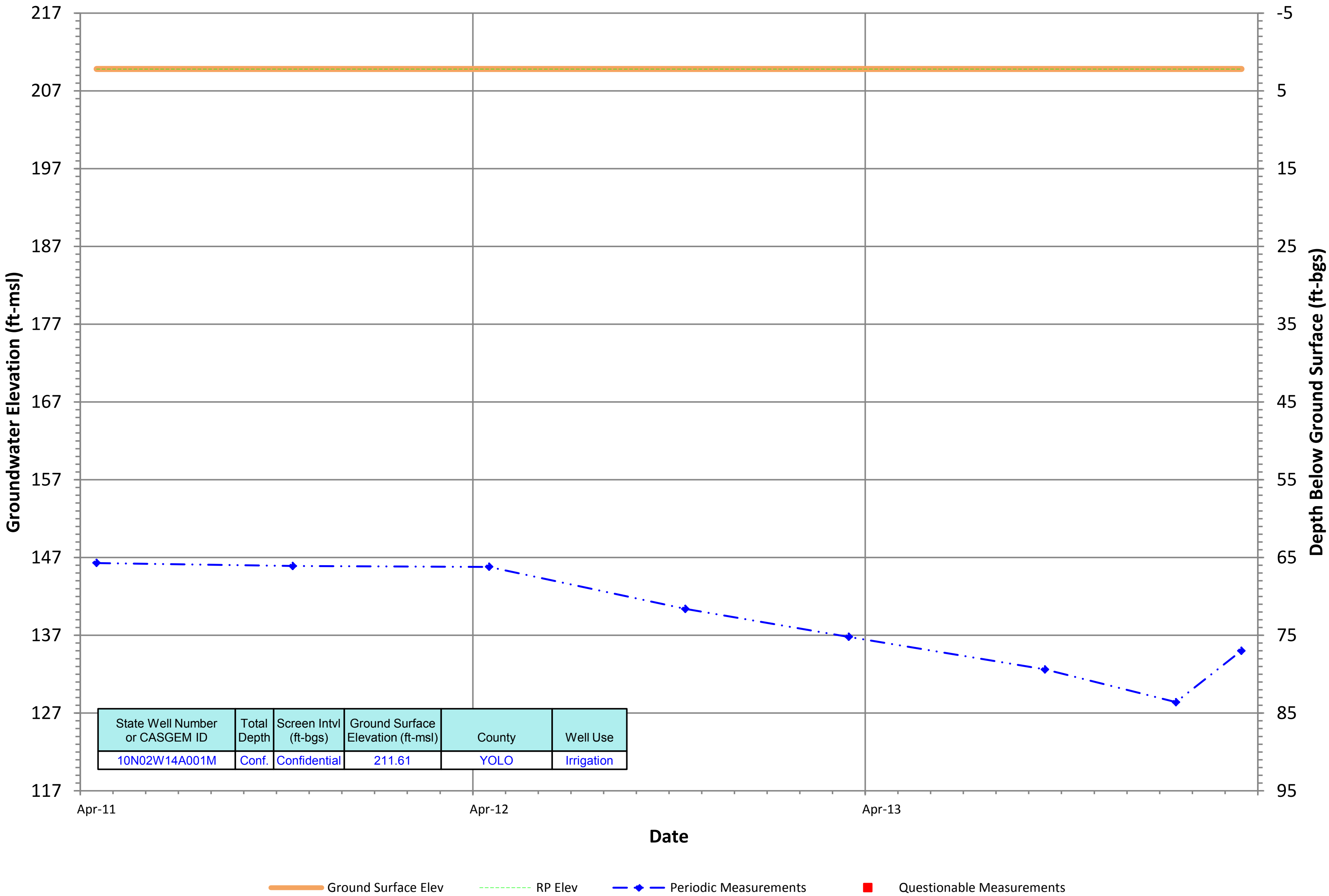
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



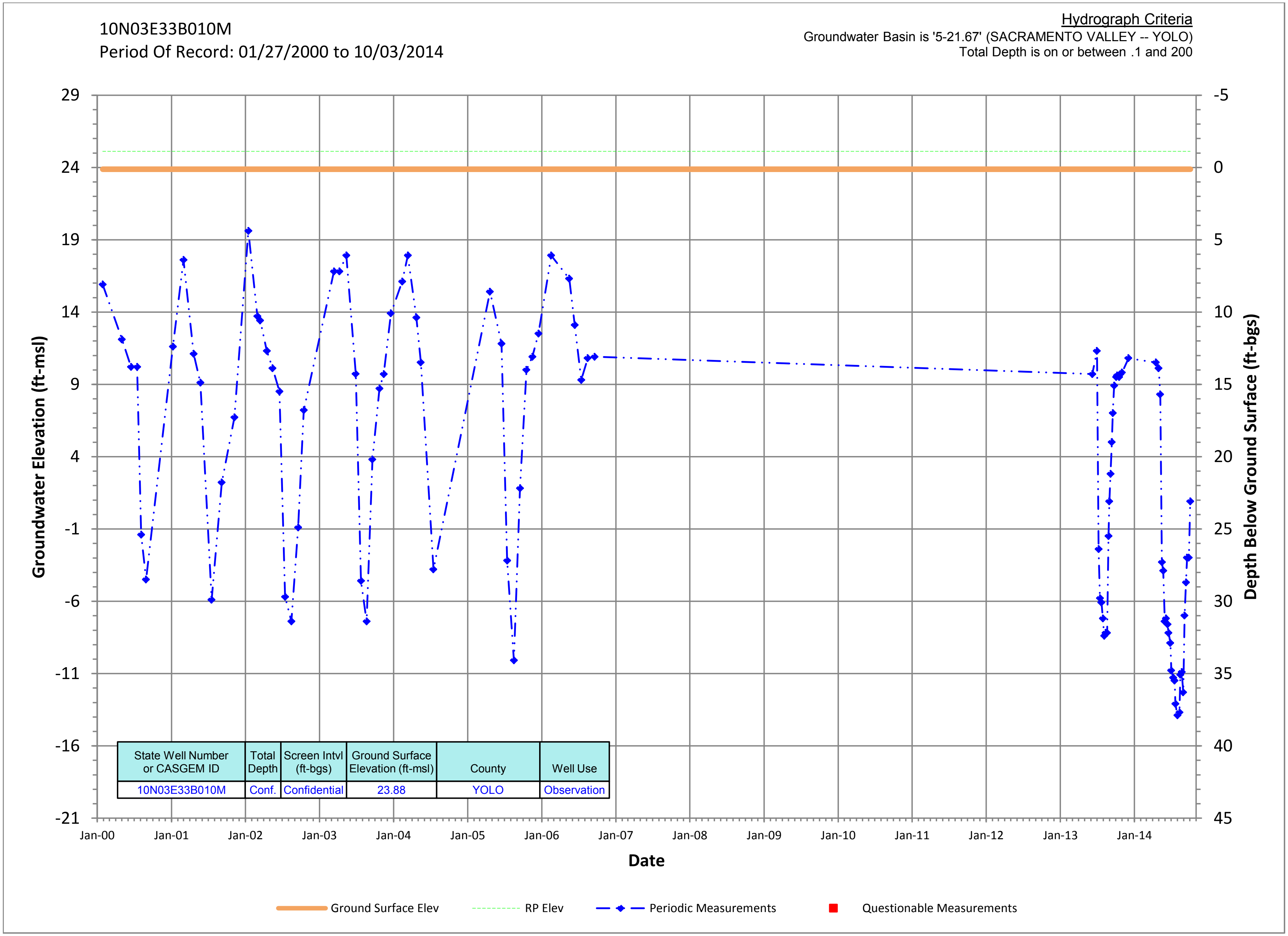
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02E36E001M	Conf.	Confidential	28.52	YOLO	Observation

10N02W14A001M
Period Of Record: 04/20/2011 to 03/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



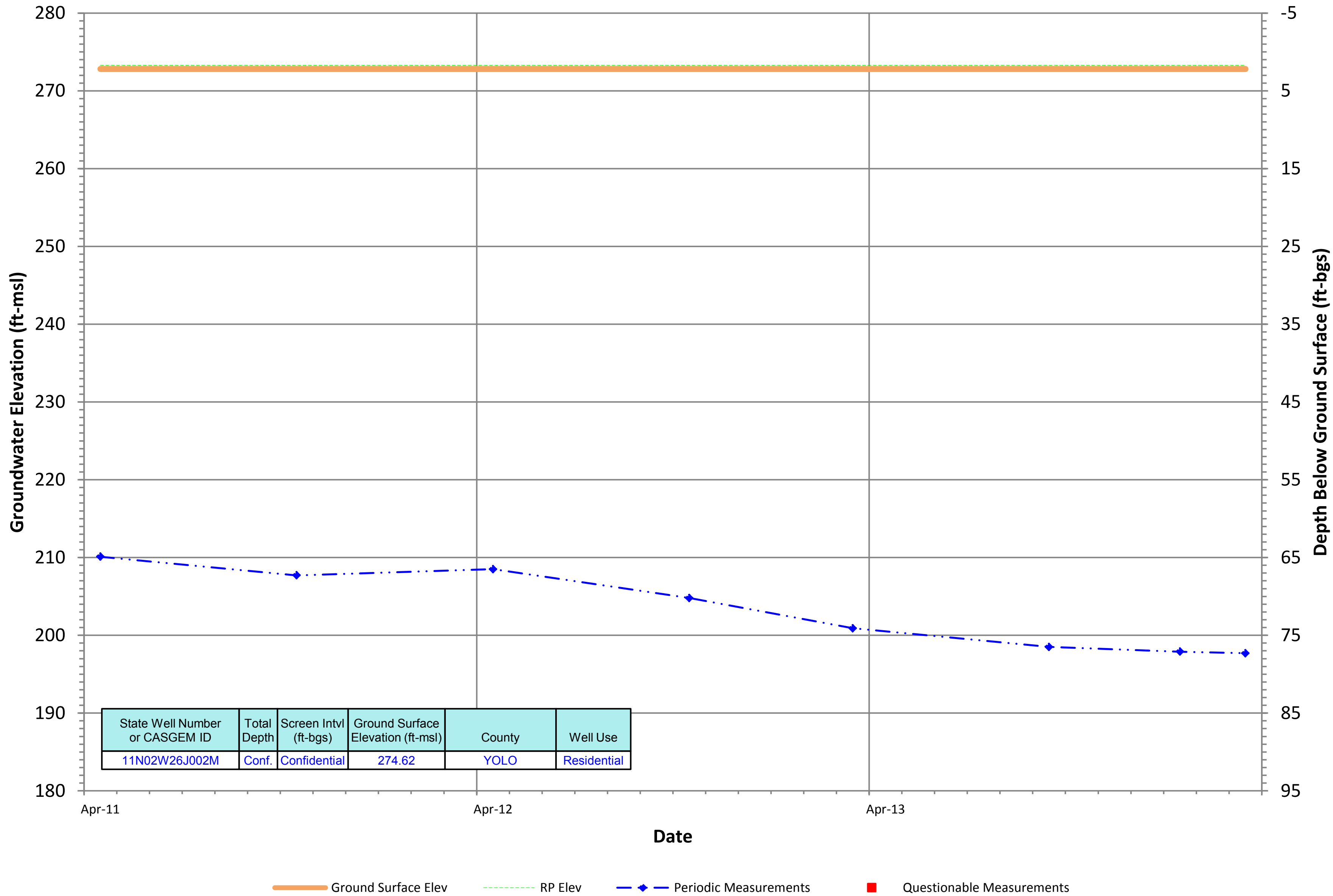
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N02W14A001M	Conf.	Confidential	211.61	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N03E33B010M	Conf.	Confidential	23.88	YOLO	Observation

11N02W26J002M
Period Of Record: 04/20/2011 to 03/13/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between .1 and 200



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
11N02W26J002M	Conf.	Confidential	274.62	YOLO	Residential

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Intermediate Depth Groundwater Monitoring Well Hydrographs- Yolo Subbasin

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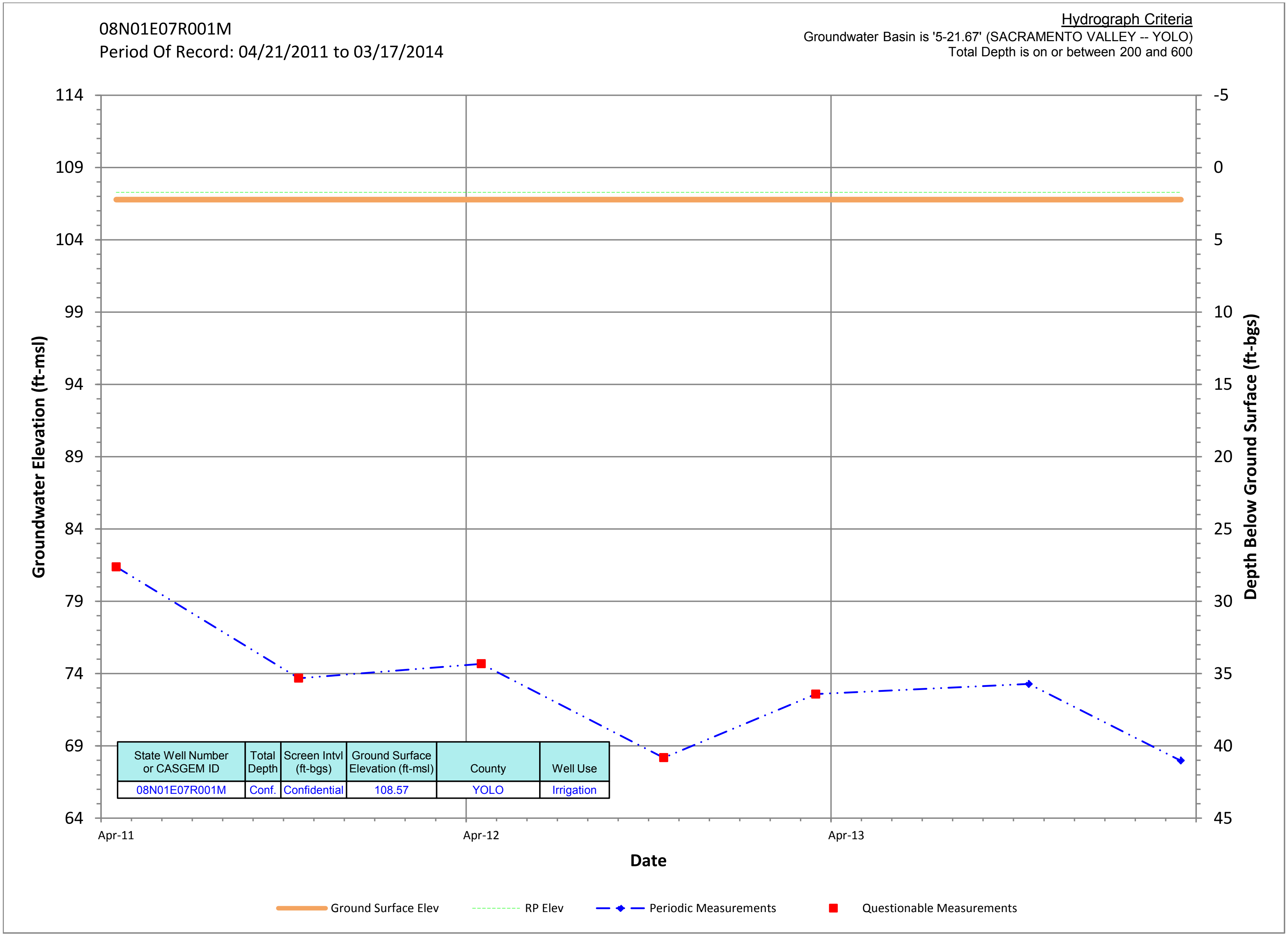
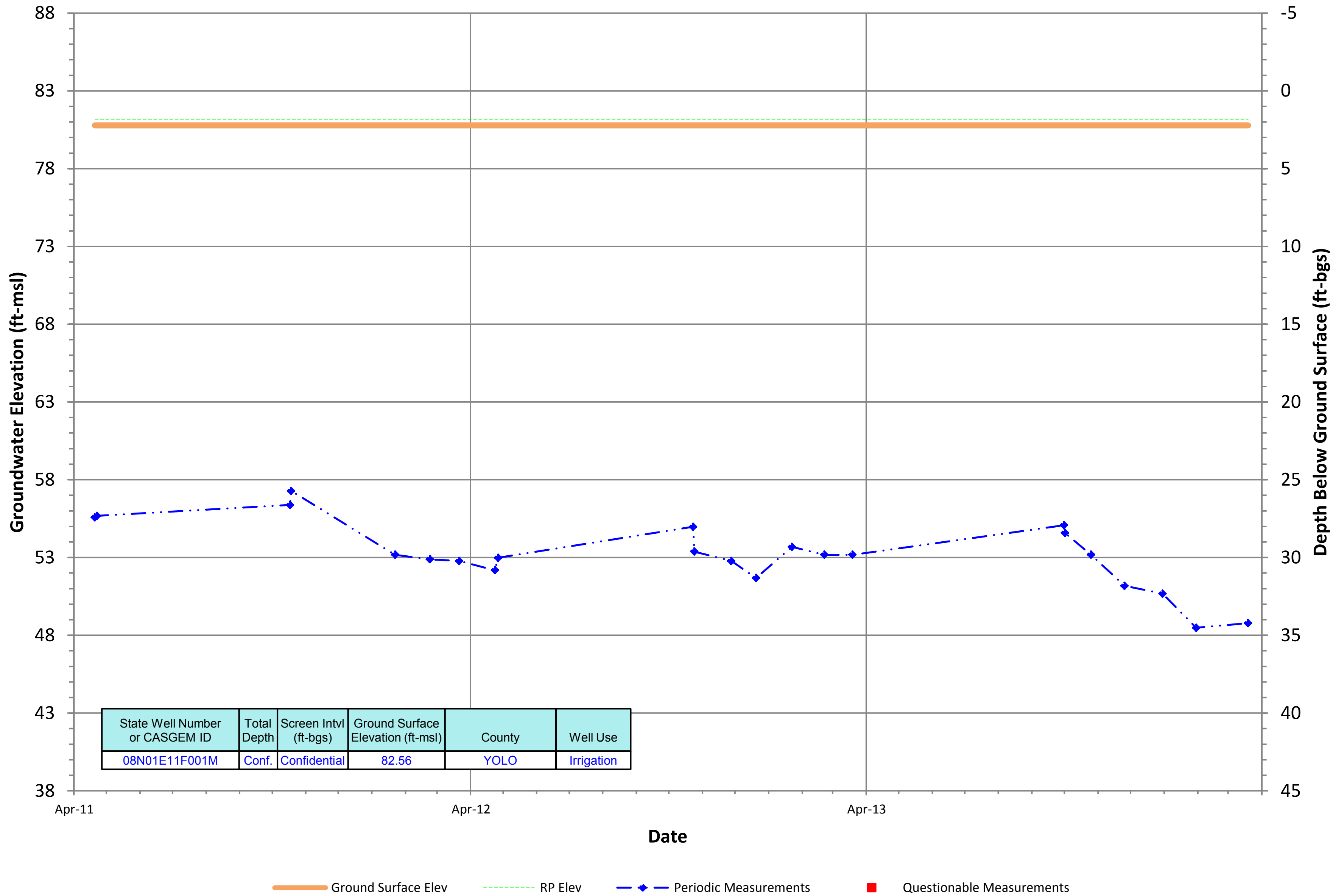


State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E07R001M	Conf.	Confidential	108.57	YOLO	Irrigation

08N01E11F001M
Period Of Record: 04/20/2011 to 03/19/2014

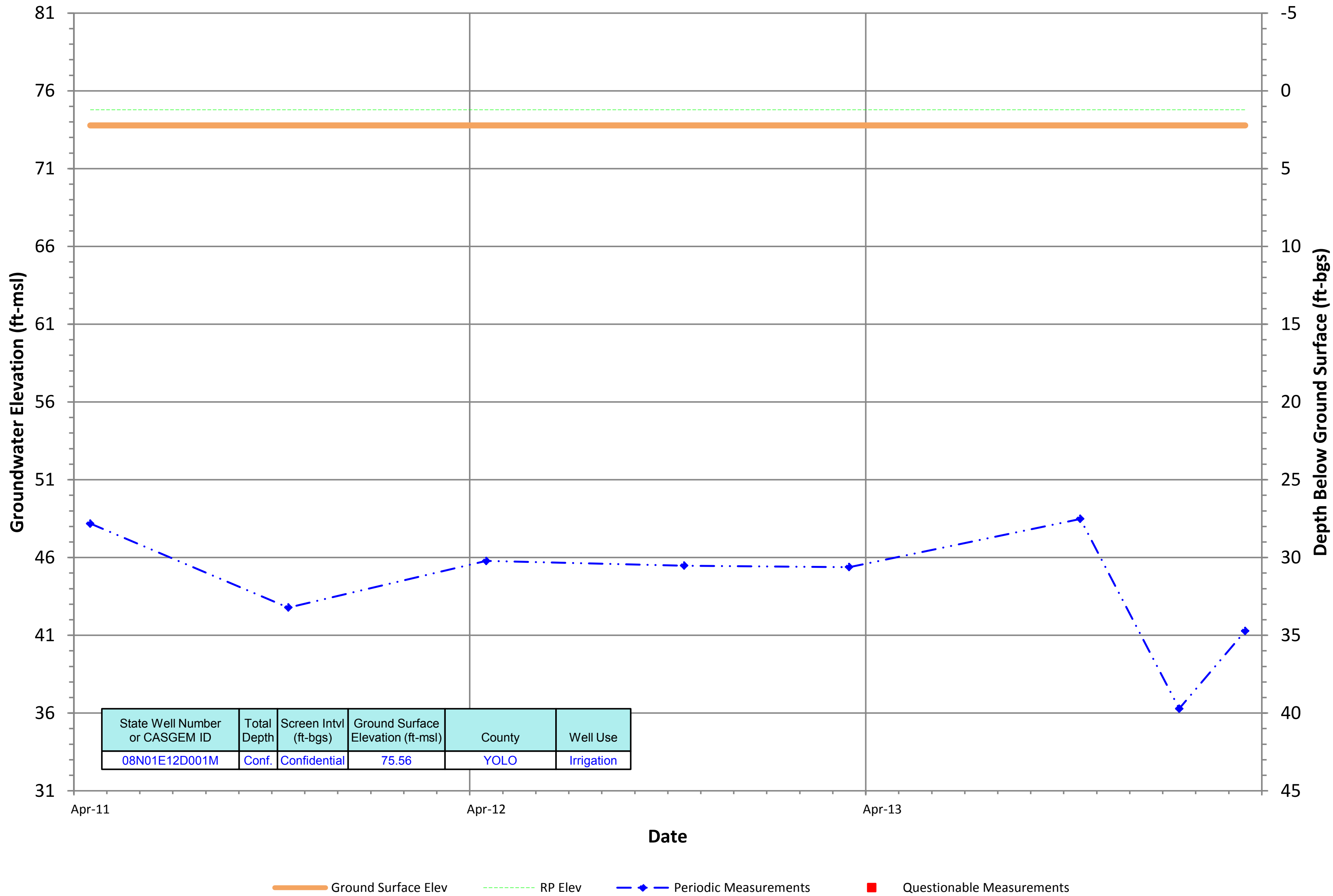
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E11F001M	Conf.	Confidential	82.56	YOLO	Irrigation

08N01E12D001M
Period Of Record: 04/22/2011 to 03/18/2014

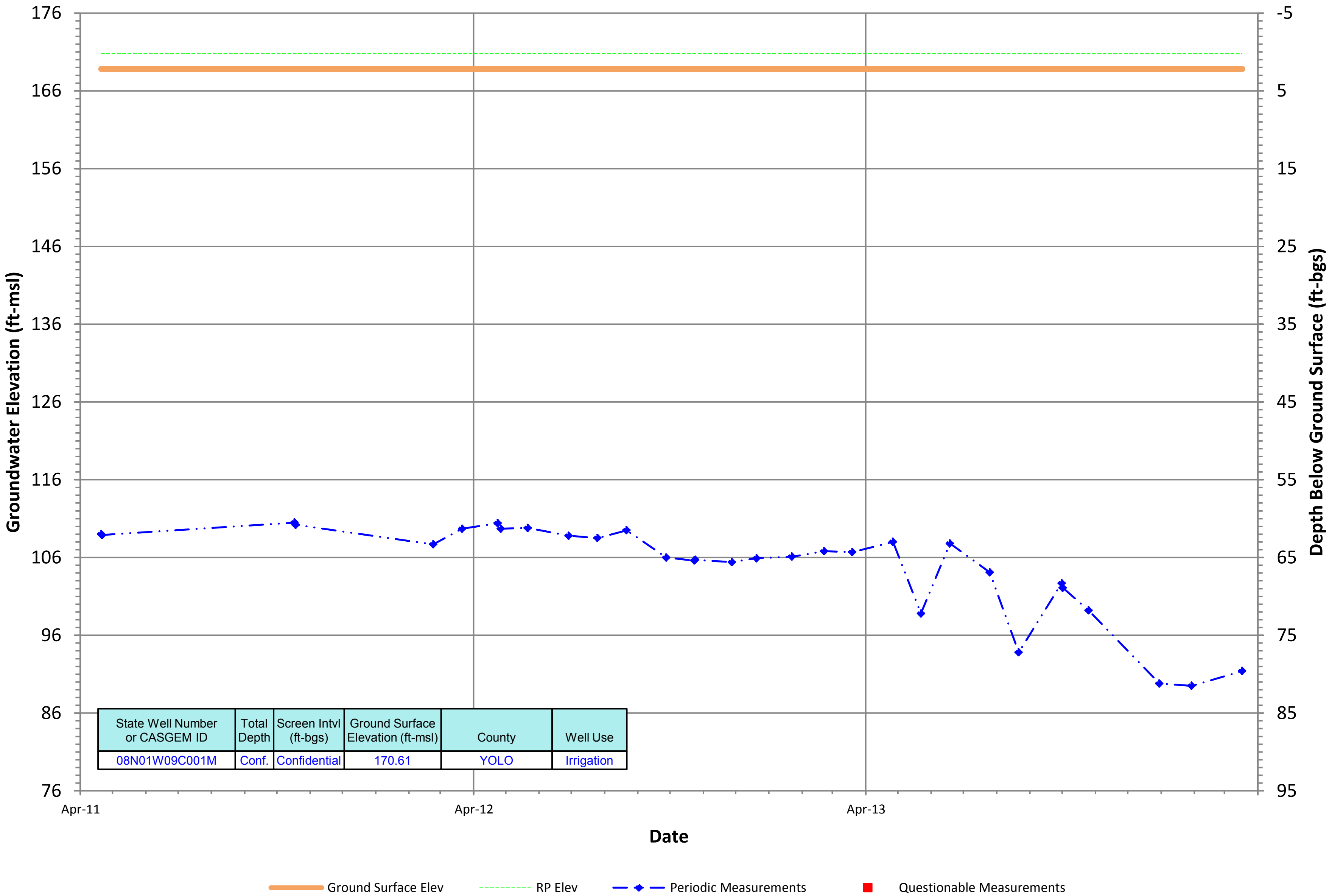
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01E12D001M	Conf.	Confidential	75.56	YOLO	Irrigation

08N01W09C001M
Period Of Record: 04/20/2011 to 03/17/2014

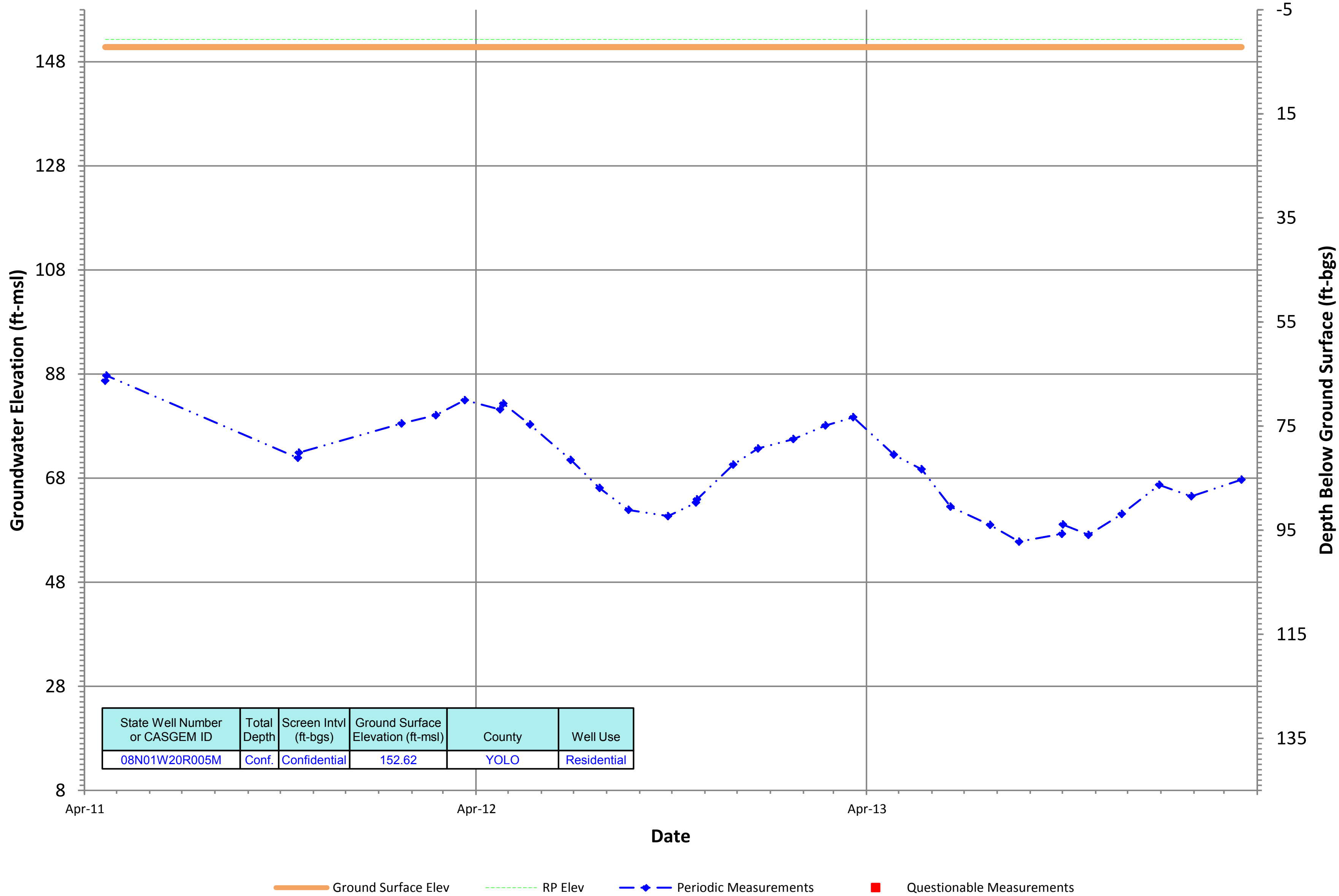
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W09C001M	Conf.	Confidential	170.61	YOLO	Irrigation

08N01W20R005M
Period Of Record: 04/20/2011 to 03/17/2014

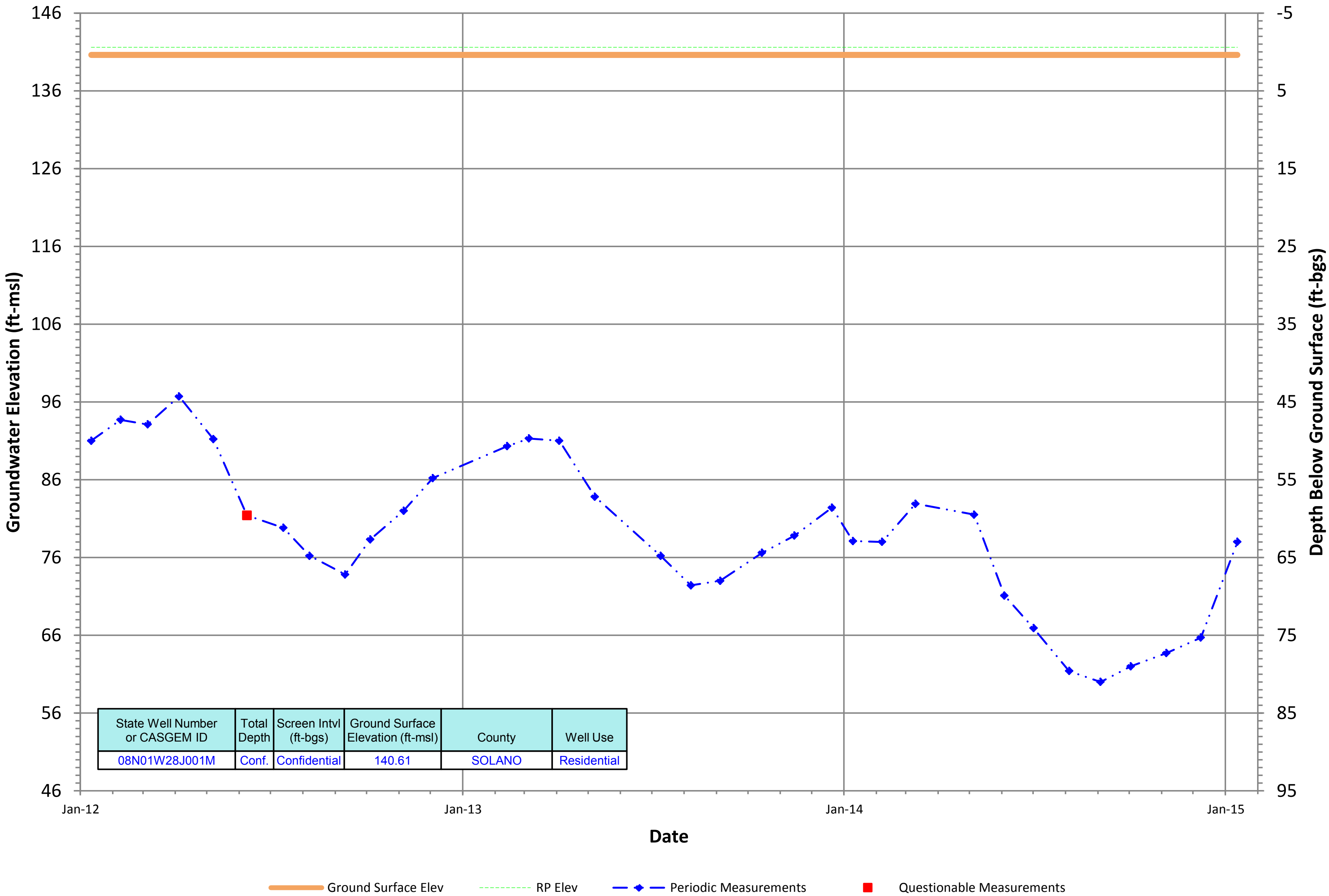
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



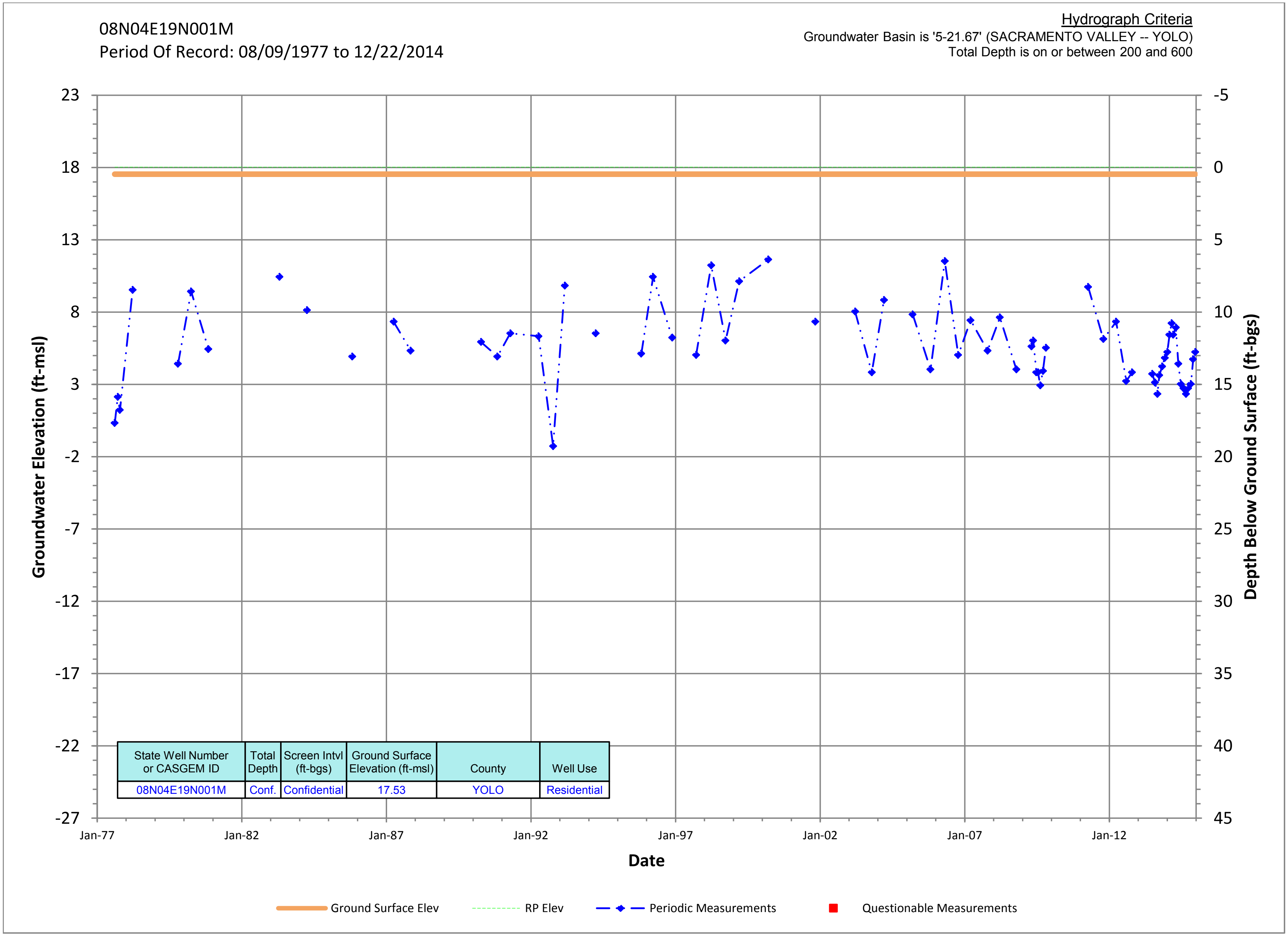
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W20R005M	Conf.	Confidential	152.62	YOLO	Residential

08N01W28J001M
Period Of Record: 01/11/2012 to 01/12/2015

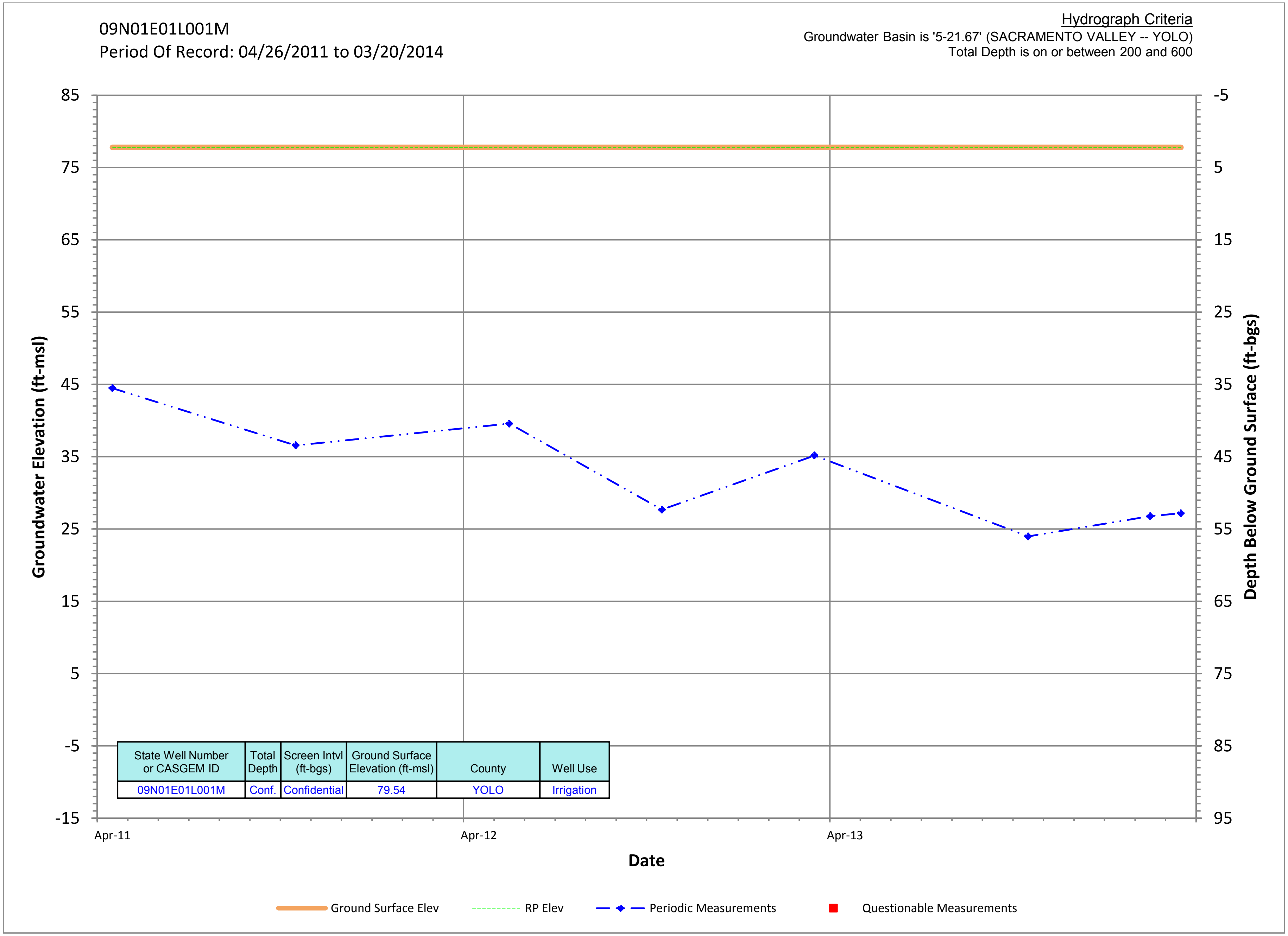
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N01W28J001M	Conf.	Confidential	140.61	SOLANO	Residential



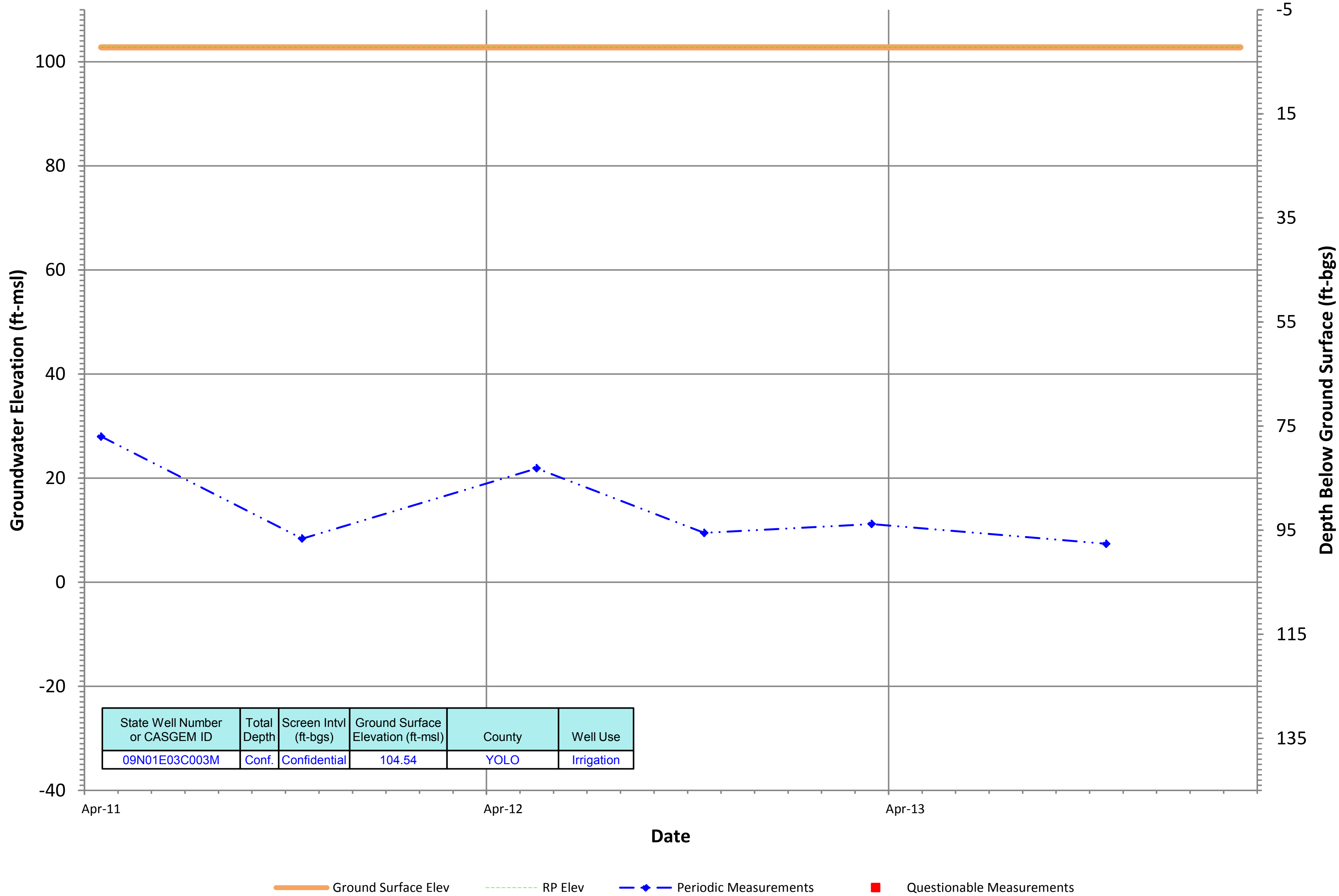
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
08N04E19N001M	Conf.	Confidential	17.53	YOLO	Residential



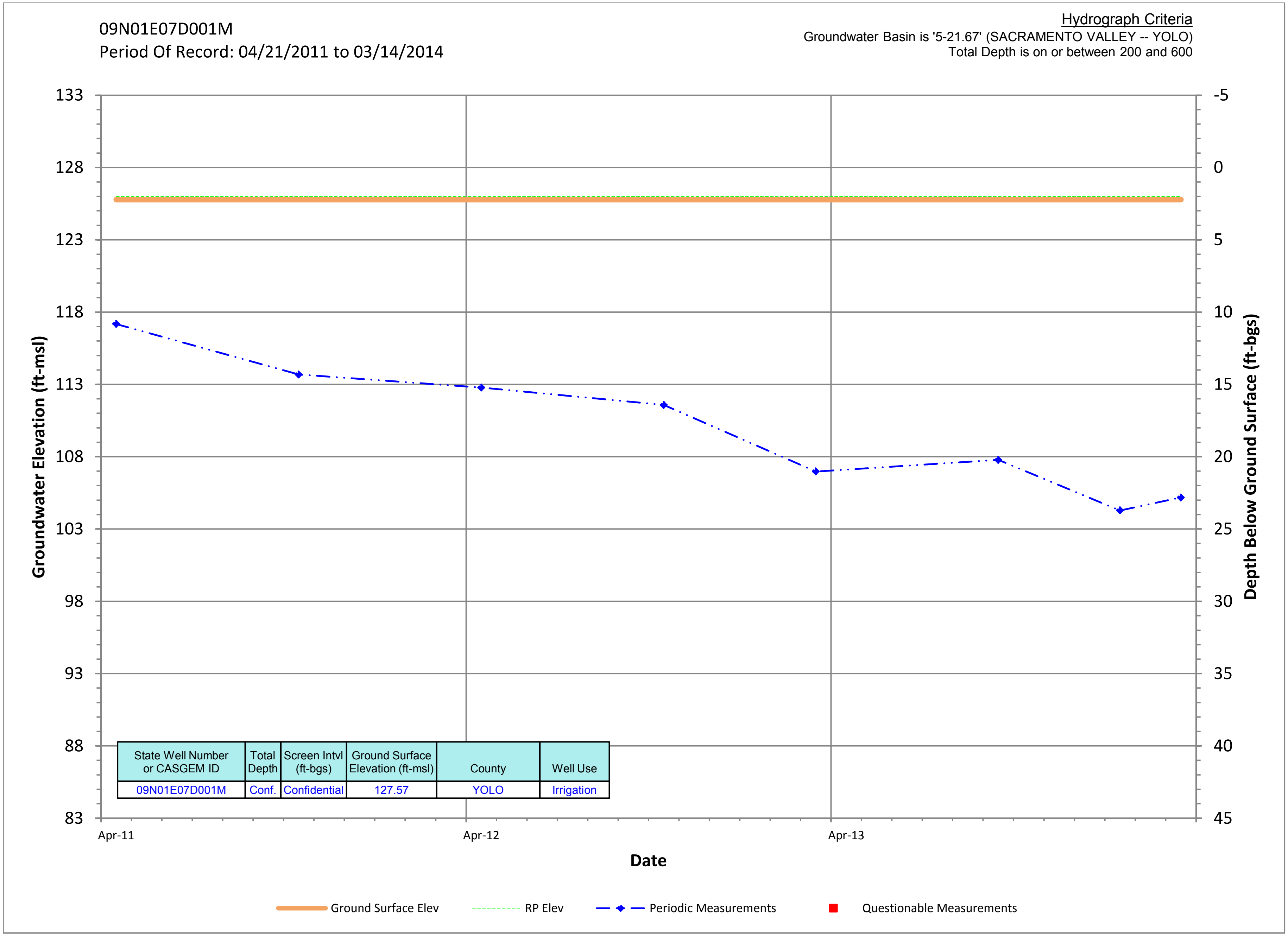
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E01L001M	Conf.	Confidential	79.54	YOLO	Irrigation

09N01E03C003M
Period Of Record: 04/26/2011 to 02/05/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



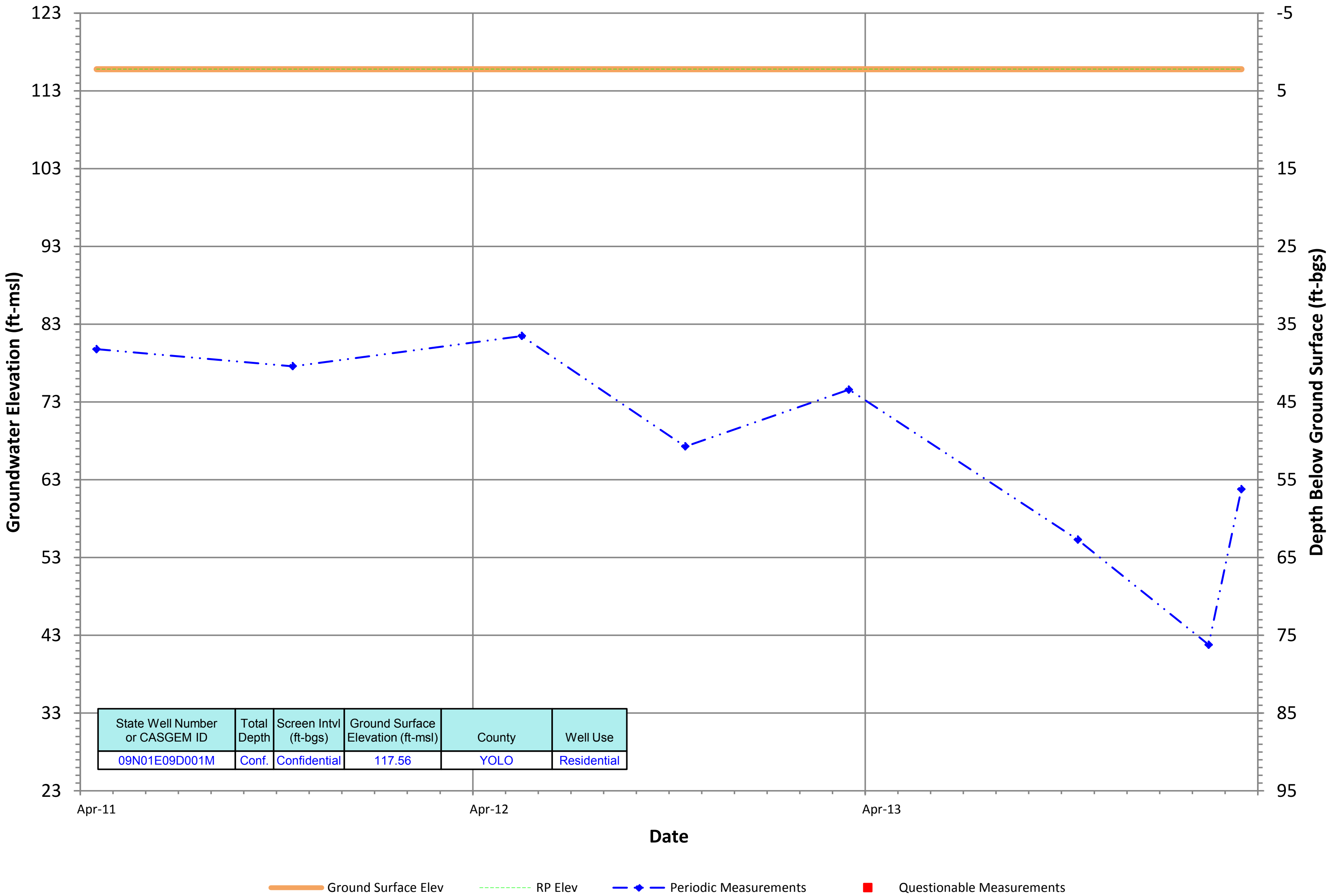
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E03C003M	Conf.	Confidential	104.54	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E07D001M	Conf.	Confidential	127.57	YOLO	Irrigation

09N01E09D001M
Period Of Record: 04/26/2011 to 03/20/2014

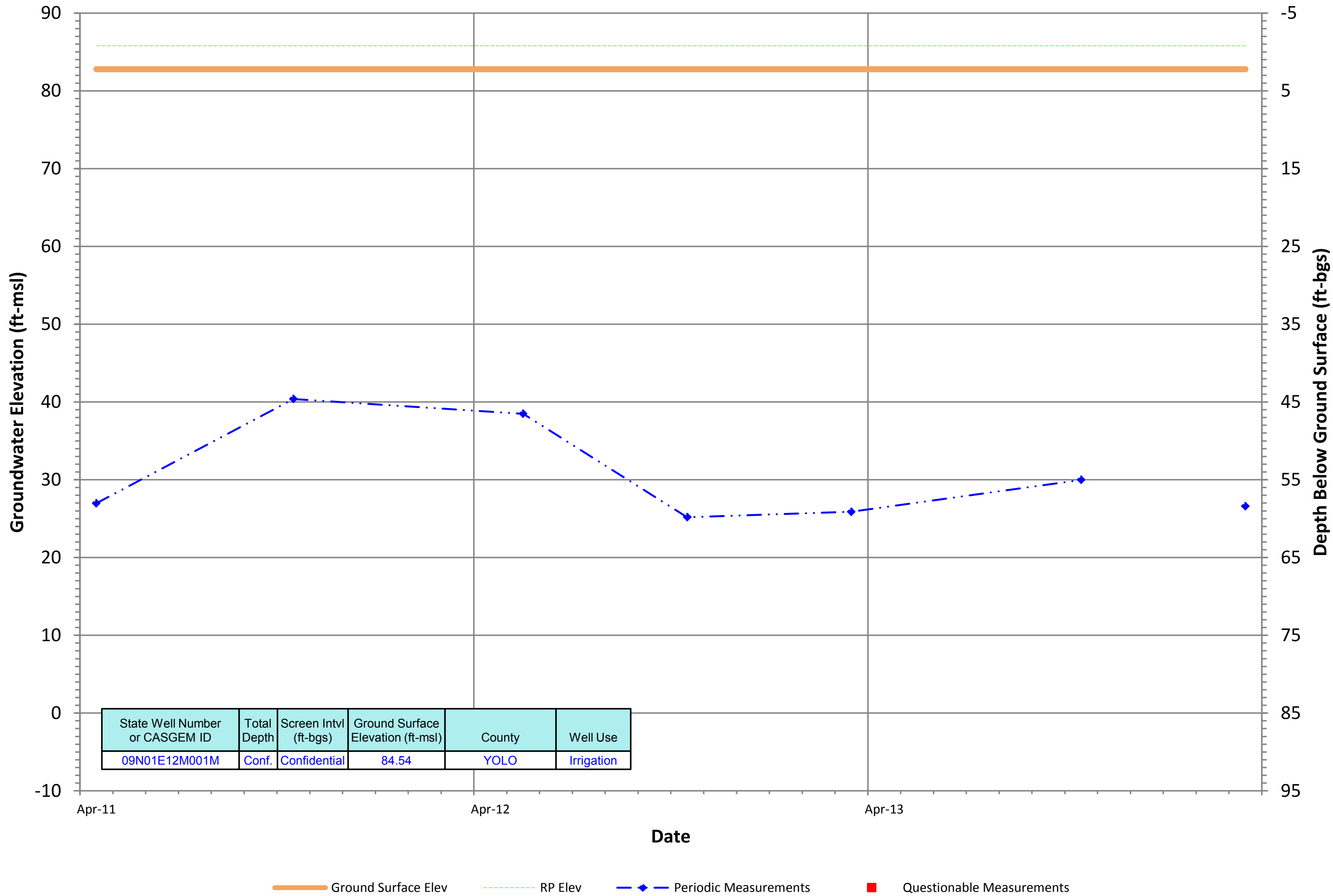
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



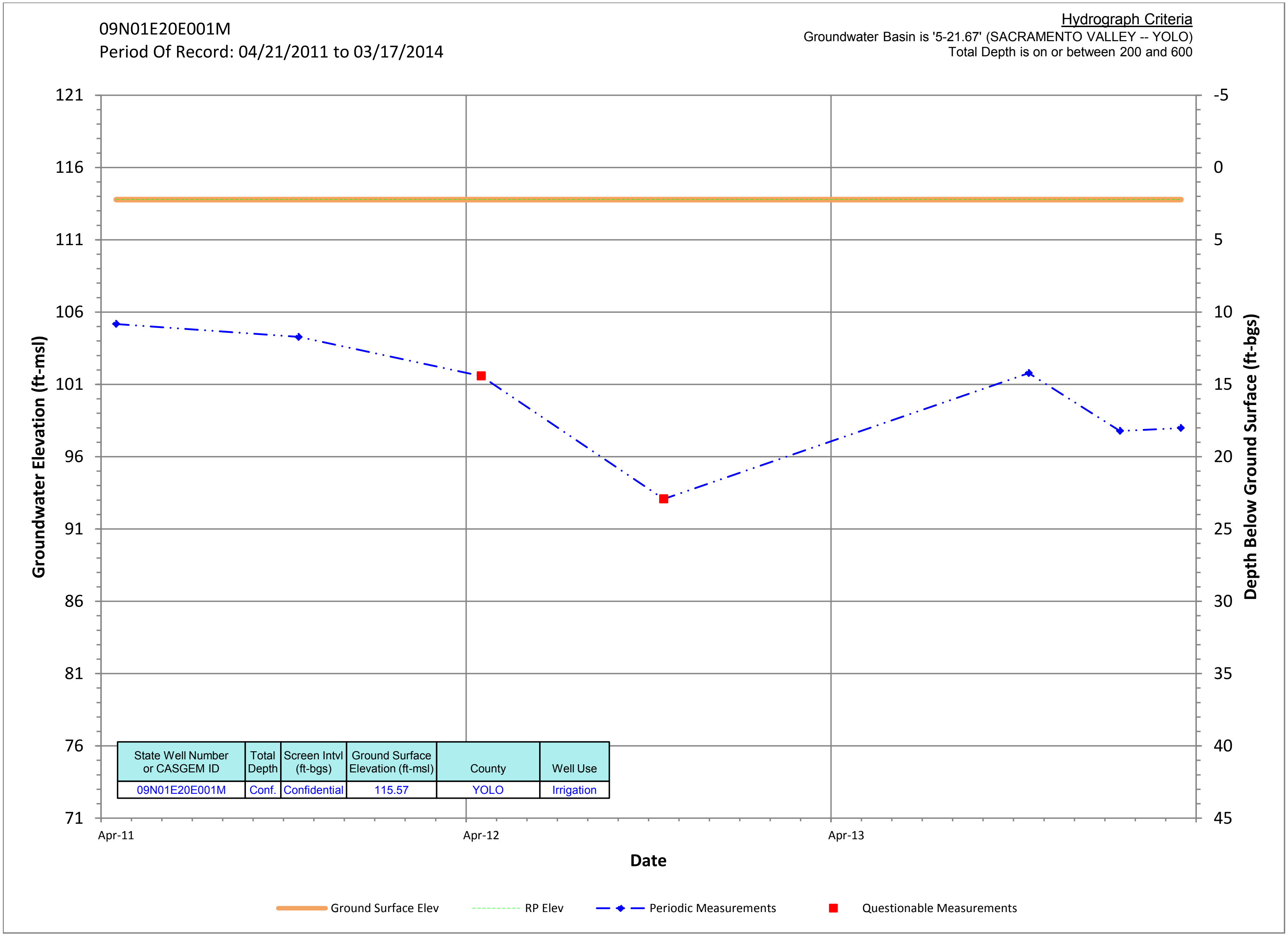
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E09D001M	Conf.	Confidential	117.56	YOLO	Residential

09N01E12M001M
Period Of Record: 04/26/2011 to 03/19/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



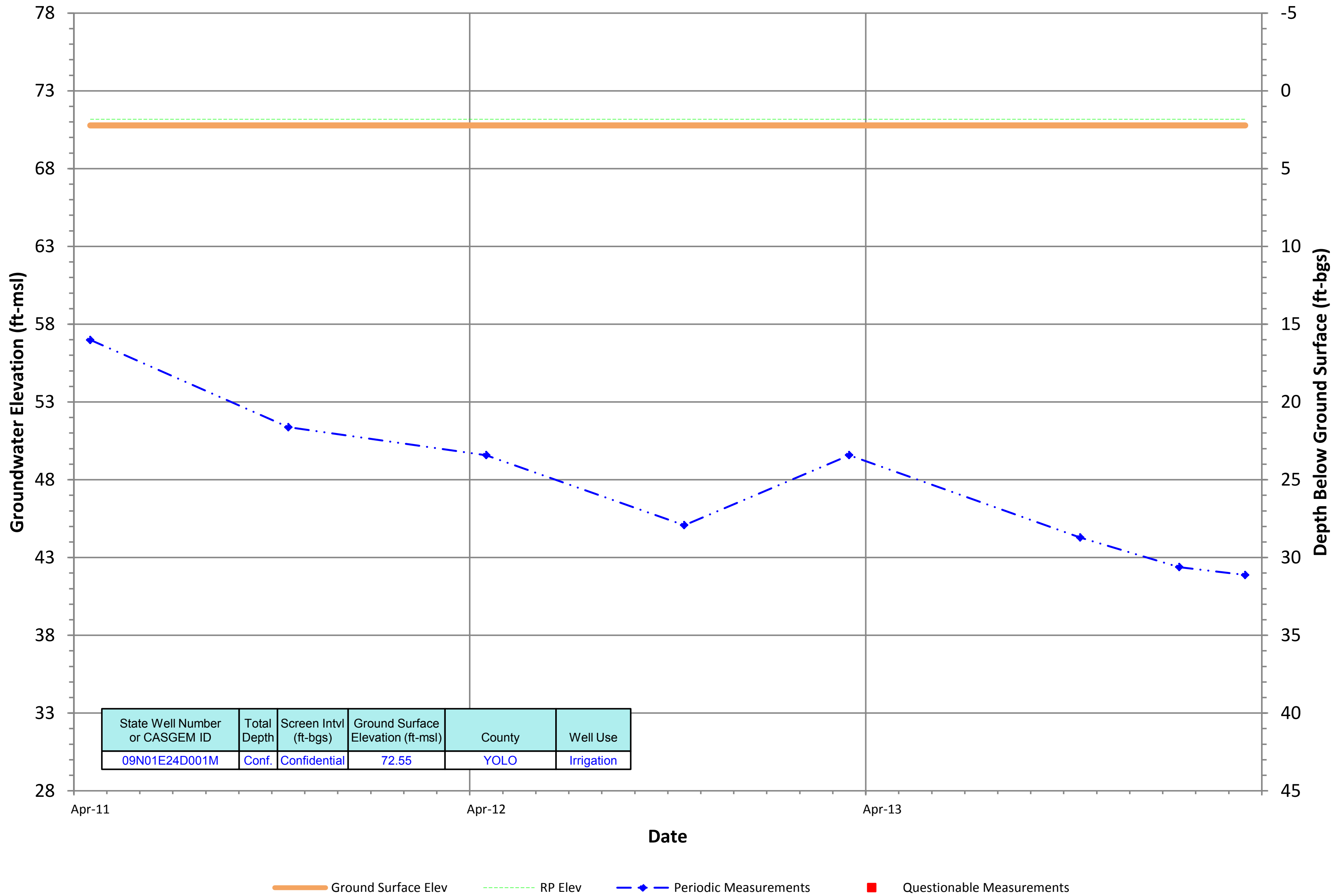
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E12M001M	Conf.	Confidential	84.54	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E20E001M	Conf.	Confidential	115.57	YOLO	Irrigation

09N01E24D001M
Period Of Record: 04/22/2011 to 03/19/2014

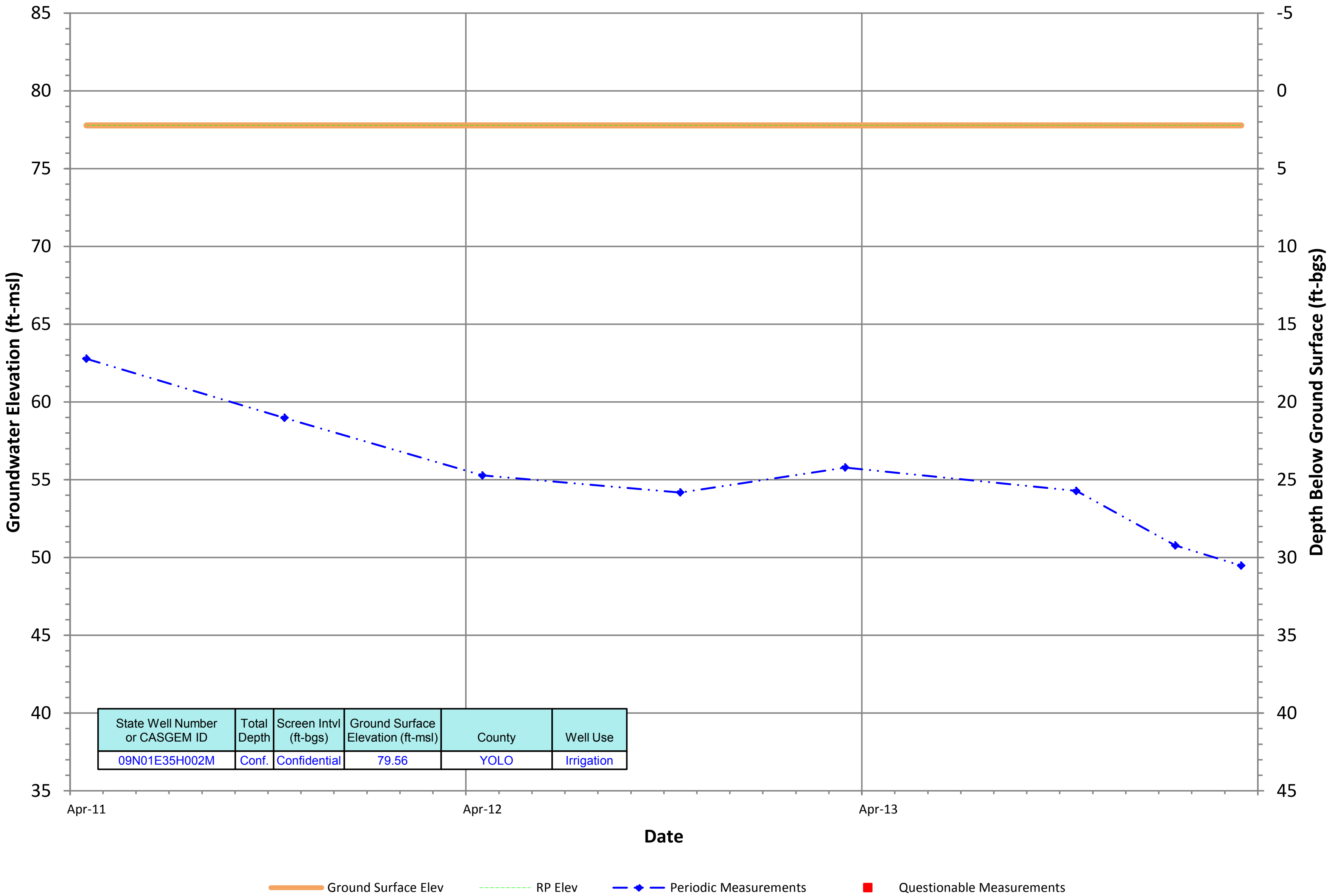
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E24D001M	Conf.	Confidential	72.55	YOLO	Irrigation

09N01E35H002M
Period Of Record: 04/22/2011 to 03/18/2014

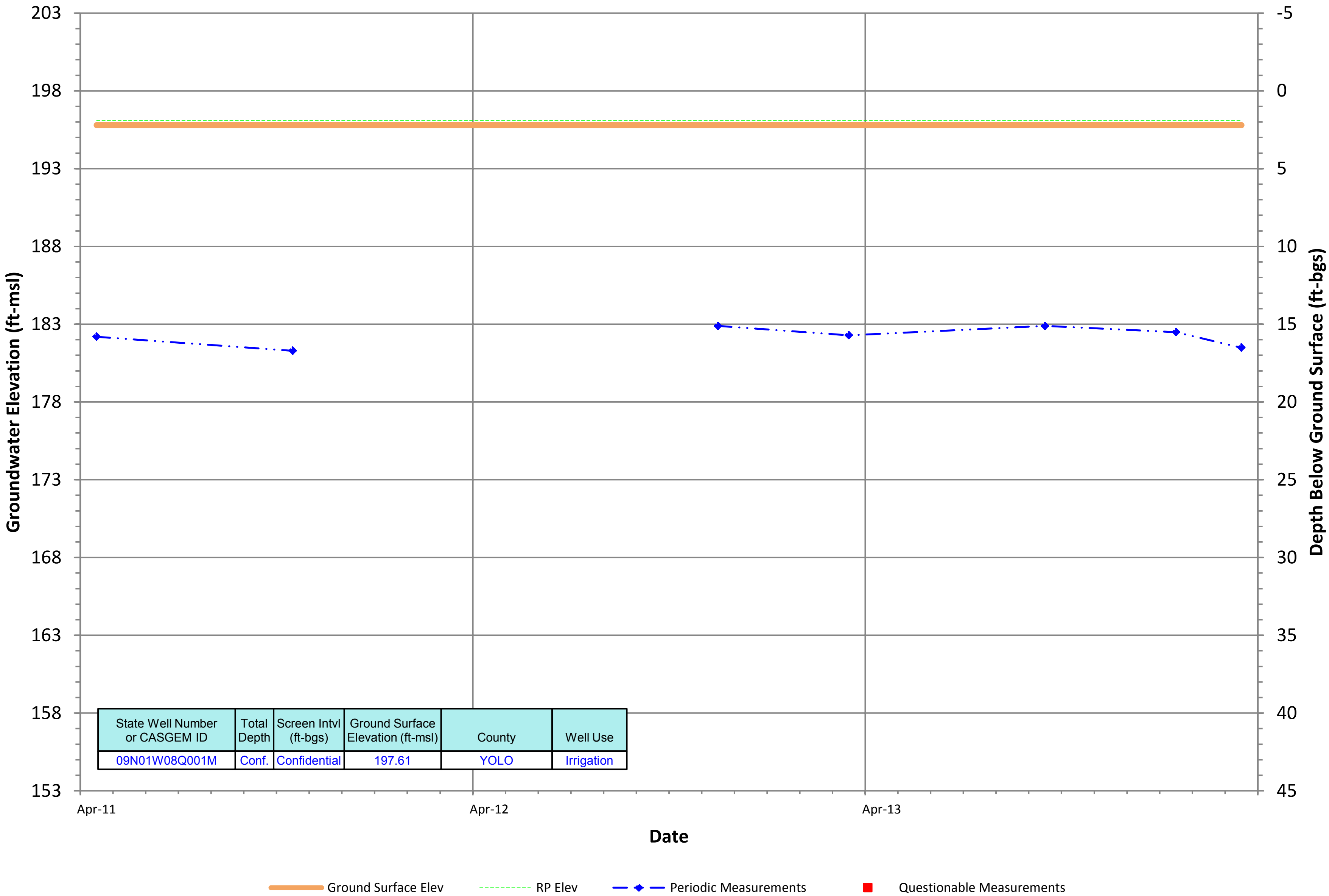
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01E35H002M	Conf.	Confidential	79.56	YOLO	Irrigation

09N01W08Q001M
Period Of Record: 04/21/2011 to 03/14/2014

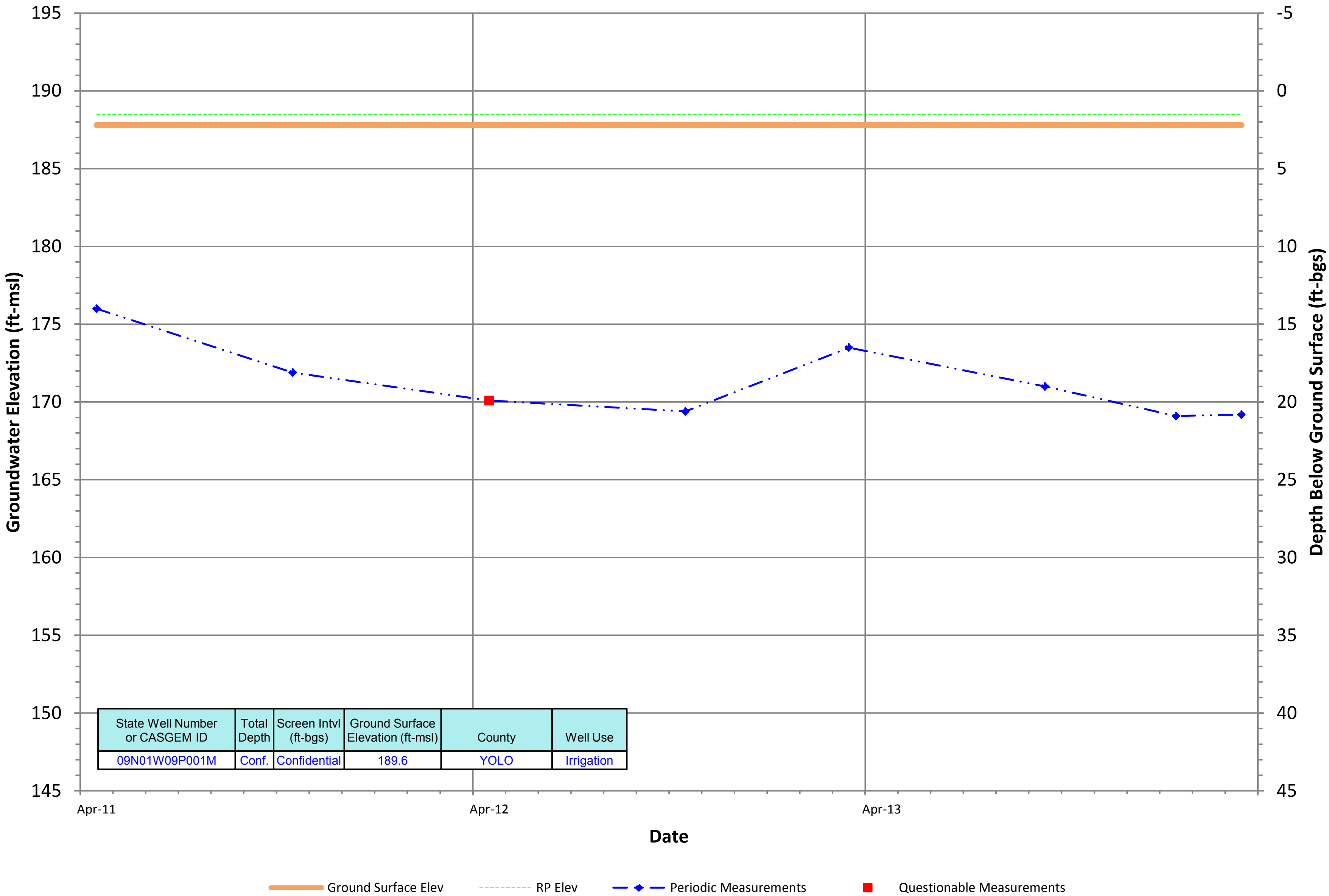
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W08Q001M	Conf.	Confidential	197.61	YOLO	Irrigation

09N01W09P001M
Period Of Record: 04/21/2011 to 03/14/2014

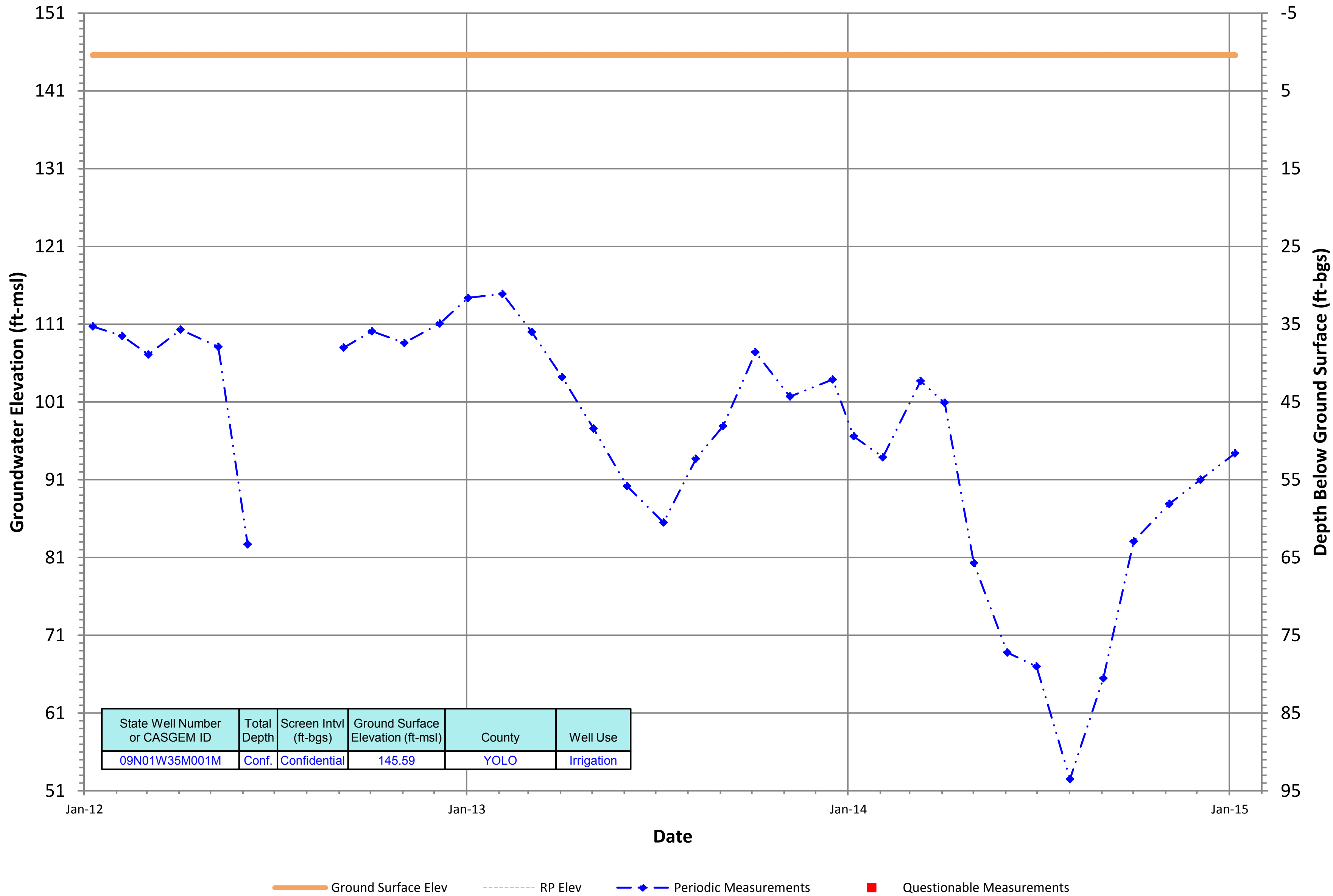
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W09P001M	Conf.	Confidential	189.6	YOLO	Irrigation

09N01W35M001M
Period Of Record: 01/09/2012 to 01/06/2015

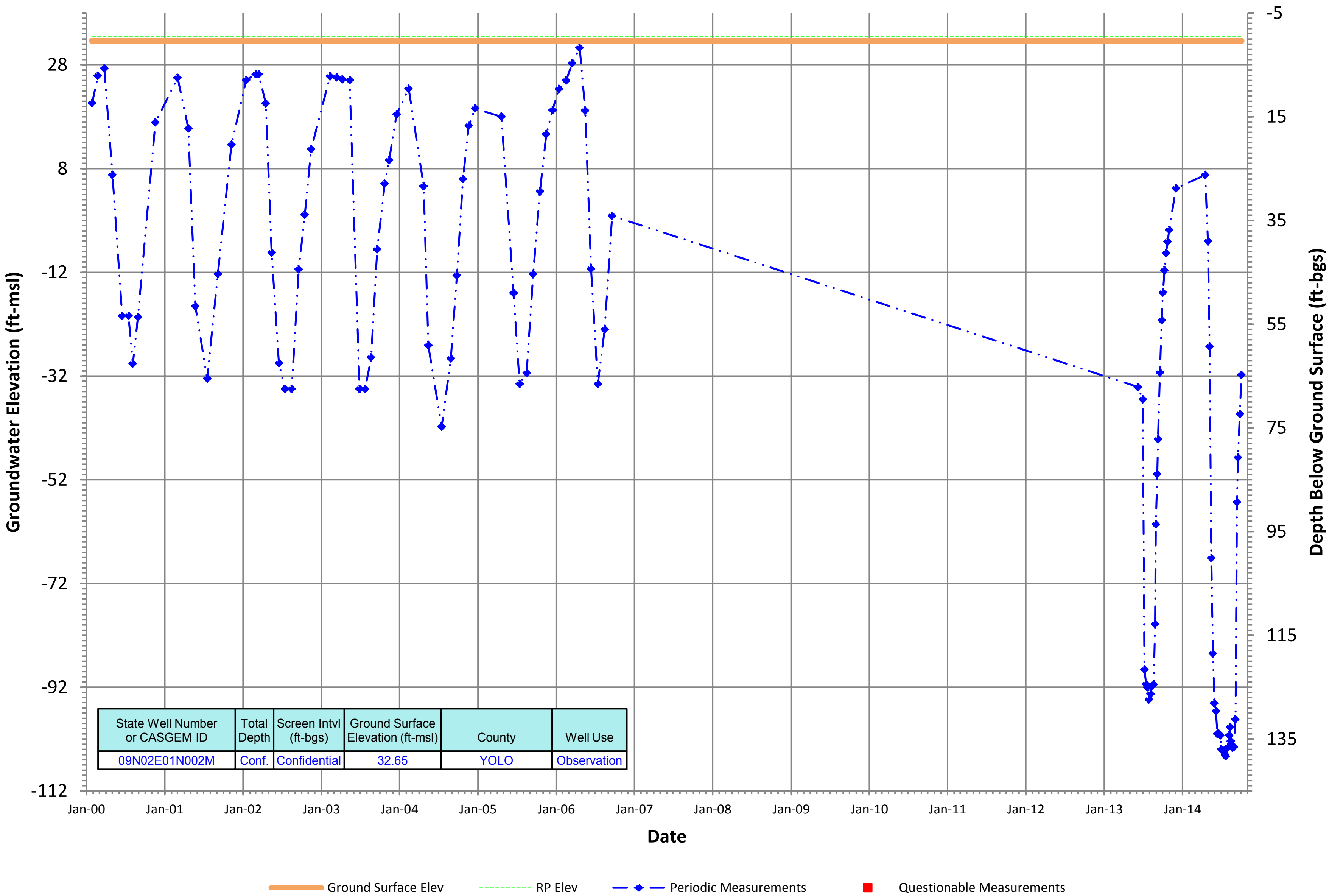
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N01W35M001M	Conf.	Confidential	145.59	YOLO	Irrigation

09N02E01N002M
Period Of Record: 01/27/2000 to 10/03/2014

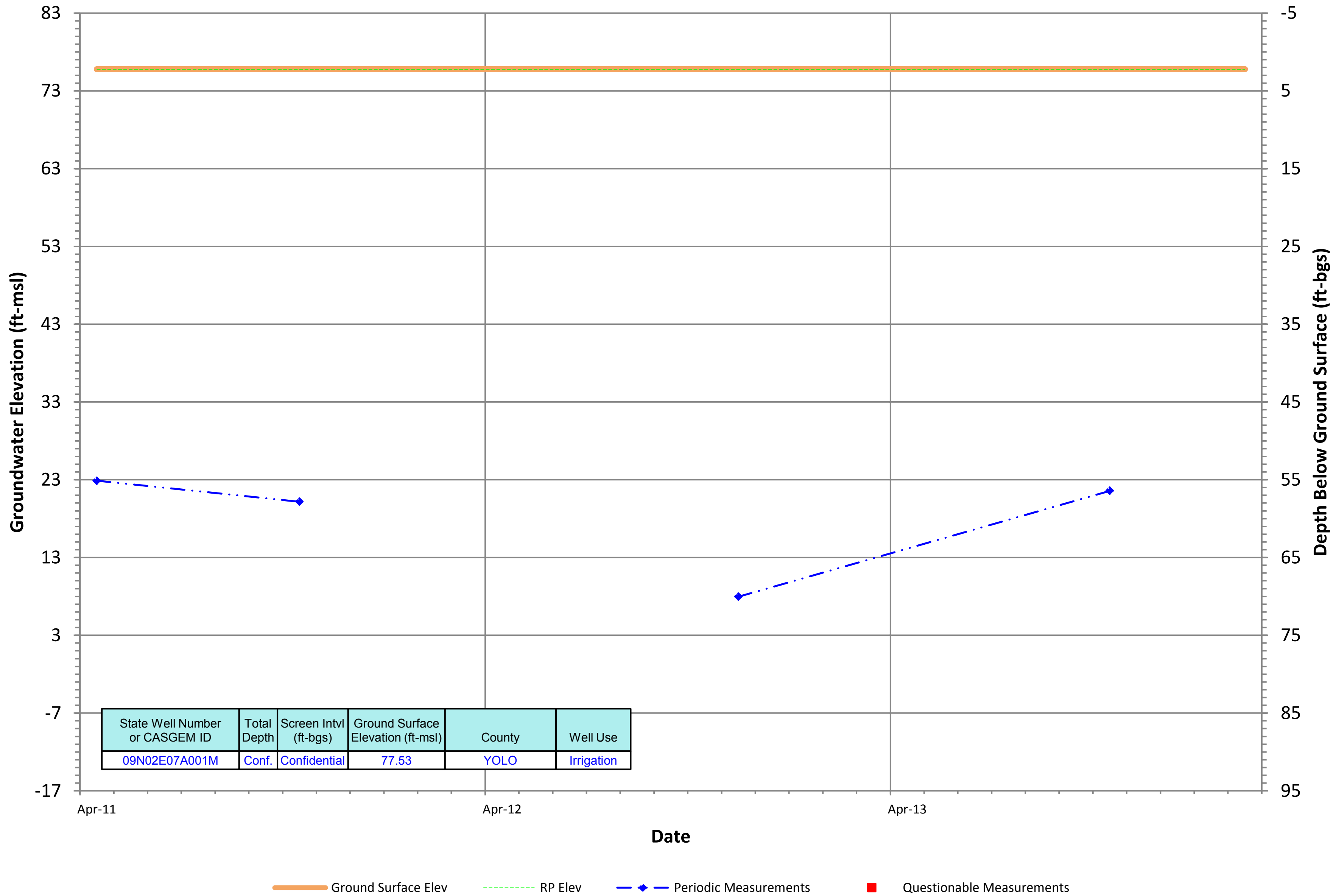
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



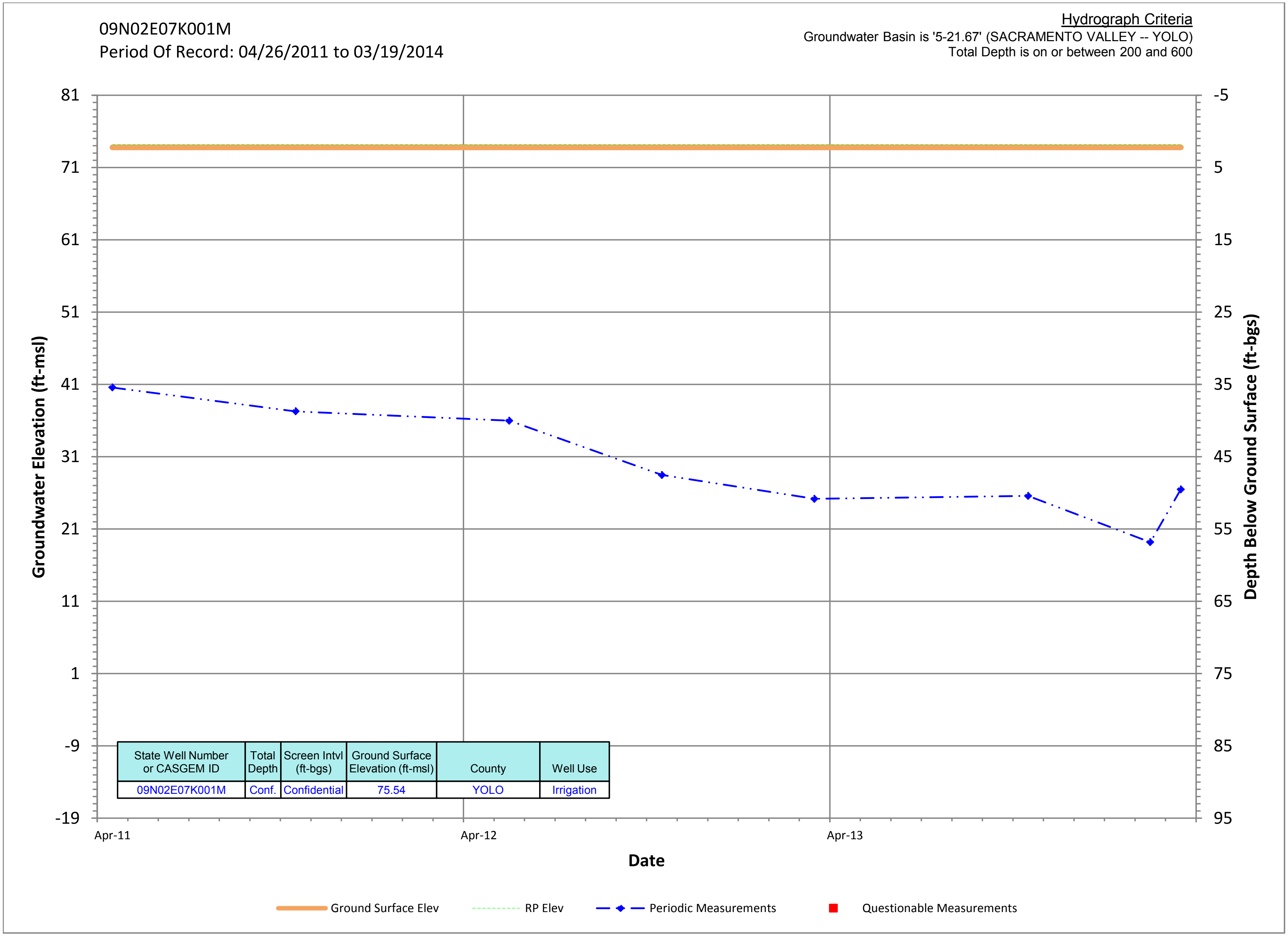
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E01N002M	Conf.	Confidential	32.65	YOLO	Observation

09N02E07A001M
Period Of Record: 04/26/2011 to 02/05/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



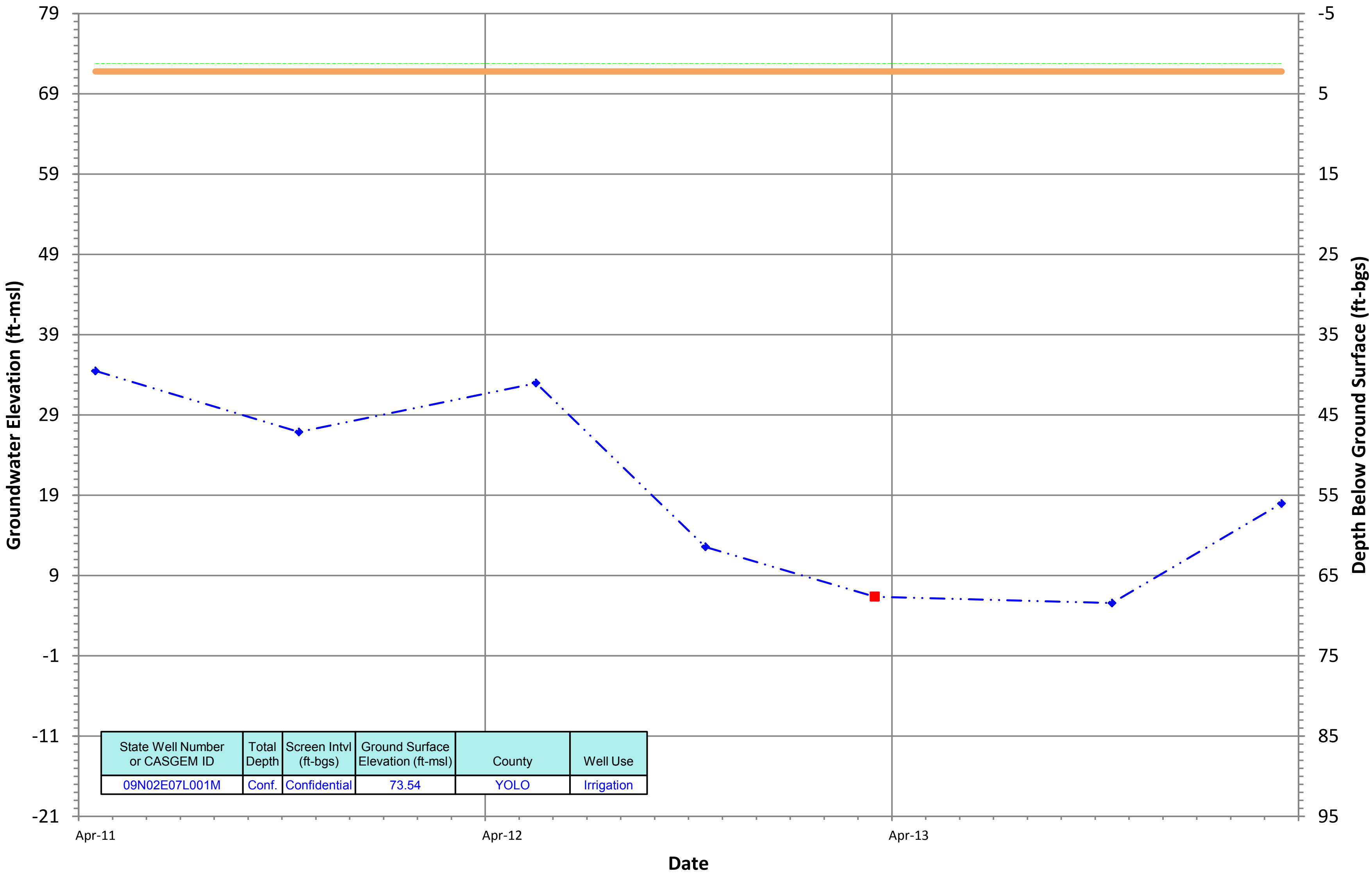
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E07A001M	Conf.	Confidential	77.53	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E07K001M	Conf.	Confidential	75.54	YOLO	Irrigation

09N02E07L001M
Period Of Record: 04/26/2011 to 03/19/2014

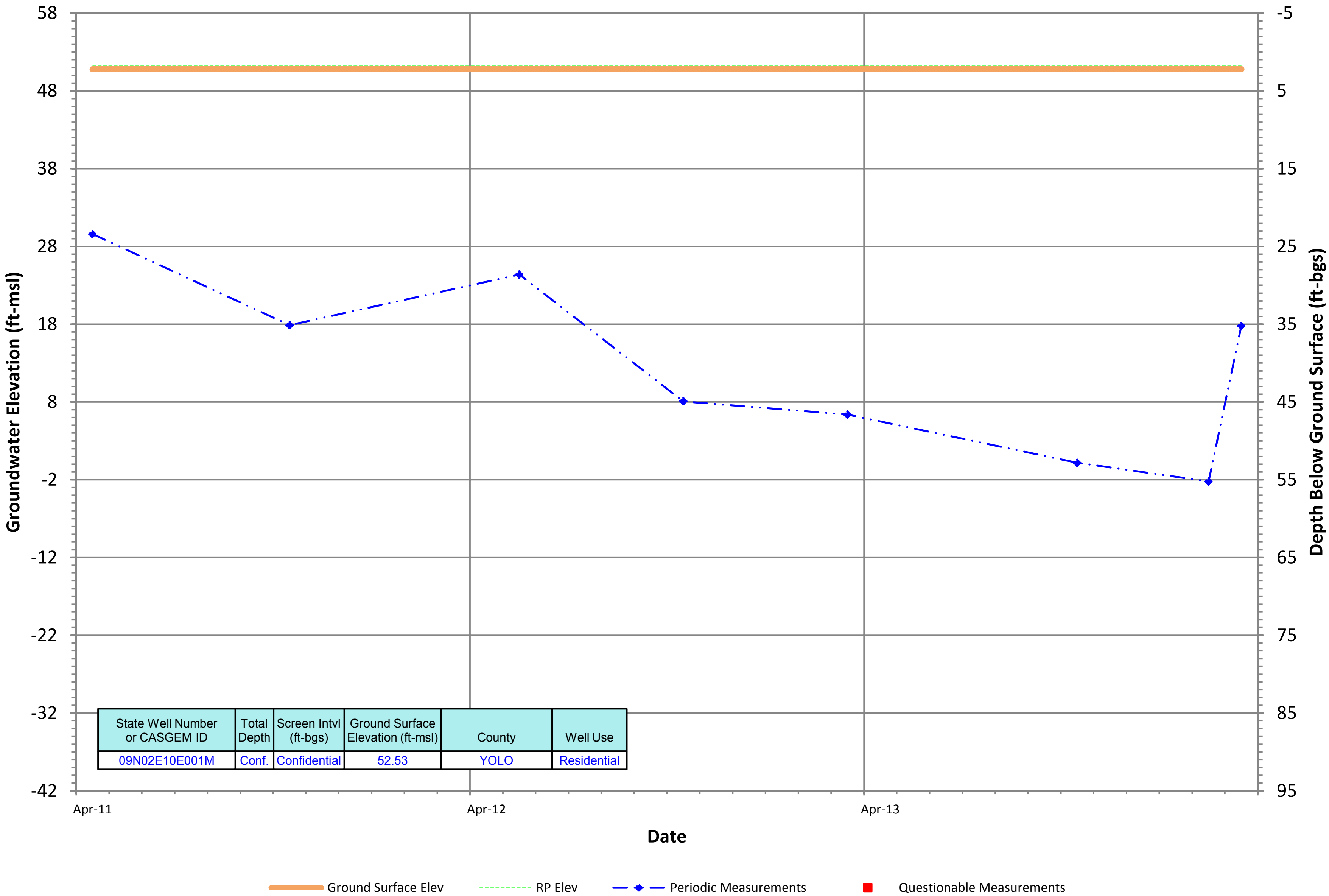
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E07L001M	Conf.	Confidential	73.54	YOLO	Irrigation

09N02E10E001M
Period Of Record: 04/26/2011 to 03/19/2014

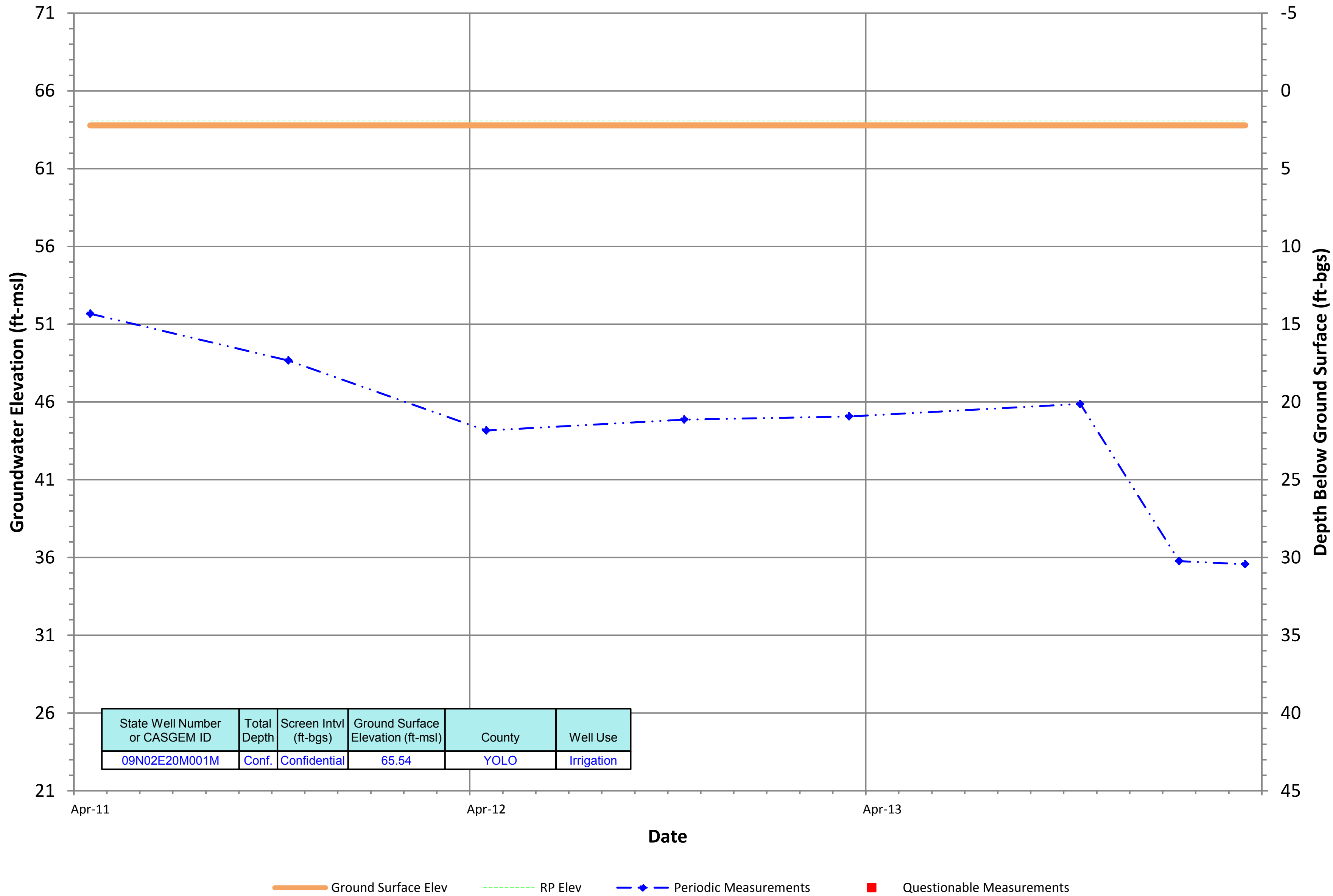
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E10E001M	Conf.	Confidential	52.53	YOLO	Residential

09N02E20M001M
Period Of Record: 04/22/2011 to 03/18/2014

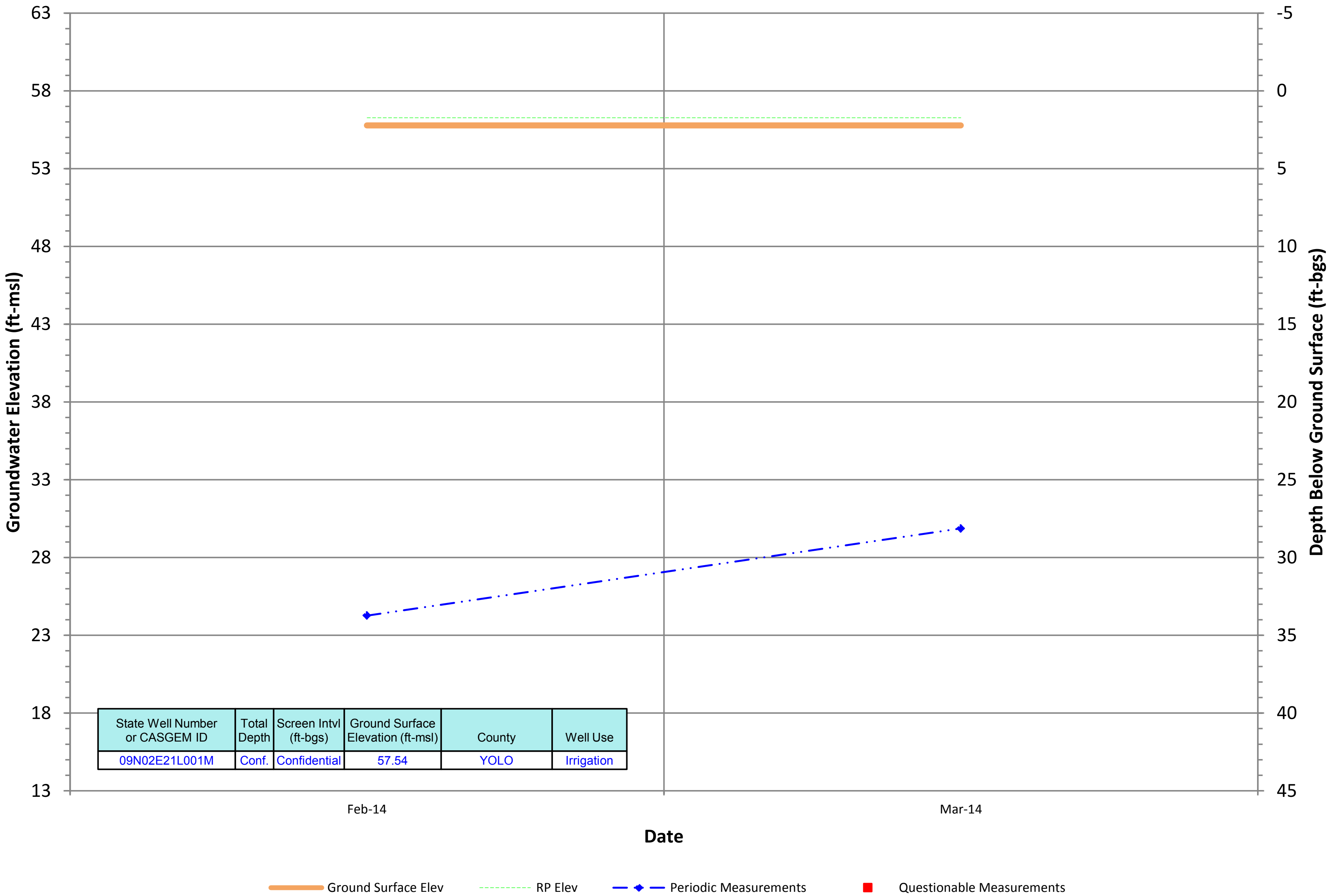
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E20M001M	Conf.	Confidential	65.54	YOLO	Irrigation

09N02E21L001M
Period Of Record: 02/13/2014 to 03/18/2014

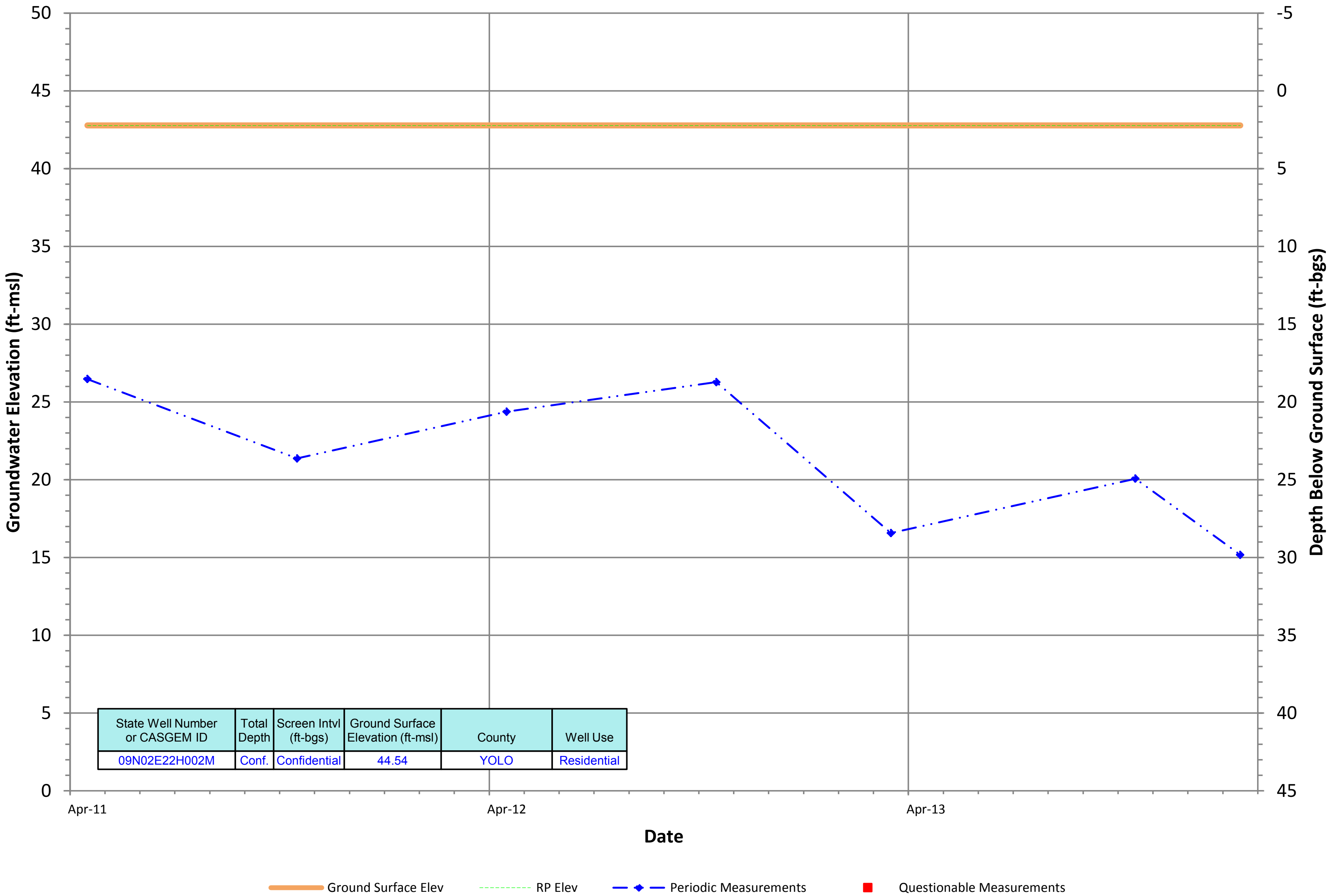
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E21L001M	Conf.	Confidential	57.54	YOLO	Irrigation

09N02E22H002M
Period Of Record: 04/22/2011 to 01/30/2014

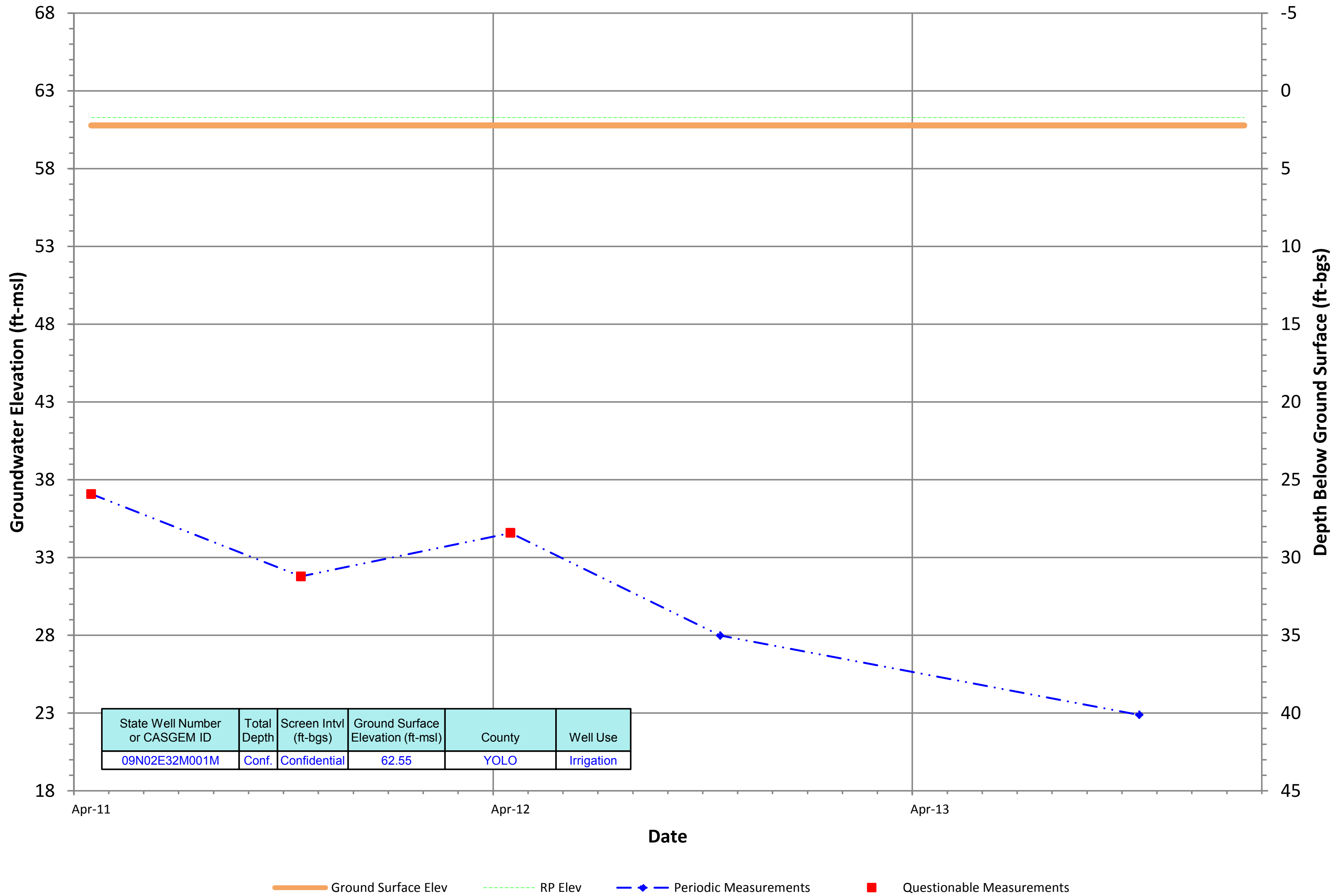
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E22H002M	Conf.	Confidential	44.54	YOLO	Residential

09N02E32M001M
Period Of Record: 04/22/2011 to 01/30/2014

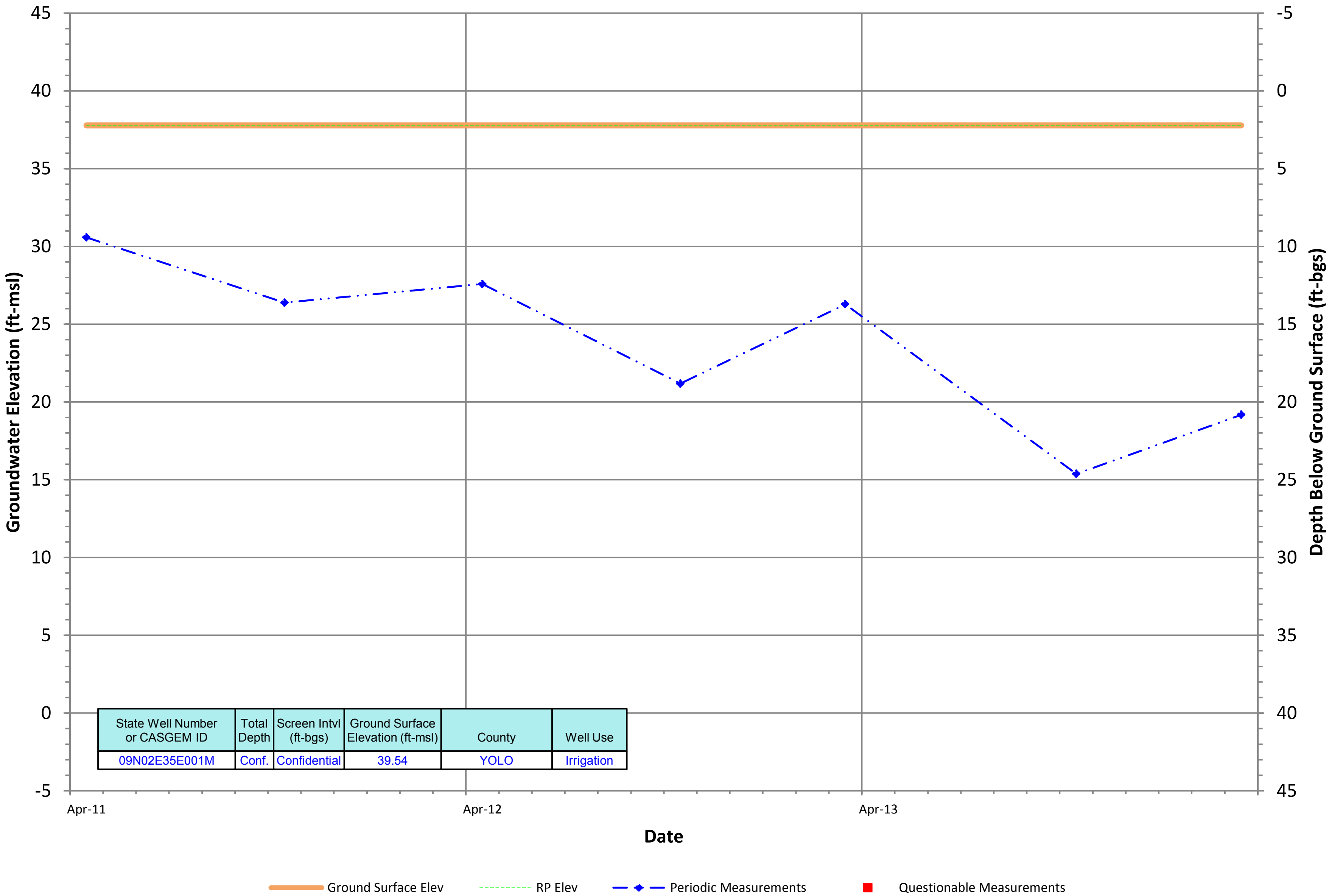
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E32M001M	Conf.	Confidential	62.55	YOLO	Irrigation

09N02E35E001M
Period Of Record: 04/22/2011 to 03/19/2014

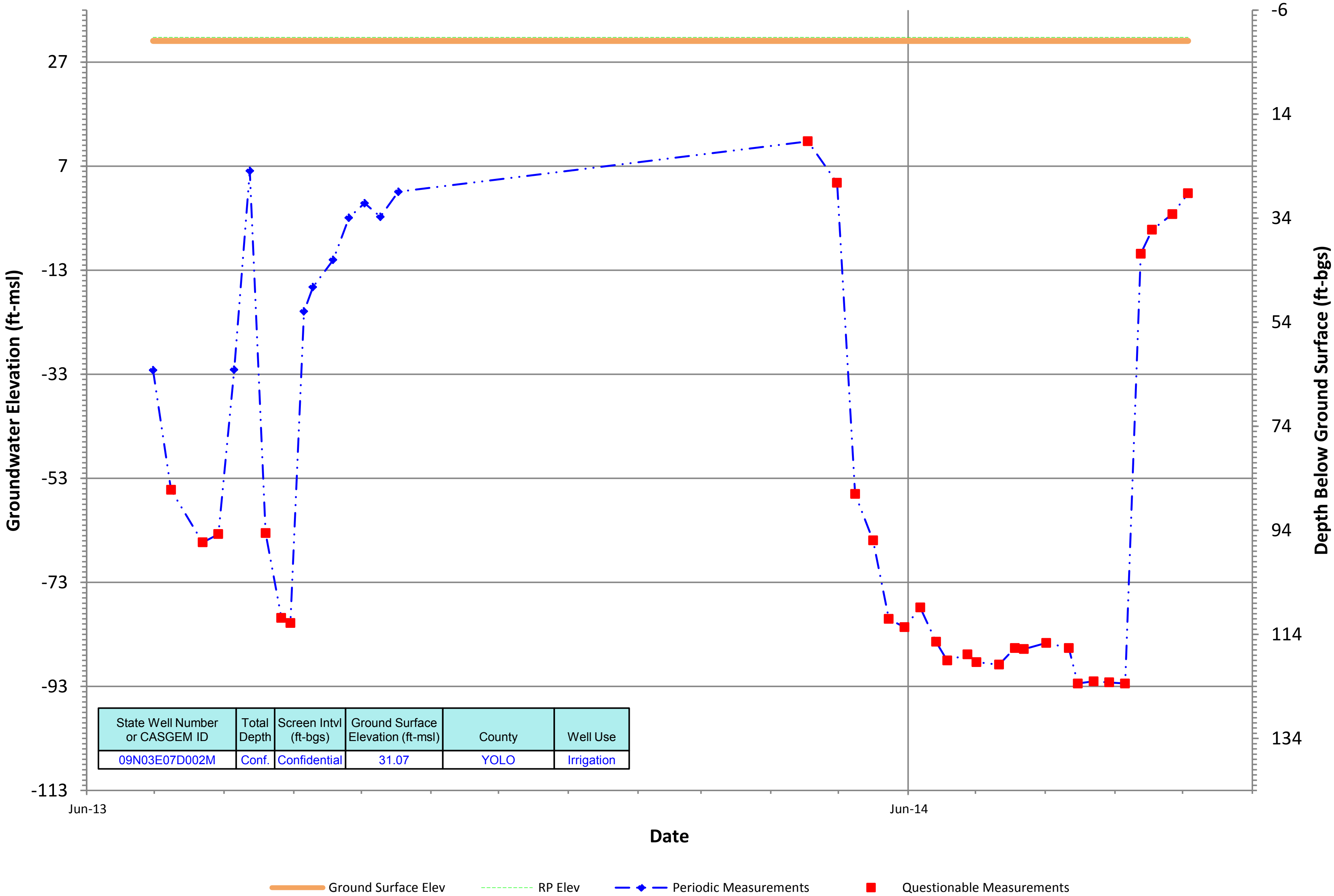
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N02E35E001M	Conf.	Confidential	39.54	YOLO	Irrigation

09N03E07D002M
Period Of Record: 06/30/2013 to 10/03/2014

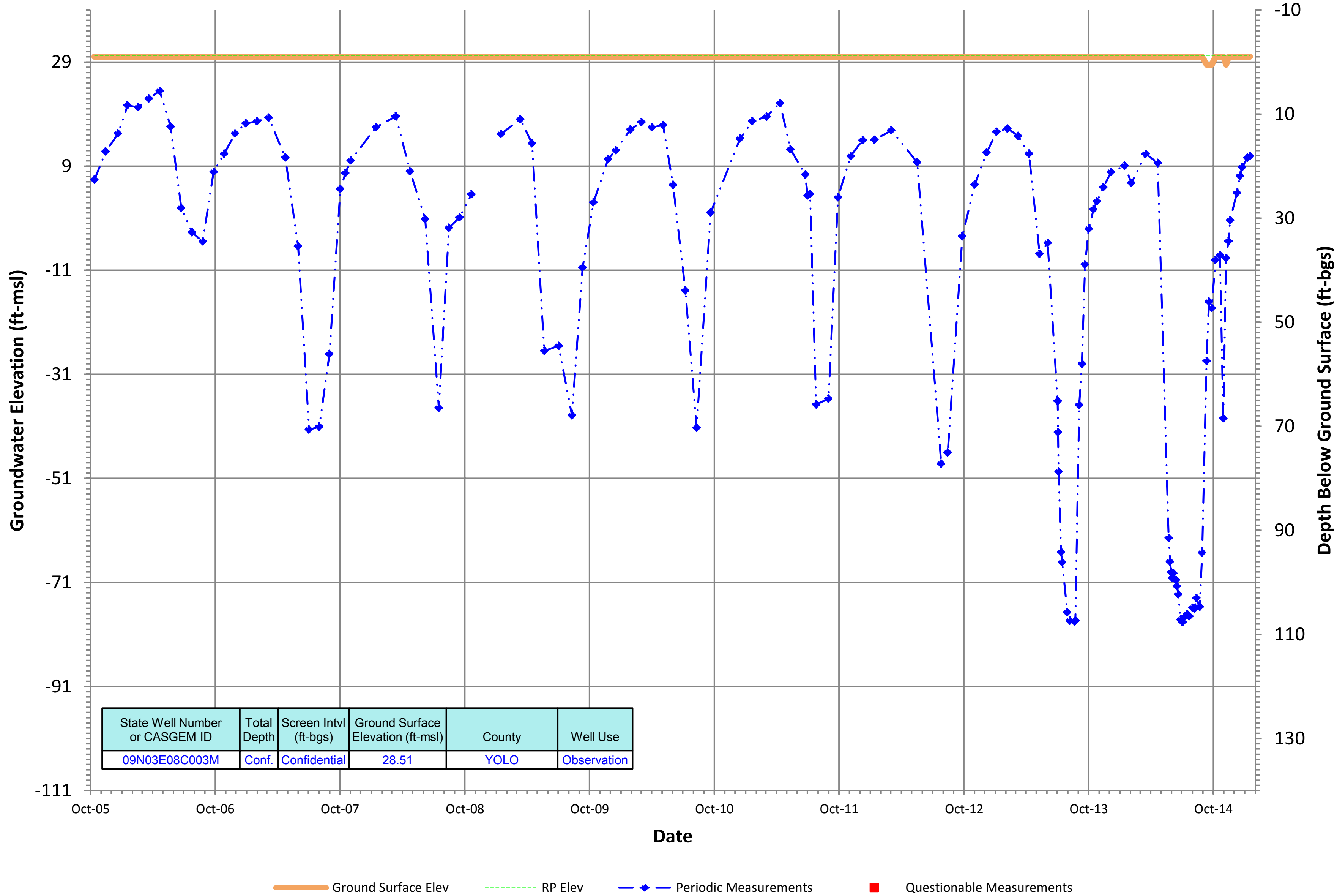
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E07D002M	Conf.	Confidential	31.07	YOLO	Irrigation

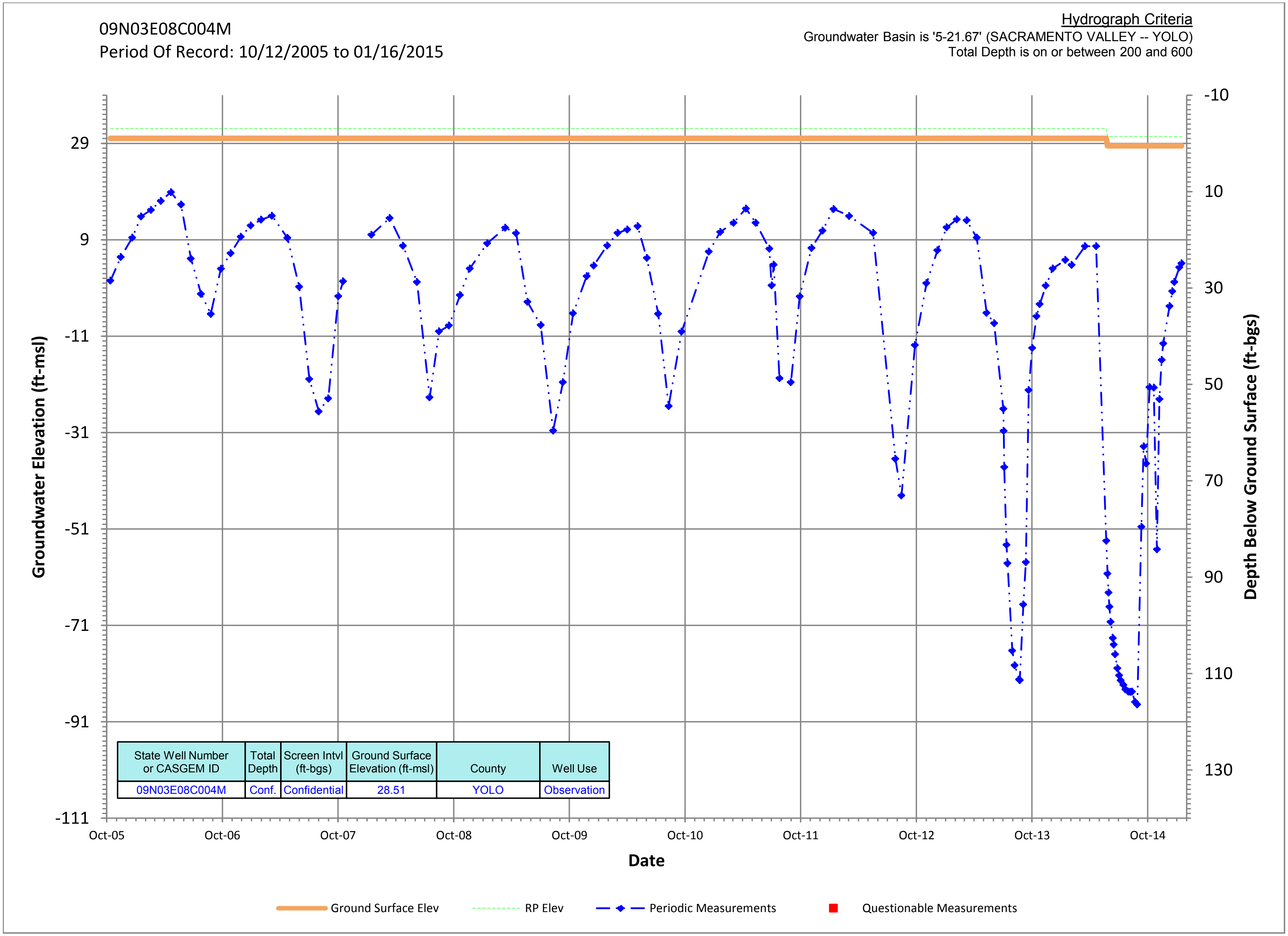
09N03E08C003M
Period Of Record: 10/12/2005 to 01/16/2015

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E08C003M	Conf.	Confidential	28.51	YOLO	Observation

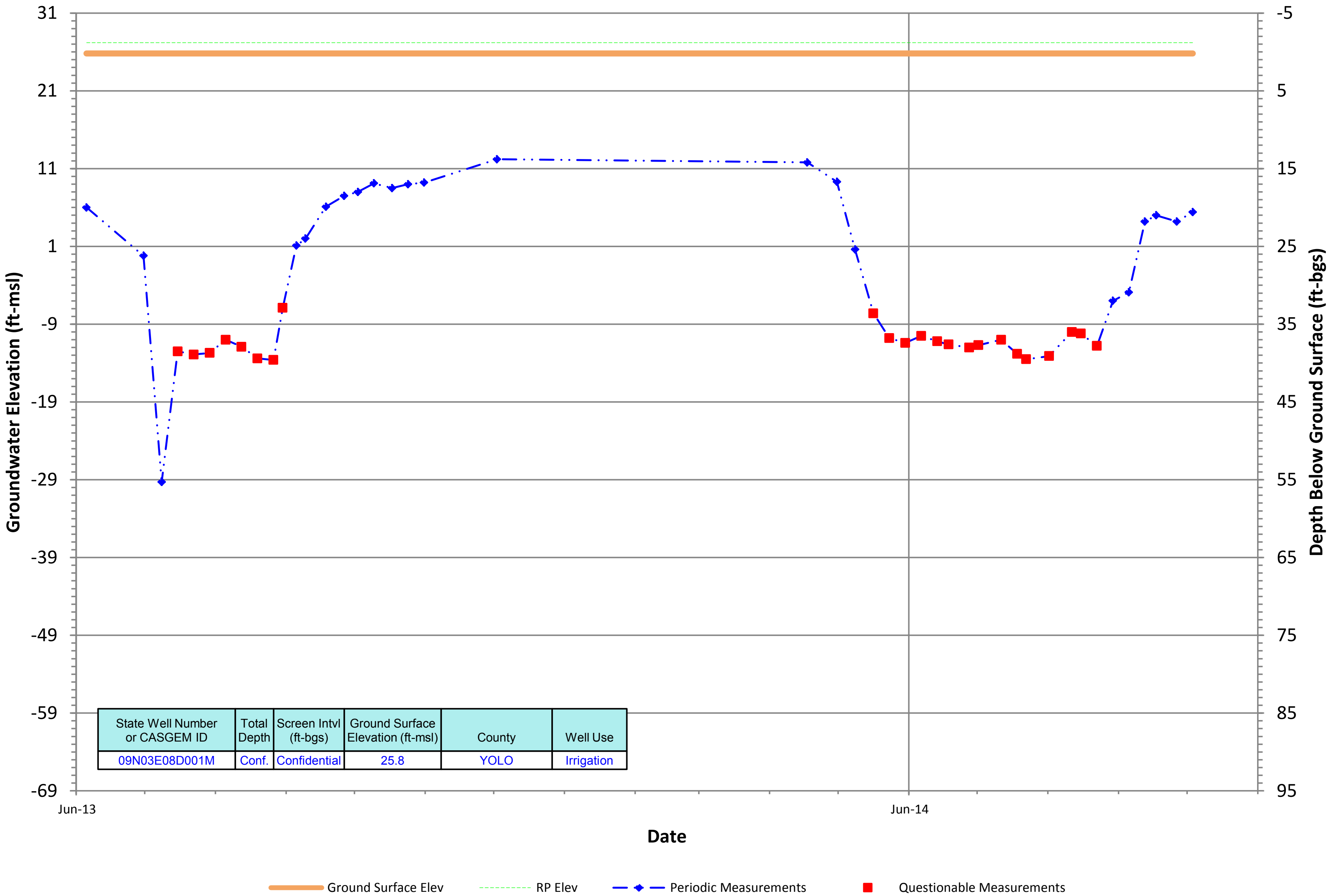
09N03E08C004M
Period Of Record: 10/12/2005 to 01/16/2015



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E08C004M	Conf.	Confidential	28.51	YOLO	Observation

09N03E08D001M
Period Of Record: 06/05/2013 to 10/03/2014

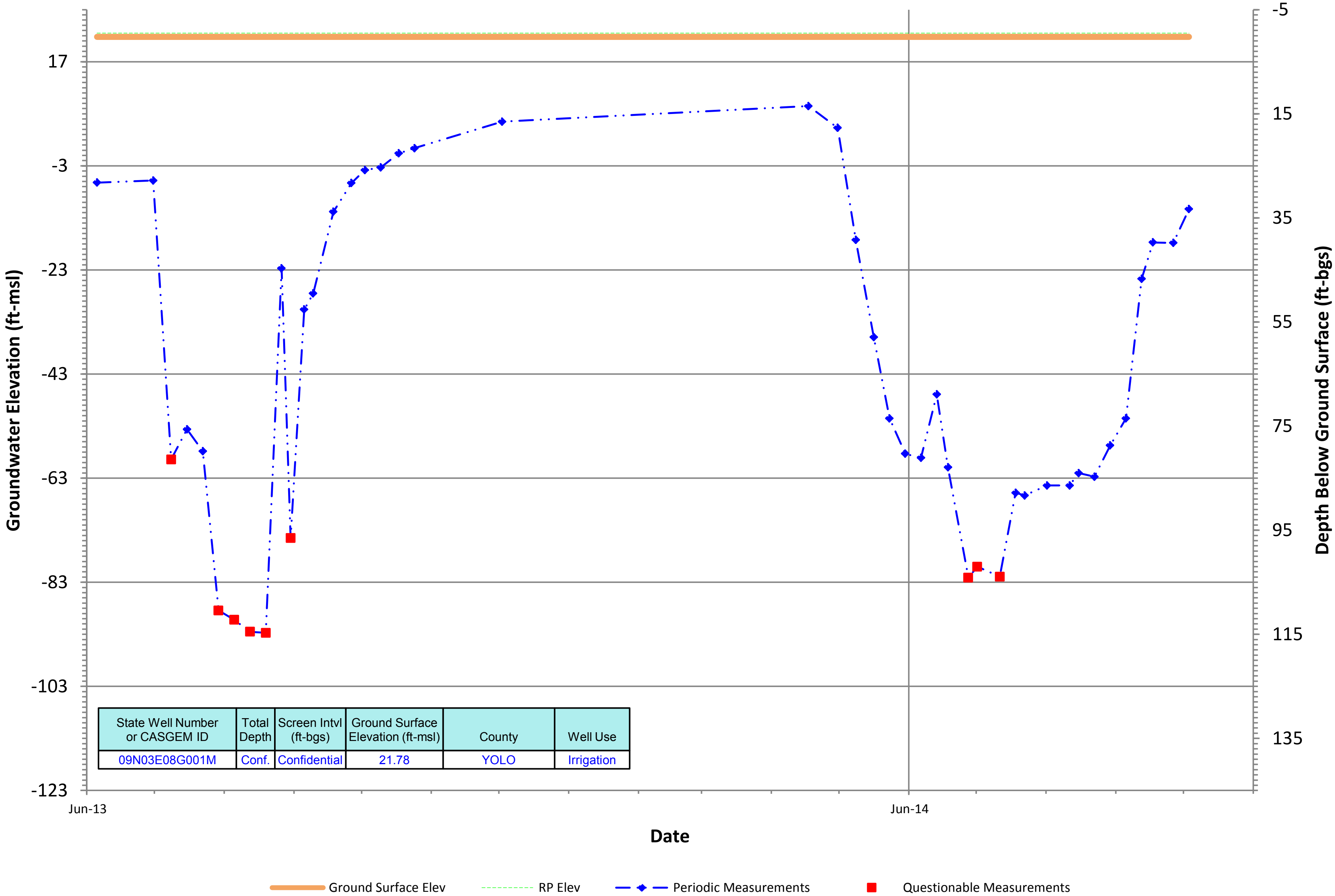
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E08D001M	Conf.	Confidential	25.8	YOLO	Irrigation

09N03E08G001M
Period Of Record: 06/05/2013 to 10/03/2014

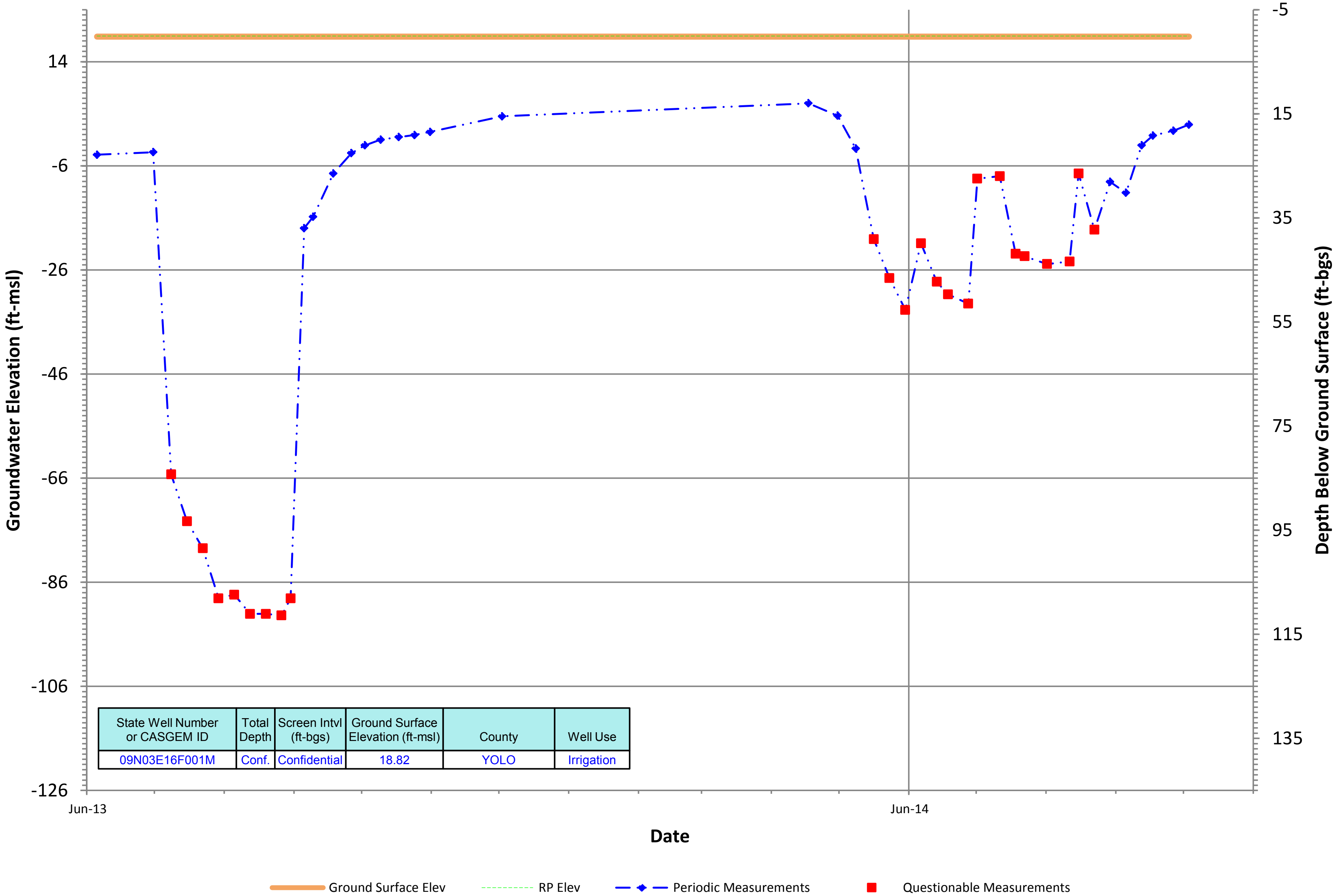
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E08G001M	Conf.	Confidential	21.78	YOLO	Irrigation

09N03E16F001M
Period Of Record: 06/05/2013 to 10/03/2014

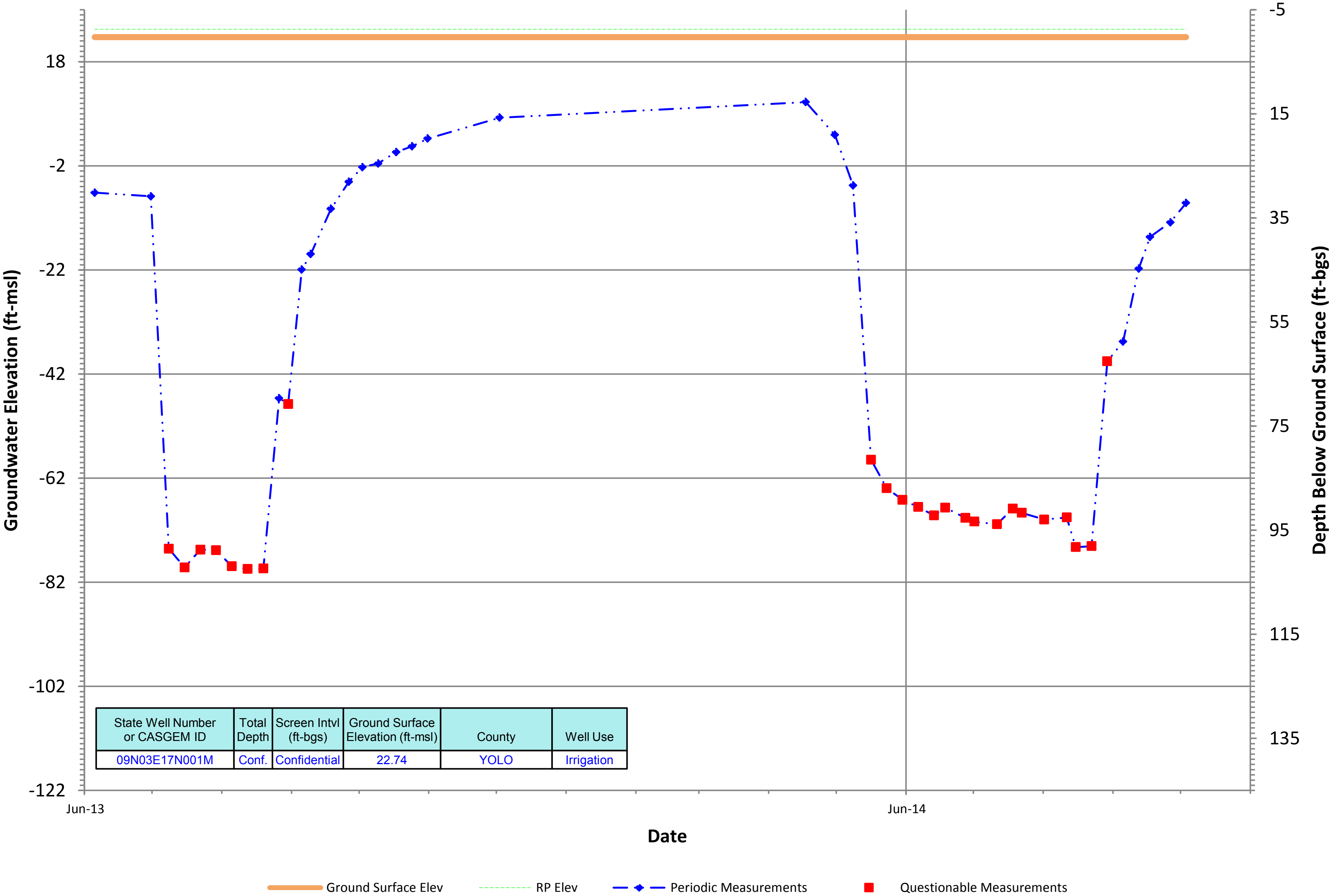
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



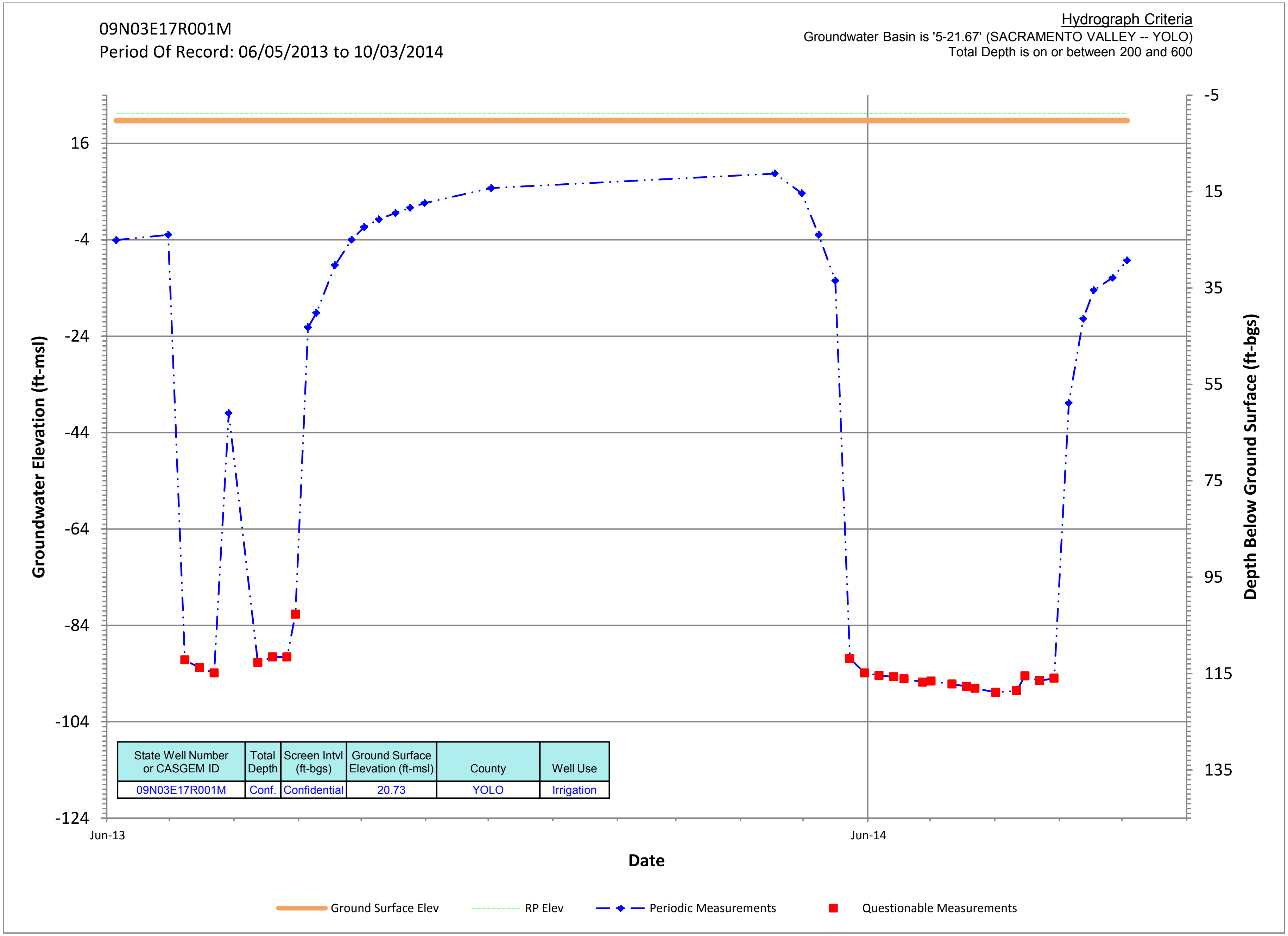
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E16F001M	Conf.	Confidential	18.82	YOLO	Irrigation

09N03E17N001M
Period Of Record: 06/05/2013 to 10/03/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



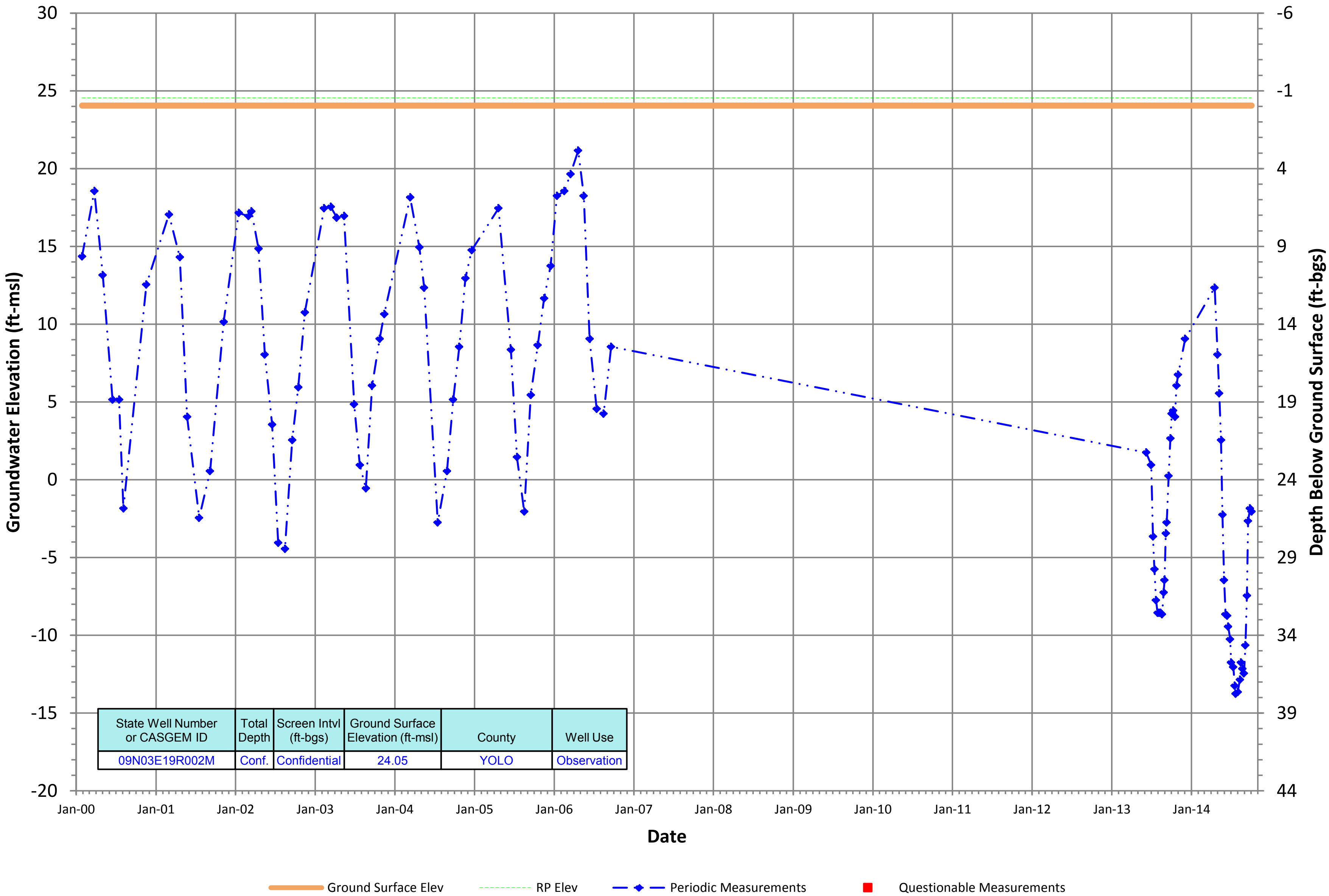
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E17N001M	Conf.	Confidential	22.74	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E17R001M	Conf.	Confidential	20.73	YOLO	Irrigation

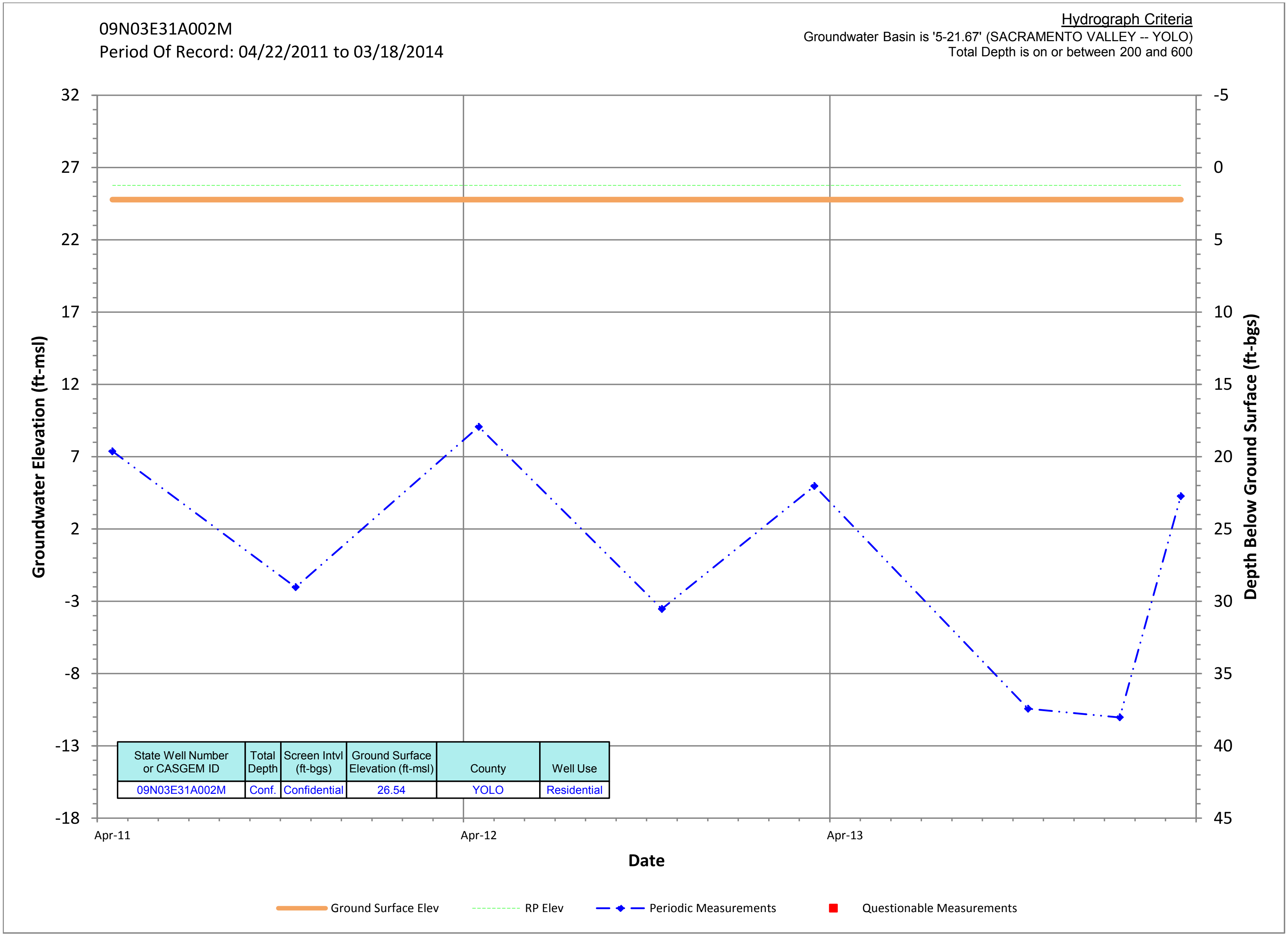
09N03E19R002M
Period Of Record: 01/27/2000 to 10/03/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E19R002M	Conf.	Confidential	24.05	YOLO	Observation

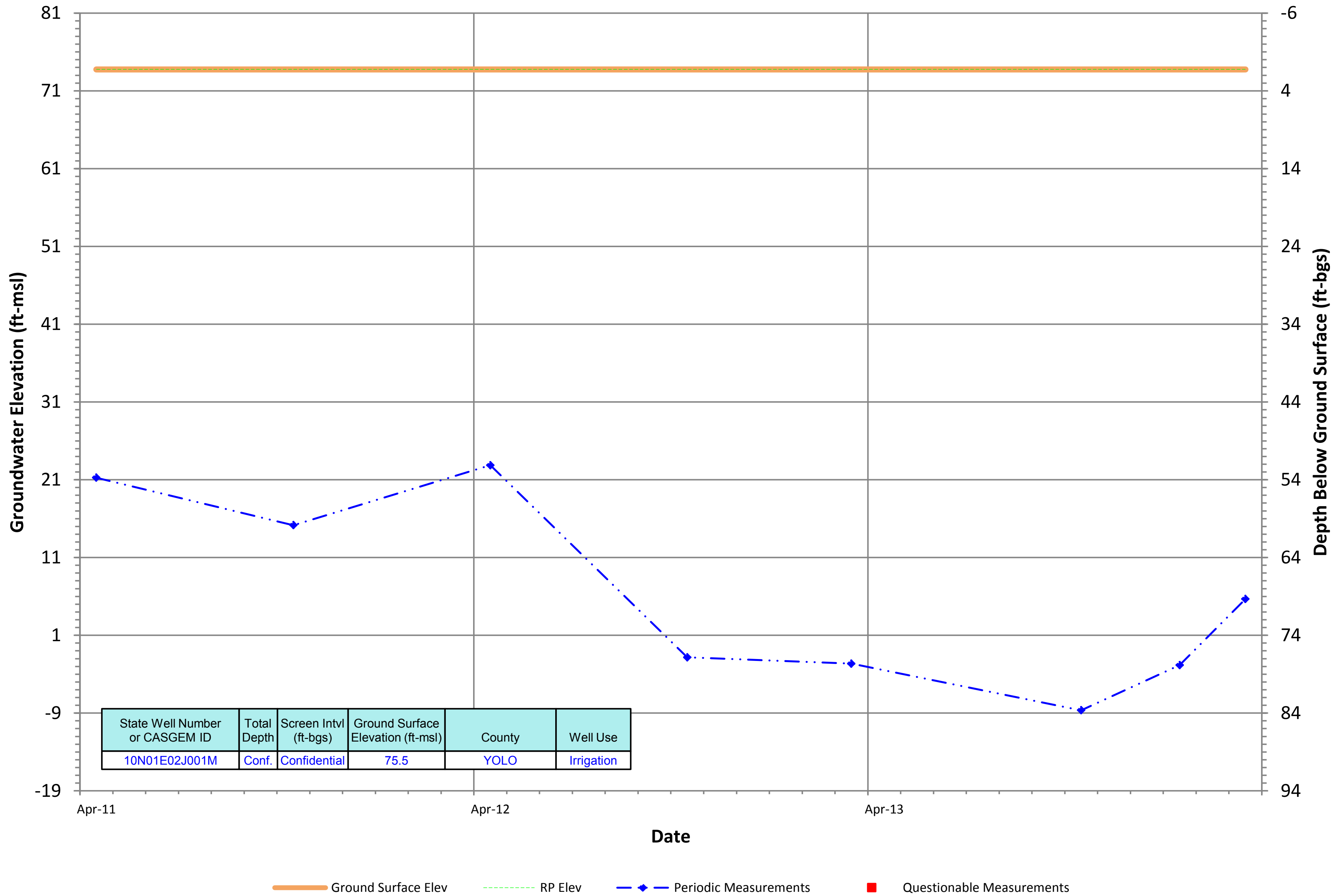
09N03E31A002M
Period Of Record: 04/22/2011 to 03/18/2014



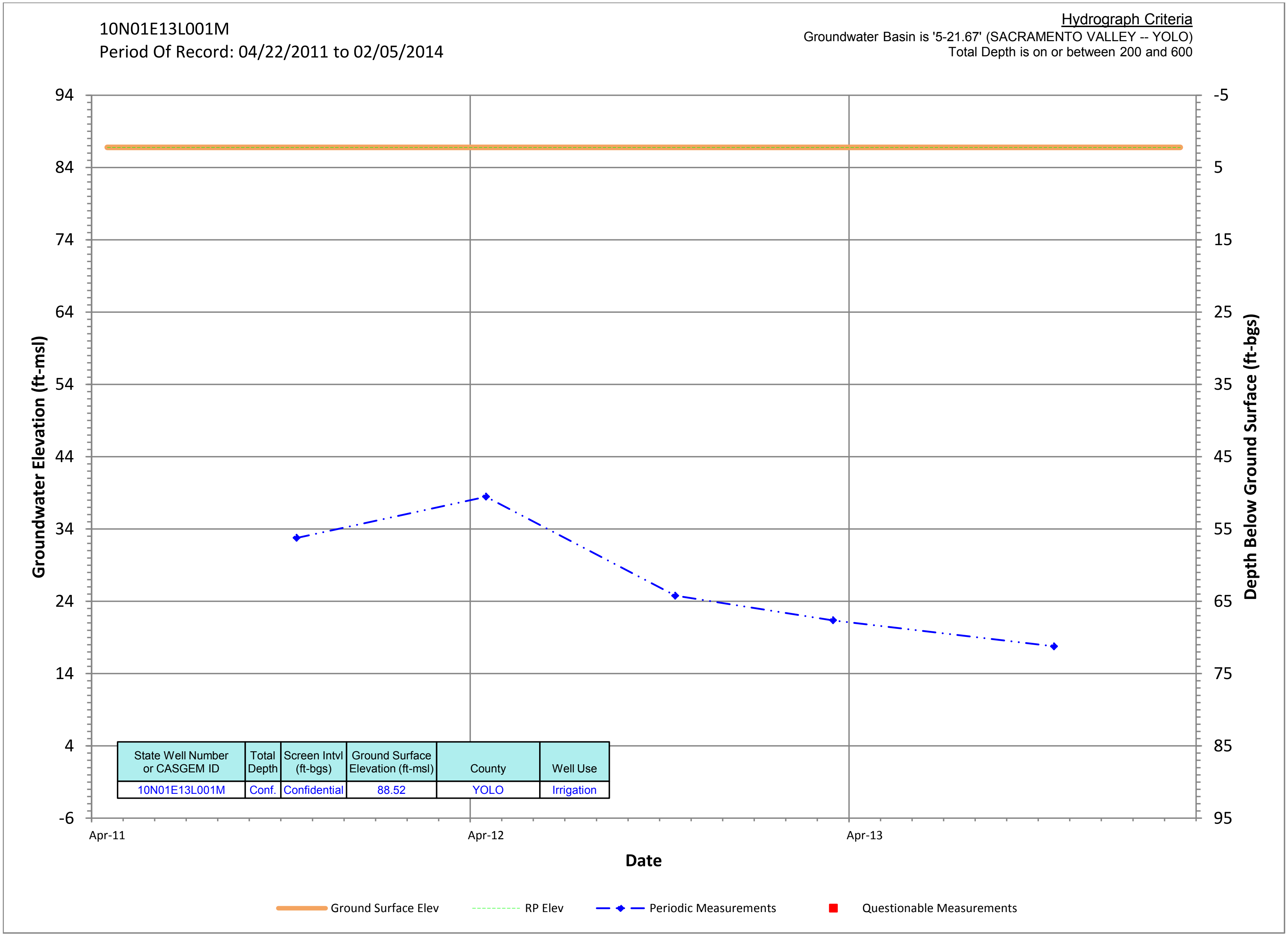
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
09N03E31A002M	Conf.	Confidential	26.54	YOLO	Residential

10N01E02J001M
Period Of Record: 04/22/2011 to 03/18/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



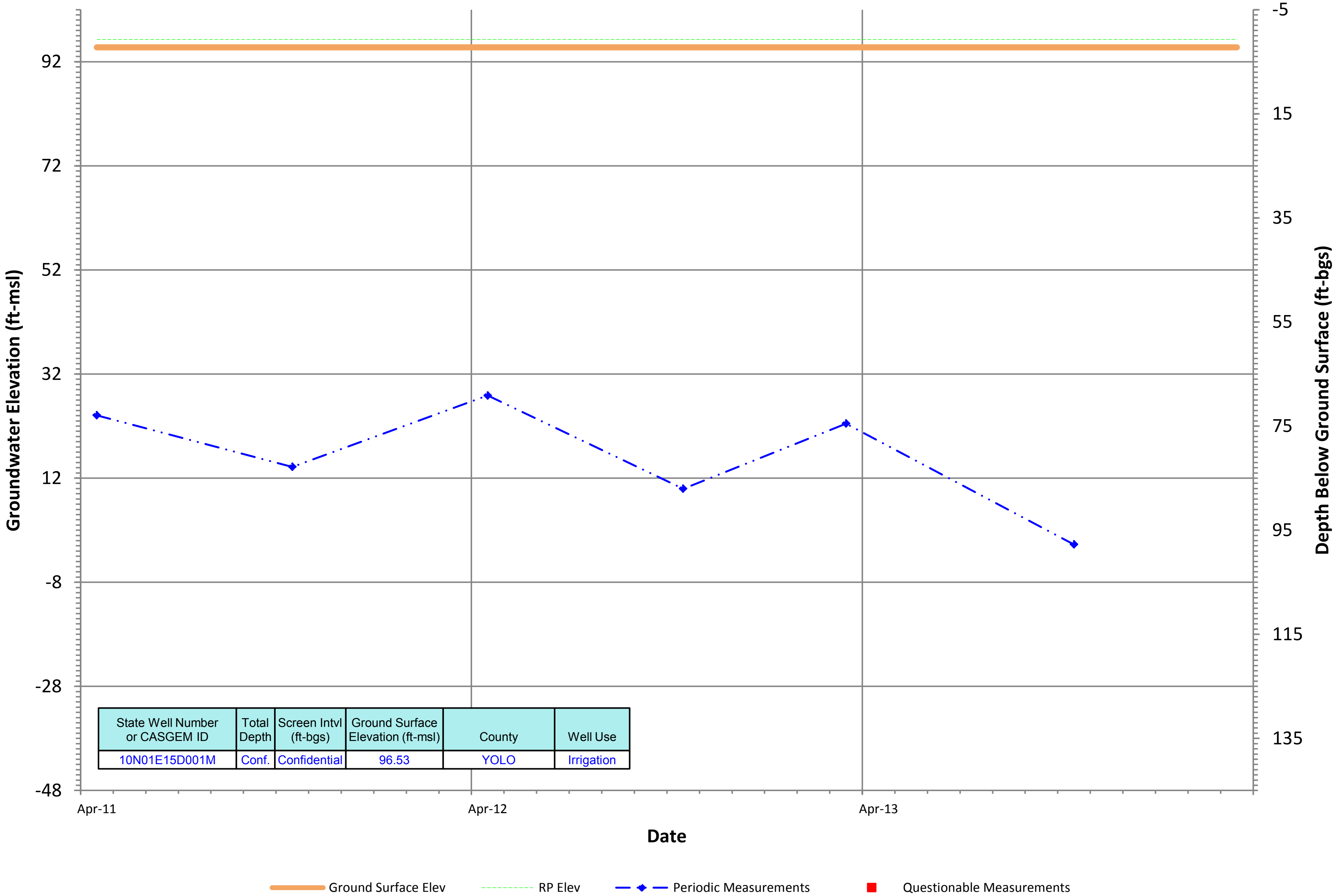
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E02J001M	Conf.	Confidential	75.5	YOLO	Irrigation



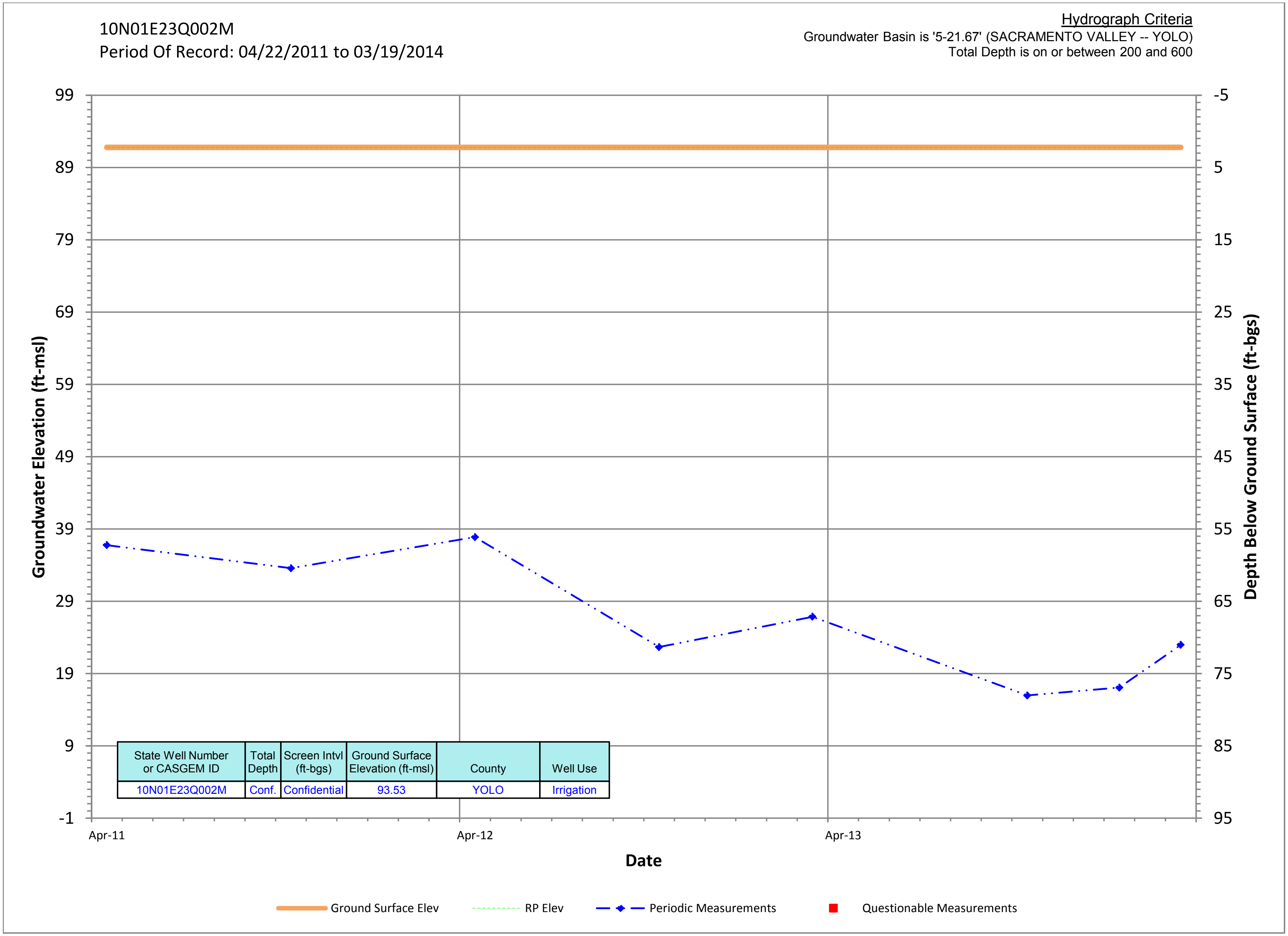
State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E13L001M	Conf.	Confidential	88.52	YOLO	Irrigation

10N01E15D001M
Period Of Record: 04/22/2011 to 03/18/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E15D001M	Conf.	Confidential	96.53	YOLO	Irrigation



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E23Q002M	Conf.	Confidential	93.53	YOLO	Irrigation

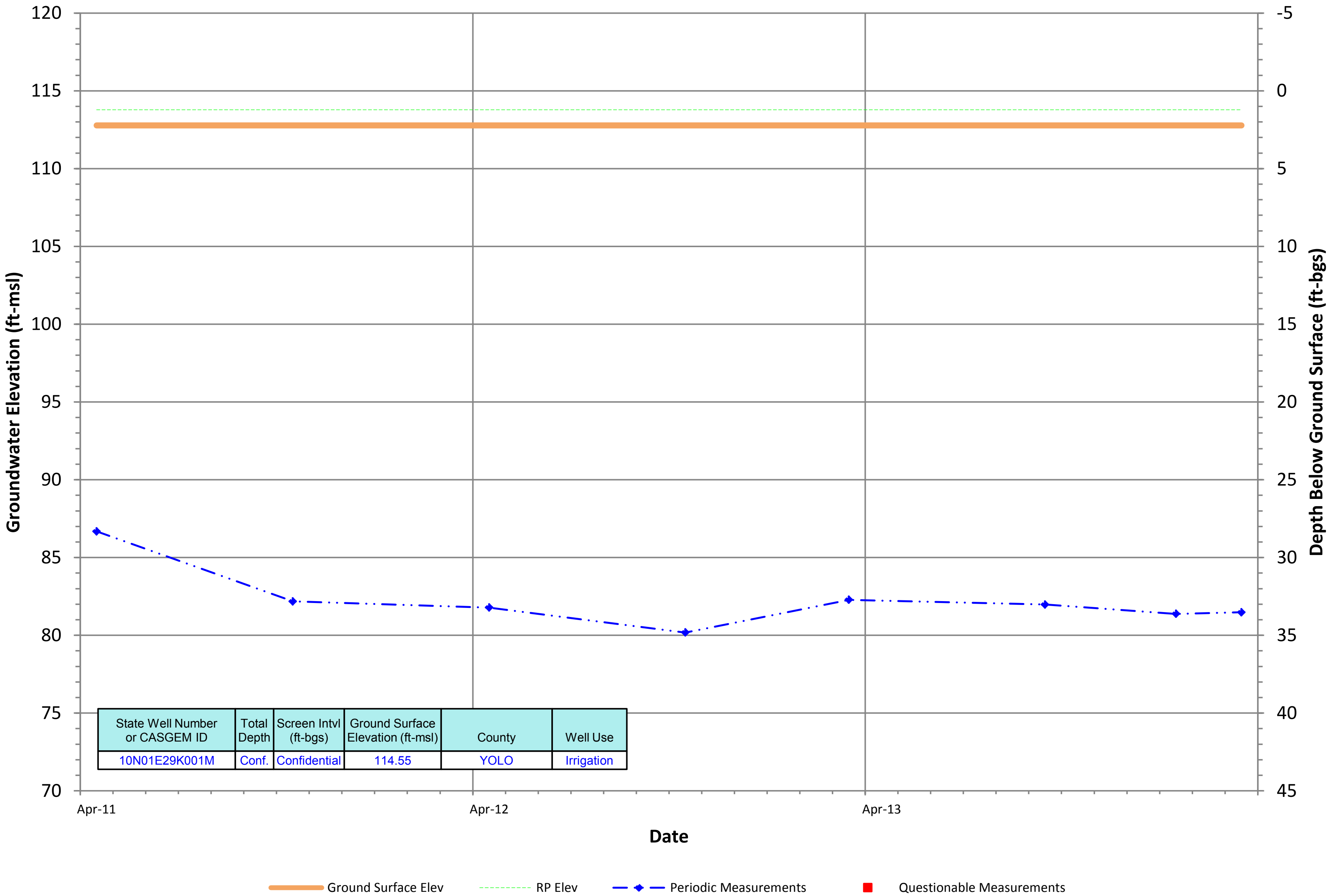
10N01E29K001M

Period Of Record: 04/21/2011 to 03/14/2014

Hydrograph Criteria

Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)

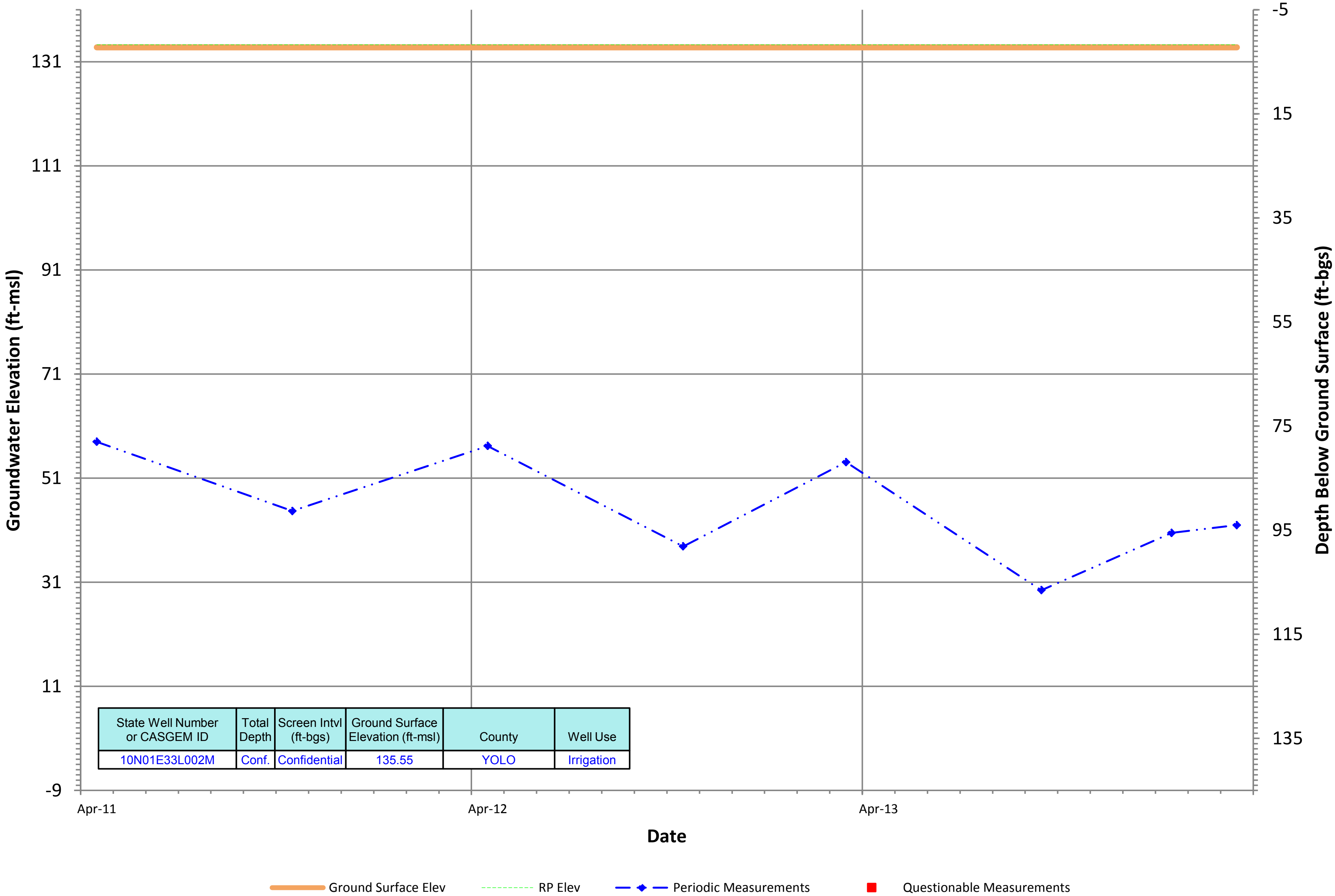
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E29K001M	Conf.	Confidential	114.55	YOLO	Irrigation

10N01E33L002M
Period Of Record: 04/21/2011 to 03/14/2014

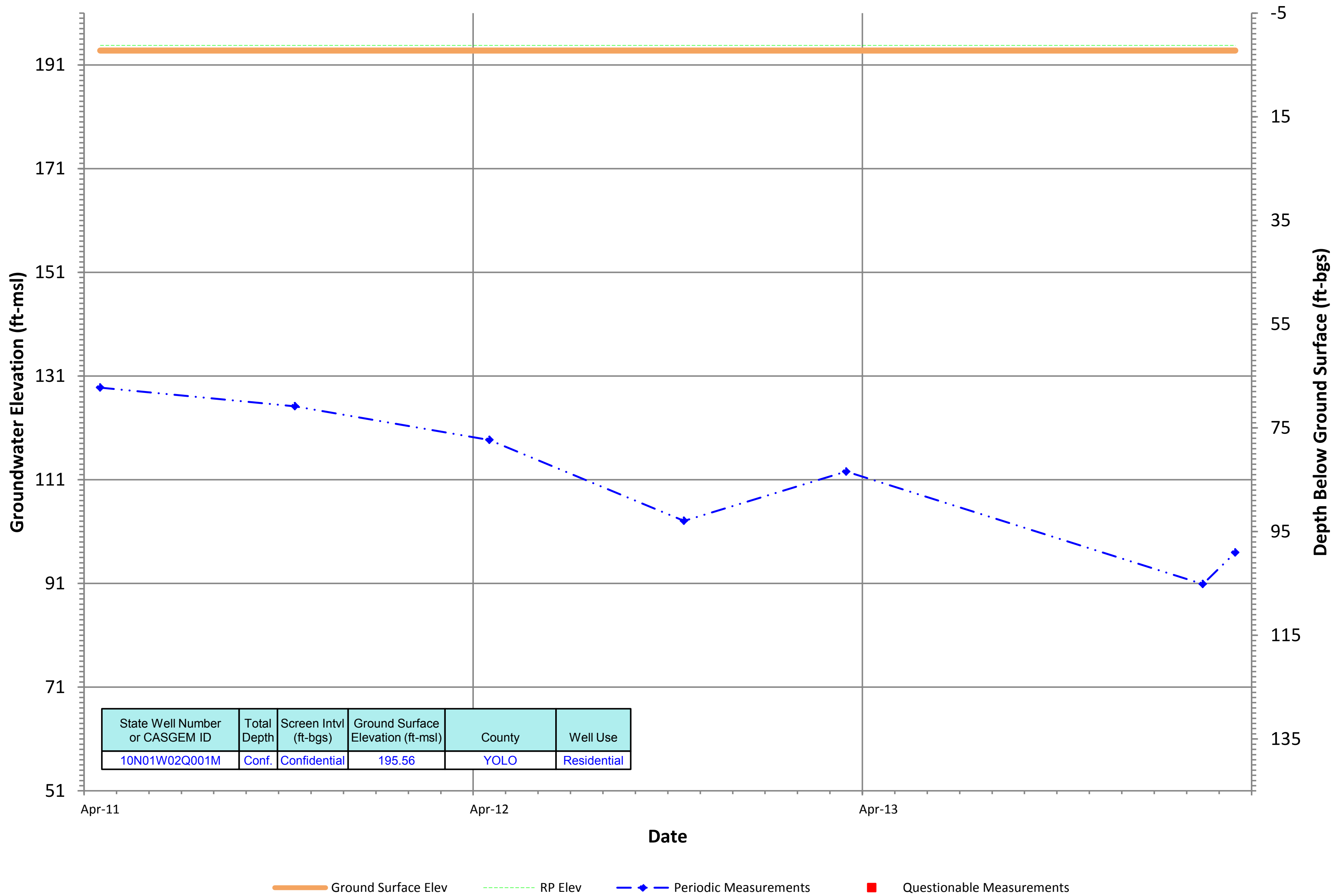
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01E33L002M	Conf.	Confidential	135.55	YOLO	Irrigation

10N01W02Q001M
Period Of Record: 04/20/2011 to 03/13/2014

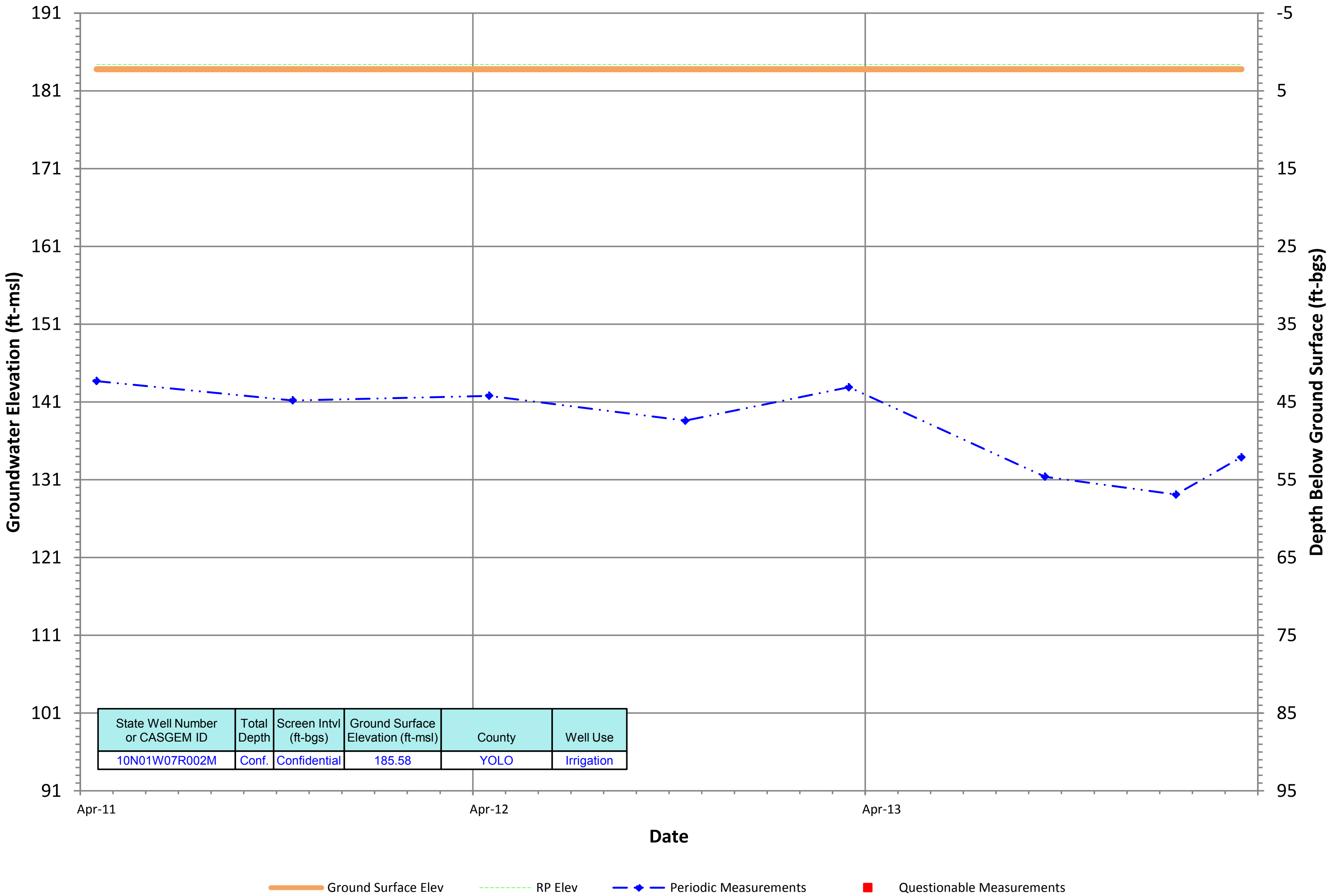
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W02Q001M	Conf.	Confidential	195.56	YOLO	Residential

10N01W07R002M
Period Of Record: 04/20/2011 to 03/13/2014

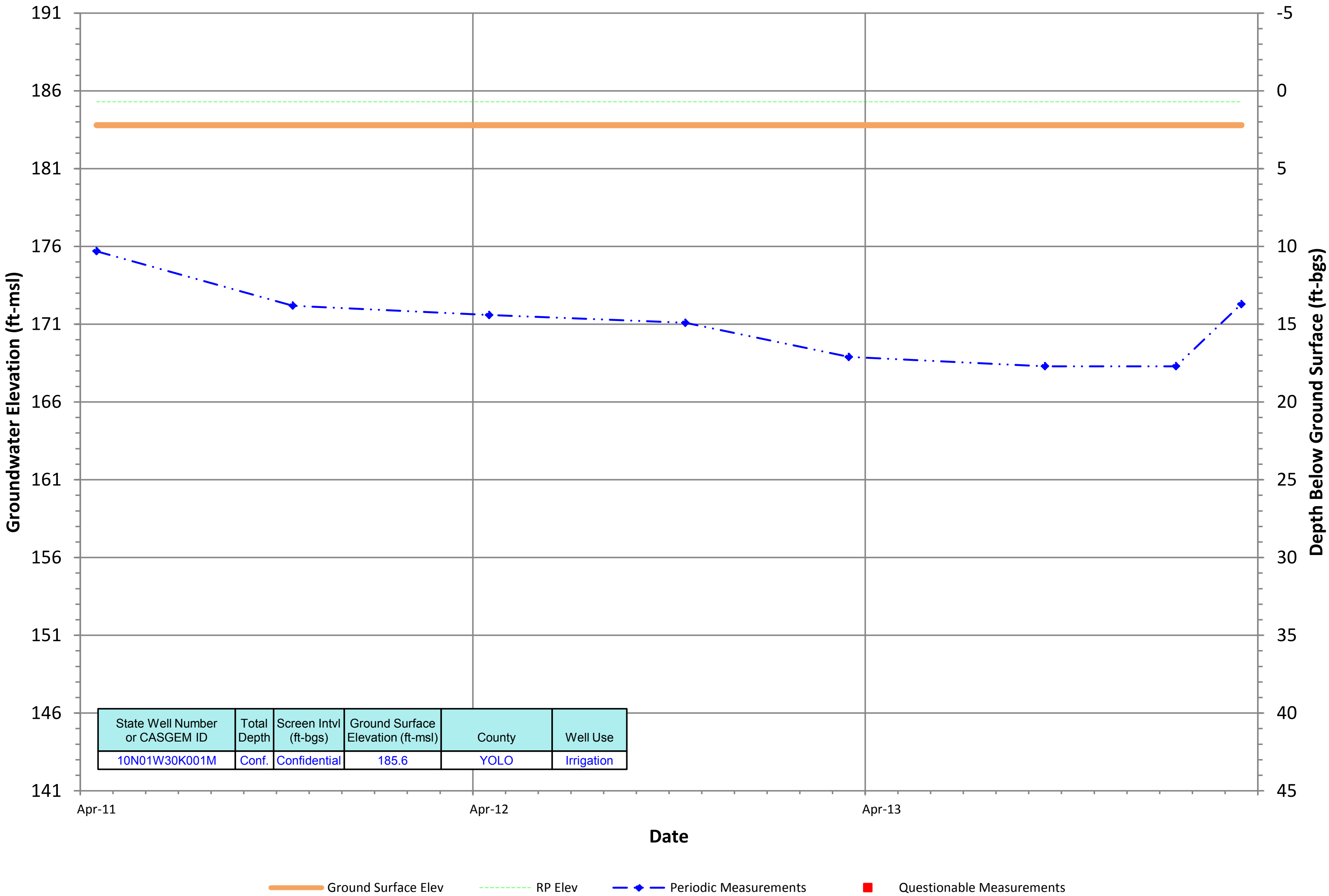
Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W07R002M	Conf.	Confidential	185.58	YOLO	Irrigation

10N01W30K001M
Period Of Record: 04/21/2011 to 03/14/2014

Hydrograph Criteria
Groundwater Basin is '5-21.67' (SACRAMENTO VALLEY -- YOLO)
Total Depth is on or between 200 and 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N01W30K001M	Conf.	Confidential	185.6	YOLO	Irrigation

10N01W35Q001M
Period Of Record: 04/21/2011 to 03/14/2014

Hydrograph Criteria
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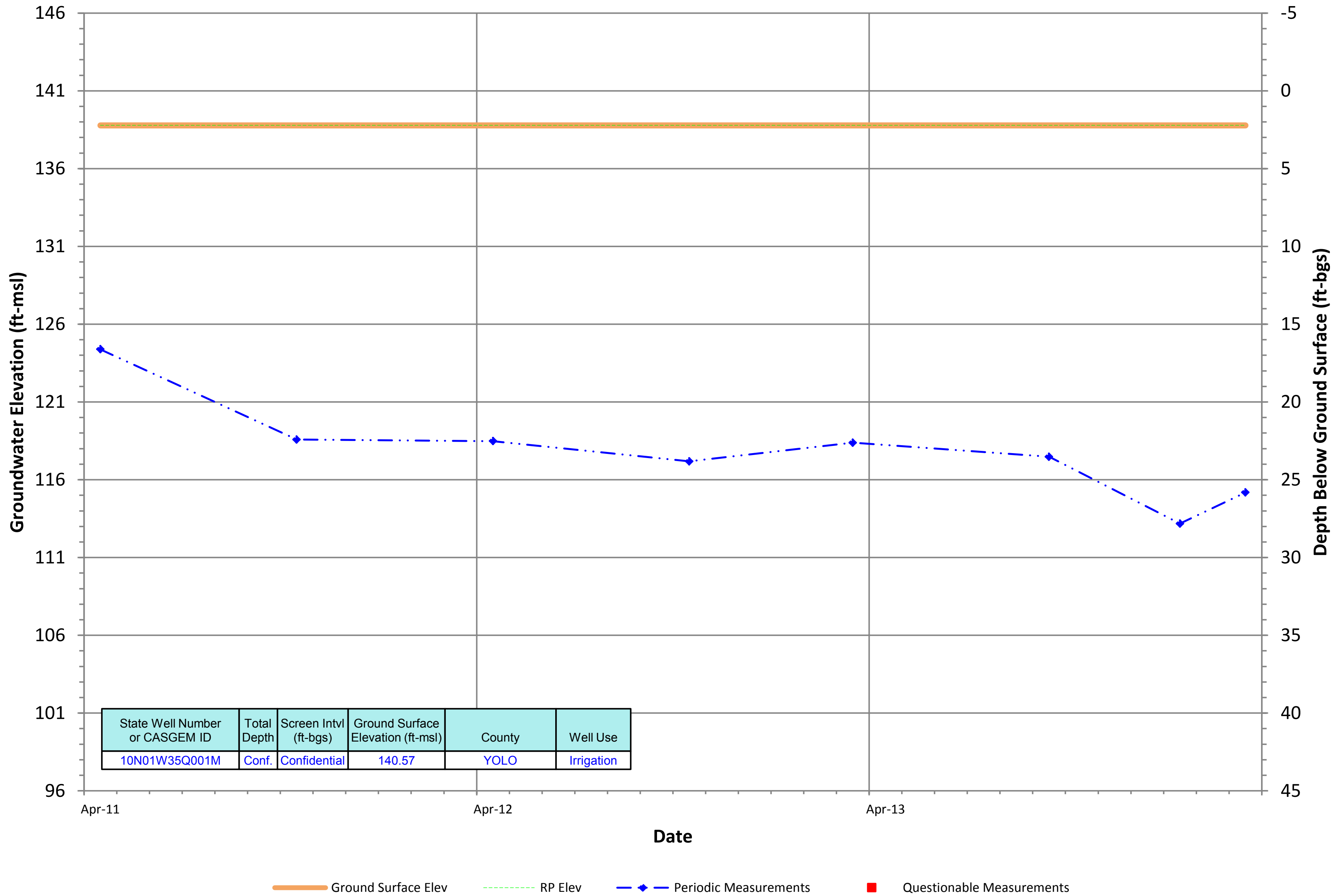
Total Depth is on or between 200 and 600



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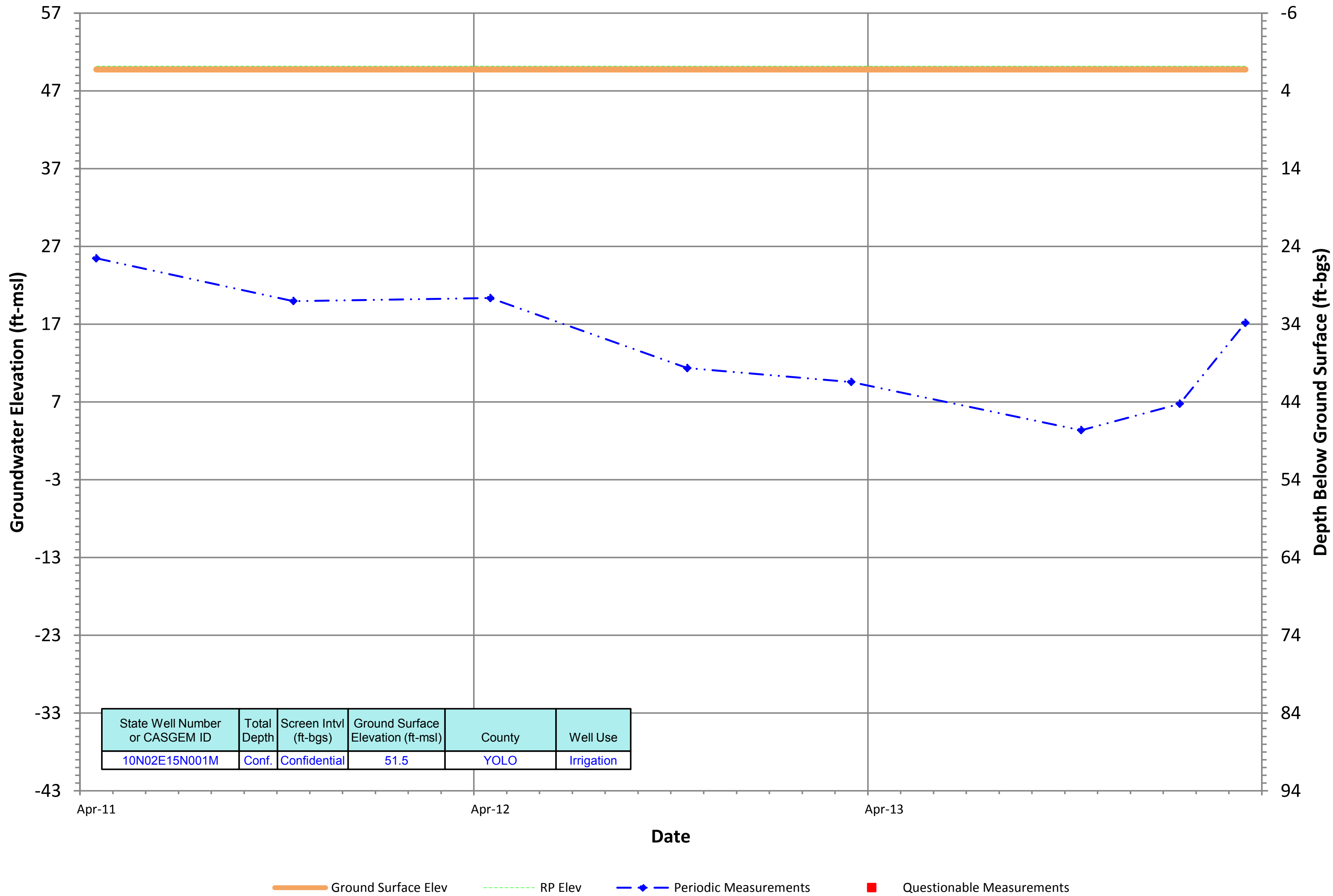

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10N02E36E002M
Period Of Record: 03/24/2000 to 10/03/2014

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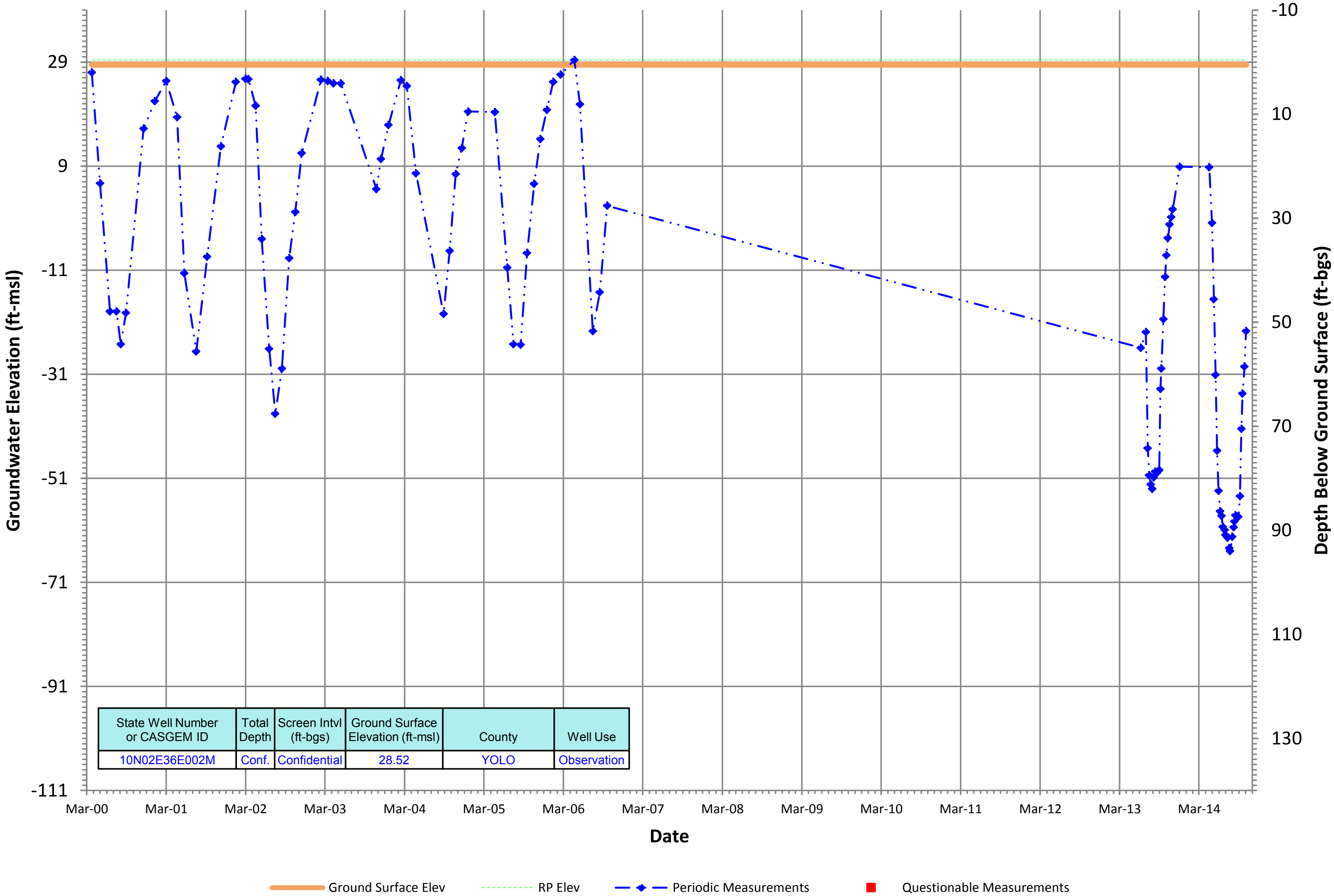

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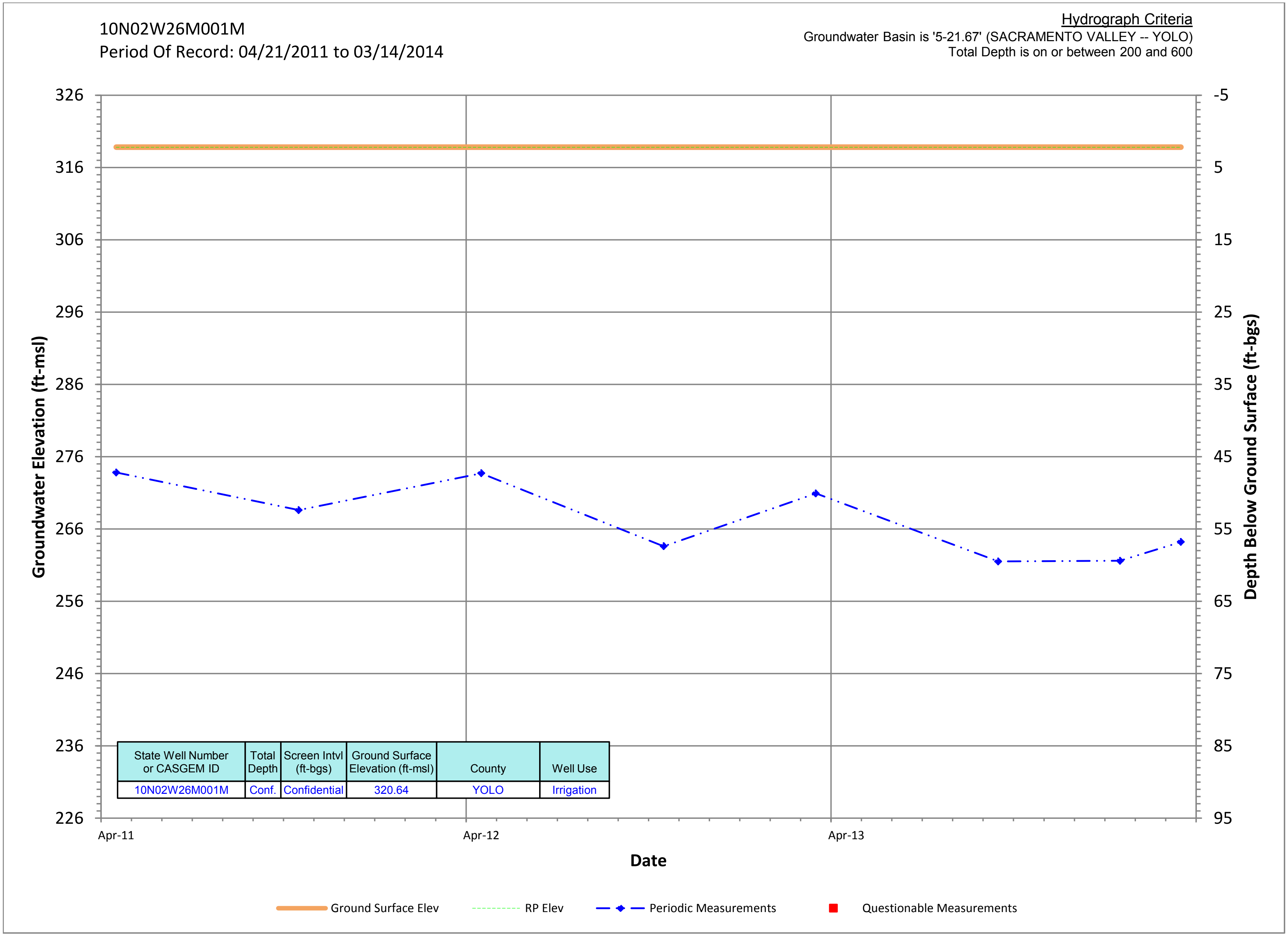

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10N02W26P001M
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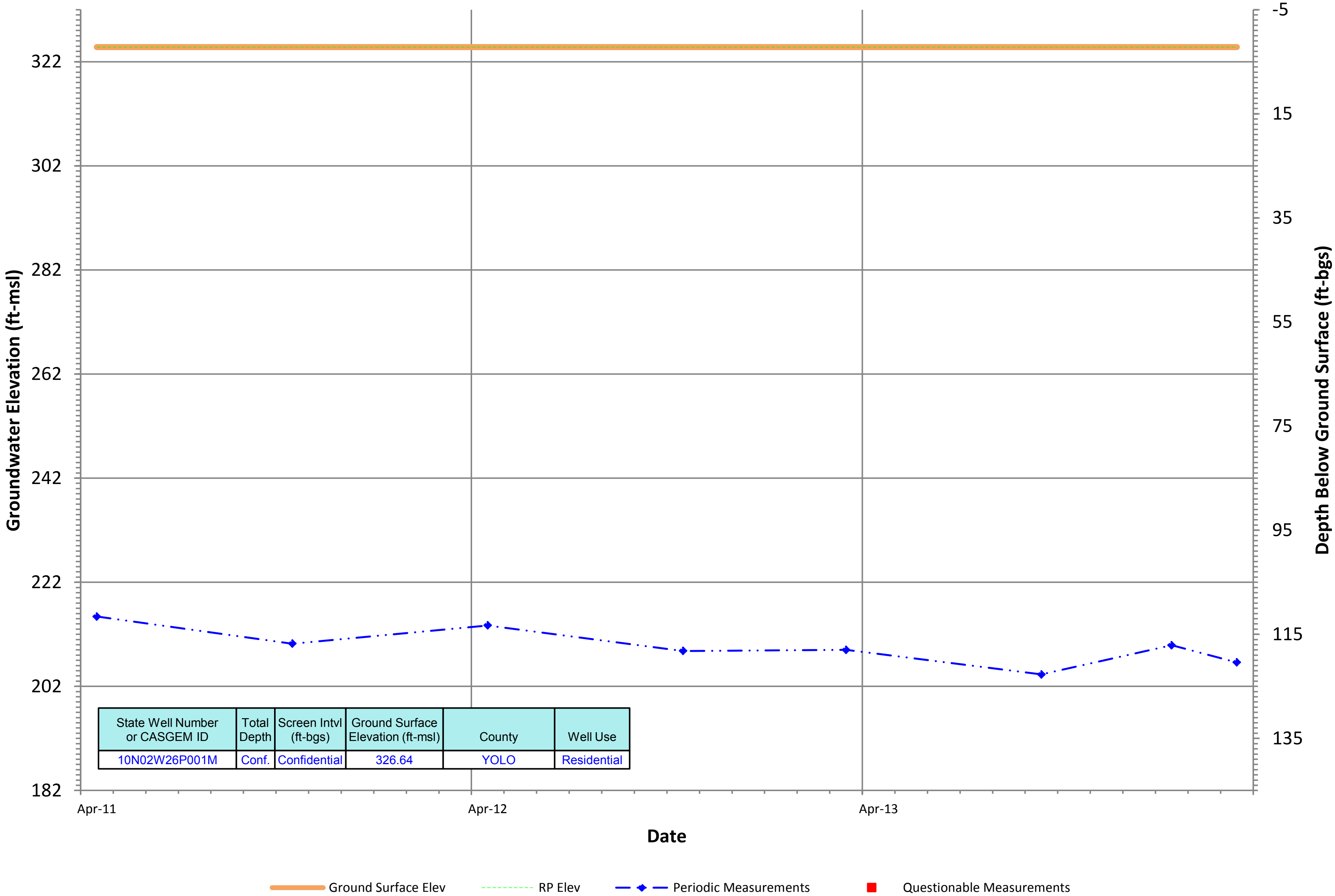

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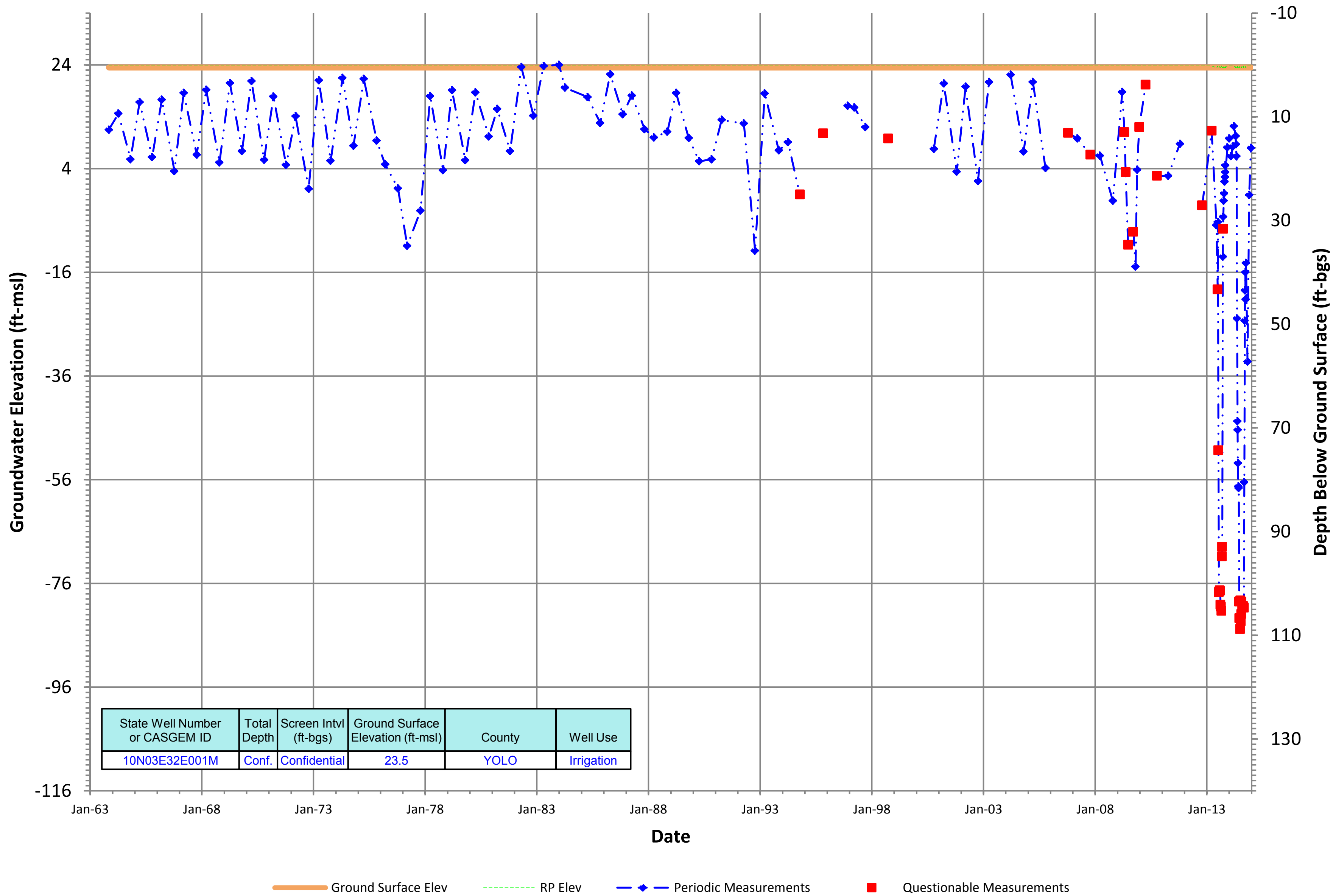

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10N03E33B011M
Period Of Record: 01/27/2000 to 10/03/2014

Hydrograph Criteria
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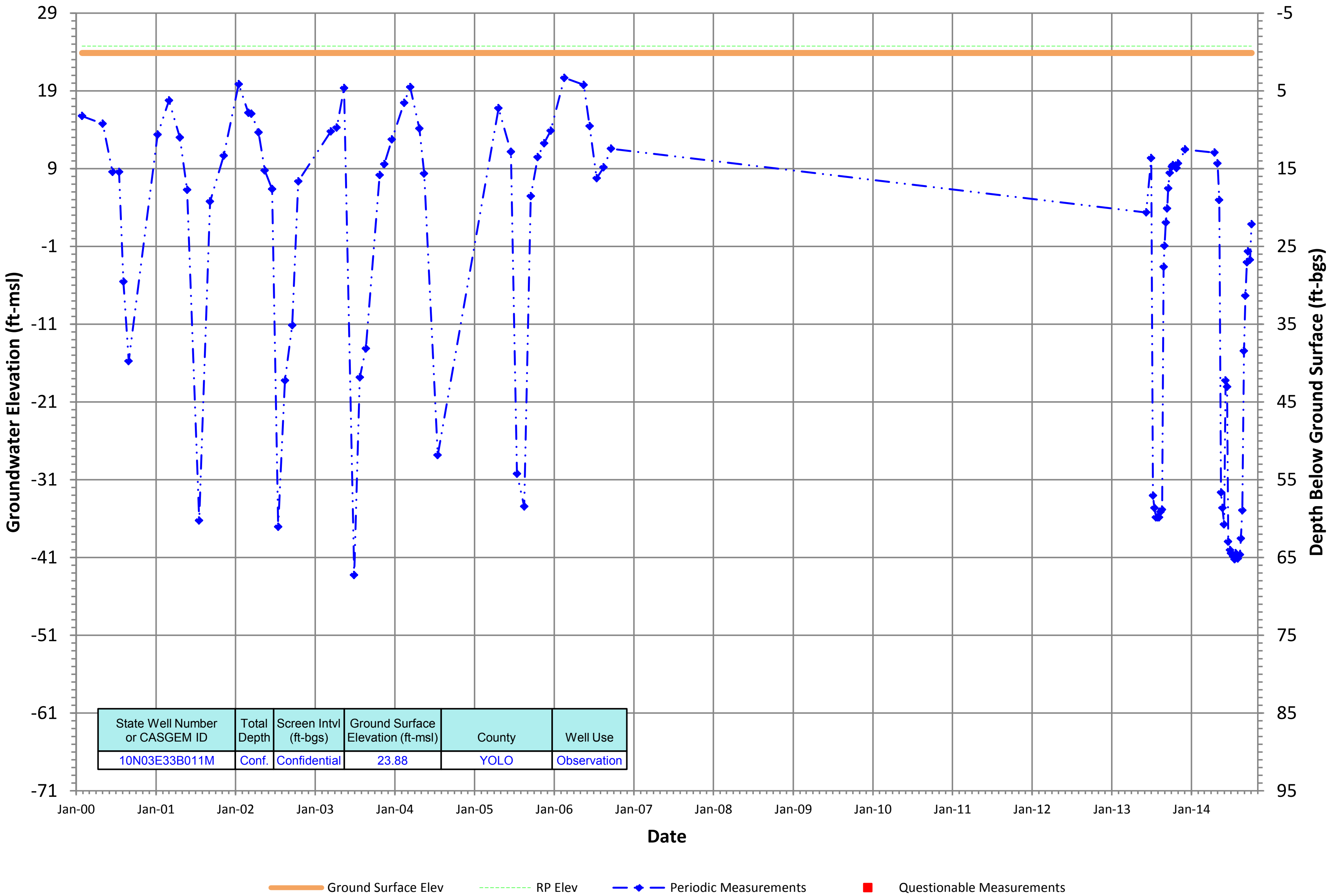

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10N03E33R001M
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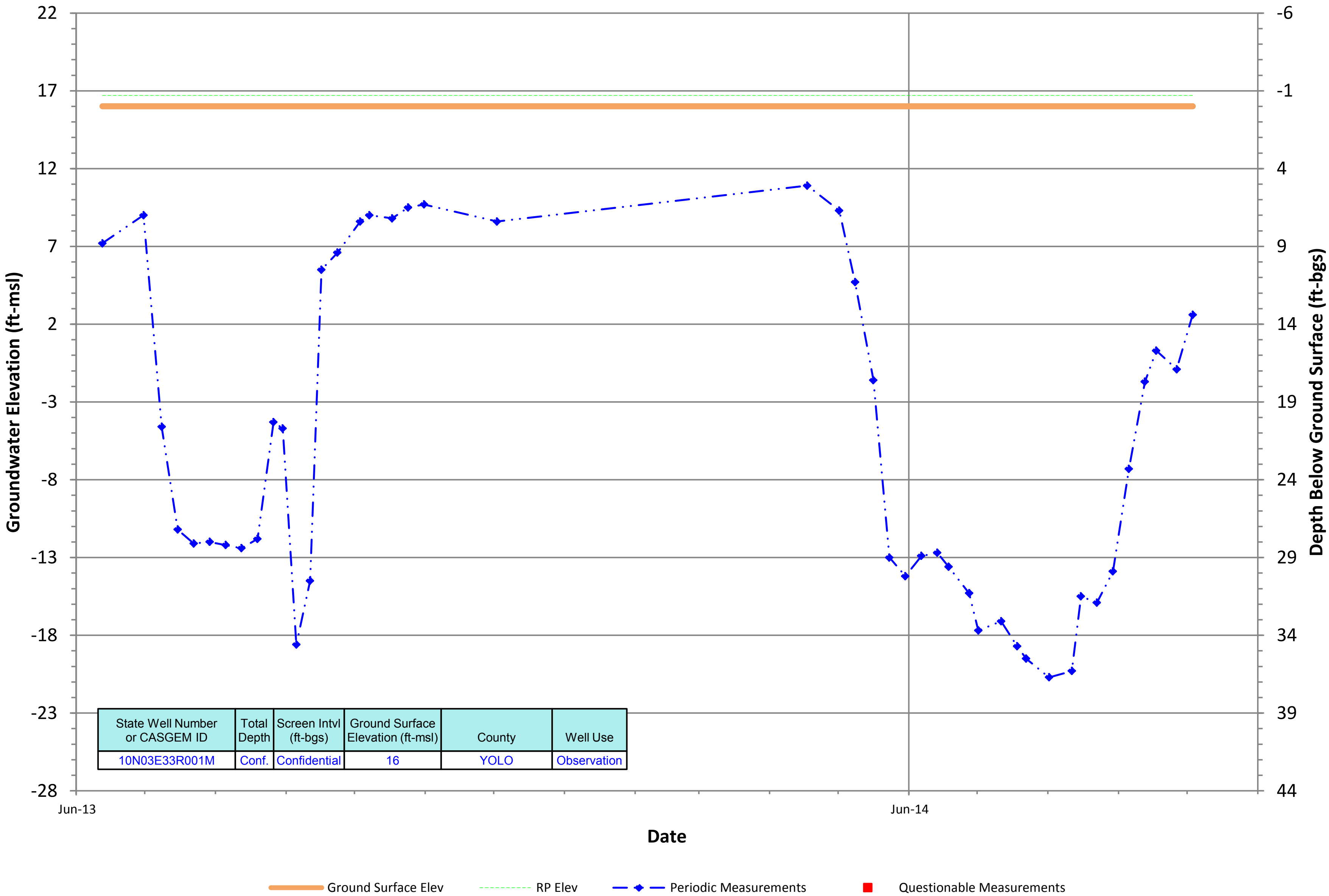

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Deep Groundwater Monitoring Well Hydrographs- Yolo Subbasin

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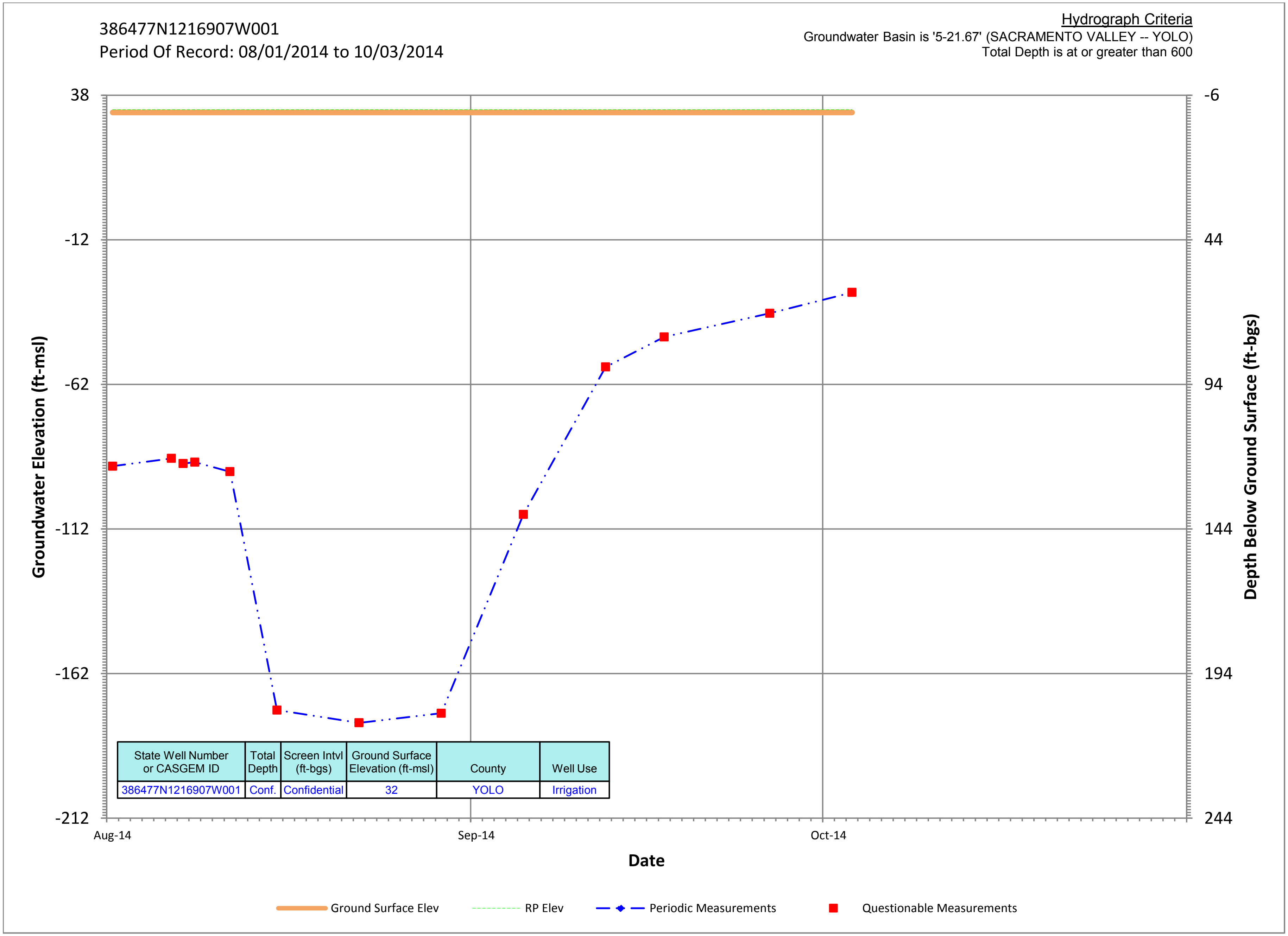

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386477N1216907W001	Conf.	Confidential	32	YOLO	Irrigation

09N02E12E001M

Period Of Record: 06/05/2013 to 10/03/2014

Hydrograph Criteria

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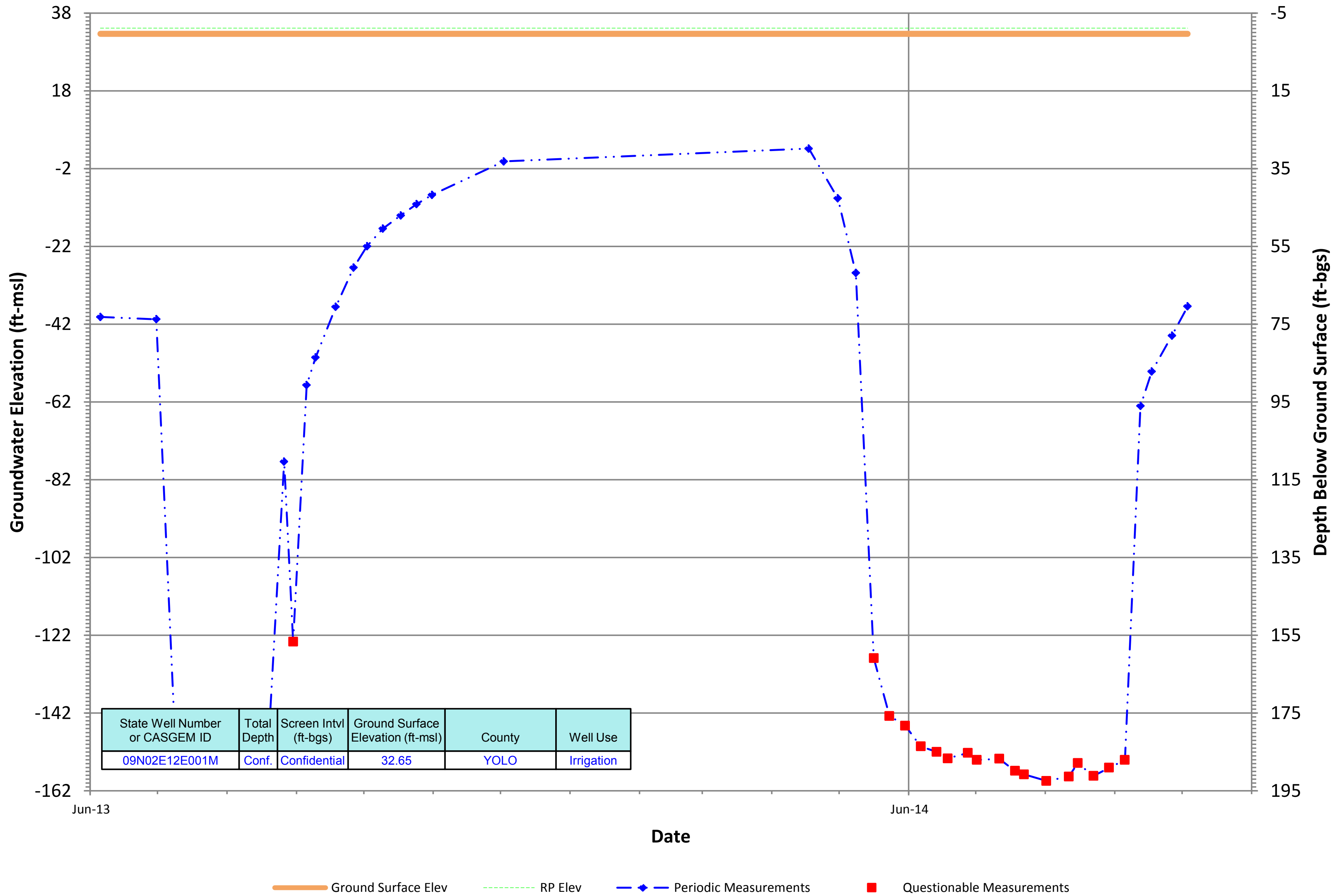
Total Depth is at or greater than 600



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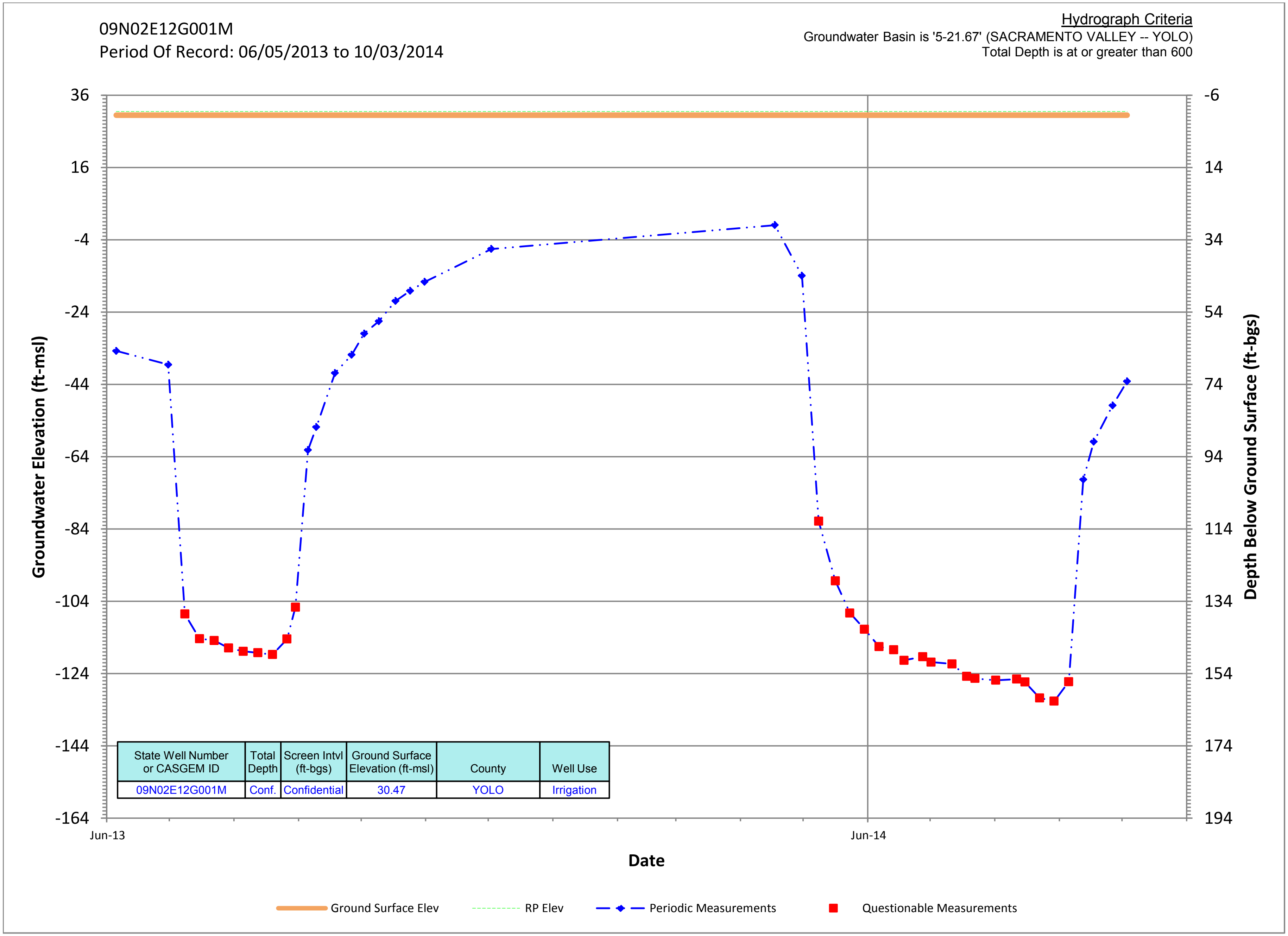

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09N02E13N002M
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Hydrograph Criteria
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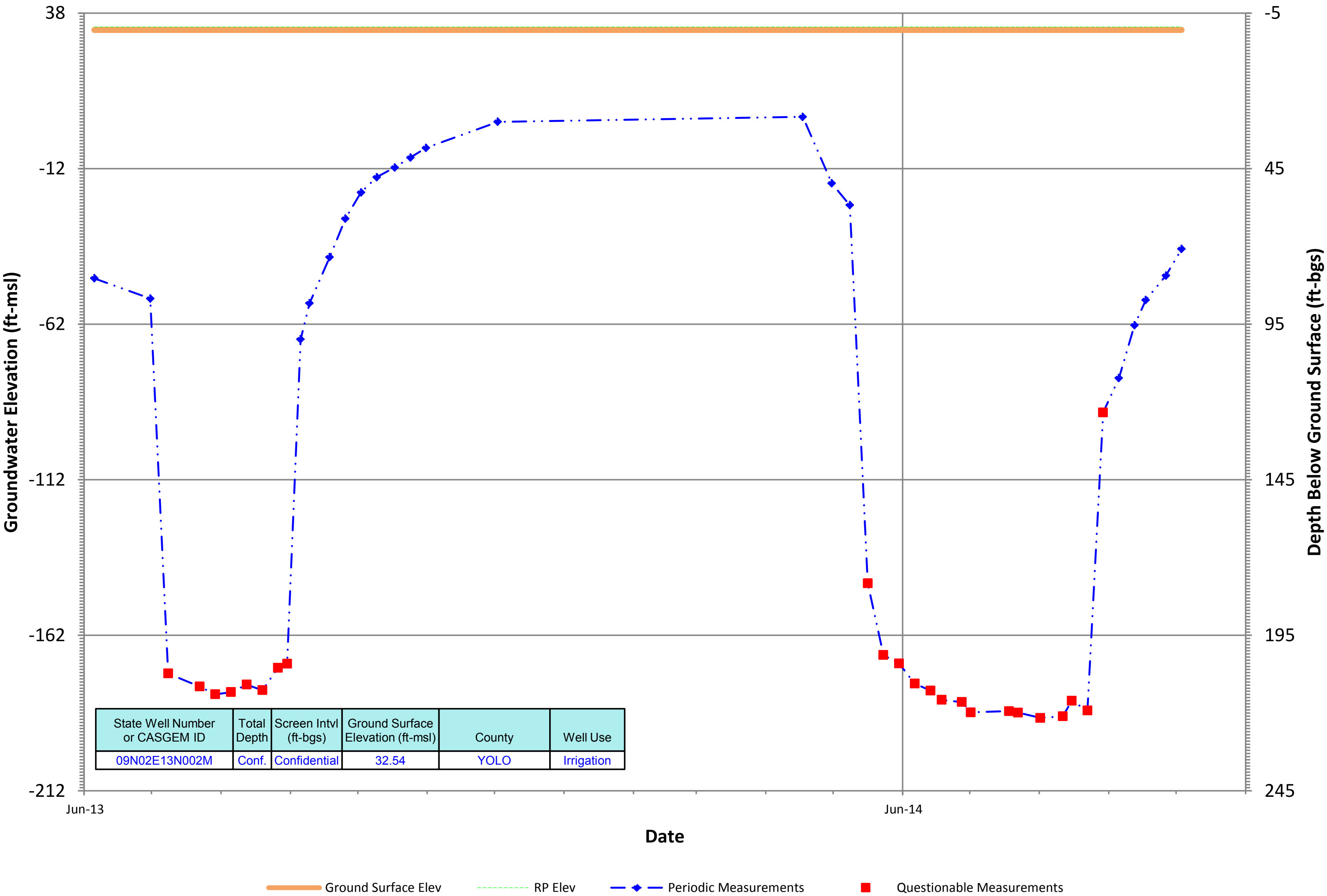
Total Depth is at or greater than 600



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09N02E13N002M	Conf.	Confidential	32.54	YOLO	Irrigation

09N03E05C001M

Period Of Record: 06/30/2013 to 10/03/2014

Hydrograph Criteria

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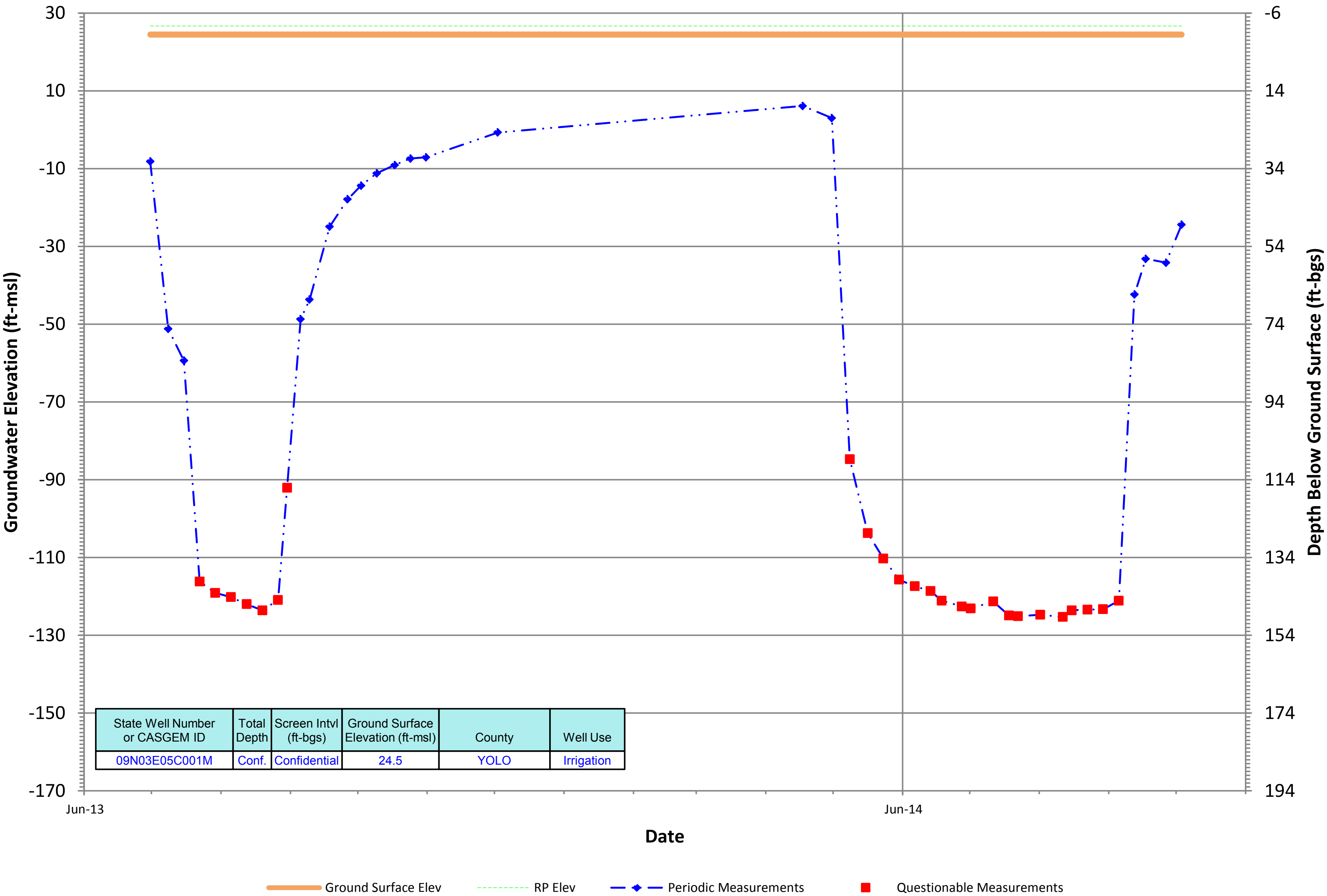
Total Depth is at or greater than 600



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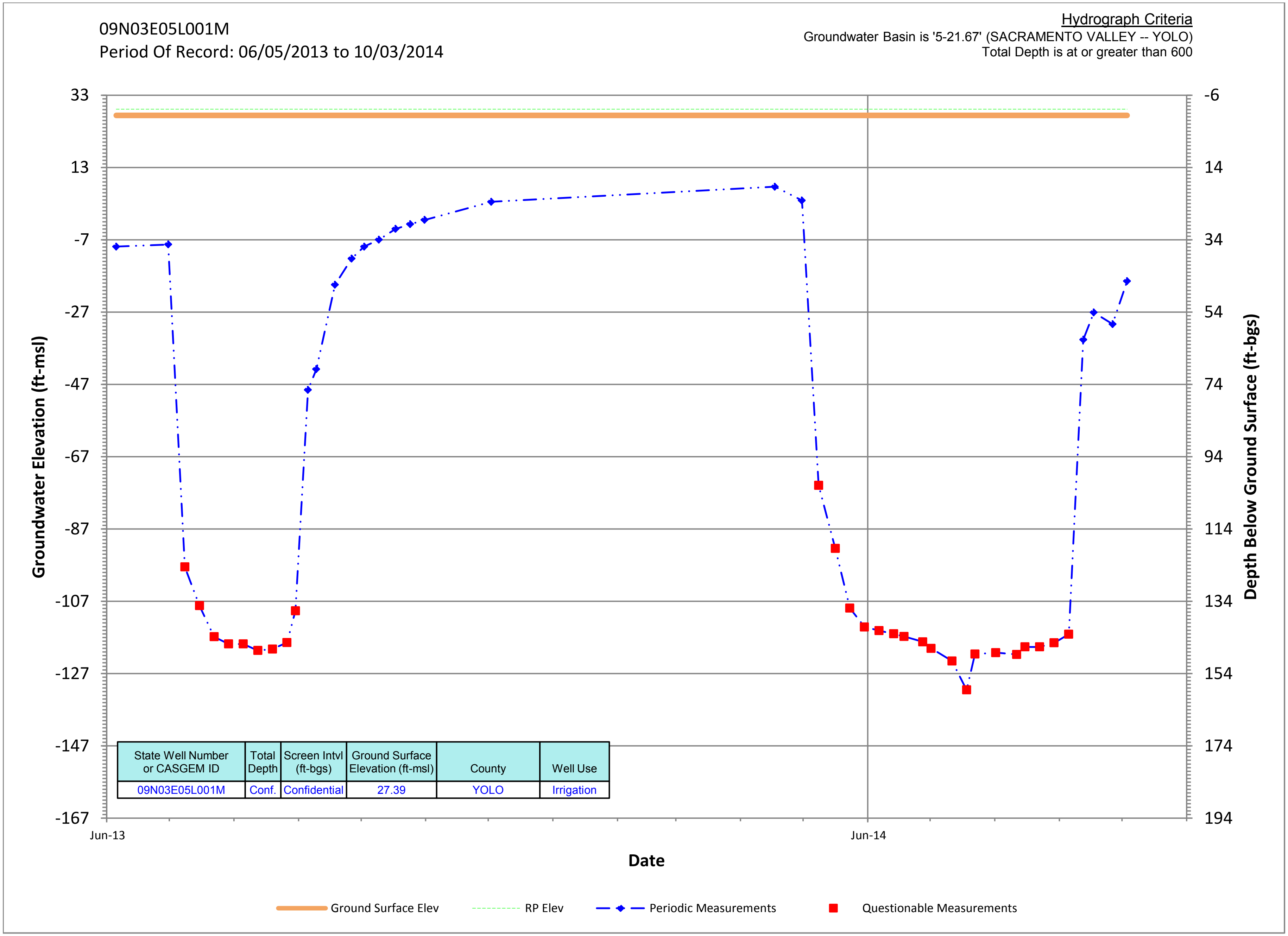

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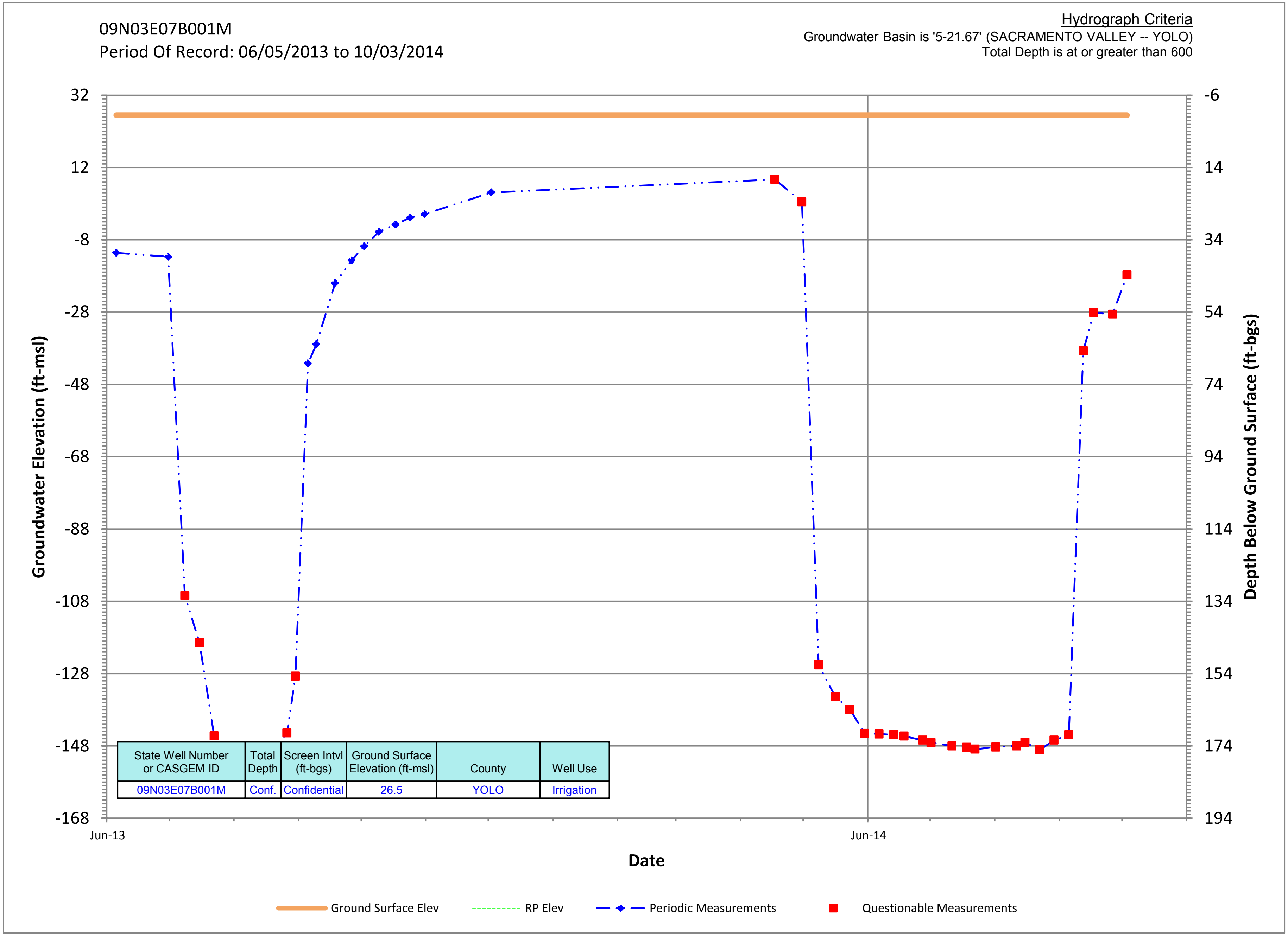
09N03E07B001M
Period Of Record: 06/05/2013 to 10/03/2014
Hydrograph Criteria
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Total Depth is at or greater than 600
Groundwater Elevation (ft-msl)
32
12
-8
-28
-48
-68
-88
-108
-128
-148
-168
Depth Below Ground Surface (ft-bgs)
-6
14
34
54
74
94
114
134
154
174
194
State Well Number or CASGEM ID
Total Depth
Screen Intvl (ft-bgs)
Ground Surface Elevation (ft-msl)
County
Well Use
09N03E07B001M
Conf.
Confidential
26.5
YOLO
Irrigation
Jun-13
Jun-14
Date
Ground Surface Elev
RP Elev
Periodic Measurements
Questionable Measurements

09N03E07K001M
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Hydrograph Criteria
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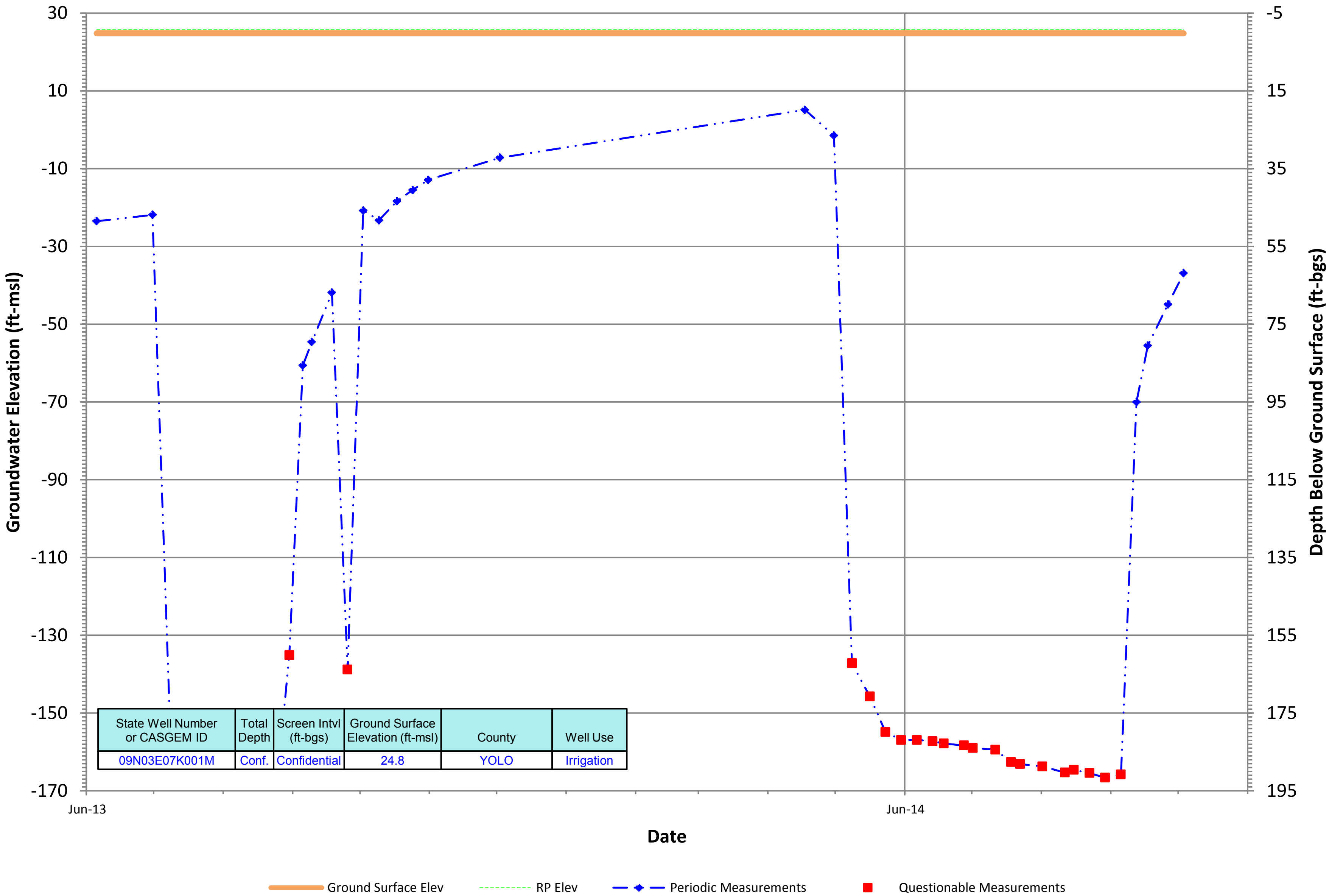

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09N03E08C005M
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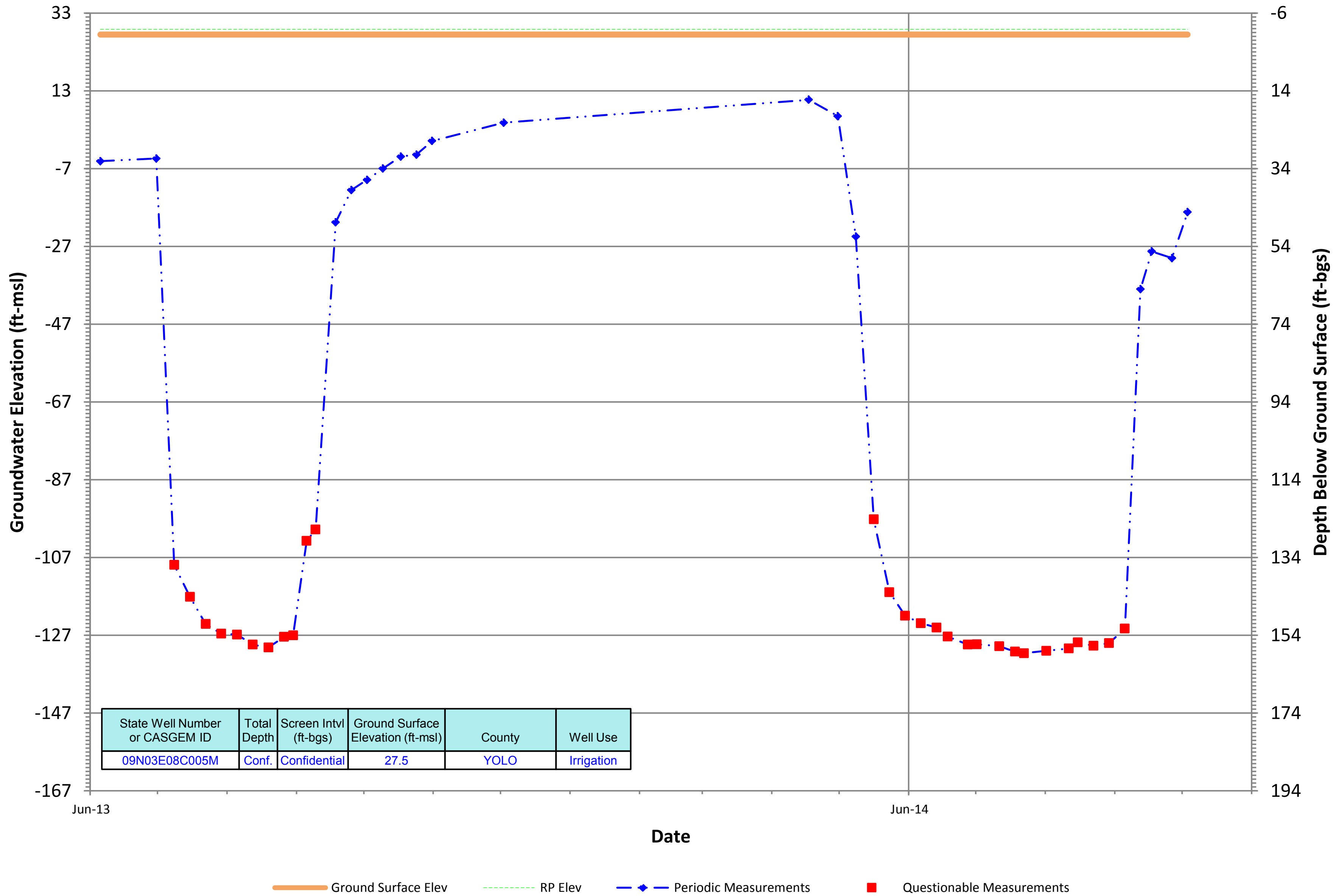

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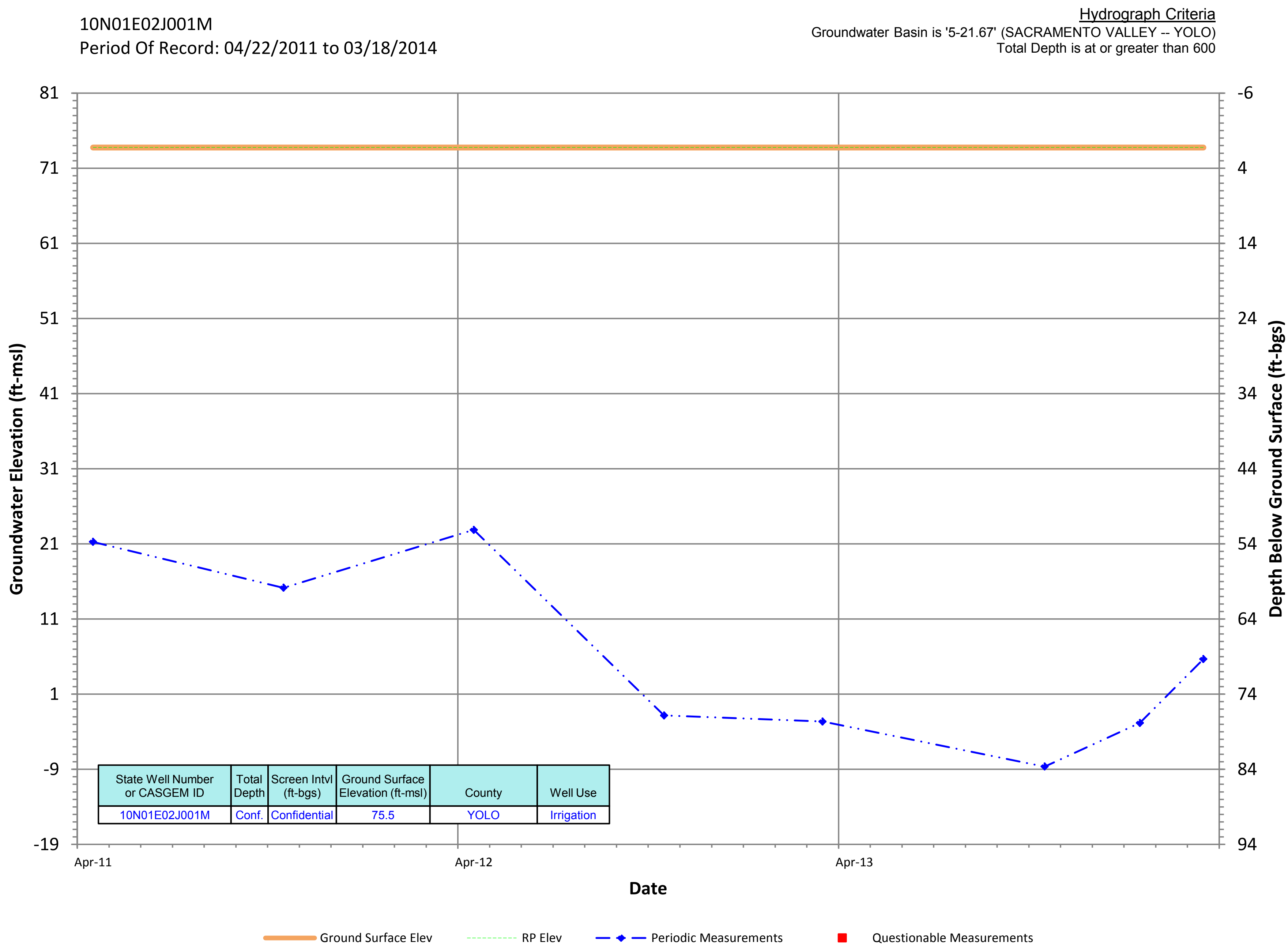

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10N03E32D012M
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Hydrograph Criteria
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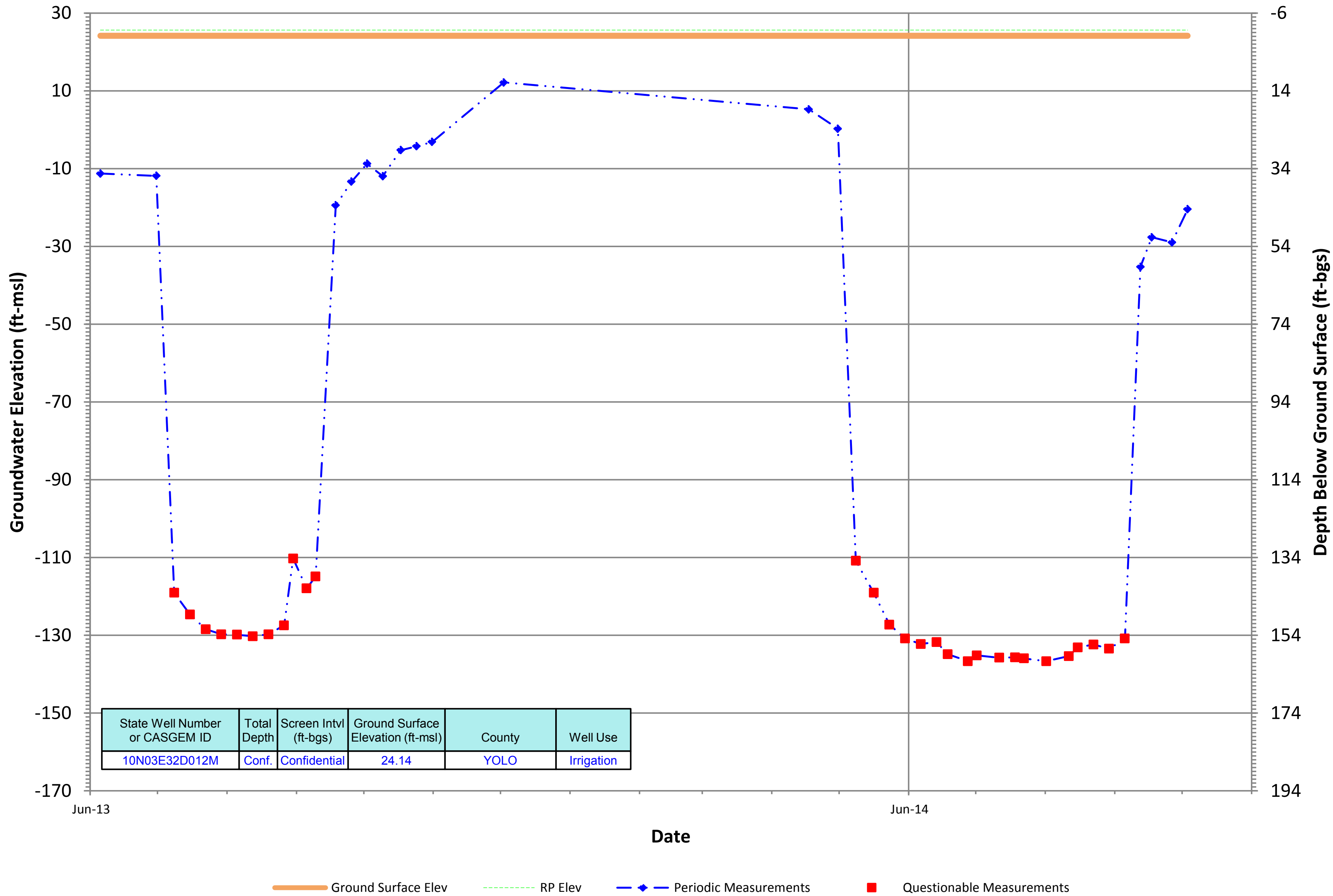
Total Depth is at or greater than 600



State Well Number or CASGEM ID	Total Depth	Screen Intvl (ft-bgs)	Ground Surface Elevation (ft-msl)	County	Well Use
10N03E32D012M	Conf.	Confidential	24.14	YOLO	Irrigation

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Appendix M

SACFEM2013 Manual

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Appendix M

SACFEM2013 Manual

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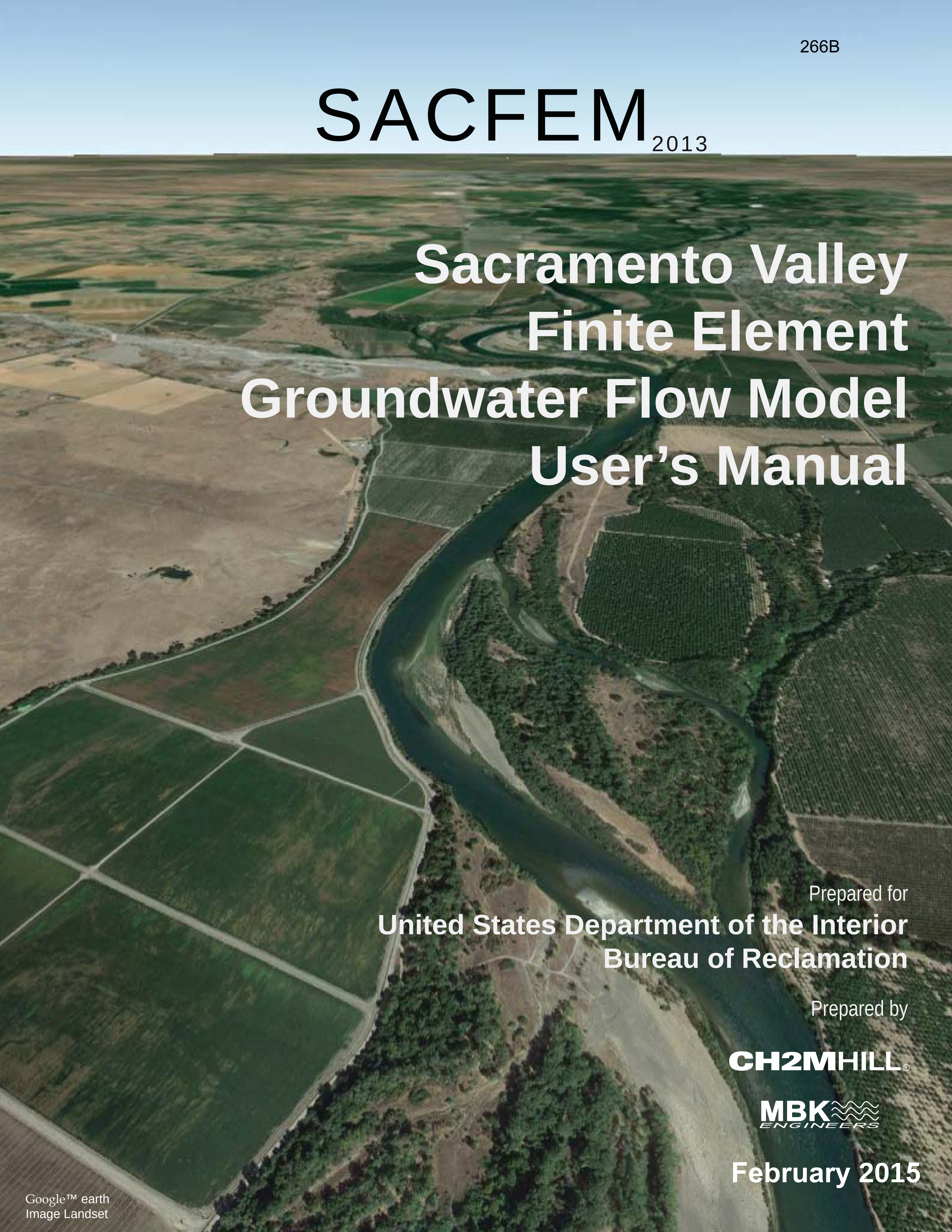
SACFEM₂₀₁₃

Sacramento Valley Finite Element Groundwater Flow Model User's Manual



Google™ earth
Image Landset

Prepared for

United States Department of the Interior
Bureau of Reclamation

Prepared by

CH2MHILL®

MBK ENGINEERS

February 2015

SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model User's Manual

Prepared for

United States Department of the Interior
Bureau of Reclamation

Prepared by

CH2M HILL and MBK Engineers, Inc.

February 2015

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Acronyms and Abbreviations

*.fem file	MicroFEM Base-model
*.fpr	SACFEM2013 project file
40-30-30	Sacramento Valley Water Year Type
ac-ft/month	acre-feet per month
AVI	audio video interleave
AWD	applied water demand
bgs	below ground surface
CSM	conceptual site model
DEM	digital elevation model
DWR	Department of Water Resources
ET	evapotranspiration
GIS	geographic information system
gpm	gallons per minute
h1	upper aquifer
IDC	Integrated Water Flow Model Demand Calculator
Kh	horizontal hydraulic conductivity
m	meters
MAF	million acre-feet
ME	Mean error
R^2	Coefficient of determination
RMSE	Root mean squared error
RMSE/Range	RMSE divided by the range of target head values
SACFEM	Sacramento Valley Finite Element Groundwater Flow Model
SVGB	Sacramento Valley Groundwater Basin
USGS	U.S. Geological Survey
WBAs	water budget areas
wh1	user-specified stream stage
wl1	critical depth
WSE	water surface elevation
WY	water year

SECTION 1
Introduction

Implementation of conjunctive water management within the Sacramento Valley is one strategy being used to enhance the reliability of the existing water supply, as well as potentially improve water quality, within the San Francisco Bay-Delta. However, operating conjunctive water management, or groundwater substitution projects, can result in adverse impacts on water resources within the Valley. The two most critical potential impacts of additional groundwater production are depression of local groundwater levels, with associated impacts on well yields from nearby water supply wells, and changes in the hydraulic relationship between the surface water and groundwater systems in the area. To support the evaluation of these potential impacts, a high-resolution, numerical groundwater modeling tool was developed to estimate the impacts of potential future conjunctive water management projects on surface water and groundwater resources within the Sacramento Valley. This model, known as the Sacramento Valley Finite Element Groundwater Flow Model (SACFEM2013), is described herein.

SECTION 2

Sacramento Valley Groundwater Basin Conceptual Site Model Overview

The following briefly summarizes the geology and hydrology of the Sacramento Valley Groundwater Basin (SVGB). The groundwater conceptual site model (CSM) is a theoretical construct that represents primary features of the physical system beneath the Sacramento Valley (Figure 1). The CSM is the primary basis for developing SACFEM2013.

2.1 Geologic Setting

The Sacramento Valley is located in the northern portion of the Great Valley physiographic region of California. The Great Valley is bounded by the Coast Ranges to the west, the Sierra Nevada to the East, and the Klamath Mountains and Cascade Range to the north. The Sacramento Valley is a north-northwestern trending asymmetrical trough filled with as much as 10 miles of both marine and continental rocks and sediment (Page, 1986). On the eastern side, the basin overlies basement bedrock that rises relatively gently to form the Sierra Nevada; on the western side, the underlying basement bedrock rises more steeply to form the Coast Ranges. Marine sandstone, shale, and conglomerate rocks that generally contain brackish or saline water overlie the basement bedrock. The more recent continental deposits, overlying the marine sediments, contain fresh water. These continental deposits are generally 2,000 to 3,000 feet thick (Page, 1986). The depth (below ground surface) to the base of fresh water typically ranges from 1,000 to 3,000 feet (Bertoldi et al., 1991). Three areas of bedrock outcrop are present within the interior of the Sacramento Valley; these include the Sutter Buttes, Black Butte, and the Dunnigan Hills. Descriptions of the major geologic units within the Sacramento Valley are listed in Table 1 (Page, 1986; California Department of Water Resources [DWR], 1978). Figure 2 presents a conceptual geologic section of the Central Valley.

2.2 Hydrogeology

The Sacramento Valley is part of the Sacramento River Hydrologic Region, which covers approximately 27,200 square miles in northern California (Figure 3) (DWR, 2003a). As shown on Figure 3, the Sacramento Valley includes the Redding Groundwater Basin (in the northern portion of the Valley) and the SVGB (in the southern portion of the Valley). The SVGB has been divided into 18 subbasins by DWR, as shown on Figure 3, based on groundwater characteristics, surface water features, and political boundaries (DWR, 2003a). However, from a hydrologic standpoint, these individual groundwater subbasins have a high degree of hydraulic interconnection because the rivers do not always act as barriers to groundwater flow. Therefore, the SVGB functions primarily as a single laterally extensive alluvial aquifer, rather than numerous discrete, smaller groundwater subbasins.

Fresh water in the SVGB is found within the continental deposits described in Section 2.1. Hydrostratigraphic units containing fresh water along the eastern portion of the basin (derived from the Sierra Nevada) are primarily the Tuscan and Mehrten Formations. In the southeastern portion of the SVGB, the Laguna, Riverbank, and Modesto Formations are important sources of fresh water. The primary hydrostratigraphic unit in the western portion of the SVGB is the Tehama Formation, which was derived from the Coast Ranges. As described above, these deeper hydrogeologic units are overlain by younger alluvial and floodplain deposits over the majority of the SVGB.

In the SVGB, surface water and groundwater systems are strongly connected and are highly variable spatially and temporally. Generally, the major trunk streams of the Valley (the Sacramento and Feather Rivers) act as drains and are recharged by groundwater throughout most of the year. The exceptions are areas of depressed groundwater elevations attributable to groundwater pumping (inducing leakage from the rivers) and localized recharge to the groundwater system. In contrast, the upper reaches of tributary streams flowing into the Sacramento River from upland areas are almost all losing streams (they recharge the groundwater system). Some of these transition to gaining streams (they receive groundwater) farther downstream, closer to their confluences with the Sacramento River. Estimates of these surface water/ groundwater exchange rates have been developed for specific reaches on a limited number of streams in the SVGB (U.S. Geological Survey [USGS], 1985), but a comprehensive Valley-wide accounting has not been performed to date.

Figure 4 presents a conceptual diagram of groundwater flow in the SVGB. Under current conditions, groundwater generally flows from the mountains toward the SVGB and then toward the Sacramento River in a southerly direction parallel to the river. Depth to groundwater throughout most of the SVGB averages about 30 feet below ground surface (bgs), with shallower depths along the Sacramento River and greater depths along the basin margins. Seasonal fluctuations in groundwater levels occur due to the recharge from precipitation and snowmelt runoff, associated fluctuations in river stages, and the pumping of groundwater to supply agricultural and municipal demands.

Groundwater level fluctuations reflect changes in the amount of groundwater stored in the aquifer system, which is driven by variability in the magnitude and timing of aquifer recharge and discharge. The primary components of groundwater inflow to the SVGB include the following:

- Groundwater recharge from precipitation
- Groundwater recharge from applied irrigation water
- Groundwater recharge from river, bypass, or lake leakage
- Groundwater recharge along the margin of the basin (mountain front recharge)

The primary components of groundwater outflow from the SVGB include the following:

- Groundwater discharge to land surface (including evapotranspiration, discharge to low-lying stream riparian areas, and discharge to low-lying areas such as the Butte Sinks in the Sutter Basin)
- Groundwater discharge to rivers
- Groundwater discharge to wells

In dry years, groundwater levels gradually decline in many areas because more water is extracted than recharged. During wet years, groundwater levels in the SVGB typically recover because more water is recharged than extracted (DWR, 2003b).-

Except during drought periods, groundwater levels recover to pre-irrigation-season levels each spring. In other words, no extensive areas of depressed groundwater levels exist in the basin except for localized conditions as described below. Historical groundwater level hydrographs suggest that even after extended droughts, groundwater levels in this basin recovered to pre-drought levels within 1 or 2 years after the return of normal rainfall.

As agricultural land use and water demands have intensified over time, groundwater levels in some areas have declined because increases in pumping have exceeded the quantity of local recharge to the groundwater system. This imbalance between pumping and recharge in portions of the Valley has been the motivating force developing supplemental surface water supplies in several areas during the past 30 to 40 years. Examples include Yolo County’s construction of Indian Valley Dam on the North Fork of Cache Creek, South Sutter Water District’s construction of Camp Far West Reservoir on the Bear River, and Yuba County’s construction of New Bullards Bar Dam and Reservoir on the North Yuba River.

Currently, groundwater levels are generally in balance Valley-wide, with pumping matched by recharge from the various sources annually. Some locales show the early signs of persistent declines in groundwater level, including northern Sacramento County, areas near Chico, and on the far west side of the Valley in Glenn County, where water demands are met primarily, and in some locales exclusively, by groundwater.

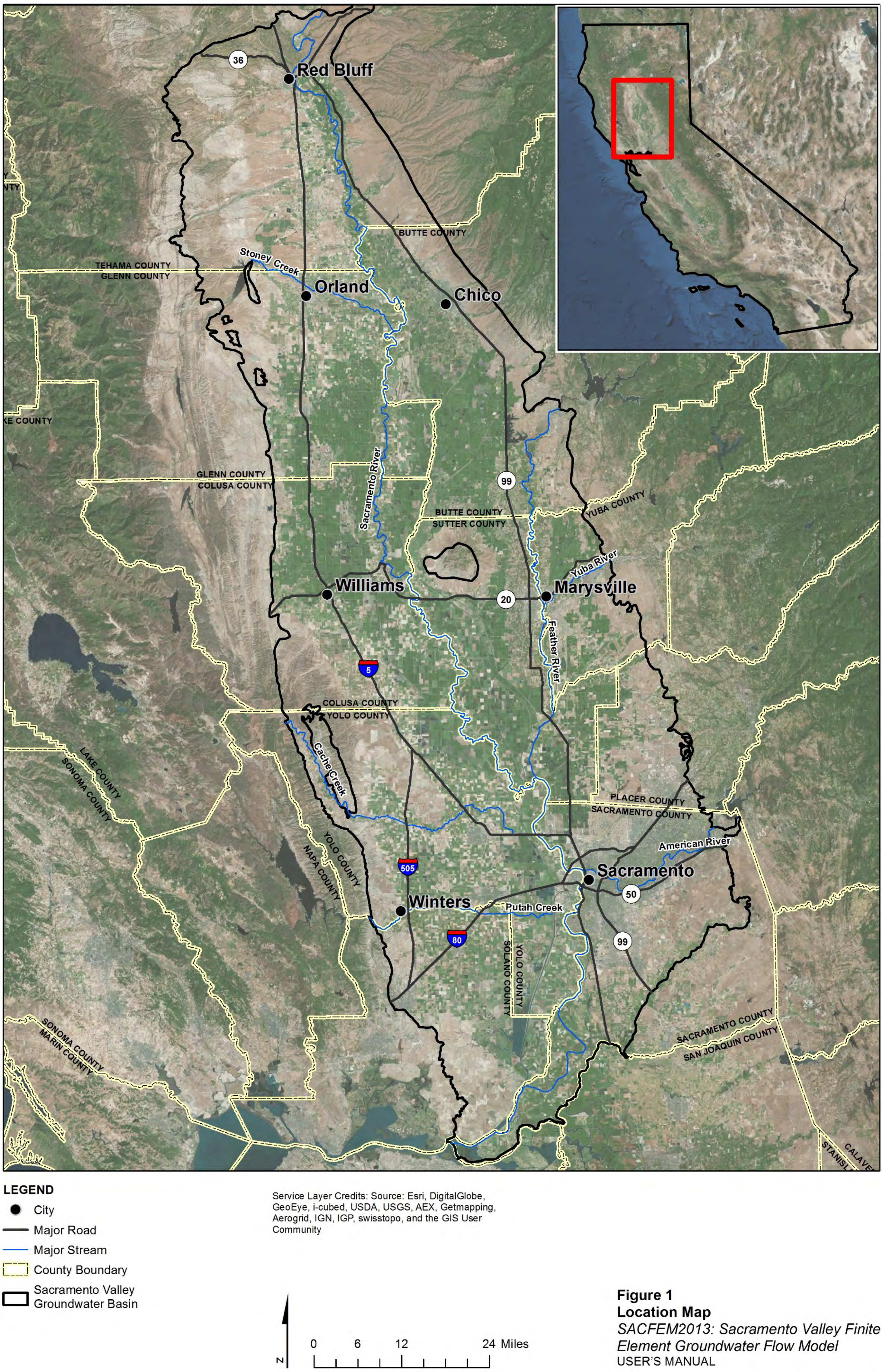


Figure 1
Location Map
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

RDD \\ODIN\PROJ\CDMSMITH\477905LTWT\FIGURES\MAPFILES\USERS_MANUAL\FIGURE_01_SACRAMENTOVALLEY.MXD HPERRY 2/4/2015 3:57:55 PM

CH2MHILL.

TABLE 1
Major Lithologic Units of the Sacramento Valley
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

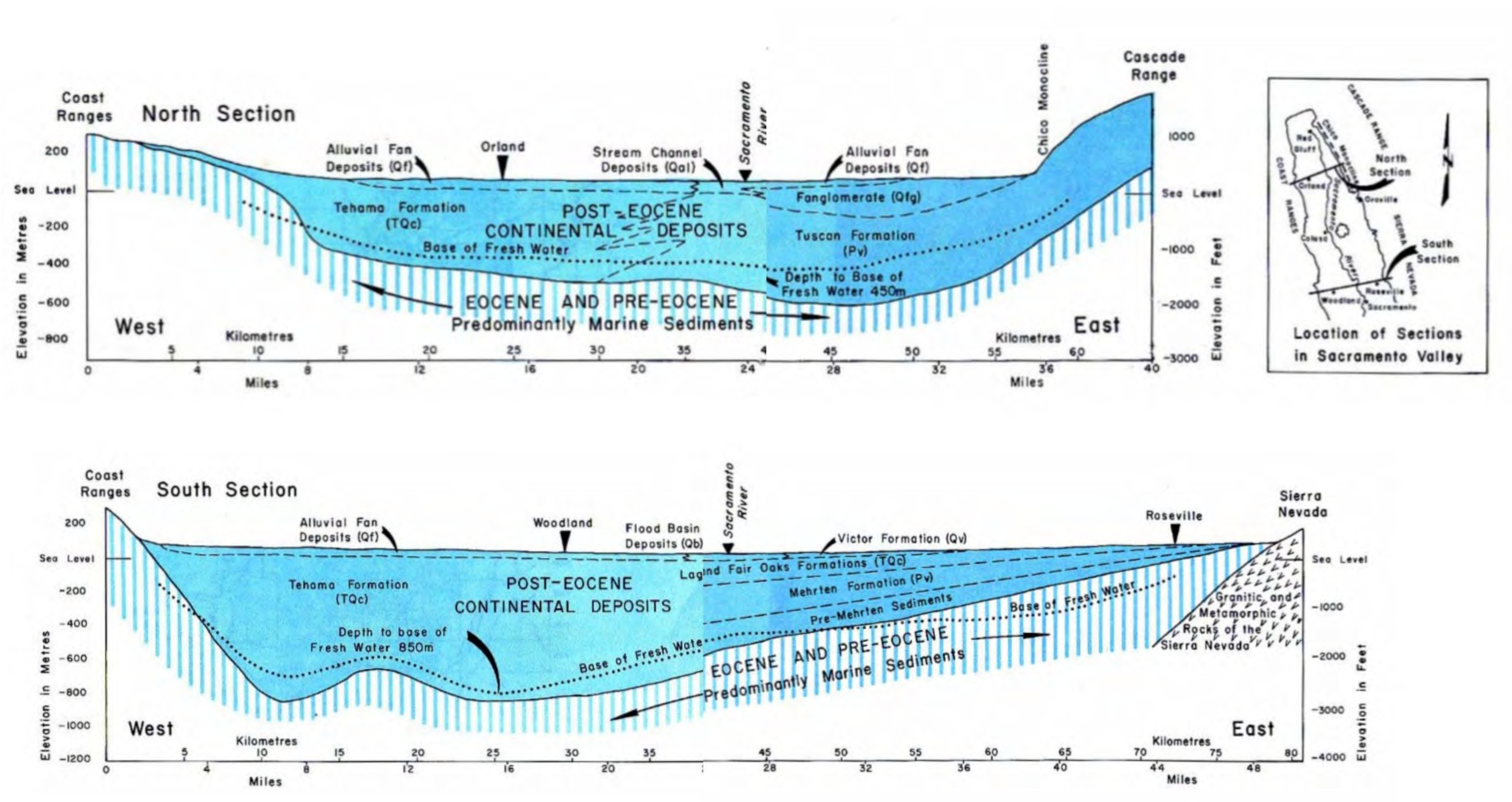
Geologic Unit	Geologic Age	Description	Water-Bearing Properties
Alluvium	Quaternary (Holocene)	Alluvial deposits not included as fans or flood basin deposits are found throughout the Sacramento Valley and consist of stream channel, natural levee, and floodplain deposits. Alluvium consists primarily of sands and gravel with minor amounts of silt and clay. Large, coarse-grained deposits are associated with larger streams in the Valley.	Stream channel deposits have high yields.
Flood Basin Deposits	Quaternary (Holocene)	Flood basin deposits are found in five distinct basins along the Sacramento River. During flood conditions, silts, clays, and fine sands were deposited in low-lying areas between the natural levees of streams and the alluvial plains on the Valley sides.	Insufficient data, but yields expected to be low given the fine-grained nature of the deposits.
Alluvial Fan Deposits	Quaternary (Pleistocene-Holocene)	Alluvial fan deposits are found along the western side of the Sacramento Valley from Stony Creek southward. Alluvial fans along the eastern side of the Valley are limited to the Chico area. Coalescing fans comprise materials ranging from clay to gravel. Alluvial fans in the Stony Creek and Chico areas contain a high proportion of coarse-grained materials.	Coarse-grained alluvial fans (Stony Creek) have reported yields up to 4,000 gpm. Alluvial fans dominated by finer-grained materials have lower yields.
Victor Formation	Quaternary (Pleistocene)	The Victor Formation is present on the eastern side of the Sacramento Valley where it forms a broad plain. The unit was deposited on a plain of aggradation by shifting streams draining the Sierra Nevada. The Victor Formation consists of stream channel sand and gravel deposits that grade laterally and vertically to silts and clays with a thickness up to 100 feet.	Important water-bearing unit for domestic and shallow irrigation wells. Limited data are available for wells completed entirely in the Victor Formation; yields up to 1,900 gpm are estimated for channel deposits of sand and gravel.
Arroyo Seco Gravel South Fork Gravels Red Bluff Formation	Quaternary (Pleistocene)	Small gravel deposits that form caps to the low hills and dissected uplands along the eastern and western sides of the Sacramento Valley. Gravel deposits are associated with glaciation of the Sierra Nevada and Coast Ranges and are generally either cemented or contain hardpan soils.	Not important water-bearing units, generally found above the regional water table, where units are saturated; well yields are generally low.
Fanglomerate	Quaternary (Pleistocene)	This unnamed geologic unit is restricted to the northeastern portion of the Sacramento Valley (north of Chico). The unit consists of coalescing alluvial fans derived from erosion of outcrops of the Tuscan Formation. The fanglomerates consist predominantly of cemented sand and gravel with large amounts of clay.	Estimated to have low to moderate yields.
Laguna Formation Fair Oaks Formation	Tertiary-Quaternary (Pliocene to middle-Pleistocene)	The Laguna Formation outcrops along the eastern margin of the basin and consists of westward-thickening deposits of silt, clay, and sand with gravel lenses. The Laguna Formation was deposited by streams draining the Sierra Nevada, with primarily granitic and metamorphic mineralogy (little/no volcanics). In portions of Sacramento County, deposits are referred to as the Fair Oaks Formation.	Finer-grained portions of the formation have low well yields. Well sorted sand units have reported well yields up to 1,750 gpm.
Tehama Formation	Tertiary-Quaternary (Pliocene to middle-Pleistocene)	The Tehama Formation occupies entire western portion of the Sacramento Valley and consists of predominantly fine-grained materials (silts and clays) with thin/ discontinuous lenses of sand and gravel derived from erosion of the Coast Ranges and the Klamath Mountains. The relative proportion of coarse-grained materials varies	The Tehama Formation is a principal water-bearing unit in the Sacramento Valley with reported well yields up to 4,000 gpm.

TABLE 1
Major Lithologic Units of the Sacramento Valley
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Geologic Unit	Geologic Age	Description	Water-Bearing Properties
Tehama Formation (cont'd)		spatially within the unit. The Tehama Formation extends eastward from the Valley margin and interfingers with the Tuscan and Laguna Formations at depth beneath the central portion of the Valley. The average thickness of the unit beneath the western half of the Sacramento Valley is approximately 2,000 feet.	
Mehrten Formation Tuscan Formation	Tertiary (Pliocene)	The Mehrten Formation is a volcanic unit that outcrops primarily along the southeastern margin of the Sacramento Valley. The formation is divided into two units: an upper fluvatile unit of interbedded black sands and blue to brown clay and a lower unit consisting of dense tuff-breccia. The formation dips and thic kens to the southwest. The Tuscan Formation outcrops in the east/northeastern portion of the Sacramento Valley and dips westward. The formation underlies approximately 900 square miles of the Valley. The Tuscan Formation is a wedge-shaped unit that thins from approximately 1,000 to 1,600 feet in the eastern outcrop areas to approximately 300 feet beneath the Valley center where it interfingers with the Tehama Formation. The unit consists of stream-deposited black volcanic sands, tuffaceous clay, and gravel.	The black sands of the Valley Springs Formation yield large quantities of fresh water to wells. The Tuscan Formation is an important water bearing unit in the Sacramento Valley, with reported well yields up to 3,000 gpm.
Valley Springs Formation	Tertiary (Miocene)	The Valley Springs Formation outcrops primarily along the southeastern margin of the Sacramento Valley. The unit consists of southwestward-dipping sequence of rhyolitic ash, clay, sand, and gravel deposited by streams with thickness up to approximately 200 feet.	Fresh water-bearing unit; low yields due to presence of fine-grained materials.
Marine and Continental Deposits (Includes Ione Formation)	Tertiary (Eocene)	Mixed marine and continental sediments deposited in a semi-isolated basin during and following uplift of the Coast Range. With transgression and regression of seas, some deposits contain both marine and sedimentary materials. Ione formation was deposited in a marsh-like environment in the east/southeastern portion of the Sacramento Valley and in fluvatile to marine environments in other portions of the Central Valley. The unit outcrops along the eastern margin of the Sacramento Valley and dips southwestward. The Ione Formation consists of clay, sand, sandstone, and conglomerate up to 400 feet thick.	Largely non-water bearing or saline. Where deposited in near-shore environment, the Ione Formation yields small quantities of fresh water to wells (up to 50 gpm).
Volcanics (Includes Sutter Buttes)	Tertiary	Andesitic and rhyolitic volcanics within interior of the Sacramento Valley.	Primarily non-water-bearing.
Marine Rocks (Includes Chico Formation)	Cretaceous	Outcrop primarily along the western side of the Sacramento Valley. Sedimentary rocks consisting primarily of eastward-dipping (and thickening) sandstones and shales.	Generally contain connate water or yield small volumes.
Basement Rocks	Pre-Tertiary	Igneous and metamorphic rocks that underlie the sedimentary deposits. Outcrops are limited to the eastern portion of the Valley, in the Sierra Nevada, and slope southwest. Igneous rocks include granitics with some mafic intrusions. Metamorphic rocks include metasedimentary, metavolcanic, and undifferentiated metamorphics.	Primarily impermeable boundary at base of groundwater basin; fractures and joints yield small quantities of water.

Notes:

Lithologic descriptions from DWR (1978) and Page (1986)
gpm = gallons per minute



Note:
Figure reproduced from DWR (1978).

Figure 2
Generalized Geologic Section of the Sacramento Valley
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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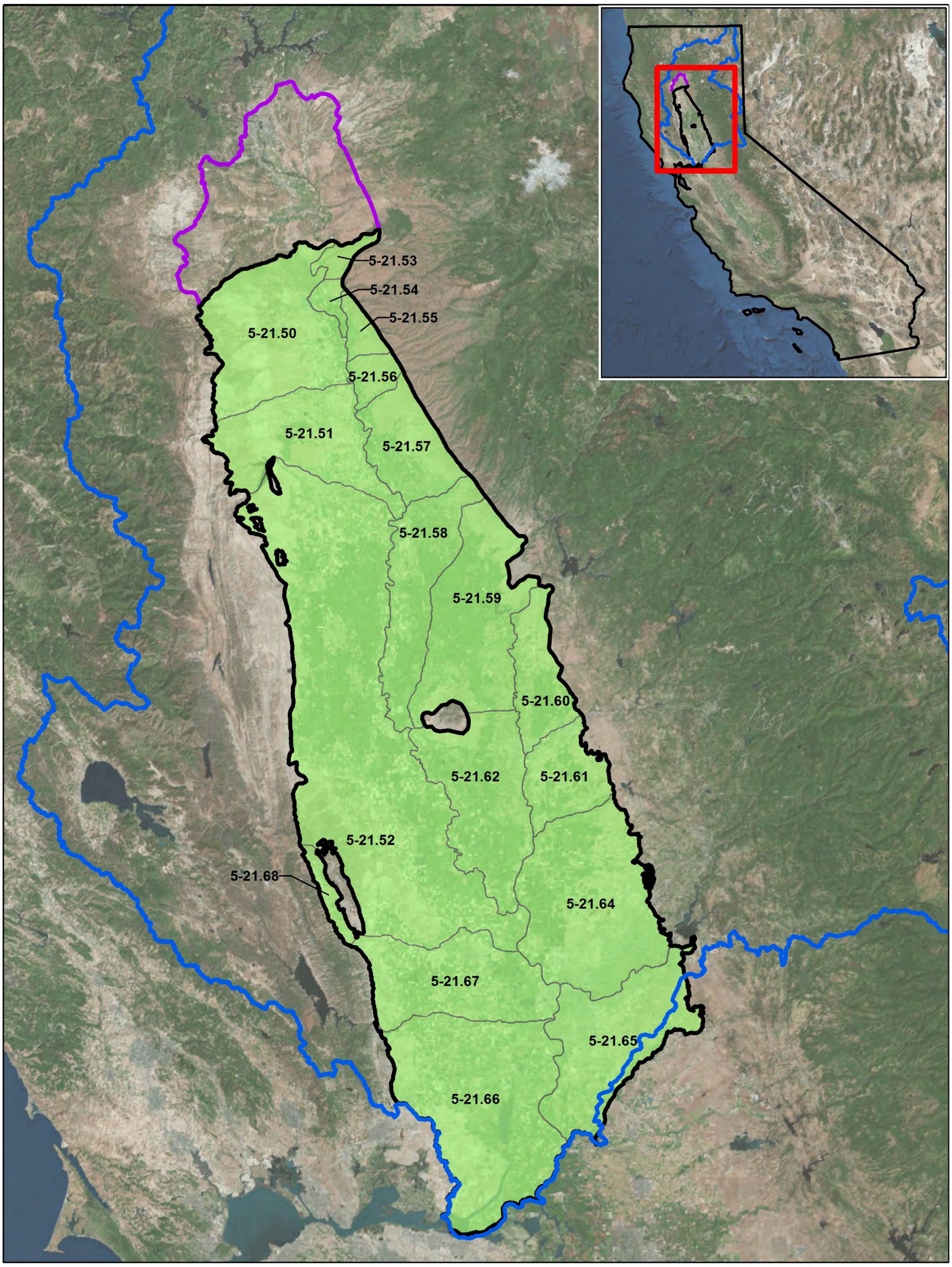

LEGEND

- Redding Groundwater Basin
- Sacramento Valley Groundwater Basin
- Sacramento River Hydrologic Region
- Groundwater Subbasin

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 3
Sacramento Valley Groundwater Basin
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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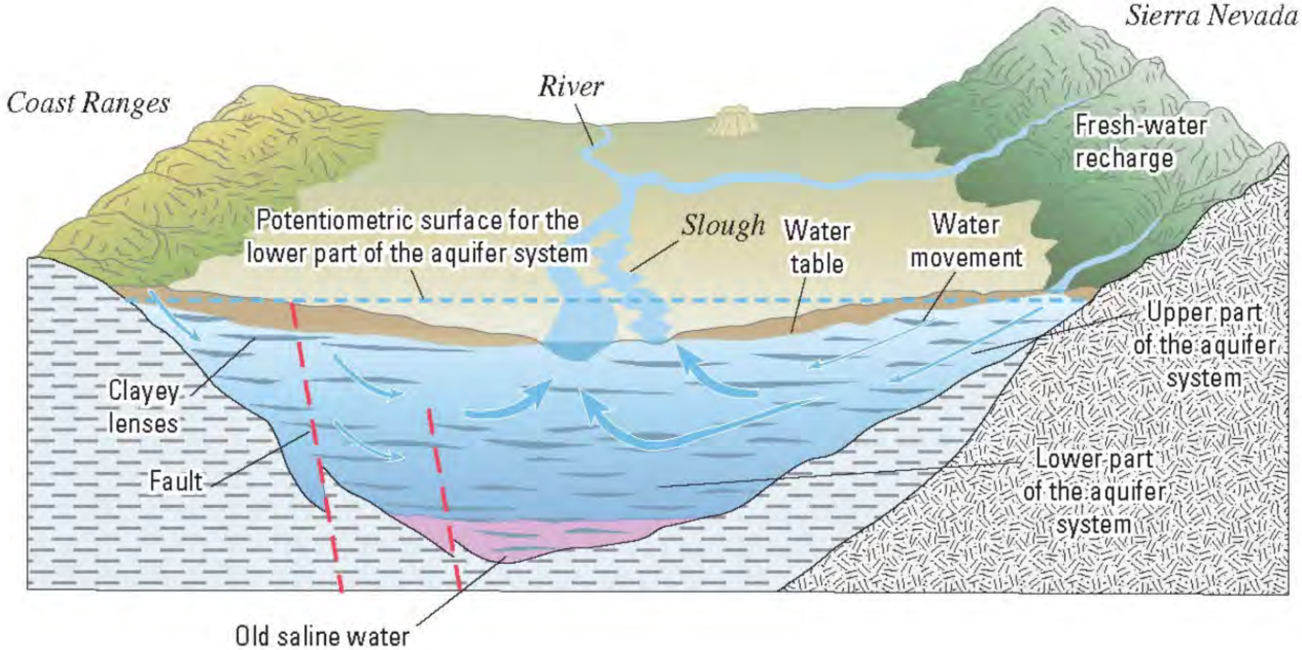

Figure 4
Conceptual Diagram of Groundwater Flow in the Sacramento Valley Groundwater Basin
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

Note:
Figure reproduced from USGS (2009).

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2.3 Regional Hydrology

The SVGB is an area of approximately 3.6 million acres on the Valley floor (Figure 3). The Sacramento River is the main surface water feature in the SVGB. It has several major tributaries draining the Sierra Nevada, including the Feather, Yuba, and American Rivers. Stony, Cache, and Putah Creeks drain the Coast Range and are the main westside tributaries to the Sacramento River. The westside tributaries contribute significantly less stream flow than those on the eastside. The Sacramento River flows south through the center of the Valley before heading west to flow to Suisun Bay.

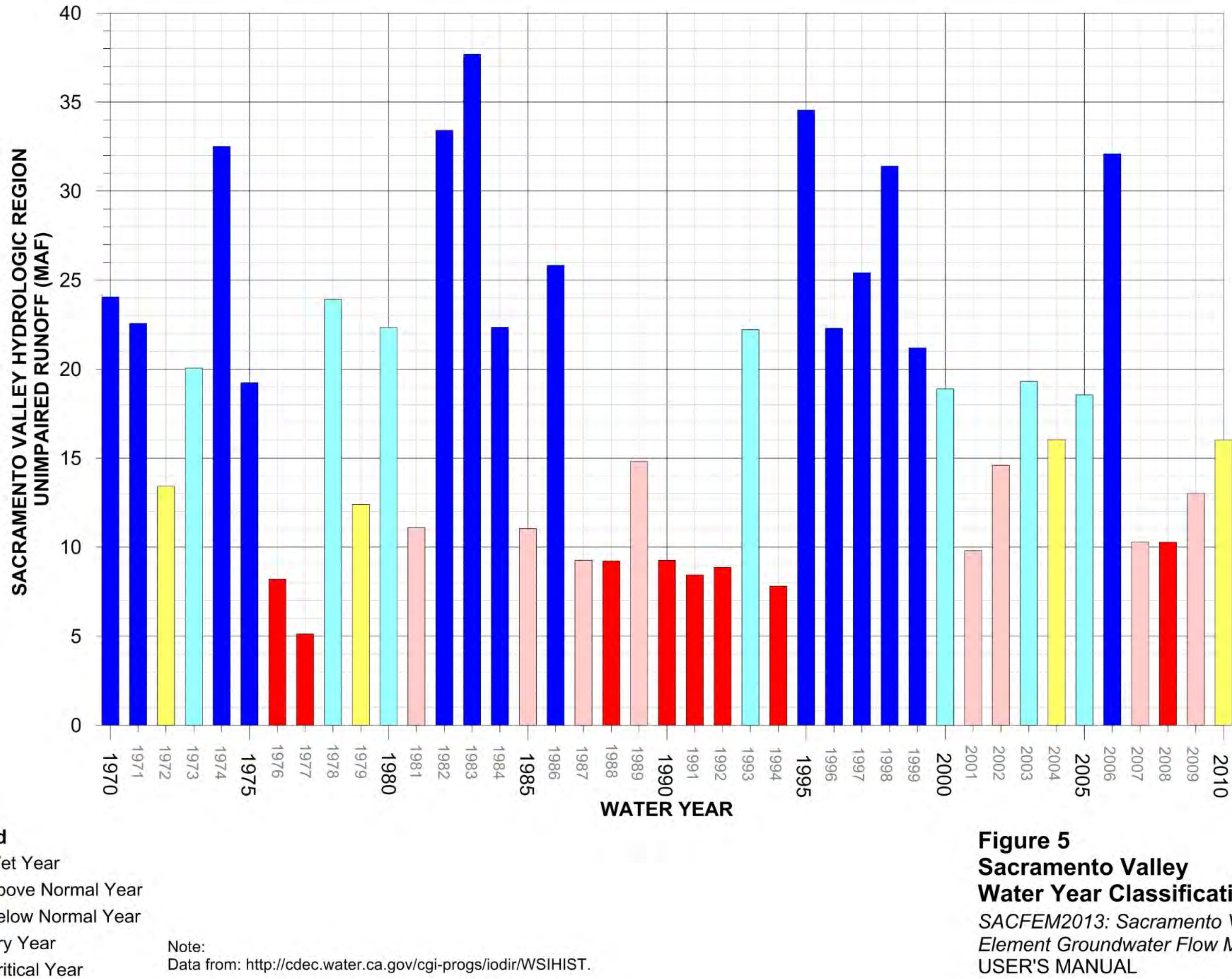
The Sacramento River and its major tributaries are the main water supply source for much of the area and provide water for urban, agricultural, and environmental uses. The flow of the major rivers and tributaries is managed by reservoir operations of the Central Valley Project, State Water Project, and locally operated projects. Groundwater pumping has been developed in much of the Valley to supplement surface water sources, and in some areas, it is the only source of water. Stream flow data for streams throughout the SVGB are collected at gaging stations operated by California DWR[1] and USGS[2].

The SVGB experiences a Mediterranean climate characterized by cool, wet winters and warm, dry summers. The average annual precipitation on the Valley floor is approximately 22 inches and varies considerably. The majority of the precipitation comes in the winter months from November through March with typically only minimal amounts from June through September. Figure 5 presents a plot of the Sacramento Valley water year[3] (WY) index between WY1970 and WY2010. The WY index is a function of the unimpaired runoff in the hydrologic region and is used to illustrate climatic variability. As shown on Figure 5, the SVGB has experienced prolonged droughts (such as WY1976-WY1977 and WY1987-WY1992) and extremely wet periods (such as WY1982-WY1984 and WY1995-WY1999).

[1] http://cdec.water.ca.gov/

[2] http://waterdata.usgs.gov/nwis

[3] A water year runs from October 1 of the previous calendar year through September 30 of the current calendar year (for example, water year 1970 includes the period of October 1, 1969, through September 30, 1970).



Note:
Data from: http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST.

Figure 5
Sacramento Valley
Water Year Classification

SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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SECTION 3

Groundwater Flow Model Construction

3.1 Model Code Description

MicroFEM (Hemker, 1997), a finite-element based, three-dimensional, integrated groundwater modeling package developed in The Netherlands, was chosen to simulate the groundwater flow systems in the SVGB. The current version of the program (4.10) has the ability to simulate up to 25 layers and 250,000 surface nodes. MicroFEM is capable of modeling saturated, single-density groundwater flow in layered systems. Horizontal flow is assumed in each layer, as is vertical flow between adjacent layers.

MicroFEM was the chosen modeling platform for the following reasons:

- The finite-element scheme allowed the construction of a model grid covering large geographic areas (more than 5,960 square miles in the SVGB) with coarse node spacing outside of the simulated project areas and finer node spacing in areas of interest (e.g., near potential project areas). The finer node spacing near simulated production wells provides greater resolution of simulated groundwater levels and stream impacts.
- The graphical interface allows rapid assignment of aquifer parameters and proofing of these values by graphical means.
- The flexible post-processing tools allow for rapid evaluation of transient water budgets for model simulations and identification of changes to stream discharges and other water fluxes across the model domain.

3.1.1 Numerical Assumptions

MicroFEM, as applied to the development of SACFEM2013, is conceptualized mathematically into a single-density subsurface groundwater flow regime. The subsurface flow regime includes the hydraulic properties that control groundwater movement and rates. All model layers are treated as vertically integrated, leaky-confined layers to facilitate accurate simulation of the 3D groundwater flow conditions. The minimum inputs required by MicroFEM to execute a simulation for a given model grid include transmissivity, vertical resistance, and boundary conditions. SACFEM2013 is simulated under confined conditions in all model layers; therefore, the user-defined transmissivity values do not vary during the model simulation.

3.1.2 Scientific Bases

The theory and numerical techniques that are incorporated into MicroFEM have been scientifically tested. The governing equations for saturated subsurface flow are well established and have been solved by several modeling codes over the past few decades on a wide range of field problems. Thus, the scientific bases of the theory and the numerical techniques for solving these equations have been well established. MicroFEM has been developed using strict quality assurance/quality control guidelines and with various levels of testing, from simple analytical solutions to complex field problems.

3.1.3 Data Formats

MicroFEM input and output files use American Standard Code for Information Interchange (ASCII) data formats and can be read and edited outside the program by a text editor.

3.1.4 Limitations

Mathematical models can only approximate processes of physical systems. Models are inherently inexact because the mathematical description of the physical system is imperfect and the understanding of interrelated physical processes is incomplete. CH2M HILL incorporated as many details of the physical system into the numerical model as possible. SACFEM2013 is a powerful tool that, when used carefully, can provide useful insight into processes of the physical system. Section 4.3 discusses potential sources of input and output error.

3.2 Model Construction

The mathematical model design is the result of translating the CSM into a form that is suitable for numerical modeling. The following steps were included in the development of the mathematical model design:

1. Establishing study area boundaries (that is, model domain) and developing a model grid
2. Spatially distributing land surface elevation values
3. Spatially distributing subsurface hydraulic parameter values
4. Selecting a time discretization approach appropriate for evaluating the field problem and fulfilling the modeling objectives
5. Establishing boundary conditions for flow (that is, water budget terms through time)

The following subsections describe the results of these design steps.

3.2.1 Model Domain

In the real world, space is continuous, but a numerical model must use discrete space to represent the hydrologic system. The simplest way to discretize space is to subdivide the study area into many subregions (that is, model elements) of variable size. This was the approach taken for development of the SACFEM2013 grid.

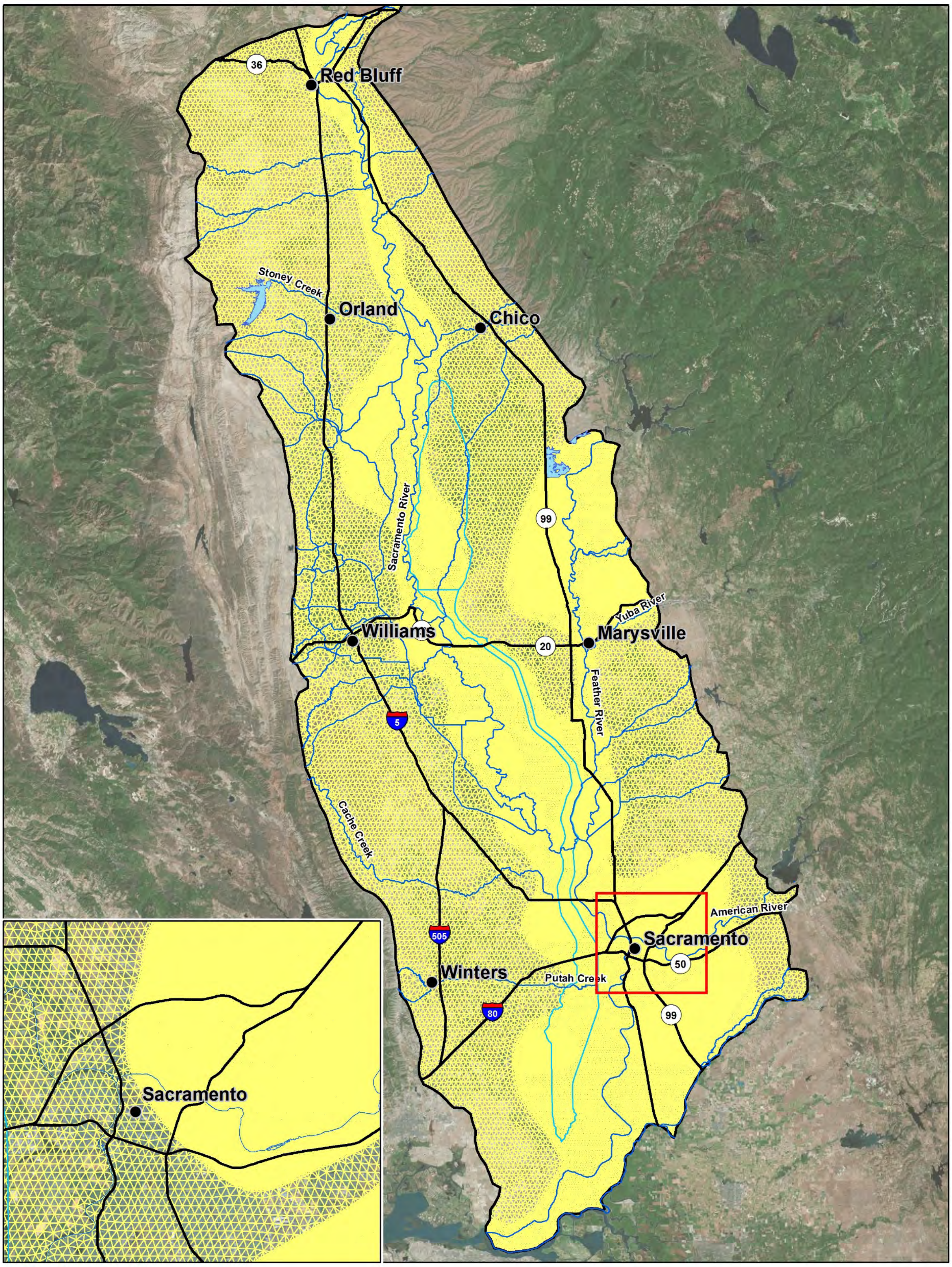
3.2.1.1 Areal Characteristics of Model Grid

The current version of the SACFEM2013 grid consists of 153,812 nodes and 306,813 elements (see Figure 6). The current grid was configured to support evaluation of potential conjunctive water management projects associated with the Long-Term Water Transfer Program; however, SACFEM2013 was designed to be grid independent, and geographic information system (GIS)-based tools have been developed to build a similar model of the Valley on any grid developed to support a particular application. The nodal spacing of the current grid varies from as large as approximately 3,300 feet (1,000 meters) near the model boundary and in areas where long-term water transfer projects are not being evaluated, to as small as 410 feet (125 meters) in areas where long-term water transfer groundwater production is being evaluated. Nodal spacing of approximately 1,640 feet (500 meters) is included along streams and flood bypasses included in SACFEM2013. The finer node spacing near proposed project areas allows for more refined estimates of the effects of groundwater pumping on groundwater levels and groundwater/surface water interaction in the potential project areas. The model domain boundary coincides with the lateral extent of the freshwater aquifer within the SVGB.

Note: The horizontal datum for SACFEM2013 is Universal Transverse Mercator, North American Datum of 1983, Zone 10 North, meters. The vertical datum for SACFEM2013 is North American Vertical Datum of 1988, meters.

3.2.1.2 Vertical Characteristics of Model Grid

As previously discussed, MicroFEM uses the user-defined aquifer transmissivity when executing calculations under confined conditions. When constructing the SACFEM2013 model, aquifer transmissivity was divided into the two components: saturated aquifer thickness and horizontal hydraulic conductivity (transmissivity is equal to saturated thickness multiplied by horizontal hydraulic conductivity). The following section describes the conceptualization of the saturated aquifer thickness.



LEGEND

- City
- Major Road
- Major Stream
- Flood Bypass
- Lake
- SACFEM2013 Model Grid
- SACFEM2013 Model Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 6
SACFEM2013 Model Grid
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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The total model thickness is defined by the thickness of the freshwater aquifer (less than 3,000 micromhos per centimeter), as defined by Berkstresser (1973) and subsequently refined in the northern portion of the Valley by DWR (2002, 2005). For the southern portion of the model area, elevation contour lines of the base of fresh water, defined by Berkstresser data, along with information from boring locations (point measurements of the elevation of the base of fresh water) were digitized and used to generate a 3D surface defining the elevation of the base of fresh groundwater. For the northern portion of the model area, the locations of geologic cross sections developed by DWR Northern District staff were plotted, along with the estimated base of freshwater elevations obtained from the cross section information, and a base-of-freshwater elevation contour map was constructed. These data sets were then merged to yield a single interpretation of the structural contour map of the base of freshwater across the SVGB (see Figure 7).

Total Aquifer Thickness. Because SACFEM 2013 is simulated under confined conditions, the uppermost boundary of SACFEM2013 is defined at the water table. To develop a total saturated aquifer thickness distribution and, therefore, a total model thickness distribution, it was necessary to construct a groundwater elevation contour map and then subtract the depth to the base of freshwater from that groundwater elevation contour map. Average calendar year 2000 groundwater elevation measurements were obtained from the DWR Water Data Library. These measurements were primarily collected biannually, during the spring and fall periods; and these values were averaged at each well location to compute an average water level for each location. These values were then contoured, considering streambed elevations for the gaining reaches of the major streams included in the model, to develop a target groundwater elevation contour map for the year 2000. As described above, the distribution of the elevation of the base of freshwater was subtracted from this groundwater elevation contour map to provide an estimate of the distribution of the total saturated aquifer thickness across the model domain (see Figure 8).

Model Layer Thickness. The strategy used to develop the overall layering of the SACFEM2013 model was to develop a tool that provides a sufficient number of layers to assess the effects of groundwater pumping on shallow features such as wetlands and streams. The model also was developed to provide sufficient vertical resolution to allow assignment of pumping stresses to appropriate depths within the aquifer that reflect the major producing zones within the aquifer system. Additionally, to facilitate investigation of potential future conjunctive water management projects using the Lower Tuscan aquifer, the layering strategy also provided for two layers explicitly representing this deep aquifer system.

Layer 1 of the SACFEM2013 model was assigned a maximum thickness of approximately 65 feet (20 meters). The thickness of this layer was limited to provide more accurate shallow groundwater elevations with which to support evaluations of the effects of changing groundwater levels on surface streams and wetland/ riparian areas. Layers 2 through 5 represent the more regional groundwater-producing zones within the Valley. The thicknesses of these layers were assigned using a specified percentage of the available aquifer thickness at a given location, to provide multiple-depth zones within which to assign regional pumping. The assumed layer thicknesses for Layers 2 through 5 were also selected to reflect typical screened intervals of production wells in the SVGB. The thicknesses of Layers 2 through 4 each represent approximately 10 percent of the total aquifer thickness (1 to 107 meters, 3 to 350 feet), and the thickness of Layer 5 represents approximately 15 percent of the total aquifer thickness on average (1 to 193 meters, 3 feet to 633 feet).

Where the Lower Tuscan aquifer is present (the northeastern and central portions of the Valley), the elevation of the top of Layer 6 was defined by the structural contour surface of the top of the Lower Tuscan aquifer (Figure 9). Two layers were assigned to represent this unit because, in many areas of the model, the depth to the base of fresh water (the base of the model) is as much as 900 feet below the upper surface of the Lower Tuscan. Groundwater production wells drilled into the Lower Tuscan would almost certainly be screened over a much smaller depth interval. To represent this condition in the model, Layer 6 was assigned a thickness of between 250 to 360 feet (75 to 110 meters) in the central portion of the northern SVGB. The total range in Layer 6 thickness is approximately 3 to 580 feet (1 to 177 meters). The remaining Lower Tuscan thickness not apportioned to Layer 6 was assigned to Layer 7. The exception to this convention is in the northeastern portion of the model near the City of Chico. The Lower Tuscan outcrops in the foothills above Chico; thus, in these areas, all layers of the model represent the Lower Tuscan aquifer. Moving west from Chico, a transition zone exists where a decreasing number of layers represents the Lower Tuscan until it is limited to Layers 6 and 7, as discussed above. In areas where the Lower Tuscan is not present, the thicknesses of Layers 6 and 7 represent 18 and 27 percent of the total aquifer thickness, respectively. A contour map of the total saturated aquifer thickness is presented on Figure 8, and cross sections illustrating SACFEM2013 model layers are presented on Figures 10 and 11 (these oversized figures are presented at the end of this report).

3.2.2 Subsurface Hydraulic Parameters

The hydraulic parameters in the SACFEM2013 were initially assigned using available and relevant field data from previous investigations. Subsurface hydraulic properties required by MicroFEM include the horizontal hydraulic conductivity (Kh) and the vertical resistance.

3.2.2.1 Horizontal Hydraulic Conductivity

The distribution of aquifer properties across the SVGB is poorly understood. In certain areas with significant levels of groundwater production, the collection of aquifer test data and the measurement of historical groundwater-level trends in response to known groundwater production rates have provided valuable information on aquifer properties. However, in the majority of the Valley, these data are not available.

To estimate the spatial distribution of aquifer properties across the model domain for this numerical modeling effort, a database of well productivity information was used. In consultation with DWR staff, a database was obtained that included all of the specific capacity yield data that were available from well log records. These data were compiled along with well construction information for each production well to yield a representative data set of well productivity across the Valley. Wells that did not have available construction data were omitted from further consideration. To protect owner privacy, the exact location of each well was modified by DWR staff to reflect the center of the section in which each well was located. This modification in well location did not adversely affect the use of the data to estimate the spatial distribution of aquifer properties, given the extremely large area encompassed by the model domain. Approximately 1,000 wells in the database within the model domain were used in this analysis.

The intent of the modeling analysis described herein is to simulate the effects of operating high-productivity irrigation wells screened within the major producing zones in the Valley to support conjunctive water management projects. Therefore, the aquifer properties that are of primary interest are those of the major aquifer zones tapped by large-diameter irrigation wells. The well database described above was filtered to remove data obtained from tests on low-yield and shallow, domestic-type wells. All test data from wells that reported a well yield below 100 gpm were eliminated from consideration, as were the test data from wells with a total depth of less than 100 feet. The only exception to this second consideration was for wells that were located along the basin margins – where aquifers are thin – that reported what appeared to be valid test results. Data from these wells were considered because they were often the only data available in the basin margin areas.

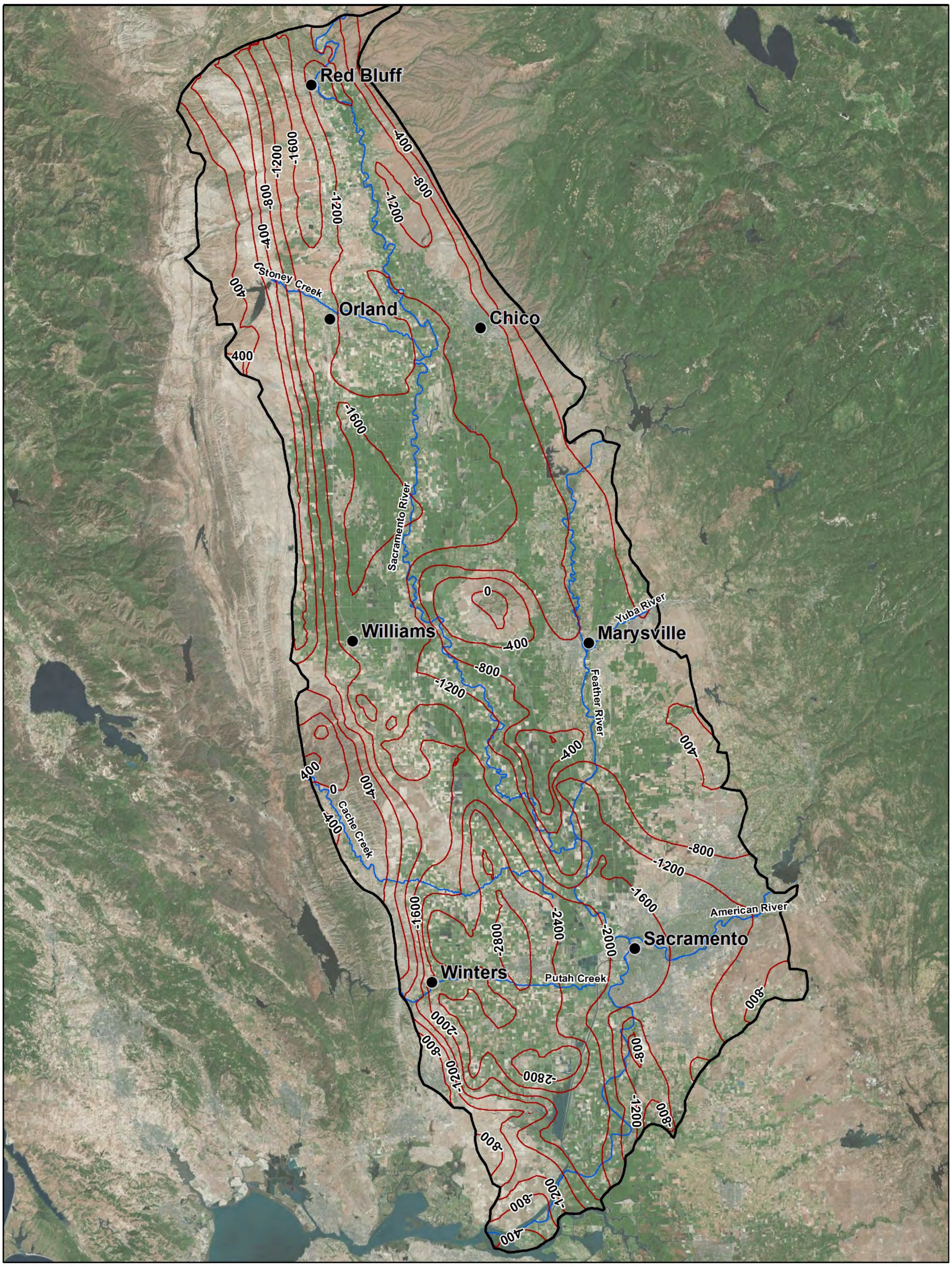
After the data set for consideration was finalized, the reported specific capacity data for each well were used to estimate an aquifer transmissivity for that location. The relationship used to estimate aquifer transmissivity was the following form of a simplified version of the Jacob non-equilibrium equation:

$$S_c = \frac{T}{2000} \quad (1)$$

Where:

S_c = specific capacity of an operating production well (gallons per minute per foot of drawdown)

T = aquifer transmissivity (gallons per day per foot)



LEGEND
- City
- Major Stream
- SACFEM2013 Model Boundary
- Simulated Base of Fresh Groundwater (feet NAVD88)

Note:
NAVD88 = North American Vertical Datum of 1988

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 7
Base of Fresh Groundwater
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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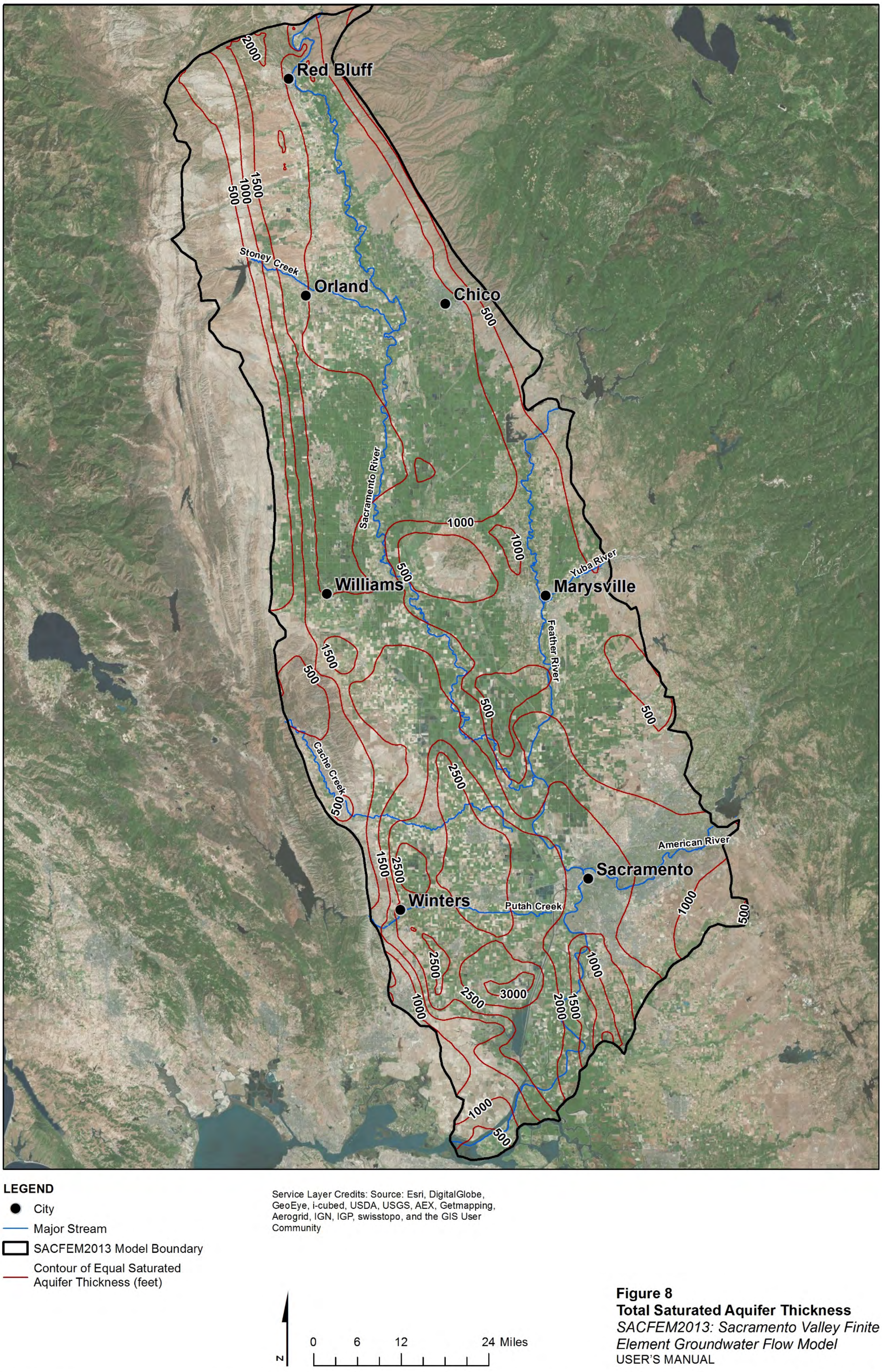

Figure 8
Total Saturated Aquifer Thickness
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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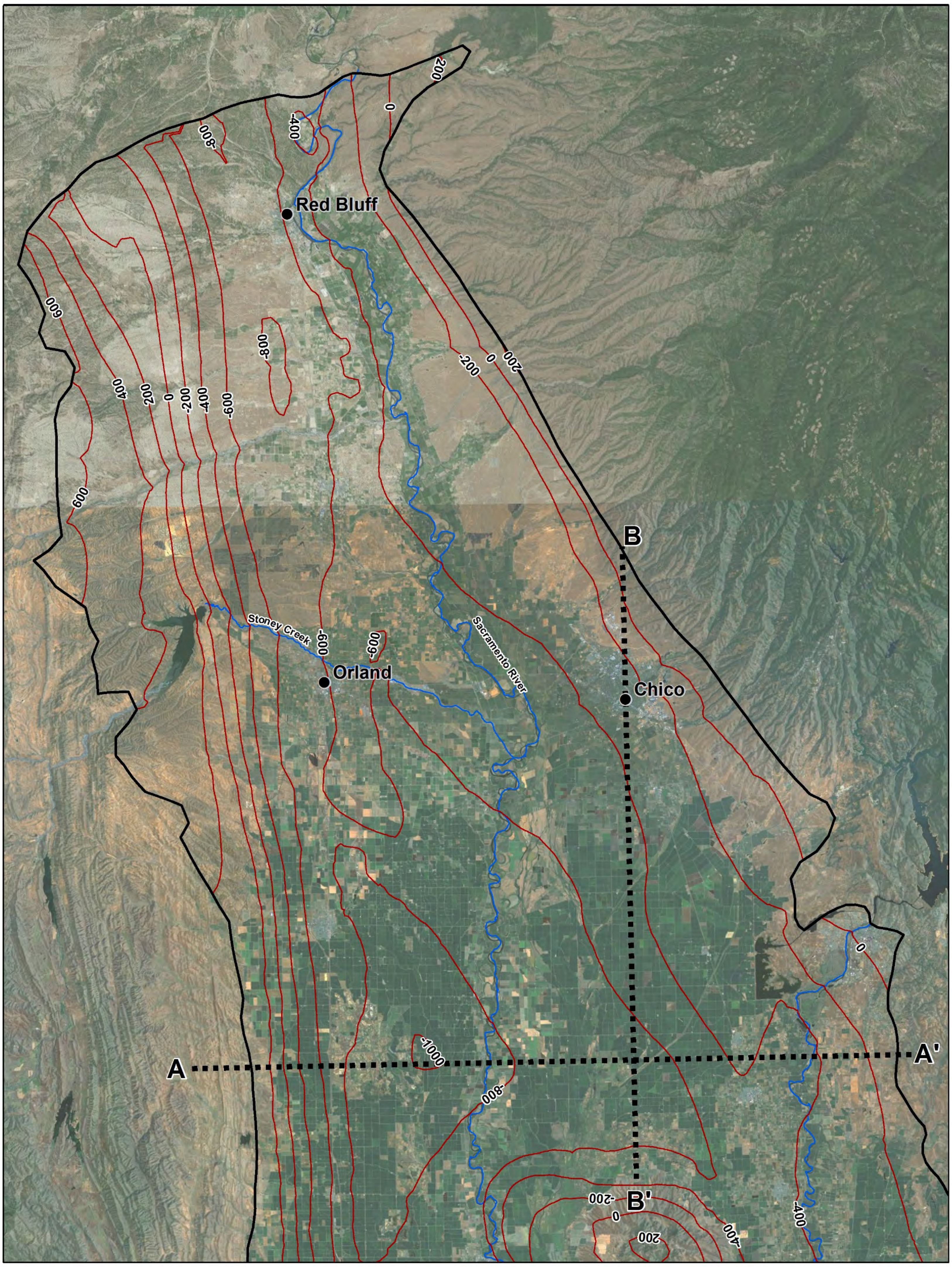

Figure 9
Elevation of the Top of Model Layer 6
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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After a transmissivity estimate was computed for each location, the transmissivity value was then divided by the screen length of the production well to yield an estimate of the aquifer Kh. The final step in the process was to smooth the Kh field to provide regional-scale information. Individual well tests produce aquifer productivity estimates that are local in nature, and might reflect small-scale aquifer heterogeneity that is not necessarily representative of the basin as a whole. To average these smaller-scale variations present in the data set, a FORTRAN program was developed that evaluated each independent Kh estimate in terms of the available surrounding estimates. When this program is executed, each Kh value is considered in conjunction with all others present within a user-specified critical radius, and the geometric mean of the available Kh values is calculated. This geometric mean value is then assigned as the representative regional hydraulic conductivity value for that location. The critical radius used in this analysis was approximately 6 miles (10,000 meters). The point values obtained by this process were then gridded to develop a Kh distribution across the model domain. The aquifer transmissivity at each model node within each model layer was then computed using the geometric mean Kh values at that node times the thickness of the model layer. Insufficient data were available to attempt to subdivide the data set into depth-varying Kh distributions, and it was, therefore, assumed that the computed mean Kh values were representative of the major aquifer units in all model layers.

The distribution of Kh was used as a calibration parameter for SACFEM2013, and minor adjustments were made during the calibration process. Figures 12 and 13 present the final Kh distributions for model Layers 1 through 5 and model Layers 6 and 7. The final distribution of Kh in model Layer 1 is slightly lower than model Layers 2 through 5 east of Dunnigan Hills; however, this is not readily apparent given the 20-foot contour interval on Figure 12. Further, bedrock areas within the interior of the SVGB were assigned Kh values of 1 foot per day in all model layers.

3.2.2.2 Vertical Resistance

MicroFEM computes vertical flow between adjacent model layers based on the simulated head difference between adjacent model layers and the vertical resistance term. The vertical resistance term in MicroFEM is calculated as follows:

$$c = \left(AF \times \frac{mt_i^2 \div 2}{t_i}\right) + \left(AF \times \frac{mt_{i+1}^2 \div 2}{t_{i+1}}\right) \quad (2)$$

Where:

c = Vertical resistance to flow between an upper model layer (i) and adjacent lower model layer (i+1) ($days^{-1}$)
AF = Anisotropy factor (ratio of horizontal to vertical hydraulic conductivity [Kh:Kv])
Kv = Vertical hydraulic conductivity
mt_i = Saturated thickness of model layer i (length [L])
mt_{i+1} = Saturated thickness of model layer i+1 (L)
t_i = Transmissivity of model layer i (L^2/time [T])
t_i+1 = Transmissivity of model layer i (L^2/T)

The Kh:Kv values were assumed to be 500:1 in Layers 2 through 7 and 50:1 in Layer 1 at all model nodes except those representing bedrock areas. The Kh:Kv in areas of bedrock outcrop (such as the Sutter Buttes, Black Butte, and Dunnigan Hills) was assumed to be 1:1 in all model layers.

3.2.2.3 Aquifer Storage

The specific yield of model Layer 1 was assumed to be 12 percent throughout the SACFEM2013 model domain. The aquifer storativity of model Layers 2 through 7 is 6.5×10^{-5} multiplied by model layer thickness throughout the majority of the model domain, with variations along small portions of the model boundary.

3.2.3 Model Time Discretization

Time is continuous in the physical system, but a numerical model must describe the field problem at discrete time intervals. SACFEM2013 was set up to simulate transient flow conditions between WY1970 and WY2010. The period WY1970 through WY2010 was used because it includes very wet periods such as the winter of WY1983, as well as dry periods such as the WY1976 to WY1977 and WY1988 through WY1992 droughts. Using a climatic period of this type allows for assessing model accuracy and the water budgeting process and replicating observed conditions during periods of extreme hydrologic conditions, as well as the more average conditions that persisted throughout the remainder of the calibration period. The 41-year simulation was discretized with monthly stress periods. As such, model stresses (such as stream stage, groundwater pumping, deep percolation) and model output are assigned/evaluated monthly.

3.2.4 Boundary Conditions

Boundary conditions are mathematical statements describing either the head or the groundwater flux within a model domain (Anderson and Woessner, 1992). Correct selection of boundary conditions is a critical step in model construction because boundaries largely determine the flow pattern in steady-state models. Boundary conditions can represent either physical boundaries, such as impermeable rock, or hydraulic boundaries, such as groundwater divides or streamlines. The following types of boundary conditions are used with the SACFEM2013:

- **Head-dependent flux:** The flux across the boundary is calculated as a function of a defined head and a resistance term (which regulates seepage) by using an appropriate governing flow equation.
- **Specified-flux:** A prescribed groundwater flux is defined along the boundary or within the model domain.

3.2.4.1 Head-dependent Flux Boundaries

Groundwater-Surface Water Interaction. A head-dependent boundary condition was chosen to simulate the major streams, flood bypasses, and reservoirs within the SVGB. The MicroFEM wadi system was used to implement streams within the model domain. MicroFEM's wadi package is a two-way, head-dependent boundary condition (that is, it can act as a source of groundwater recharge or as a groundwater sink) that calculates the magnitude and direction of nodal fluxes by using the relative values of the user-specified stream stage (wh1) and the calculated head in the upper aquifer (h1), but is limited by a critical depth (wl1). When calculated groundwater elevations fall below this critical depth, it is assumed that the water table de-couples from the river system, and the leakage rate from the river to the aquifer becomes constant. The equations that govern operation of the wadi package are as follows:

Groundwater discharge to a stream is simulated if h1 > wh1:

$$Q_{outflow} = a * (h1 - wh1) / wc1 \tag{3}$$

In coupled streams (groundwater elevation is above the stream bottom elevation), groundwater recharge from a stream is simulated if h1 < wh1:

$$Q_{inflow} = a * (wh1 - h1) / wc1 \tag{4}$$

In de-coupled streams (groundwater elevation is below the stream bottom elevation), groundwater recharge from a stream is simulated if:

$$Q_{inflow} = a * (wh1 - wl1) / wc1 \tag{5}$$

Where:

Q	=	volumetric flux (L^3/T)
a	=	nodal area (L^2)
h1	=	simulated groundwater elevation in layer 1 (L)
wh1	=	simulated stream stage (L)
wl1	=	stream bottom elevation (L)
wc1	=	resistance across the streambed (T^{-1})

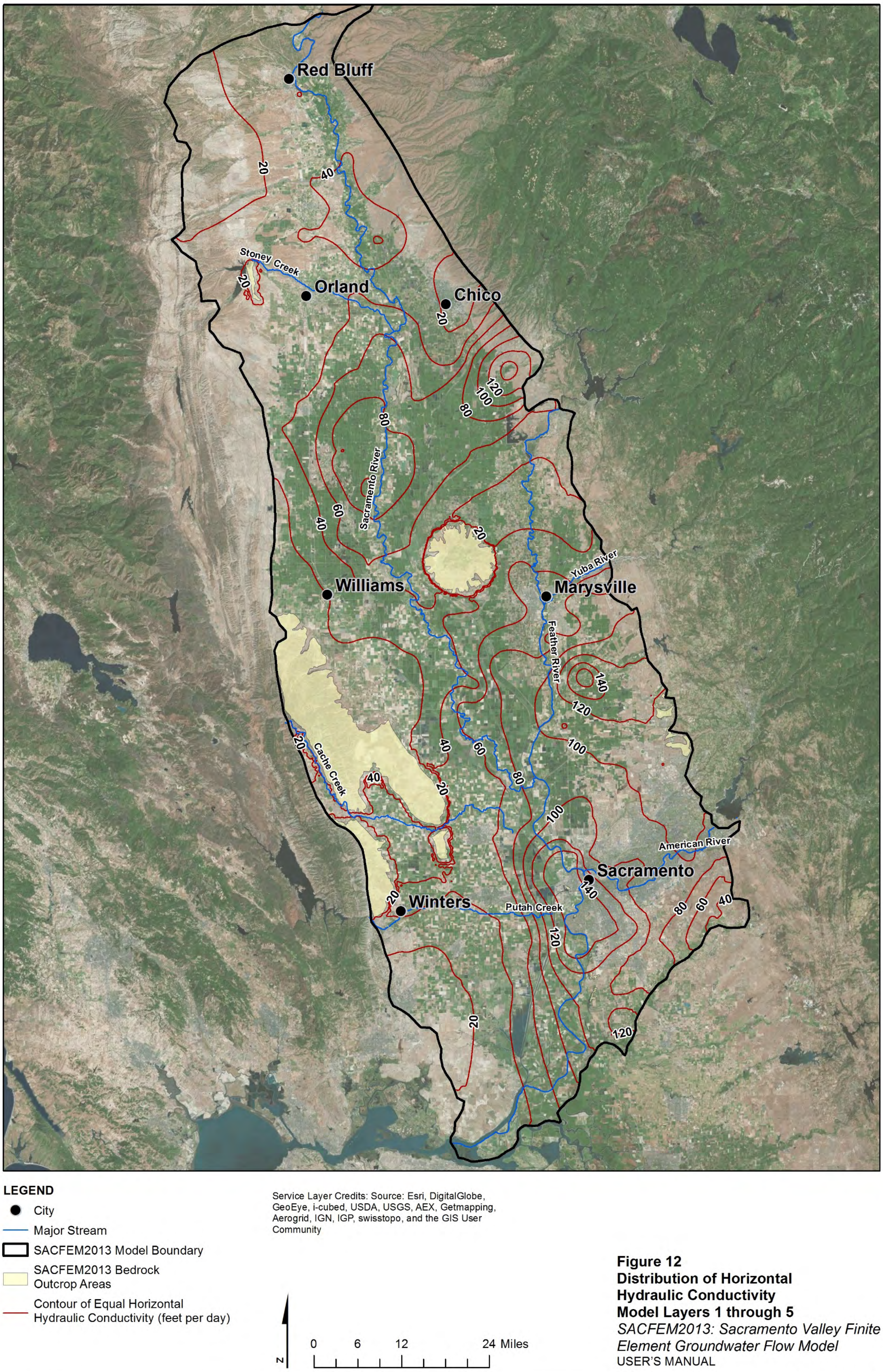

Figure 12
Distribution of Horizontal Hydraulic Conductivity Model Layers 1 through 5
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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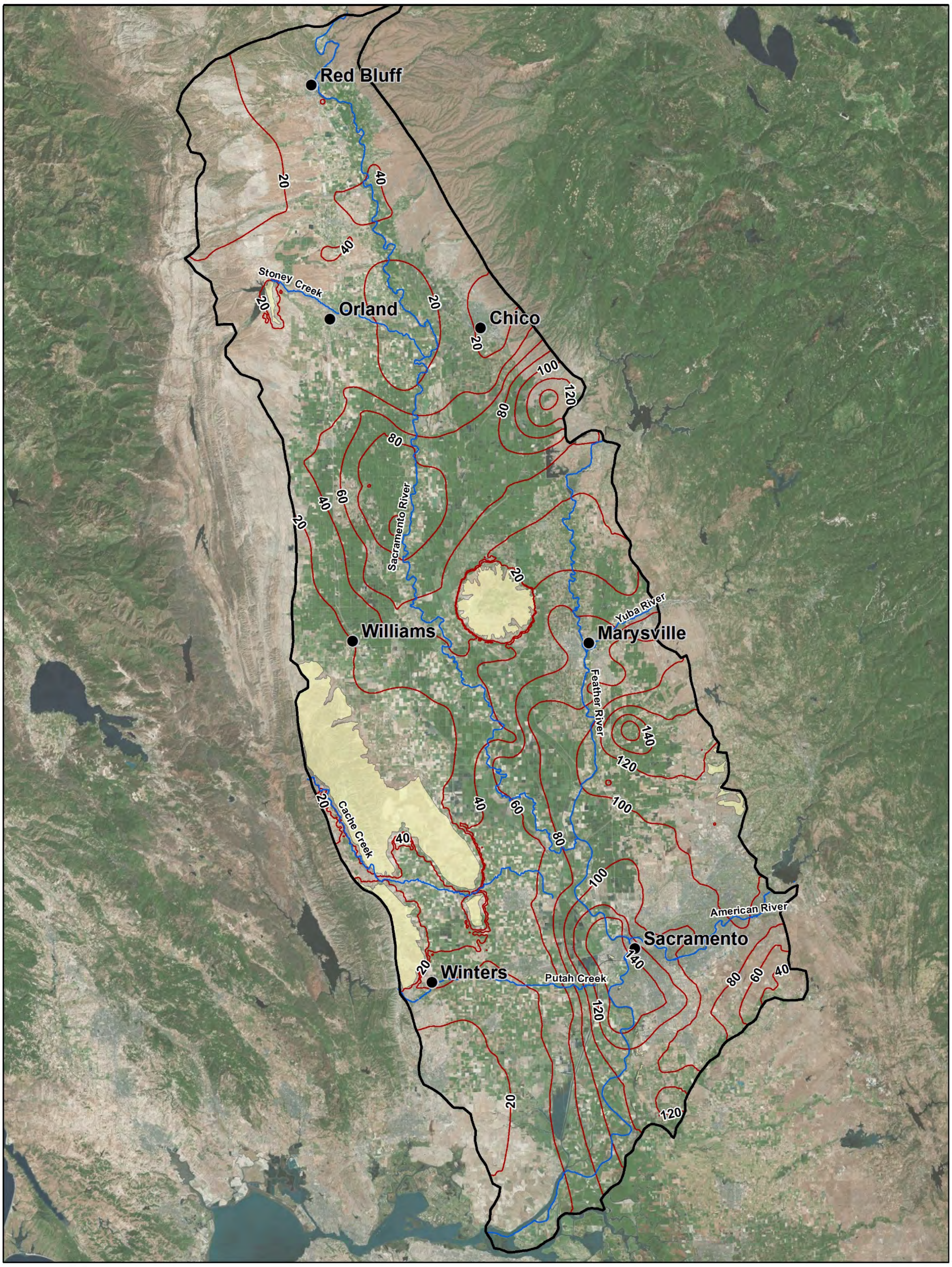

LEGEND

- City
- Major Stream
- SACFEM2013 Model Boundary
- SACFEM2013 Bedrock Outcrop Areas
- Contour of Equal Horizontal Hydraulic Conductivity (feet per day)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 13
Distribution of Horizontal Hydraulic Conductivity Model Layers 6 and 7
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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Nodal area is a grid-dependent parameter that can be automatically calculated within MicroFEM. In general, the nodal area around a node that represents a discrete reach of a stream is greater than the surface area of that stream along the reach in the field. The effective resistance term (wc1) incorporates an areal correction factor to account for this discrepancy; the wadi resistance term (wc1) is a measure of the resistivity of the streambed sediments. The resistances are calculated as follows:

$$wc1 = Dr/Kv * (a/LW) \tag{6}$$

Where:

Dr	=	thickness of streambed sediments (L)
Kv	=	vertical hydraulic conductivity of streambed sediments (L/T)
L	=	stream length represented by the model node (L)
W	=	field width of the wetted river channel within the stream reach represented by L (L)

Fifty individual streams are simulated with MicroFEM's wadi package in the current version of SACFEM2013. Stream locations were digitized from existing base maps and USGS topographic quad sheets and imported into the model domain. Figure 14 presents the locations of surface water features included in SACFEM2013. Stream length within a given node is a grid-dependent variable calculated by MicroFEM at each river node. The stream-length term is generally overestimated by MicroFEM at stream confluences. Manual corrections of this term were made where necessary. Streambed thickness was assumed to be 3.28 feet (1 meter) for all river nodes. Assumptions of streambed Kv were based on the type of streambed deposits expected given stream size. Further, the streambed Kv for individual streams was included as a calibration parameter for SACFEM2013. Figure 15 presents the final distribution of streambed Kv. These data are also included in Table 2. Streams draining the Sierra Nevada were generally assigned lower streambed Kv values, with all streams except the Bear River and Big Chico Creek having values of 6.6 ft/day (0.0023 centimeters per second [cm/s]) or less. Westside streams were assigned higher values, with most having assigned Kv values greater than or equal to 16.4 ft/day (0.0058 cm/sec).

Wetted stream width was calculated from aerial photographs at two locations along each stream. Table 3 presents the average wetted stream width included in SACFEM2013. Few streams showed greater variability in width to necessitate developing a continuously variable distribution along the stream length. This was accomplished by estimating wetted stream width at several points via examination of aerial photographs and fitting a polynomial to the data points to interpolate between the measured points. The ranges of wetted stream width are included in Table 3 for these streams.

Representation of Streams. Previous versions of SACFEM included average stream stage elevations (wh1) in the model simulations that did not vary through time. SACFEM2013 incorporates transient stream stage elevations to improve the representation of stream-groundwater interaction under varying hydrologic conditions. Review of historical river stage data shows that stage along the Sacramento and Feather rivers can vary by up to approximately 20 feet between high winter flows and low summer flows. Figure 16 is a plot of historical stage data for the Sacramento and Feather Rivers that illustrates this variability.

A data set of transient stream stage (wh1) was developed for use in SACFEM2013. This involved multiple steps and several assumptions as described in the following sections. There are 55 rivers, streams, and surface water canals or drains and reservoirs explicitly represented in SACFEM2013 (see Figure 14). These 55 surface water features are represented by approximately 5,500 model nodes. As discussed in Section 2.1, SACFEM2013 simulates a 41-year period from WY1970 through WY2010 with 492 monthly time-steps. Therefore, transient stream stage inputs for SACFEM2013 number approximately 2.7 million separate inputs for the entire simulation period (i.e., 5,500 nodes multiplied by 492 time-steps).

Estimating Streambed Elevations. The first step in developing transient stream stage inputs was to estimate the streambed elevation for each stream node. MicroFEM input for stream boundary conditions consists of a water surface elevation (WSE) for each node that must relate to the model streambed elevation for the node. Streambed elevations must also relate to model ground surface elevation for surrounding nodes. Therefore, a consistent vertical datum must be used for ground surface, streambed, and WSE.

The ground surface in SACFEM2013 is based on 30-meter digital elevation model (DEM) data. Model ground surface was developed through a GIS analysis that intersected the SACFEM2013 grid with 30-meter DEM data and calculated statistics for areas that contribute to each SACFEM2013 node. Statistics include the maximum, minimum, and mean elevations for areas that contribute to each node. Ground surface elevation for each node was assumed to be equal to the mean DEM elevation. An initial streambed elevation was estimated as the minimum DEM elevation for the area that contributes to each stream node.

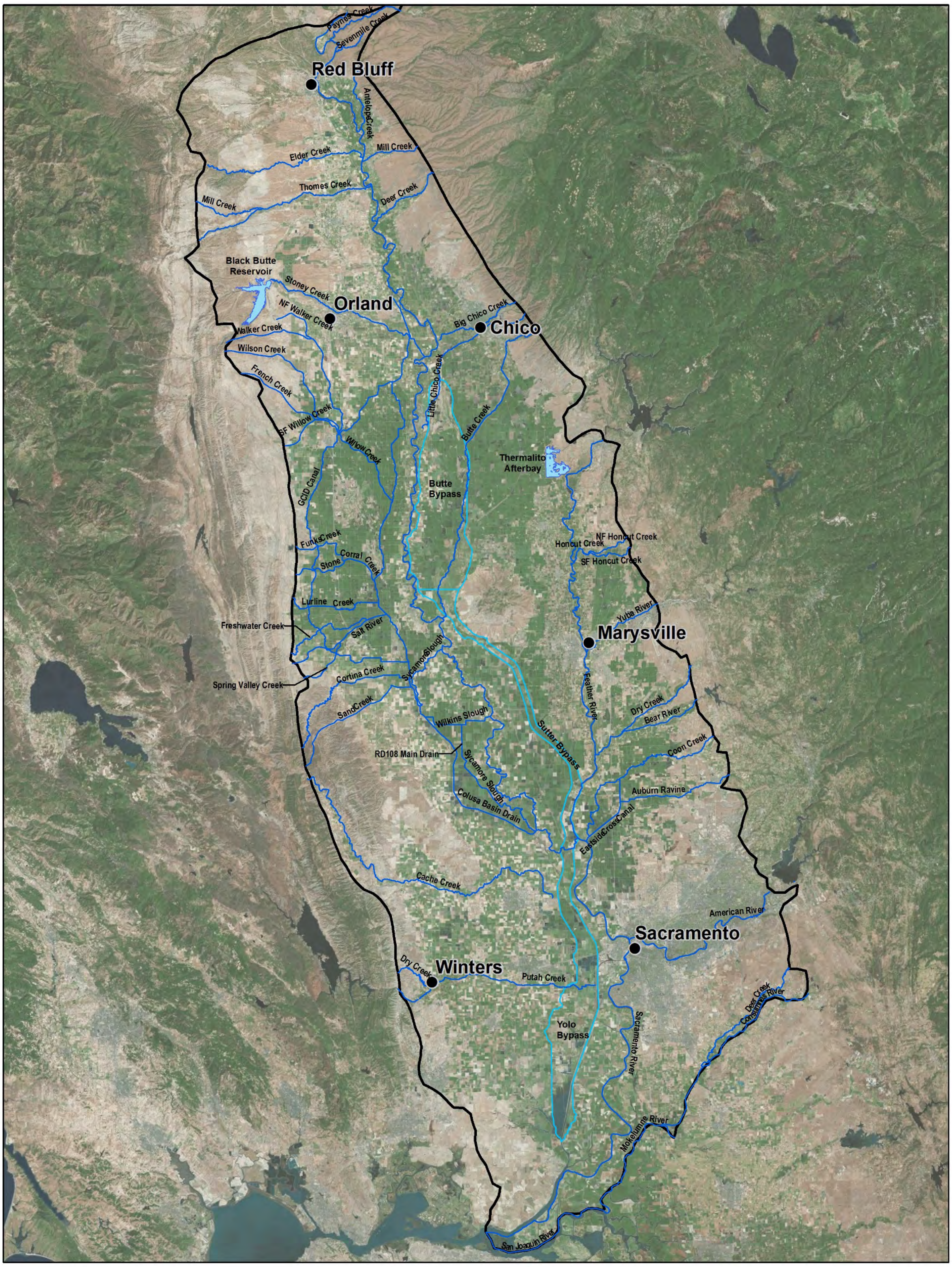
Minimum DEM elevations, or initial streambed elevations, for each stream were reviewed and plotted versus stream node distance from the confluence. These plots illustrate initial streambed elevation based on DEM data from downstream to upstream. Figure 17 is an example of the initial streambed elevation data for all Sacramento River stream nodes.

Review of initial streambed elevations for many streams showed unrealistic increases and decreases in streambed elevations between nodes. For the Sacramento River, minimum DEM elevations provided streambed elevations that are generally flat in the lower reaches of the Sacramento River in and near the Sacramento-San Joaquin River Delta, and a steeper streambed slope at the upstream end of the model. These are expected results based on the topography of the Sacramento Valley. However, there are also areas of significant variation in streambed elevation such as the reach between 75 and 100 miles upstream from the confluence with the San Joaquin River (see Figure 17). These variations illustrate limitations of using 30-meter DEM data and GIS analysis to estimate streambed elevation. Therefore, for each stream, a polynomial trend line was fit through the minimum DEM elevations to provide a more ordered set of streambed elevations. Figure 18 illustrates the trend line used to estimate streambed elevation along the Sacramento River. The trend line provides a set of well-ordered streambed elevations that decrease from upstream to downstream while generally following the topography of the basin.

Stream Stage. A well-ordered estimate of streambed elevation is needed to best utilize available stage and flow data. SACFEM2013 stream stage inputs were developed to represent historical stage that occurred in each surface water feature. Therefore, historical stream stage and flow data were collected and analyzed. These data were collected from a variety of sources including USGS records, DWR gage records and publications, and available data from local water districts and agencies. Available stream stage data are frequently based on different vertical datums, including elevations for individual gages that cannot be related to a standard vertical datum such as North American Vertical Datum of 1988 (NAVD 88). Therefore, it is not possible to establish a consistent vertical datum for all available stage and flow data. Additionally, many gaged streams report only stream flow, not stage, and rating curves are not readily available for most of these streams, or if available, rating curves do not provide the vertical datum.

To utilize as much of the available gage data as possible while addressing the issue of multiple or unknown vertical datums, historical stage data were assumed to approximate stream depth above the streambed elevation. Historical stream depths were then added to estimated streambed elevations to determine water surface elevations for input into SACFEM2013.

There were multiple challenges to develop a complete and realistic dataset of water surface elevations for all surface water features in SACFEM2013. These challenges included estimates for ungaged streams or gaged streams with an incomplete record, estimates for stage along the entire length of the stream based on a single gage location, and methods to estimate water surface elevations at stream confluences.



LEGEND

- City
- SACFEM2013 Stream
- Flood Bypass
- SACFEM2013 Model Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 14
SACFEM2013 Surface Water Features
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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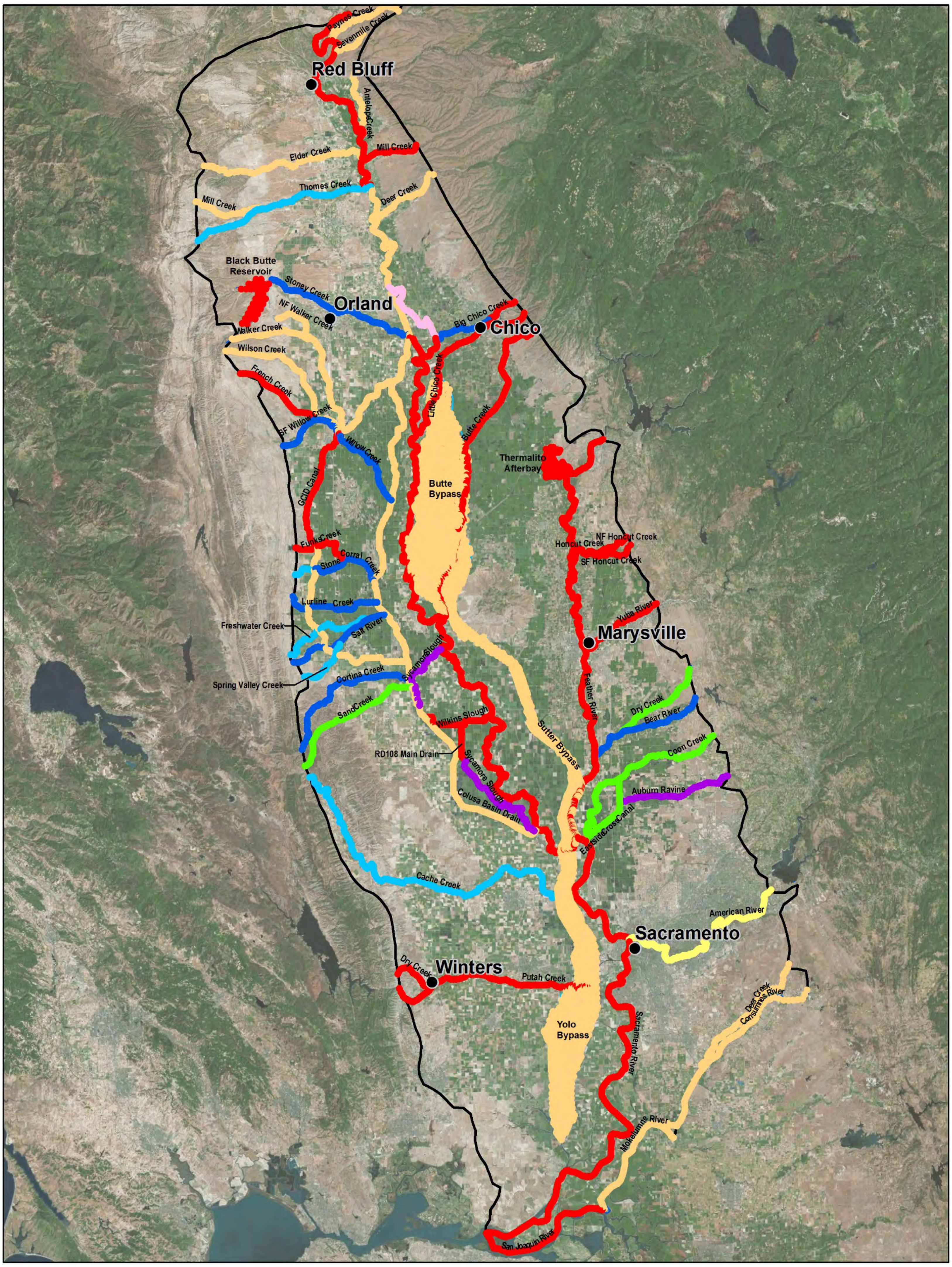

LEGEND

- City
- SACFEM2013 Model Boundary

Streambed Vertical Hydraulic Conductivity (feet per day)

0.1	3.3
0.3	6.6
0.6	16.4
1.6	32.8

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 15
Distribution of Vertical Hydraulic Conductivity, Surface Water Features
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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TABLE 2
Assumed Streambed Vertical Hydraulic Conductivity
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Stream	Vertical Hydraulic Conductivity (foot/day)	Vertical Hydraulic Conductivity (centimeters/second)
American River	0.1	3.47E-05
Antelope Creek	0.3	1.16E-04
Auburn Ravine	0.7	2.31E-04
Bear River	32.8	1.16E-02
Big Chico Creek	3.3 – 32.8	1.16E-03 – 1.16E-02
Black Butte Reservoir	3.3	1.16E-03
Butte Bypass	0.3	1.16E-04
Butte Creek	3.3	1.16E-03
Cache Creek	16.4	5.79E-03
Colusa Basin Drain	0.3	1.16E-04
Consumnes River	0.3	1.16E-04
Coon Creek	6.6	2.31E-03
Cortina Creek	32.8	1.16E-02
Deer Creek (Tehama County)	0.3	1.16E-04
Deer Creek (Sacramento County)	0.3	1.16E-04
Dry Creek (Yolo County)	3.3	1.16E-03
Dry Creek (Yuba County)	6.6	2.31E-03
Eastside Cross Canal	6.6	2.31E-03
Elder Creek	0.3	1.16E-04
Feather River	3.3	1.16E-03
French Creek	3.3	1.16E-03
Freshwater Creek	16.4	5.79E-03
Funks Creek	3.3	1.16E-03
Glen Colusa Irrigation District Canal	0.3 – 3.3	1.16E-04 – 1.16E-03
Honcut Creek	3.3	1.16E-03
Little Chico Creek	3.3	1.16E-03
Lurline Creek	32.8	1.16E-02
Mill Creek (Eastern Tehama County)	3.3	1.16E-03
Mill Creek (Western Tehama County)	0.3	1.16E-04
Mokelumne River	0.3	1.16E-04
North Honcut Creek	3.3	1.16E-03
North Fork Walker Creek	0.3	1.16E-04
Paynes Creek	0.3	1.16E-04
Putah Creek	3.3	1.16E-03
RD108 Main Drain	3.3	1.16E-03
South Honcut Creek	3.3	1.16E-03
Sacramento River	0.3 – 3.3	1.16E-04 – 1.16E-03

TABLE 2
Assumed Streambed Vertical Hydraulic Conductivity
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Stream	Vertical Hydraulic Conductivity (foot/day)	Vertical Hydraulic Conductivity (centimeters/second)
Salt River	32.8	1.16E-02
San Joaquin River	3.3	1.16E-03
Sand Creek	6.6	2.31E-03
Seven Mile Creek	0.3	1.16E-04
South Fork Willow Creek	32.8	1.16E-02
Spring Valley Creek	16.4	5.79E-03
Stone Corral Creek	16.4 – 32.8	5.79E-03 – 1.16E-02
Stoney Creek	3.3 – 32.8	1.16E-03 – 1.16E-02
Sutter Bypass	0.3	1.16E-04
Lower Sycamore Slough	0.7	2.31E-04
Thermalito	3.3	1.16E-03
Thomes Creek	16.4	5.79E-03
Walker Creek	0.3	1.16E-04
Wilkins Slough Canal	3.3	1.16E-03
Willow Creek	32.8	1.16E-02
Wilson Creek	0.3	1.16E-04
Yolo Bypass	0.3	1.16E-04
Yuba River	3.3	1.16E-03

TABLE 3
Wetted Stream Width Values
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Stream Name	Wetted Stream Width (feet)
American River	394
Antelope Creek	49
Auburn Ravine	33
Bear River	91 – 167
Big Chico Creek	49
Butte Creek	43 – 144
Cache Creek	39 – 108
Colusa Basin Drain	24 – 100
	98
Coon Creek	49
Cortina Creek	33
Deer Creek (Tehama County)	66
Deer Creek (Sacramento County)	49

TABLE 3
Wetted Stream Width Values
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Stream Name	Wetted Stream Width (feet)
Dry Creek (Yuba County)	49
Dry Creek (Yolo County)	49
Eastside Cross Canal	49
Elder Creek	13 – 79
Feather River	233 – 758
French Creek	16
Freshwater Creek	33
Funks Creek	33
Glen Colusa Irrigation District Canal	43 – 242
Honcut Creek	49
Little Chico Creek	20 – 144
Lurline Creek	33
Mill Creek (Eastern Tehama County)	49
Mill Creek (Western Tehama County)	33
Mokelumne River	312
North Fork Walker Creek	33
North Honcut Creek	66
Paynes Creek	33
Putah Creek	61 – 95
RD108 Main Drain	65
Sacramento River	230 – 4,433
Salt River	16
San Joaquin River	3,248
Sand Creek	33
Sevenmile Creek	33
South Fork Willow Creek	33
South Honcut Creek	49
Spring Valley Creek	16
Stone Corral Creek	33
Stoney Creek	56 – 131
Sycamore Slough	10 – 115
Thomes Creek	49
Walker Creek	49
Wilkins Slough Canal	49
Willow Creek	33
Wilson Creek	33
Yuba River	230 – 356

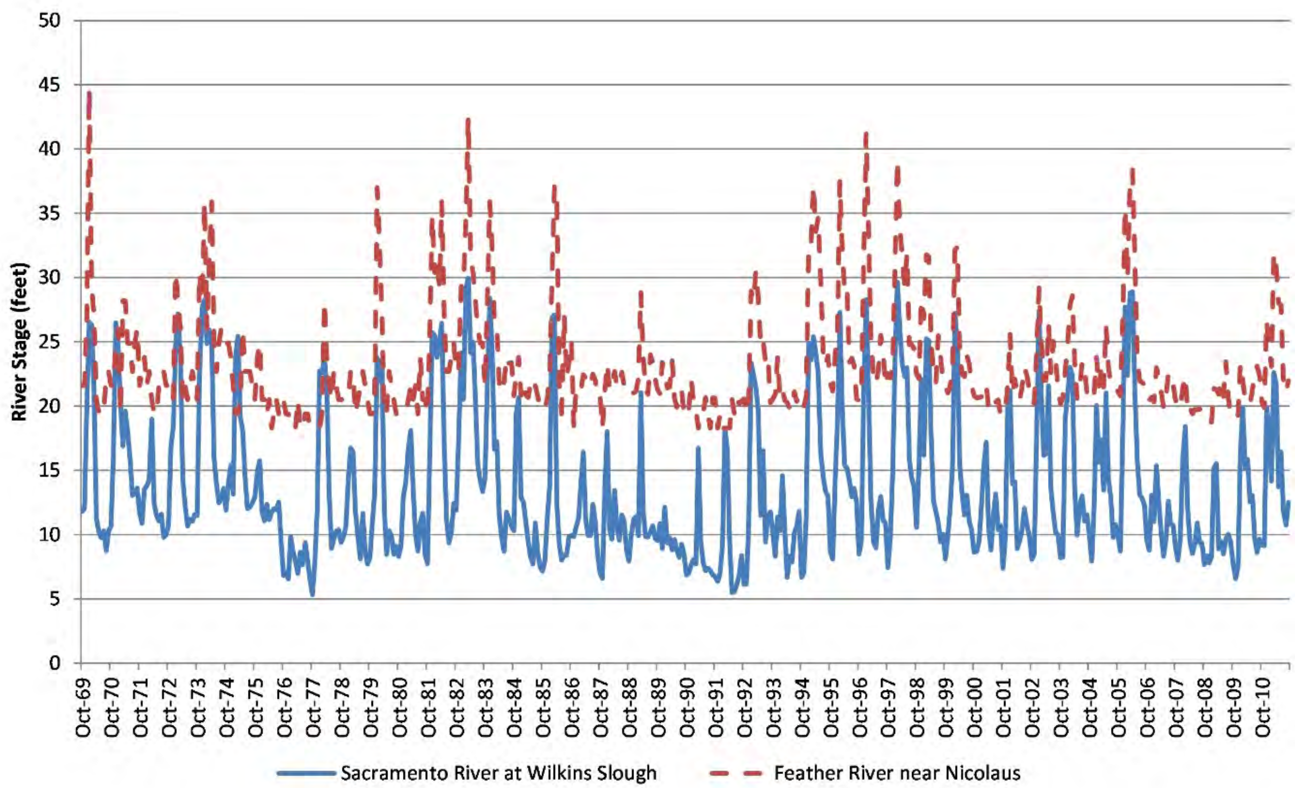

Figure 16
Historical Sacramento and Feather River Stage

SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

MBK ENGINEERS

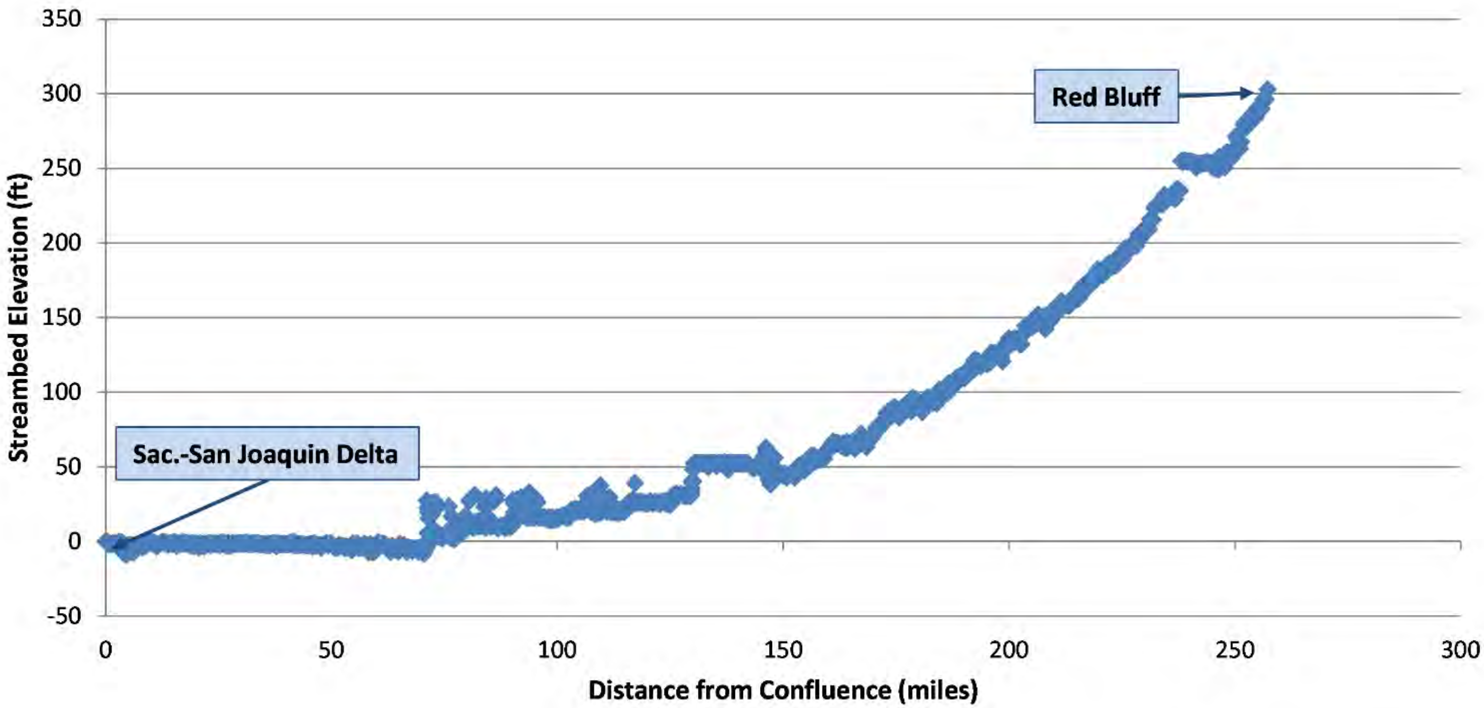

Figure 17
Initial Sacramento River Streambed Elevation based on 30-meter Digital Elevation Model Data
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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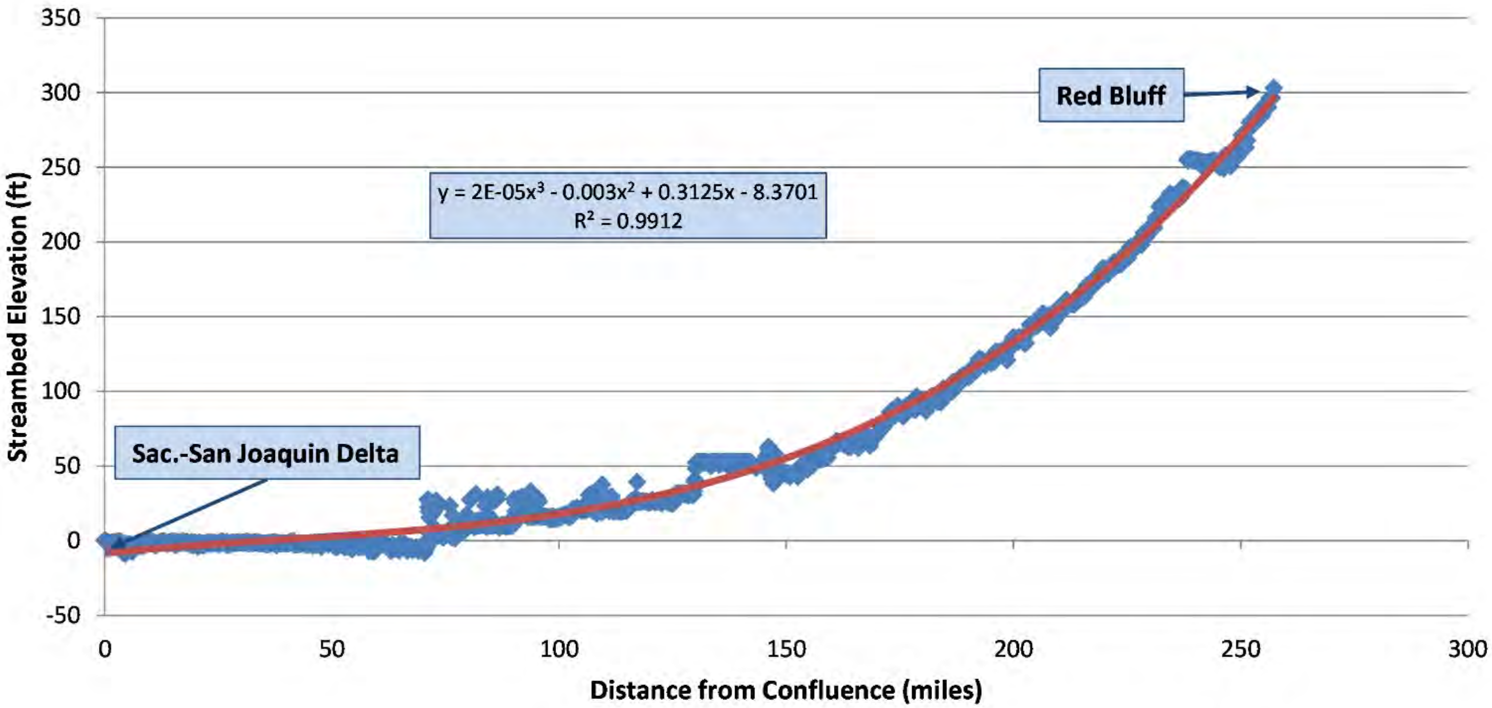

Figure 18
Sacramento River
Streambed Elevation based on Regression Trendline

SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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Ungaged Streams and Incomplete Records. Review of available stream stage and flow data identified available records for all or a part of the simulation period for 35 streams and canals explicitly represented in SACFEM2013. The remaining surface water features were estimated using data from nearby and similar gaged streams. The majority of ungaged streams are small streams on the west side of the Colusa Basin or small streams near the Bear River. Incomplete gage records were extended or missing periods filled by correlation with nearby and similar streams with complete records, when an adequate correlation could be developed. When an adequate correlation could not be developed, these streams were estimated based on nearby and similar gaged streams.

Stage along Length of Streams. Most gaged streams are gaged at only one location along the entire length of the stream. This information provides one data point on stream stage that must then be extended along the entire length of the stream for all stream nodes. Absent any additional data, it was assumed that depth of water at the gage location is uniform along the length of the stream. Multiple factors can affect stream stage along the length of the stream including watershed area contributing to flow, diversions and return flows from the stream, channel geometry, and others. Attempting to research and account for all such factors for each stream would be a significant undertaking beyond the scope of this project. Exceptions to this assumption are the Sacramento and Feather Rivers. Multiple gages for flow or stage exist along these two rivers, and these gages were used to develop SACFEM2013 inputs. Table 4 shows the gage data used to estimate stream depth along each river.

TABLE 4
Gage Locations Used to Estimate Sacramento and Feather River Stage
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Sacramento River Gages	Feather River Gages
Bend Bridge	Gridley
Colusa	Yuba City
Wilkins Slough	Nicolaus
Verona	
Freeport	

Water depth at stream nodes nearest gage locations was set equal to the gage record. Water depth at stream nodes between each gage location was interpolated based on stream distance. Water depths at stream nodes upstream of the most upstream gage (i.e., Bend Bridge on the Sacramento River and Gridley on the Feather River) were assumed to equal depth at the gage. Water depths in the Sacramento River downstream of Freeport were assumed to equal water depth at Freeport. Water depths in the Feather River between Nicolaus and the confluence with the Sacramento River were determined based on gage data at Nicolaus and the estimate of Sacramento River water surface elevation at the confluence as described in the following section.

Stream Confluences. An additional review was undertaken and adjustment was made where tributary streams join the Sacramento and Feather Rivers. In some streams and time-steps, WSE in tributary stream nodes at the downstream end of the stream was below the calculated WSE in the trunk stream where the tributary entered. For these tributary streams and time-steps, the WSE in the tributary stream nodes was set equal to the WSE in the trunk stream to represent a back-water effect at the confluence. This adjustment was made at each tributary stream node where the calculated WSE was less than that in the trunk stream for the given time-step.

Review and Quality Assurance. WSE inputs were calculated for each of the approximately 5,500 stream and canal nodes simulated in SACFEM2013 for each of the 492 model time-steps. A spreadsheet was developed to plot streambed and water surface elevation for a given stream and time-step as a method to review and check the input files. A plot for each time-step was created and saved for a given stream, and all plots were compiled into a single audio video interleave (AVI) file to illustrate stream WSE throughout the simulation period. AVI files were reviewed to ensure that input WSEs were reasonable and varied appropriately through time.

Figure 19 is an example of individual time-step plots for the American River WSE. Figure 19 illustrates WSE and the streambed in February 1986 during a large flood event, and August 1992 during a critical drought.

Figure 19 illustrates change in American River WSE for these two months. Figures such as these were developed for each time-step and reviewed to ensure WSE increased and decreased appropriately through time and relative to simulated streambed elevation. These figures also illustrate how WSE at the downstream end of the American River was adjusted based on the WSE in the Sacramento River in these time-steps. WSE at nodes in the downstream end of the American River is controlled by stage in the Sacramento River in both figures. WSE in these nodes was set equal to the WSE in the Sacramento River at the confluence with the American to represent back-water effects in the lower American River and avoid having adjacent stream nodes with significant differences in simulated WSE.

Representation of Flood Bypasses. A similar process was used to estimate water surface elevation within flood bypass areas in the SVGB. These areas differ from stream nodes in that the majority of nodes within the flood bypass areas are typically dry. However, during wet periods some or all of these nodes are flooded and represent a source of aquifer recharge in SACFEM2013.

Definition of Flood Bypass Areas. The first step in calculating WSE inputs in flood bypass areas was to delineate areas within the three major flood bypasses of the Butte Basin, Sutter Bypass, and Yolo Bypass. Each of these three major areas was further divided into sub-areas based on locations of major inflows or outflows. Existing GIS data on locations of levees and bypasses were used to identify bypass areas. Figure 20 illustrates the flood levee locations and the polygons used to represent the flood bypass areas and where those areas were subdivided.

After flood bypass areas were identified in GIS, bypass areas were intersected with the SACFEM2013 model grid to identify model nodes within bypass areas. This process identified 15,742 model nodes within bypass areas. Model ground surface elevation for these nodes was also identified based on 30-meter DEM data statistics for the area contributing to each node. The minimum elevation from the GIS intersection with DEM data was used as ground surface for nodes within bypass areas.

The approach to calculate WSE within flood bypass areas differs from that used for streams and other surface water features. An actual WSE was calculated based on historical flow data and flow-stage relationships from existing hydraulic models of the Sacramento River flood control system. Historical flow data were compiled from a variety of sources including USGS gage records and DWR's Water Data Library and California Data Exchange Center. Flows within bypass areas are from streams such as Butte and Cache Creeks plus flows over the Moulton, Colusa, Tisdale, Fremont, and Sacramento weirs. Flow goes over these weirs and into the bypass areas when stage is high in the Sacramento and Feather Rivers.

Flow was estimated at each of the lines that separate the flood bypass sub-areas on Figure 20. These separating lines represent cross section locations in the hydraulic model. For example, flow was estimated at the horizontal line that separates the upper Butte Basin area (BB1 Upper) from the middle Butte Basin area (BB2 Middle). Streams that contribute to flow in the upper Butte Basin area include Big and Little Chico creeks and Butte Creek. These flows were summed to estimate flow at the cross section between the upper and middle Butte Basin areas. Estimates of flow at downstream cross sections were made by adding additional inflows to the estimated flow at the upstream cross section. For example, flow at the cross section that separates the middle and lower Butte Basin (BB3 Lower) area was estimated by adding spills over the Moulton Weir to flows at the upstream cross section.

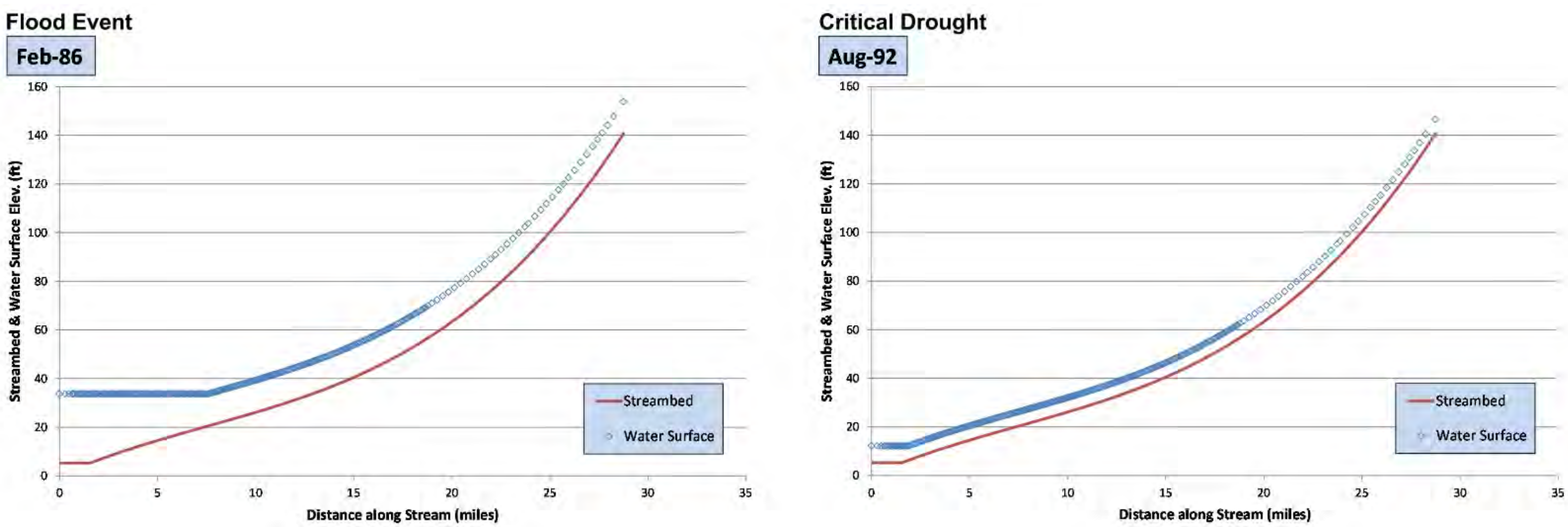


Figure 19
American River Water Surface Elevation during Flood Event and Drought
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

Flows at each cross section were used to calculate a WSE at the cross section. Flow-stage relationships from hydraulic models were used to estimate WSE with the same vertical datum as the ground surface in SACFEM2013. It was assumed that WSE changed linearly from upstream to downstream, and WSE at nodes between cross sections was interpolated from WSE at the upstream and downstream cross sections based on distance. WSE in the most upstream section, upper Butte Basin area (BB1 Upper), and most downstream section, lower Yolo Bypass (YB4 Lower), was assumed to be constant. This assumption is reasonable for the lower Yolo Bypass where flow enters the Sacramento-San Joaquin Delta. This assumption was made for the upper Butte Basin because there is little data to estimate inundated areas.

Calculated WSE was compared to ground surface elevation for each node to determine if the node was flooded. Some nodes within flood bypass areas are at higher elevation and may not flood at the same time as lower elevation nodes. WSE is calculated only for nodes that are flooded during a given time-step. Nodes that are not flooded are identified with a WSE of "-99" in the input files.

Review and Quality Assurance. WSE inputs are calculated for each of the 15,742 model nodes located within flood bypass areas for each of the 492 model time-steps. A spreadsheet was developed to plot WSE for all bypass area nodes compared to ground surface to review and check input files in each time-step. These plots were saved and compiled into a single AVI file to allow for easier review. Figure 21 is an example of one plot for the January 1995 time-step when most of the flood bypass areas were flooded.

Figure 21 is a plot of ground surface and WSE for each of the 15,742 model nodes in January 1995. The x-axis is the northing, so that the left side of the plot illustrates the downstream end of the flood bypass areas, the lower Yolo Bypass, and the right side illustrates the upstream end or upper Butte Basin. Cross sections are denoted by the black vertical lines that also mark changes in slope in the WSE line. Multiple ground surface elevations for a given northing indicate the multiple model nodes in the east-west direction across the flood bypass area. In the lower Yolo Bypass, many nodes have ground surface elevations above the WSE in this time-step and are not flooded. This is consistent with the topography of the lower Yolo Bypass where areas on the western side of the bypass are at higher elevation and flood less frequently than the eastern side.

Reservoir Water Surface Elevation. The final surface water bodies simulated in SACFEM2013 using MicroFEM's wadi package are the major reservoirs located within the interior of the SVGB, Black Butte Reservoir and Thermalito Afterbay. The lake bottom elevations were assumed to be constant for both reservoirs, and were simulated as 100 feet below the average DEM elevation (assumed to represent lake stage) for Black Butte Reservoir and 40 feet below the average DEM elevation for Thermalito Afterbay. The wc1 values were assumed to be 1 for both reservoirs. The lake-stage elevation was assumed to be constant spatially across each reservoir; however, historical data were evaluated to develop monthly-variable lake-stage datasets for the SACFEM2013 simulation period.

Groundwater Discharge to Land Surface. MicroFEM's drainage package was used to simulate boundary conditions across the top surface of the model, excluding nodes where wadi boundaries exist. Drainage boundary conditions are one-way head-dependent boundaries that allow the transfer of water out of the model domain only. The elevation of the drain boundaries were set at the land surface. The drain boundaries were included in the model to represent a combination of surficial processes that occur in areas of shallow groundwater, including evapotranspiration and groundwater discharge to the surface. Additionally, specific streams and flood bypasses were converted from wadi boundary conditions to drain boundary conditions during periods when a given surface water body was interpreted as being dry.

Groundwater discharge to a drain is simulated as follows if h1 > dh1:

$$Q_{outflow} = a * (h1 - dh1) / dc1 \quad (7)$$

Where:

Q = volumetric flux (L^3/T)
a = nodal area (L^2)
h1 = simulated groundwater elevation in model layer 1 (L)
dh1 = simulated drainage boundary elevation (L)
dc1 = resistance of the drainage boundary (T^{-1})

Groundwater discharge to a drain is simulated as follows if h1 < dh1:

$$Q_{outflow} = 0 \quad (8)$$

The parameter dc1 represents the drain conductance and is a measure of the resistance to flow across the drain boundary. The dc1 was assumed to be 500 throughout the model domain.

3.2.4.2 Specified-flux Boundaries

Three sets of specified-flux boundary conditions were implemented in the SACFEM2013 model. These conditions are as follows: (1) deep percolation of applied water and precipitation along with agricultural pumping, (2) mountain-front recharge, and (3) urban pumping. Each is discussed in more detail below.

Deep Percolation of Applied Water, and Precipitation and Agricultural Pumping. The first set of specified-flux boundary conditions reflects the deep percolation of precipitation and applied water across the Valley, as well as the regional agricultural pumping. The deep percolation flux values were applied to every surface node in the model. The pumping stresses due to agricultural pumping were applied at selected locations in model Layers 2 through 4 (the depths of the regional producing zones across the Valley). The spatial distribution and magnitudes of these fluxes were derived from the surface water budget calculations described in full detail in the Surface Water Budget, Section 3.2.5.

Mountain-front Recharge. The second set of specified-flux boundary conditions represents the subsurface inflow of precipitation falling within the Sacramento River watershed but outside the extent of the model domain. To estimate these flux values, the USGS 30-meter DEM along with GIS-based hydrography coverages for the SVGB were used to delineate the drainage areas that are tributary to the model domain but fall outside of the watersheds of the streams explicitly represented in the model. It is these areas that can contribute water to the model domain but are not accounted for in the wadi boundary conditions defined in the model. After the extents of these watershed areas were defined, they were intersected with monthly PRISM[4] rainfall datasets using GIS tools, and the volume of precipitation falling on the watershed was computed. Using the computed total volume of precipitation, the deep percolation to the groundwater system was calculated using the following empirical relationship developed by Turner (1991):

$$DP = (PPT-2.32)*(PPT)^{0.66} \quad (9)$$

Where:

DP = average annual deep percolation of precipitation (inches per year)
PPT = annual precipitation (inches per year)

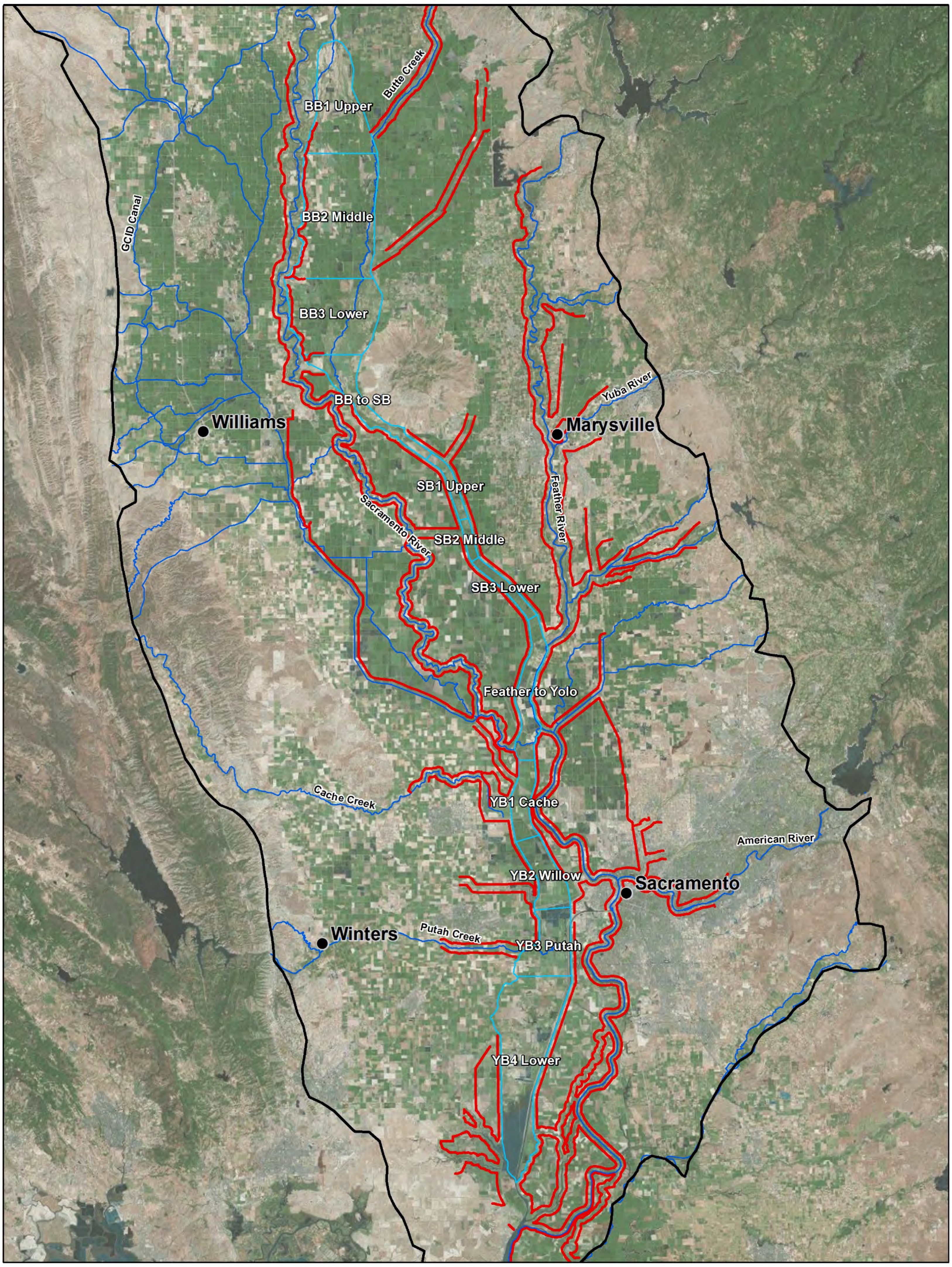
The process that was used to estimate the quantity of subsurface inflow, otherwise known as mountain-front recharge, is summarized as follows:

[4] http://prism.oregonstate.edu/

1. The area of each drainage basin tributary to the model domain that is not represented by streams explicitly simulated in SACFEM2013 was computed using a GIS-based analysis of the land surface topography. The extent of these smaller watersheds is shown on Figure 22.
2. Each drainage area polygon was then intersected with a GIS coverage of annual total rainfall estimated using the PRISM model for each year of the simulation period. This distribution of annual average rainfall was then used to calculate the total volume of rainfall falling on the small watershed areas, and an overall average rainfall rate was computed (inches per year).
3. The total annual rainfall rate was then used to compute a deep percolation quantity using the relationship between annual rainfall and deep percolation rate developed by Turner (1991) and described above.
4. The annual volume of deep percolation computed in Step 3 was then converted into monthly values that were based on the monthly distribution of streamflow measured in ungaged sections of Deer Creek (Table 5). These monthly deep percolation quantities were then introduced at the model domain boundary of each small watershed polygon using injection wells into Layer 1. The quantity applied to each model boundary node was proportional to boundary length of each element divided by the total boundary length of the drainage polygon.
5. The deep percolation rates for individual drainage basins were adjusted during SACFEM2013 calibration to improve the match between simulated and measured groundwater elevations. Final factors applied to the deep percolation rates range from 0.5 to 1.5 (Table 6).

TABLE 5
Monthly Distribution of Total Annual Mountain Front Recharge
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Month	Percentage of Annual Mountain Front Recharge (%)
January	14.2
February	15.2
March	15.4
April	13.6
May	10.3
June	5.1
July	3.1
August	2.6
September	2.4
October	3.0
November	4.9
December	10.2



LEGEND

- City
- Major Stream
- Flood Bypass
- Levee
- SACFEM2013 Model Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 20
Flood Bypass Areas and Subareas
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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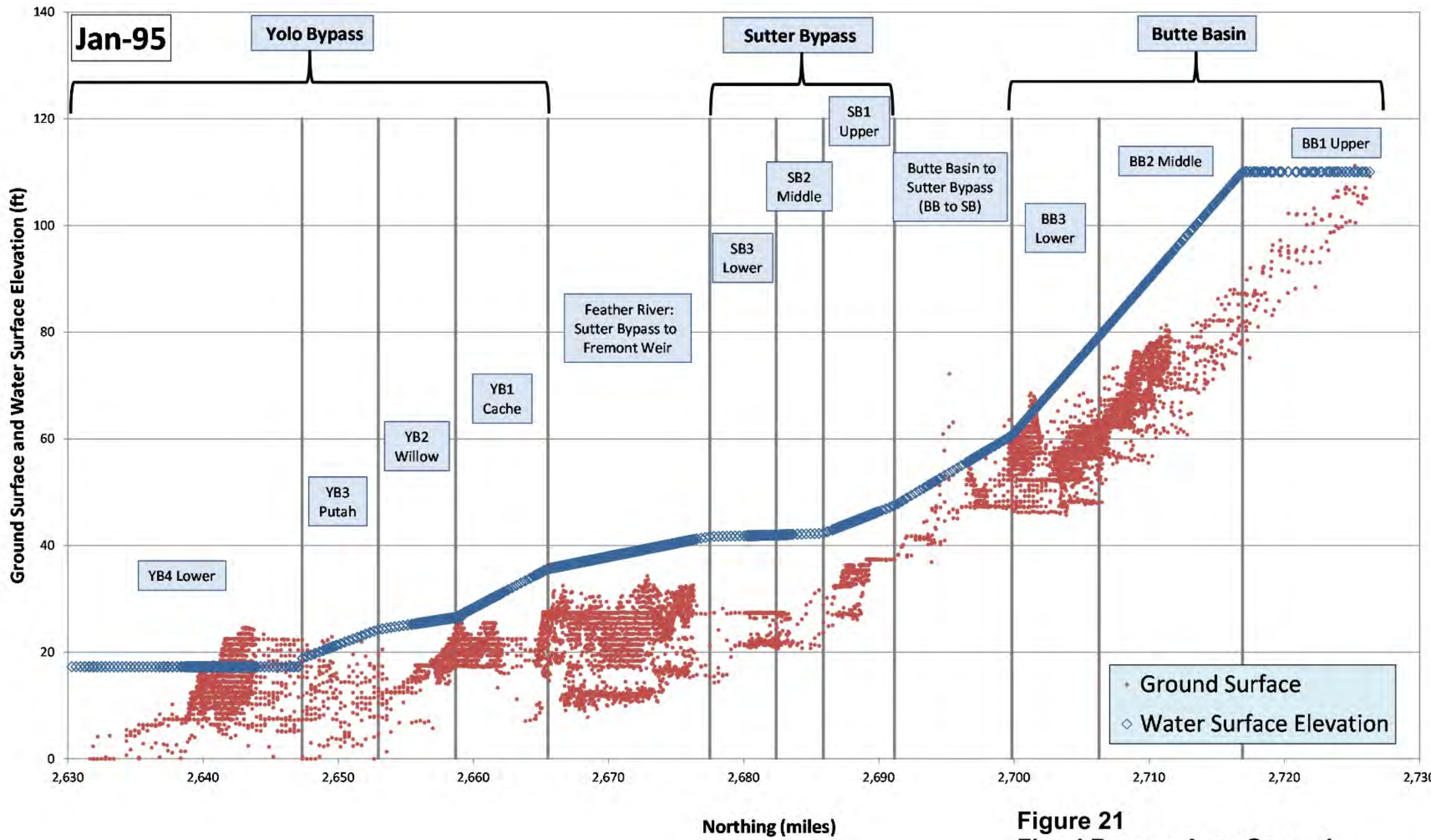

Figure 21
Flood Bypass Area Ground Surface and Water Surface Elevation
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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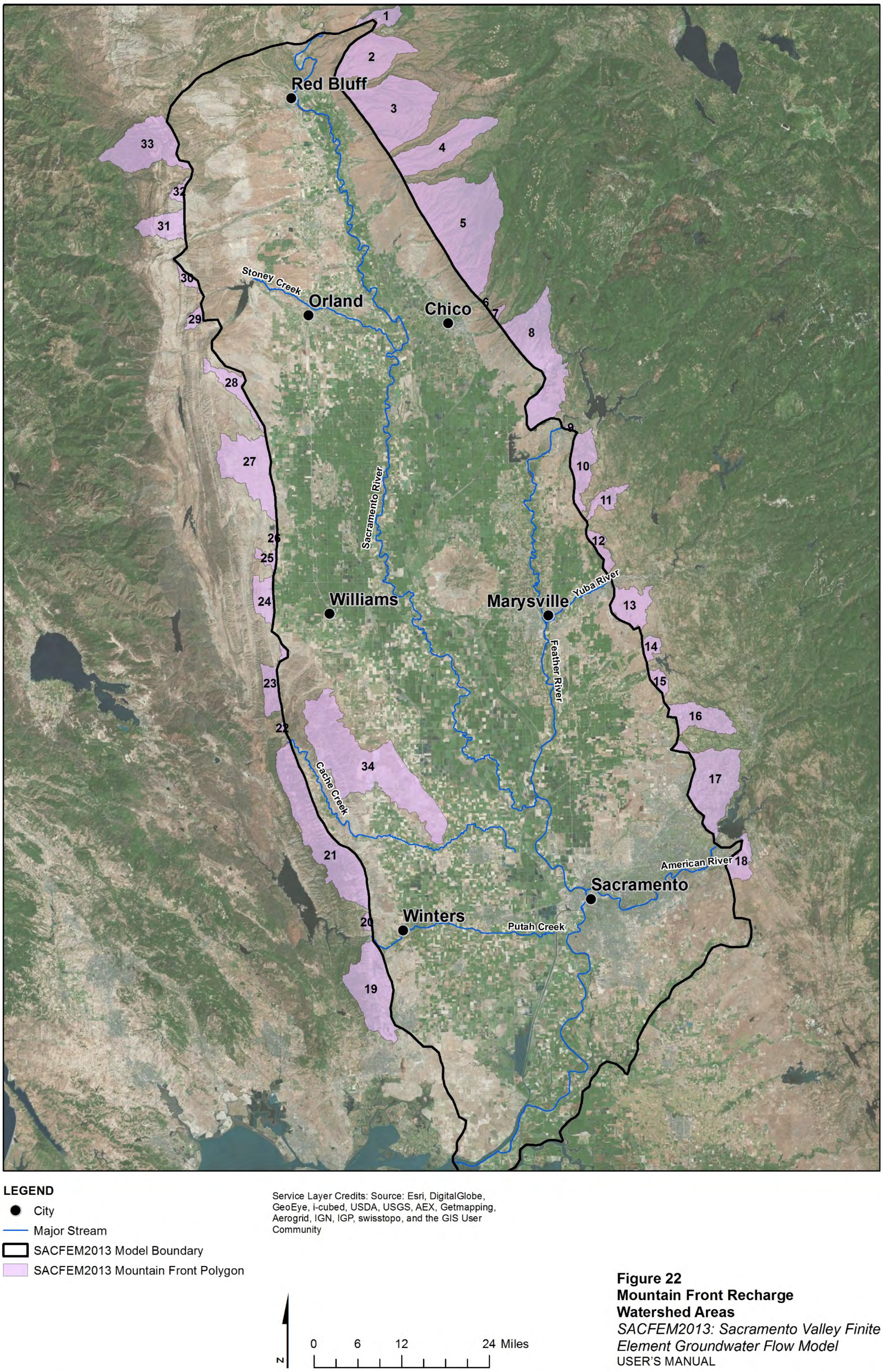

Figure 22
Mountain Front Recharge Watershed Areas
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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TABLE 6
Mountain Front Recharge Adjustment Factors
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Sub-watershed Number	Adjustment Factor	Sub-watershed Number	Adjustment Factor
1	0.5	18	0.5
2	0.5	19	1.5
3	0.5	20	1
4	0.5	21	1
5	0.5	22	1.5
6	1	23	1.5
7	1	24	1
8	1	25	1
9	1	26	1
10	1	27	1
11	1	28	1
12	1	29	1
13	1	30	1
14	1.5	31	1
15	1.5	32	1
16	1.5	33	1
17	0.5	34	1

Urban Pumping. The final set of specified-flux boundary conditions applied in the SACFEM2013 model reflects urban pumping within the model domain. The distribution of agricultural pumping that was developed using the surface water budgeting methodologies described below does not include urban pumping. As a first step to estimate the quantity of urban pumping to apply to the model, the year 2010 U.S. Census[5] data were evaluated. Each municipal area with a population greater than 5,000 that used groundwater as a source of municipal supply was further assessed. For municipalities where urban water management plans were available, the reported annual groundwater use was simulated in SACFEM2013. For cities that do not have a current water management plan, a pumping volume that was based on an annual average per capita value of 271 gallons/capita/day was simulated. Further, municipalities in the northern Sacramento area pumping rates were assigned consistent with the SacIGSM model (WRIME, 2011). Table 7 presents the annual urban pumping volumes included in SACFEM2013. Urban pumping was assigned spatially to all SACFEM2013 nodes within a given city area and was apportioned equally to model Layers 2 through 4. Figure 23 presents the locations of municipalities and SacIGSM subareas included in SACFEM2013. The monthly variability in urban pumping quantity was distributed based on typical seasonal trends for municipal water use listed in Table 8.

[5] http://www.census.gov/2010census/

TABLE 7
Urban Pumping
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Urban Area	SACFEM2013 Pumping Volume (acre-feet/year)	Source
Beale Air Force Base	401	Per Capita Estimate (census 2010)
Chico	26,800	2010 Urban Water Management Plan
Colusa	1,814	Per Capita Estimate (census 2010)
Corning	2,328	Per Capita Estimate (census 2010)
Davis	11,955	2010 Urban Water Management Plan
Dixon	5,575	Per Capita Estimate (census 2010)
Durham	1,676	Per Capita Estimate (census 2010)
Elk Grove	46,484	Per Capita Estimate (census 2010)
Florin	14,434	Per Capita Estimate (census 2010)
Gold River	2,404	Per Capita Estimate (census 2010)
Gridley	2,000	Per Capita Estimate (census 2010)
La Riviera	3,282	Per Capita Estimate (census 2010)
Lincoln	962	2010 Urban Water Management Plan
Linda	5,399	Per Capita Estimate (census 2010)
Live Oak	5,212	Per Capita Estimate (census 2010)
Marysville	2,365	2010 Urban Water Management Plan
Olivehurst and Plumas Lake	2,900	2010 Urban Water Management Plan
Orland	2,215	Per Capita Estimate (census 2010)
Oroville	0	Urban Water Management Plan
Palermo	0	Urban Water Management Plan
Parkway, Fruitridge, and Lemon	10,389	Per Capita Estimate (census 2010)
Rancho Cordova	19,678	Per Capita Estimate (census 2010)
Red Bluff	4,276	Per Capita Estimate (census 2010)
Rio Vista	2,420	2010 Urban Water Management Plan
Rocklin	0	2010 Urban Water Management Plan for Placer Co. Water Agency
Rosemont	6,890	Per Capita Estimate (census 2010)
Roseville	0	Urban Water Management Plan
Sacramento	0	
South Oroville	1,744	Per Capita Estimate (census 2010)
Thermalito	2,019	Per Capita Estimate (census 2010)
University of California Davis	1,758	Per Capita Estimate (census 2010)

TABLE 7
Urban Pumping
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Urban Area	SACFEM2013 Pumping Volume (acre-feet/year)	Source
Vacaville	6,500	2010 Urban Water Management Plan
Vineyard	7,545	Per Capita Estimate (census 2010)
West Sacramento	14,808	Per Capita Estimate (census 2010)
Williams	1,556	Per Capita Estimate (census 2010)
Willows	1,937	2010 Urban Water Management Plan
Winters	2,012	Per Capita Estimate (census 2010)
Woodland	13,921	2010 Urban Water Management Plan
Yuba City	3,600	2005 Urban Water Management Plan
North Sacramento SacIGSM Subarea		
Cal-AmAntelope	3,784	SacIGSM (1970-2004 average)
Cal-AmLincolnOaks	8,092	SacIGSM (1970-2004 average)
CarmichaelWD	4,524	SacIGSM (1970-2004 average)
CitrusHeightsWD	3,202	SacIGSM (1970-2004 average)
CityOfFolsom	142	SacIGSM (1970-2004 average)
CityOfSacramentoEast	16,845	SacIGSM (1970-2004 average)
CityOfSacramentoWest	8,917	SacIGSM (1970-2004 average)
FairOaksWD	1,516	SacIGSM (1970-2004 average)
McClellanPark	3,634	SacIGSM (1970-2004 average)
Natomas Unorganized	2,488	SacIGSM (1970-2004 average)
NatomasMWC East	1,650	SacIGSM (1970-2004 average)
NatomasMWC West	1,953	SacIGSM (1970-2004 average)
OrangevaleWC	773	SacIGSM (1970-2004 average)
Rio Linda North	4,873	SacIGSM (1970-2004 average)
Rio Linda South	4,478	SacIGSM (1970-2004 average)
SacIntlAirport	3,670	SacIGSM (1970-2004 average)
SacramentoSuburbanTownAndCountry	27,164	SacIGSM (1970-2004 average)
SacSuburbanNorthHighlands	5,559	SacIGSM (1970-2004 average)
SacSuburbanNorthridge	14,318	SacIGSM (1970-2004 average)
SanJuanWD	527	SacIGSM (1970-2004 average)

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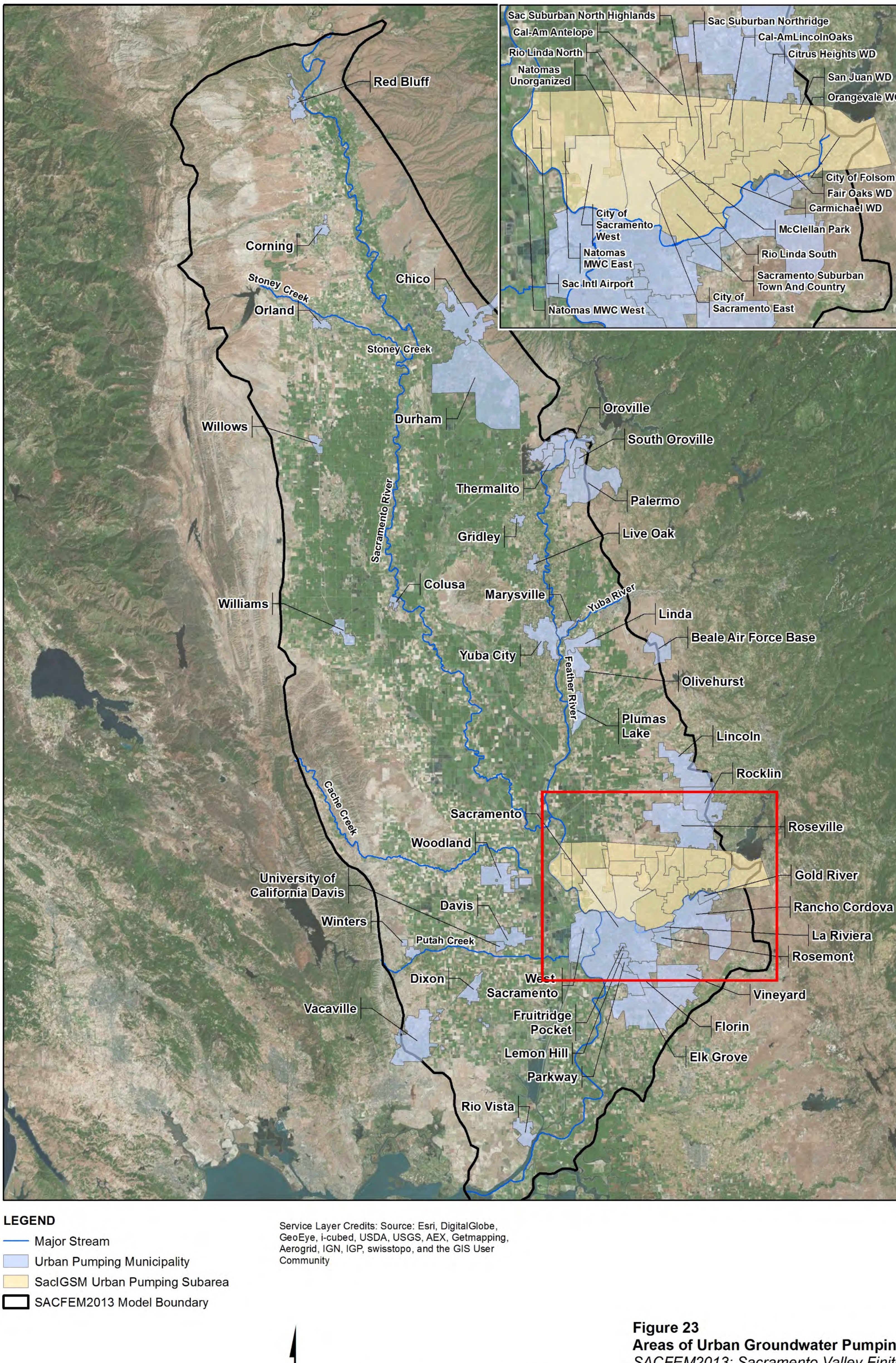

Figure 23
Areas of Urban Groundwater Pumping
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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TABLE 8
Monthly Distribution of Annual Urban Pumping
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Month	Percentage of Annual Total Urban Pumping
January	4.6
February	4.6
March	4.6
April	6.1
May	6.1
June	10.9
July	14.8
August	15.3
September	13.1
October	10.7
November	4.6
	4.6

3.2.4.3 No-flow Boundaries

A no-flow boundary was specified across the bottom boundary of the model, representing the freshwater/ brackish water interface.

3.2.5 Agricultural Water Budget

One of the most critical components to the successful operation of the SACFEM2013 is computing transient agricultural water budget components. These water budget components were estimated by using a variety of spatial information including land use, cropping patterns, source of irrigation water, surface water availability in different year types and locations, and the spatial distribution of precipitation. Surface water budget components include deep percolation of applied water, deep percolation of precipitation, and agricultural pumping.

3.2.5.1 Background and Approach

A root-zone model was used to calculate agricultural water budgets and determine two major fluxes for input to SACFEM2013; deep percolation of precipitation and applied agricultural water and agricultural groundwater pumping. The root-zone model simulates the movement of irrigation water and precipitation that infiltrates below ground surface and into the root-zone where water is either used by plant evapotranspiration or drained as deep percolation when moisture content exceeds soil holding capacity.

3.2.5.2 Overview of the Method

Root-zone dynamics are simulated using the Integrated Water Flow Model Demand Calculator (IDC) developed by DWR's Bay Delta Office. IDC calculates agricultural demand for applied water based on soil parameters and crop water use, and routes infiltrated applied water and precipitation through the soil column to determine evapotranspiration, deep percolation, and soil moisture storage. An approach was developed to create the needed inputs for SACFEM2013 without simulating the entire SACFEM2013 model domain and grid in IDC. This approach involved simulating root-zone water balances for one unit acre of land for each unique combination of crop type, soil, and historical precipitation throughout the SVGB. This process provides a time-series of deep percolation and demand for applied water. These unit-area time-series are applied to uniquely classified areas developed in GIS to calculate time-series of deep percolation and agricultural groundwater pumping for each node.

3.2.5.3 Development of GIS Dataset

A GIS dataset that contains information on crop type, soils, water source, and geographic location (used to determine the availability of surface water) was developed from a variety of sources. These datasets are intersected with the SACFEM2013 model grid to provide detailed data for the agricultural water budget for each SACFEM2013 model node. The following sections describe the source of data compiled in the GIS dataset.

Land Use. DWR's Land and Water Use Program historically conducted land use surveys of major agricultural counties throughout the state every 5 years. These data are in geo-referenced shapefiles that provide land use at approximately the field level. The most recent surveys of counties within the SACFEM2013 model domain were combined to create a single shapefile.

SACFEM revisions in 2011 included updates to land use data for Glenn and Colusa Counties. These data were developed by Davids Engineering based on multiple sources including DWR land use surveys conducted in 2003, U.S. Department of Agriculture, Glenn County, local water districts, and field surveys by Davids Engineering in 2010 (Davids Engineering, Inc., 2011).Table 9 provides the source and survey year for the land use data of each county within the SACFEM2013 model domain. Land use data were from the most recent surveys available in 2011.

TABLE 9
Land Use Data Source and Year by County
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

County	Land Use Source, Survey Year
Butte	DWR, 2004[a]
Colusa	DWR, 2003[a] and Davids Engineering, 2010[b]
Glenn	DWR, 2003 and Davids Engineering, 2010[b]
Placer	DWR, 1994[a]
Sacramento	DWR, 2000[a]
Solano	DWR, 1994[a]
Sutter	DWR, 2004[a]
Tehama	DWR, 1999[a]
Yolo	DWR, 1997[a]
Yuba	DWR, 1995[a]

Notes:
[a] California Department of Water Resources land use survey data downloaded from http://www.water.ca.gov/landwateruse/lusrvymain.cfm
[b] Davids Engineering land use data from Davids Engineering, Inc. (2011)

Land use data are aggregated into 20 categories with 16 agricultural crop types, native vegetation, urban areas, bare soil, and water bodies. Figure 24 illustrates the distribution of land use data across the different categories used in SACFEM2013, minus urban areas and water bodies that are not included in the agricultural water budgets. The SACFEM2013 model domain covers approximately 3.6 million acres of land on the Sacramento Valley floor. The largest single land use category within the SACFEM2013 model domain is native vegetation. The largest agricultural crop type is rice.

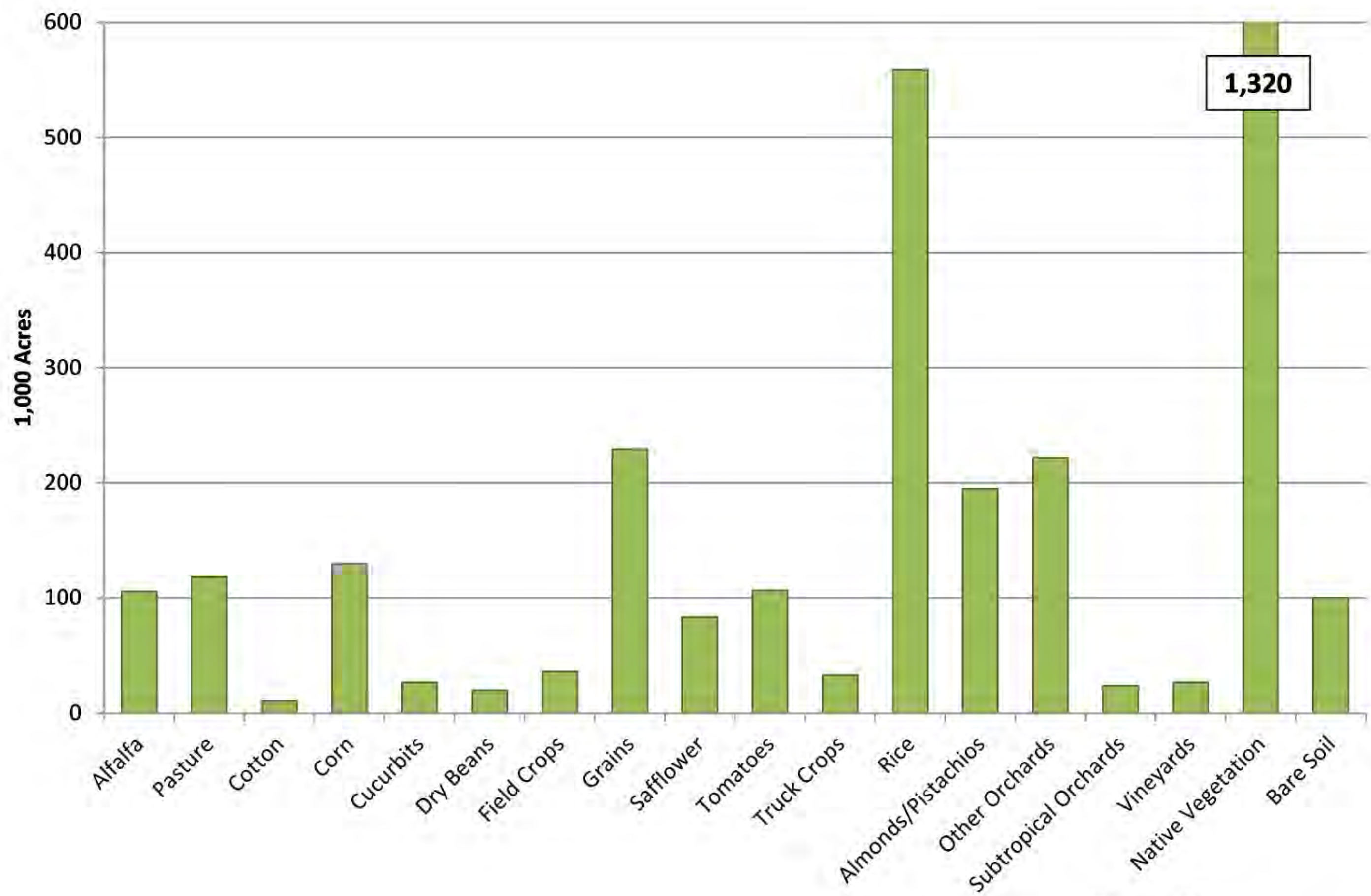

Figure 24
SACFEM2013 Land Use Data
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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Water Source. DWR's land use surveys typically include information on the source of water used for irrigation. Survey data classify the water source as either surface water, groundwater, mixed, or unknown. Water source data are included in the land-use dataset developed for agricultural water budgets and used in calculating agricultural groundwater pumping as described in subsequent sections.

Soils Data. The land use and water source data were joined with hydrologic soils group data from the Natural Resource Conservation Service Soil Survey Geographic (SSURGO) database. The hydrologic soils group characterizes soils and classifies them into four groups (A through D) based on transmission rate of water, texture, structure, and runoff response. Hydrologic soils group data are used to determine inputs to IDC, specifically soil parameters that determine the potential for rainfall or applied water to infiltrate the root zone.

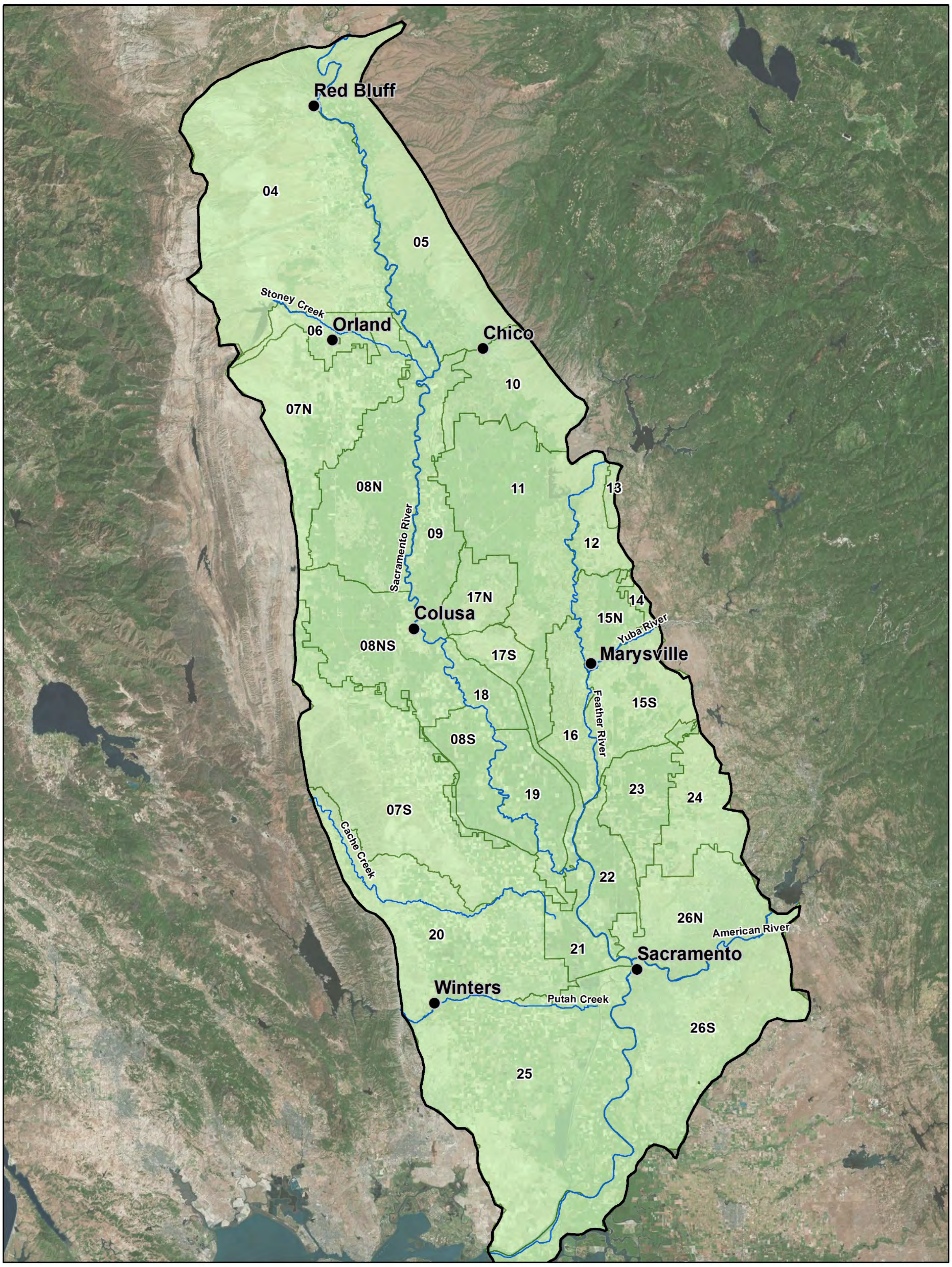
Water Budget Areas. Land use, water source, and soils data are then joined with boundaries of water budget areas (WBAs) within the SVGB. The SVGB was previously disaggregated into WBAs for the purpose of developing water budgets and inputs to other models such as CALSIM III. WBAs were defined by irrigation district boundaries, historical planning areas such as DWR's depletion study areas, and physical boundaries such as rivers, creeks, or canals. WBAs are areas wherein availability and source of water, climate, and other factors that govern water use are similar. WBAs are used to determine IDC inputs for precipitation and availability of surface water as described in subsequent sections. Figure 25 shows how the entire SACFEM2013 model domain is split into various WBAs.

Land Use Data by SACFEM2013 Node. Lastly, the combined data on land use, soils, WBAs, and water source were intersected with the SACFEM2013 model grid and resulting areas for each component were calculated. The result of this final process is a dataset that defines the land use, soils, and WBA of areas that contribute to all of the SACFEM2013 model nodes. There are multiple records for many nodes (that is, the area of a given model node intersects multiple land use, soils, WBA, or water source categories). As such, the final dataset approaches a half million unique records. Acreages in this dataset were combined with unit-area time-series from IDC on deep percolation and applied water demand (AWD) to develop time-series of deep percolation and agricultural groundwater pumping at each node for the SACFEM2013 period of simulation. Figure 26 illustrates the five data sets that are combined in the final GIS data set.

3.2.5.4 IDC Model Inputs

The GIS dataset is combined with unit-area time-series from IDC to calculate SACFEM2013 input. IDC was set up to simulate 1-acre areas for each unique combination of land use, soils, and precipitation. These three factors affect simulation of the root zone and the resulting deep percolation and AWD. IDC simulation of the root-zone was performed on a daily time-step. A daily time-step was appropriate for determining rainfall infiltration, and provides a more accurate calculation of AWD compared to using a weekly or monthly time-step. The following sections describe the source of data used as input to IDC. Additional detail on the computational methods and theory within IDC can be found in the documentation and users' manual (DWR, 2014).

Precipitation. Daily rainfall records from seven stations were collected from the National Climatic Data Center maintained by the National Oceanic and Atmospheric Administration and California Data Exchange Center maintained by DWR. Some WBAs are located between these seven stations and, for these areas, an average of two stations was used. The result of this analysis was a total of 12 different precipitation time-series comprising the seven stations and five averaged time-series from two different stations. Table 10 summarizes the 12 precipitation time-series and associated WBAs. The seven precipitation stations are also shown on Figure 25 in relation to associated WBAs.



LEGEND

- City/Precipitation Station
- Major Stream
- Water Budget Area
- SACFEM2013 Model Boundary

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 25
Water Budget Areas
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

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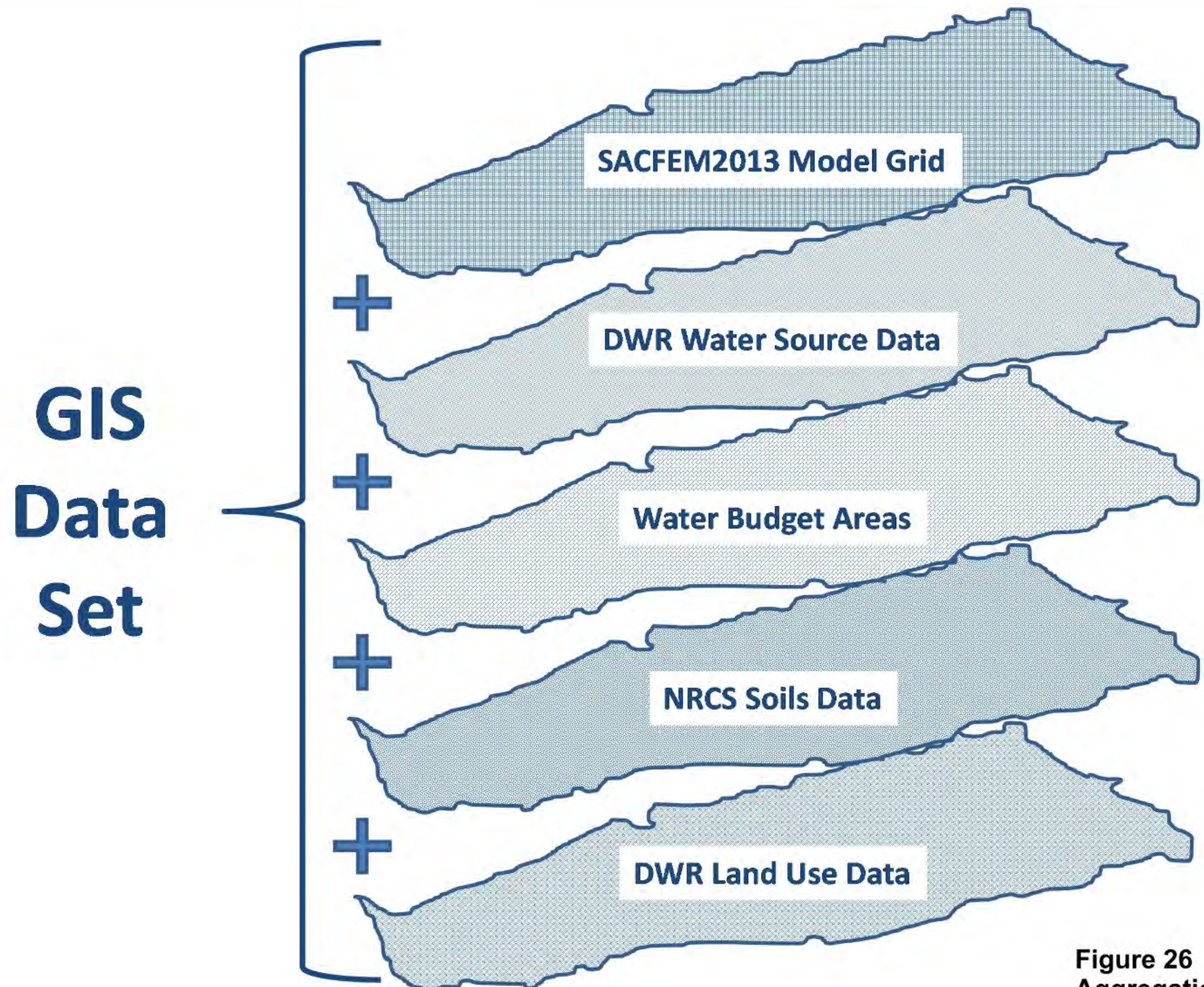

Figure 26
Aggregation of GIS Datasets for Agricultural Water Budgets
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL
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TABLE 10
Precipitation Stations and Associated Water Budget Areas
SACFEM2013, Sacramento Valley Finite Element Groundwater Model, User's Manual

Time-Series	Precipitation Station(s)	Associated WBA(s)
1	Red Bluff	4, 5
2	Orland	6, 7N
3	Chico	10
4	Colusa	7S, 8NS, 17N, 17S, 18
5	Marysville	14, 15N, 15S, 16
6	Winters	20, 25
7	Sacramento	21, 22, 26N
8	Avg. Orland & Colusa	8N
9	Avg. Chico & Colusa	9
10	Avg. Chico & Marysville	11, 12, 13
11	Avg. Colusa & Winters	8S
12	Avg. Marysville & Sacramento	19, 23, 24

Evapotranspiration. Monthly evapotranspiration (ET) values used in IDC were developed from data published by the Irrigation Training and Research Center at California Polytechnic State University (ITRC, 2003). ITRC published crop ET values for wet, typical, and dry years for reference ET zones throughout California. The majority of the SVGB is within ITRC zones 12 and 14, and an average crop ET value from these two zones was used in IDC. Therefore, crop ET values used in IDC do not vary spatially throughout the model, but can vary by year for three different year-types of wet, typical, and dry. The Sacramento Valley Water Year Type (40-30-30) Index was used to determine the year-type with above normal and below normal 40-30-30 Index years being defined as typical, dry, and critical 40-30-30 Index years defined as dry, and wet 40-30-30 Index years defined as wet.

Soil Parameters. IDC inputs for soil parameters include field capacity, wilting point, total porosity, pore size distribution index, and saturated hydraulic conductivity. These parameters are used in IDC to characterize the movement of water in the root zone. Soil parameters used in IDC were determined in part by hydrologic soils group and land use. A range of magnitudes covering the classifications of the hydrologic soils group were determined and applied in IDC. Values for rice and native vegetation land uses typically differed from non-ponded crops. For example, it was assumed that rice was grown on soils with lower saturated hydraulic conductivity and a higher field capacity than soil used to grow other crops.

Crop Parameters. An irrigation season is input to IDC for each irrigated crop. The irrigation season flag is used to determine months when AWD is calculated. Most crops are irrigated starting in March or April and continuing through August, September, or October. AWD is not calculated outside of these months. Additionally, rice includes an AWD for cultural practices that flood fields to suppress weed growth and decompose rice straw. The timing and quantity of applied water for spring flood-up and fall decomposition used in IDC is representative of practices in the Sacramento Valley.

A second parameter input to IDC for simulation of the root-zone is the rooting depth for each crop and for native vegetation. Rooting depth, in combination with inputs such as field capacity, is used to determine soil moisture storage capacity. Soil moisture storage affects deep percolation and applied water demand and crops with shallower rooting depths may have more deep percolation because there is less capacity to water in the root zone.

Surface Runoff. IDC uses a modified version of the Natural Resource Conservation Service (previously the Soil Conservation Service) curve number method to simulate rainfall runoff and infiltration of precipitation. The curve number method is described in Technical Reference number 55 and the National Engineering

Handbook (USDA, 2004). A curve number is determined from land use and soil type. IDC uses the curve number in combination with antecedent soil moisture conditions to determine the portion of precipitation that runs off versus infiltrates into the soil.

3.2.5.5 Calculation of SACFEM2013 Inputs

Time-series of output for deep percolation and AWD from IDC for unit-acres of each unique land use and soil type were combined with the GIS dataset for each model node in SACFEM2013. Python scripts were used to calculate time-series of deep percolation and groundwater pumping inputs for each model node. The following sections describe the process used for each input.

Deep Percolation. Output from IDC is a time-series of deep percolation per unit-acre for each unique combination of land use, soil type, and precipitation (indicated by associated WBA). The GIS dataset contains records for all agricultural and native vegetation areas that contribute to each model node. The GIS dataset includes identifiers for WBA, land use, and soil type that are used by the Python script to reference the correct output time-series from IDC and calculate the deep percolation for each node as the sum of the deep percolation for individual areas that contribute to each node. Figure 27 is an example of the calculation performed for an individual node and time-step.

Agricultural Groundwater Pumping. Time-series of groundwater pumping were developed for each SACFEM2013 model node based on land use data, water source data, and surface water availability for areas that contribute to each SACFEM2013 node. Calculated groundwater pumping is based on AWD of the crop as calculated in IDC. A similar process as illustrated on Figure 27 is performed to calculate the AWD for each node. Several additional steps are then performed to calculate agricultural groundwater pumping.

Groundwater pumping for areas identified as being met from groundwater in DWR surveys is the AWD (AWDgw). This is one component of agricultural groundwater pumping calculated for each node in SACFEM2013. For areas met from non-groundwater sources (surface, mixed, or unknown), groundwater pumping is calculated as AWD for the area not identified as met from groundwater in DWR surveys (AWDnon-gw) multiplied by a pumping percentage. The pumping percentage is used to estimate pumping when surface water supplies are not adequate to meet the AWD, such as during drought periods. This is the second component of agricultural groundwater pumping in SACFEM2013. Total groundwater pumping for a node is the sum of these two components, as shown in Equation 10.

$$Groundwater\ Pumping_{node\ Ā} = ĀĀĀ_{ĀĀĀ-ĀĀ} * Pumping\ Percentage + ĀĀĀ_{ĀĀ} \qquad (10)$$

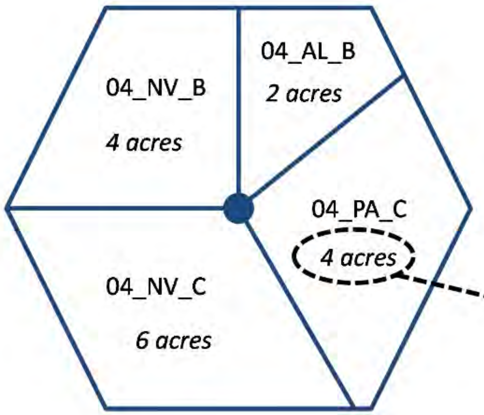
Many nodes include areas that are met from both groundwater and non-groundwater sources, areas of different crops and soils and, therefore different AWD or different pumping percentage. Groundwater pumping is calculated separately for each area and summed for the node each month.

Pumping percentage is calculated based on surface water availability. Surface water availability can change from year-to-year and by water district or other boundaries in the SVGB. Surface water availability is identified by WBA. Therefore, pumping percentage is calculated based on AWDnon-gw and available surface water for a WBA with the same water supply, such as Glenn-Colusa Irrigation District. Pumping percentage is calculated annually for each area as follows:

$$Pumping\ Percentage_{area\ Ā} = 1 - Minimum.\ \frac{Surface\ \ Supply_{\ area\ \ j}}{AWD_{non\ -gw}{}_{\ area\ \ j}}\ or\ 1 \Big) \qquad (11)$$

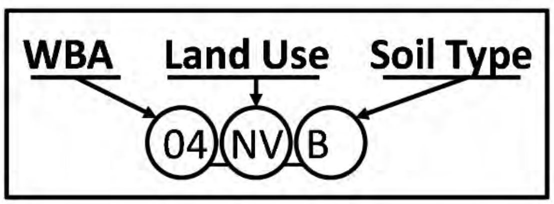
AWD used in the denominator is the annual AWD of the area minus any AWD from lands identified as supplied by groundwater. In some years, available surface supply can exceed AWDnon-gw and the pumping percentage is zero. An annual pumping percentage is calculated for most areas and multiplied by the AWDnon-gw each month. Available surface water supply was estimated from a variety of data sources including historical diversion records, contracts for water, historical hydrology, CALSIM II output, and assumptions based on knowledge of the Sacramento Valley. Many areas of the Sacramento Valley have

GIS Data Set for Nodal Area



IDC Output for Unit Areas (feet)				
Date	04_NV_B	04_NV_C	04_AL_B	04_PA_C
Oct 1969	0.001	0.000	0.005	0.013
Nov 1969	0.001	0.000	0.003	0.002
Dec 1969	0.039	0.037	0.026	0.103
...	...	...	...	...
Sep 2010	0.001	0.000	0.018	0.014

$$\text{Node Deep Perc.}_{\text{Oct 1969}} = 4 \times 0.001 + 6 \times 0.000 + 2 \times 0.005 + 4 \times 0.013$$



Note:
IDC = Integrated Water Flow Model Demand Calculator

Figure 27
Example Calculation of Nodal Deep Percolation using GIS Dataset and IDC Output
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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relatively stable surface water supplies that are only reduced during periods of extreme or prolonged drought. Additional detail on estimates of available surface water supply is contained in a technical memorandum titled, *Response to SacFEM Peer Review Tier 1 Findings 1, 2, and 3* (MBK, 2013).

3.2.5.6 Review and Quality Assurance

Deep percolation and agricultural groundwater pumping inputs to SACFEM2013 are large datasets of more than 75 million values each (492 monthly time-steps for the more than 153,000 SACFEM2013 model nodes). Additionally, both input parameters are typically only estimated with little to no available observed data for comparison with calculated values. However, calculated values from IDC and final SACFEM2013 inputs were aggregated for different areas and compared against available data. Additionally, values for the entire SACFEM2013 model domain were aggregated and compared to generally accepted estimates.

Detailed Water Budgets. Calculated values for both groundwater pumping and deep percolation within Glenn-Colusa Irrigation District were compared with detailed water budget estimates developed by Davids Engineering, Inc. for the period 2001 through 2010. Detailed water budgets included applied surface water, groundwater pumping, runoff/return flow, and estimated deep percolation as the closure term based on a root-zone simulation model. IDC-calculated values for groundwater pumping, total applied water demand, runoff/return flow, and deep percolation compared well with measured and calculated values from Davids Engineering, Inc. IDC input values for soil parameters such as field capacity and saturated hydraulic conductivity were adjusted and calibrated as part of this comparison.

Applied Water Demand. AWD is calculated in IDC as a function of crop type, soils data, and precipitation. AWD calculated in IDC was validated by comparison with historical surface water delivery data for areas known to be irrigated only, or primarily with surface water. These comparisons were made for a common period of available IDC output and observed surface water diversion data. Examples of these validations are presented in Appendix A. AWD calculated in IDC compared well for most comparison areas. AWD calculated in IDC is the basis for much of the calculated groundwater pumping.

Model Domain Comparisons. Values for total deep percolation and groundwater pumping were reviewed as monthly and annual time-series and compared for different crop types and soil conditions. Figure 28 illustrates the annual volume of deep percolation for the entire model domain throughout the simulation period plotted with average precipitation for the seven stations used as input to IDC. Figure 28 illustrates how deep percolation generally fluctuates with precipitation and can vary significantly from year-to-year with a range of approximately 0.5 million acre-feet (MAF) to 3.5 MAF.

Figure 29 illustrates annual agricultural groundwater pumping inputs to SACFEM2013. The average annual groundwater pumping for the entire simulation period is approximately 2.75 MAF and generally falls in the range of 2.0 to 2.5 MAF in non-drought years. General estimates of average typical year groundwater pumping for the SVGB are on the order of 2.0 to 2.5 MAF.

3.3 Model Assumptions

The groundwater flow model construction, described in the preceding sections, followed the following inherent assumptions:

- Groundwater flow is simulated under confined conditions under all model layers. This assumes that changes in aquifer transmissivity due to processes such as groundwater extraction are negligible.
- Transmissivity of the modeled system does not change through time.
- Lateral groundwater underflow is not included in SACFEM2013. The model assumes that all groundwater enters and exits the model through the boundary conditions listed in Section 3.2.4.
- Effects of water density and viscosity variations to groundwater flow are negligible.
- Hydrologic variations occurring at a temporal scale finer than monthly are not simulated.

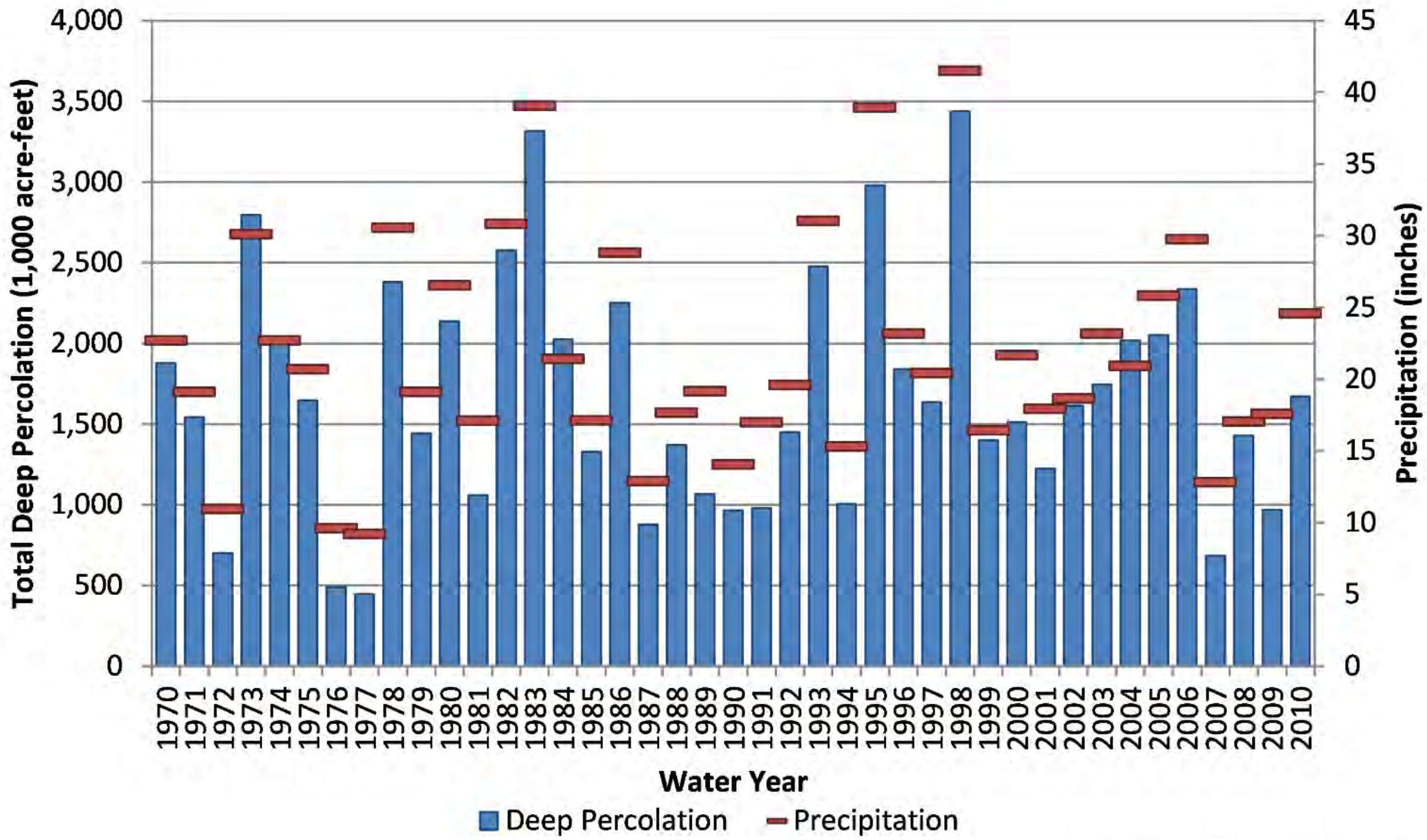

Figure 28
Annual Deep Percolation from Agricultural and Native Vegetation Areas

SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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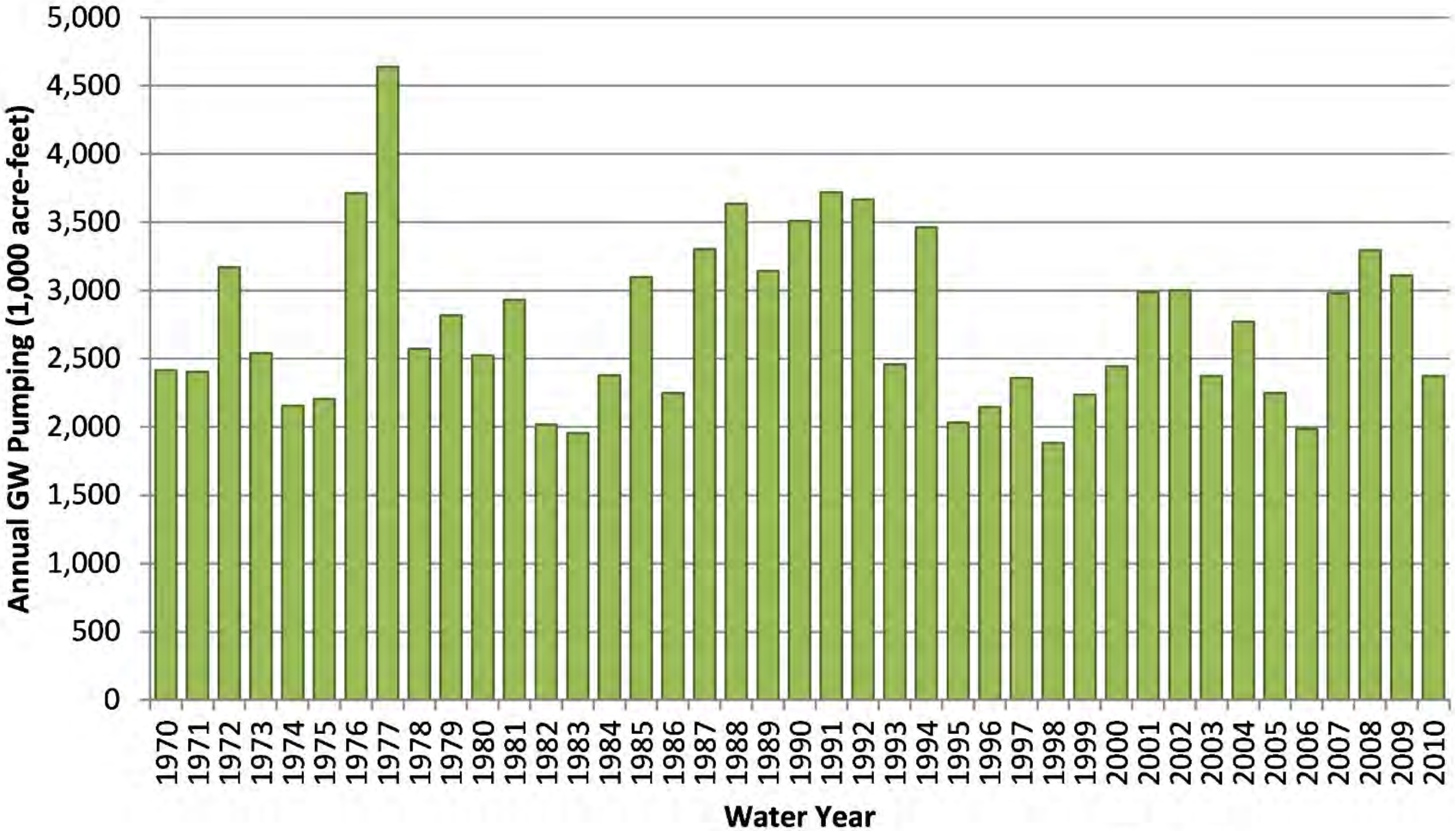

Figure 29
Annual Agricultural Groundwater Pumping
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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SECTION 4
Groundwater Flow Model Calibration

Model calibration is a process of systematically altering model parameters to simulate subsurface flow conditions measured in the field. For SACFEM2013, this process ensured that the numerical model could accurately replicate the hydrologic processes observed within the SVGB, and that the model was a reliable tool to use to forecast future hydraulic conditions resulting from changes in water management within the basin. SACFEM2013 was generally calibrated in accordance with the *Standard Guide for Calibrating a Ground-Water Flow Model Application* (American Society for Testing and Materials [now ASTM International], 1996).

4.1 Calibration Process

As is discussed in earlier sections of this report, CH2M HILL incorporated details of the SVGB physical system into SACFEM2013, and then a step-wise calibration approach was implemented to achieve sufficient calibration to observed conditions in the Valley as efficiently as possible.

4.1.1 Selection of Calibration Targets

Calibration targets are defined as the selected field-measured values that quantify hydrologic conditions of interest with consideration of data quality and worth. Both qualitative and quantitative calibration targets were selected to evaluate the progress of calibration during development of SACFEM2013. Following is a discussion of how the specific quantitative and qualitative calibration targets were selected for this effort.

4.1.1.1 Quantitative Calibration Targets

SACFEM2013 underwent a transient calibration; therefore, selected field-measured heads recorded between WY1970 and WY2010 served as quantitative calibration targets, or target heads. Calibration target wells were selected from the DWR Water Data Library. The selection process generally proceeded as follows:

- DWR databases were queried to identify all wells with well construction information; wells with unknown construction were eliminated from consideration.
- The number of data records that were associated with each of the remaining wells was summarized within the SACFEM2013 simulation period (WY1970-WY2010); wells with a higher number of records were preferred.
- The spatial location of wells identified in the previous two steps were plotted to ensure that the final wells selected as calibration targets provided a good geographic distribution throughout the model domain, both within individual layers and with depth. This step was performed using a visual identification method as opposed to an automated query.
- The final step was to review additional target well locations recommended during the peer review of the previous version of SACFEM (WRIME, 2011). Select wells that did not necessarily meet the criterion of having a long period of record, but that provided good spatial or vertical (i.e., well clusters) coverage, were added to the calibration target dataset.

The overall result of this process was that 210 wells were identified as transient groundwater elevation targets over the simulation period. The locations of the calibration wells within each model layer are shown on Figure 30. Calibration summary statistics were computed to provide a quantitative measure of the ability of the model to replicate calibration target heads. Head calibration was evaluated using a variety of summary statistics, including the following:

- Residual error, computed as the simulated head value minus the target head value
- Mean error (ME), computed as the sum of all residual errors divided by the number of observations (n)

- Coefficient of determination (R^2), computed as the square of the correlation coefficient
- Root mean squared error (RMSE), computed as the square root of the mean of all residual squared errors
- RMSE divided by the range of target head values (RMSE/Range)

Rather than setting arbitrary goals for individual summary statistics as part of quantitative calibration, CH2M HILL moved forward with the following general goals:

- Minimize spatial bias of residual errors in key areas of the domain
- Minimize residual error, ME, RMSE, and RMSE/Range values
- Have R^2 values as close to 1.00 as possible

Appendix B presents the quantitative calibration targets selected for SACFEM2013, which included 210 target head locations. The target groundwater elevations are also included on the hydrographs in Appendix C.

4.1.1.2 Qualitative Calibration Targets

Qualitative calibration targets refer to general observations of temporal or spatial patterns of the field problem that were compared with model output. These targets included general patterns of gaining and losing streams and bypasses under differing hydrologic conditions. Calibration summary statistics were not used to characterize the ability of SACFEM2013 to replicate qualitative calibration targets; rather, these targets were evaluated to determine if the model is generally able to replicate the expected overall patterns in stream gain/loss. Although the exact stream reaches that gain or lose flow because of surface water/groundwater interaction are not fully delineated, and this relationship changes over time with fluctuating groundwater levels and stream stages, the general pattern observed in the Valley is that the major trunk streams, such as the Sacramento, Feather, and American Rivers, tend to gain flow, especially in their lower reaches. Smaller upper tributaries near the basin margin tend to lose flow to the groundwater system.

4.1.2 Calibration Parameters

Parameter values of streambed Kv, mountain front recharge adjustment factor, Kh, and Kh:Kv were adjusted during the calibration of SACFEM2013. No modifications were made to deep percolation of applied water/precipitation or agricultural pumping data estimated from IDC.

4.1.3 Iterative Manual Calibration Procedure

The general calibration procedure was an iterative process executed using manual techniques. During the calibration phase, property zones were spatially defined and assigned values. This involved manually running the simulations, comparing model results with qualitative and quantitative calibration targets to assess the progress of calibration, and making manual changes to parameter values and boundary conditions (or both) in areas where important calibration mismatches were noted for the next round of simulations. This procedure was repeated until only minor improvements in calibration were achieved with each round of simulations, and the calibration was deemed appropriate.

4.2 Calibration Results

4.2.1 Groundwater Elevations

Locations of SACFEM2013 calibration target wells selected for this evaluation are shown on Figure 30. Measured heads for each calibration target well, along with the associated calibration statistics, are summarized in Appendix B. The purpose of computing summary statistics is to quantify the goodness of fit between simulated and target head data. Goodness-of-fit statistics that accompany model calibration are not necessarily good indicators of the predictive capabilities of a model. Summary statistics are highly sensitive to the number of observations, quality of measured data, and outlier data. Poor calibration statistics can result from a variety of reasons, as described in Section 4.3.

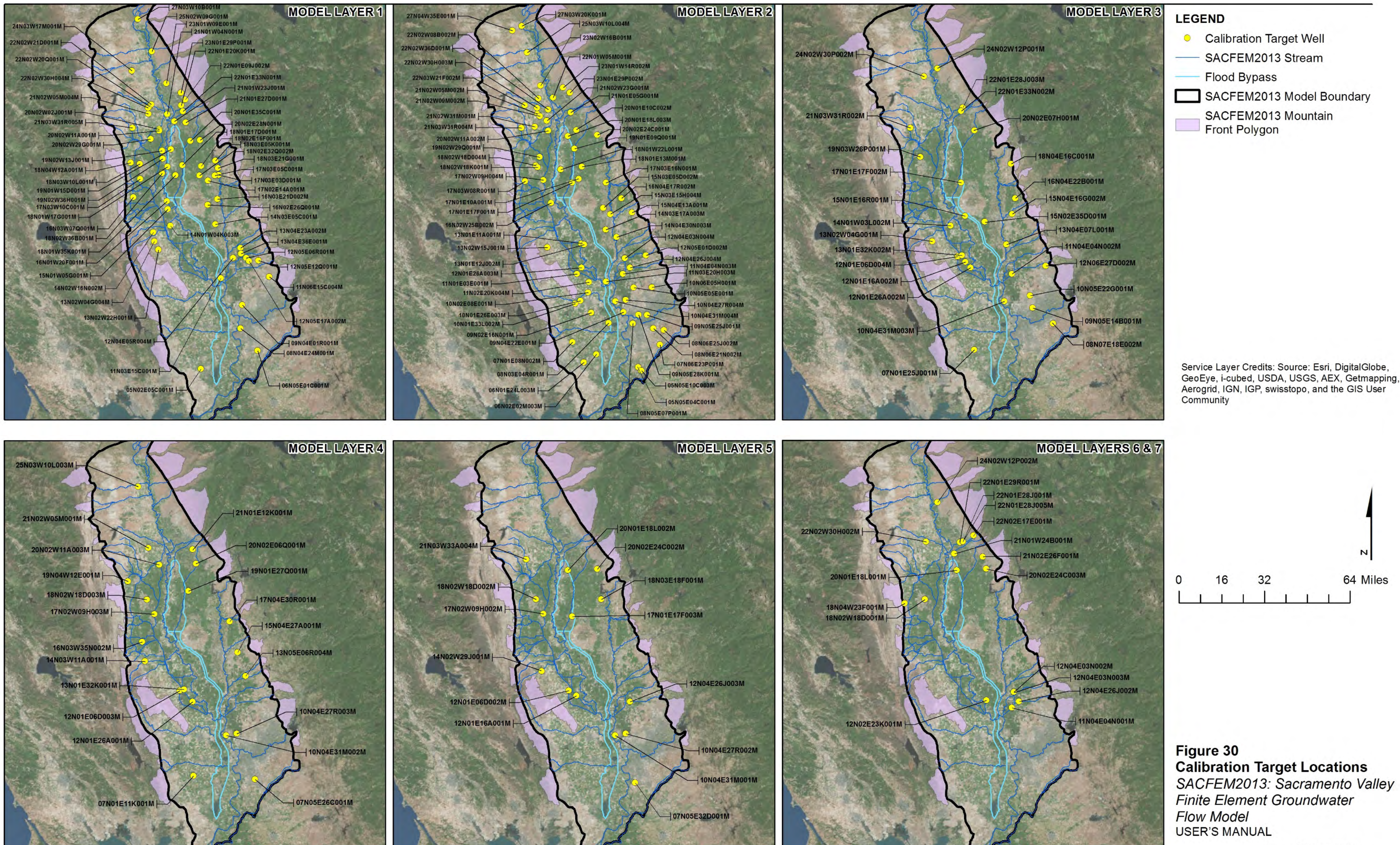

Figure 30
Calibration Target Locations
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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Figure 31 is a scatter plot of individual simulated-versus-target head values. The summary statistics for data presented on Figure 31 and defined in Section 4.1.1.1 are as follows:

- ME = 1.6 feet
- RMSE = 19.6 feet
- Range in calibration target head values = 417.8 feet
- RMSE/Range = 5 percent
- R^2 = 0.93
- n = 32,263

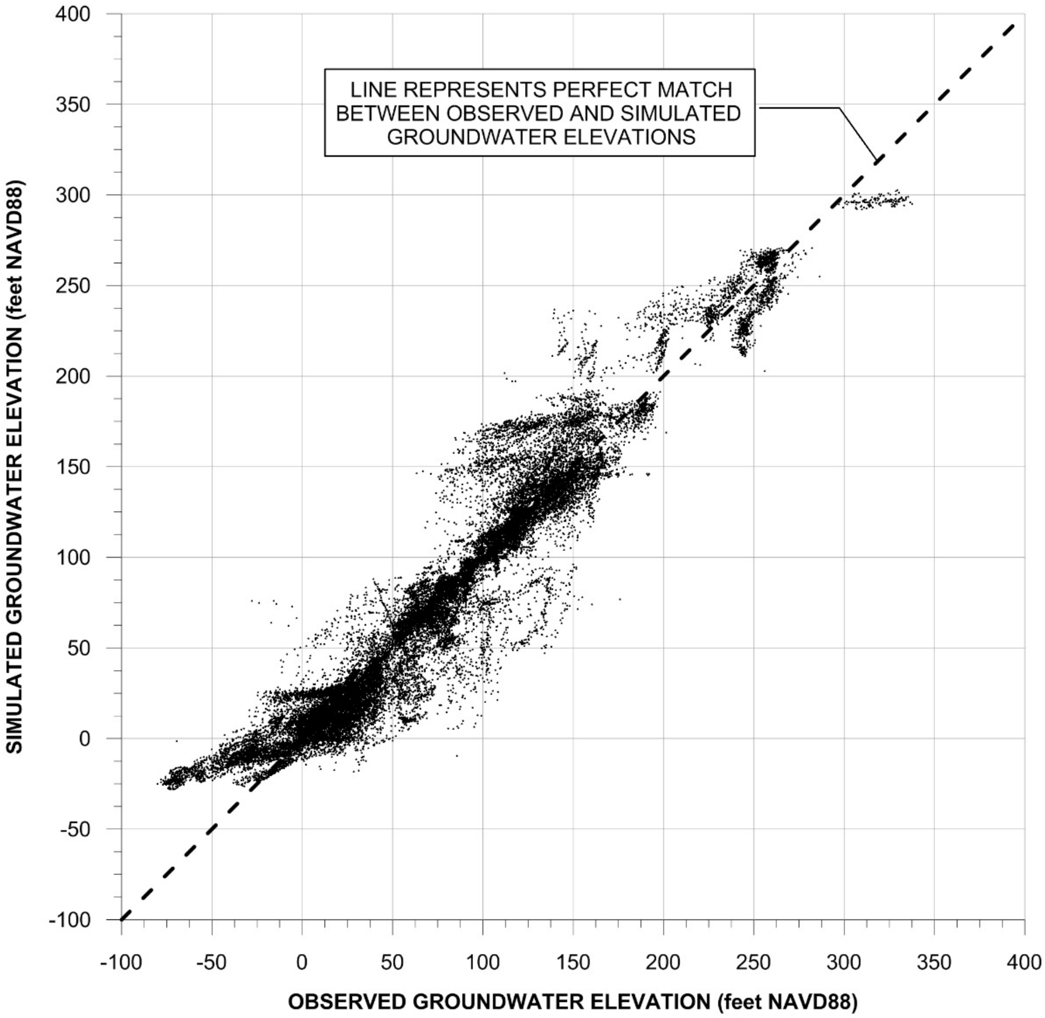
The ME value of 1.6 feet indicates that SACFEM2013 slightly over-predicted heads throughout the domain, as shown by the positive value. However, the ME, RMSE, and RMSE/Range are relatively small, particularly given the scale of the model domain. Additionally, as shown on Figure 31, there is a strong correlation (R^2 = 0.93) between simulated and target head data. A well-calibrated model should also have mostly low residual errors, with some simulated heads above and below their target heads. Figure 31 shows that points are above and below the 1:1 correlation line. Thus, the calibration results for this effort do not indicate global bias (that is, all positive or all negative residual errors).

Figure 32 shows the spatial distribution of the mean error in simulated heads that are listed in Appendix B by model layer. The data presented on Figure 32 and in Appendix B indicate that mean error in nearly half of the target wells is within ±5 feet. The data further suggest that there may be slight spatial bias indicating that wells east of Dunnigan Hills and in Placer County/southeastern Sutter County are simulated low, and wells near the southern model boundary (Sacramento County) and in northern Butte County are simulated slightly high. This is likely the result of small-scale features not explicitly simulated in SACFEM2013. Overall, the statistics listed above and presented in Appendix B and Figure 32 are considered to represent good calibration.

The other method used to evaluate the quality of the transient calibration was to compare the simulated hydrographs for each of the 210 target monitoring wells with the measured hydrograph data. These hydrograph comparisons are presented on Appendix C. Examination of the time-series simulated and measured groundwater hydrographs helps to inform the mean errors presented on Figure 32. For example, in the southeastern portion of the model domain (06N05E01C001M, model Layer 1) the time series data show that SACFEM2013 does a good job of replicating the transient groundwater level fluctuations; however, the simulated heads are overestimated. Another example, 15N04E13A001M (model Layer 2) suggests that SACFEM2013 does an excellent job of replicating the later-time measured groundwater elevations; however, there are local factors not explicitly simulated that result in over-estimation of the earlier time groundwater elevations. The result is a mean error of approximately 21 feet, which is biased by the early time data. Finally, there are select calibration targets (such as 07N01E11K001M, model Layer 4) that appear to be in close proximity to a pumping well, as suggested by the large seasonal variability in measured groundwater elevations. Because individual pumping wells are not explicitly simulated in SACFEM2013, the magnitude of simulated groundwater fluctuation is less than observed. Although some deviations remain between simulated and observed data during certain periods at select locations, SACFEM2013 generally does a good job of replicating both the absolute groundwater elevations and transient trends in the majority of the 210 calibration target wells within the model domain.

4.2.2 Stream Gain/Loss

As discussed above, the general patterns of losing and gaining reaches of streams and bypasses were included as qualitative targets during the calibration of SACFEM2013. Figure 5 presents water year type designations for the SACFEM2013 simulation period. Stream and bypass reaches predicted by the model to



n = 32,263
ME (ft) = 1.6
RMSE (ft) = 19.6
Range (ft) = 417.8
RMSE/Range = 0.05
r^2 = 0.93

Notes:
1. n = number of measurements
2. ME = mean error
3. RMSE = root mean squared error
4. Range = range in measured groundwater elevations
5. RMS/Range is a measure of model calibration and is equal to the root mean squared error (RMS) divided by the range in measured groundwater elevation.
6. NAVD88 = North American Vertical Datum of 1988.

Figure 31
Simulated versus Observed Groundwater Elevations
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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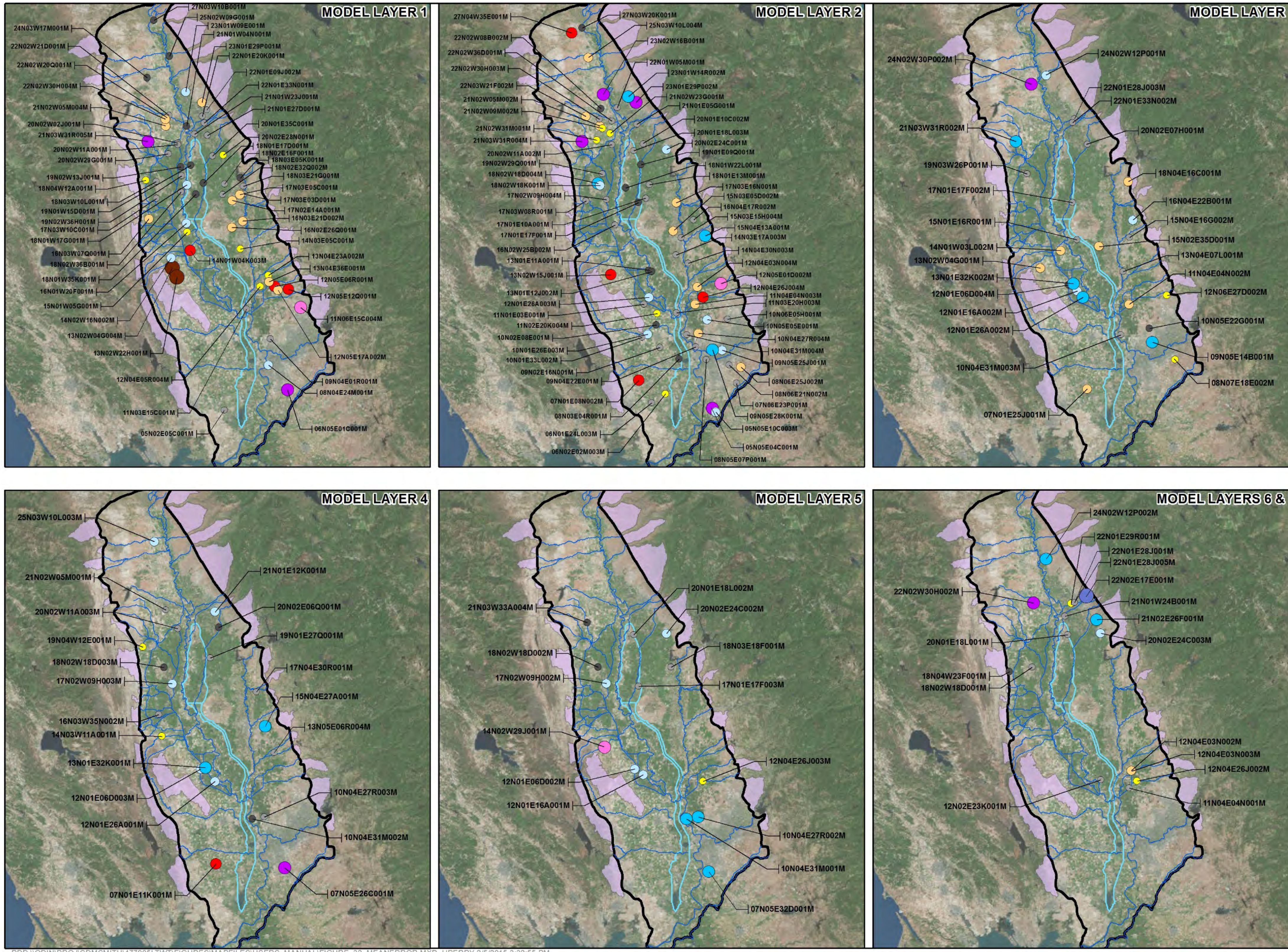

LEGEND

- SACFEM2013 Stream
- Flood Bypass
- SACFEM2013 Model Boundary
- SACFEM2013_VoidPolygons

Mean Error (feet)

- -71.8 to -50.0
- -49.9 to -30.0
- -29.9 to -20.0
- -19.9 to -10.0
- -9.9 to -5.0
- -4.9 to 5.0
- 5.1 to 10.0
- 10.1 to 20.0
- 20.1 to 30.0
- 30.1 to 50.0
- 50.1 to 80.0

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

N

0 16 32 64 Miles

Figure 32
Simulated Mean Error in Groundwater Elevation
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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gain or lose flow to the groundwater aquifer were evaluated under typical above-normal hydrologic conditions (April 2000, see Figure 33), extreme drought (July 1977, see Figure 34), and wet conditions (January 1983, see Figure 35). As shown on Figure 33, the pattern of predicted stream gain/loss during April 2000 is consistent with what would be expected during an above-normal period. The major trunk streams throughout the Valley, such as the Sacramento and Feather Rivers, are gaining, while the smaller tributaries are losing flow to the groundwater system. Further, the flood bypasses are not active under these hydrologic conditions. Figure 34 presents the distribution of simulated gaining/losing stream reaches in July 1977. Model output suggests that the majority of streams throughout the Valley are losing flow to the aquifer system, which is consistent with what would be expected under this critically dry condition. Many of the smaller tributary streams as well as the flood bypasses are inactive during this period, as evidenced by the lack of stream gain/loss symbology (i.e. blue or yellow circle). Finally, the predicted distribution of stream and bypass gain/loss during January 1983 is presented on Figure 35. Model output suggests that, although there are limited gaining stream reaches, the vast majority of streams and bypasses are losing flow to the groundwater system. This is likely a result of high stream stage elevations during runoff in this extremely wet hydrologic period. Overall, the patterns predicted by the calibrated groundwater flow model are reasonably consistent with expected stream gains and losses under the varying hydrologic conditions, and calibration of SACFEM2013 against this qualitative target is considered good.

4.2.3 Calibrated Hydraulic Parameters

Figures 12 and 13 show the modeled hydraulic conductivity values that resulted from the calibration process. These values are within a reasonable range of literature values for heterogeneous unconsolidated deposits and bedrock. As discussed in Section 3.2.2.2, a Kh:Kv of 50:1 was assigned in model Layer 1, 500:1 was assigned in model Layers 2 through 7, and 1:1 was assigned to bedrock areas in all model layers throughout most of the model domain. The final set of mountain front recharge adjustment factors is included in Table 6, and the final streambed Kv values are presented on Figure 15 and in Table 2.

4.2.4 Groundwater Balance

Figures 36 and 37 summarize the primary inflow and outflow components of the transient groundwater budget for SACFEM2013. These plots were generated by totaling the monthly inflows and outflows for each of the components by water year. The SACFEM2013 model output presented on these figures indicates that the inflows are highly variable from year to year, while the outflows are more or less consistent. Figure 36 presents the annual volumes for the SACFEM2013 inflow components, deep percolation of applied irrigation water and precipitation, groundwater recharge from stream leakage, and groundwater recharge along the mountain front. The pattern in annual volumes of inflow to SACFEM2013 are such that the magnitudes are highest during wet hydrologic periods and lowest during dry hydrologic periods. For example, the maximum annual inflow (approximately 6.5 MAF) occurs during the extremely wet period of WY1983 and the minimum annual inflow (approximately 1.8 MAF) occurs during the critical drought of WY1976-WY1977. Groundwater recharge from streams comprises the largest component of the water budget, ranging from 33 to 68 percent of the annual inflow. Deep percolation of applied water and precipitation ranges from 24 to 54 percent of the annual inflow, and recharge along the mountain front ranges from 4 to 17 percent of the total annual inflow.

Figure 37 presents the annual volumes for the SACFEM2013 outflow components, groundwater pumping, groundwater discharge to streams, and groundwater discharge to land surface. The volumes of outflow from SACFEM2013 have an opposite pattern with respect to hydrologic cycles in the SVGB than groundwater inflow components. The minimum annual outflow occurs during wet periods, such as WY1982-WY1983 and WY1995-WY1999, and the maximum annual outflow occurs during dry periods, such as the critical drought of WY1976-WY1977. Groundwater pumping is by far the largest outflow component of the water budget, ranging from 56 percent (2.3 MAF) to 96 percent (5 MAF) of the annual outflow. Groundwater discharge to land surface ranges from 1 to 33 percent of the total annual outflow, and groundwater discharge to streams ranges from 3 to 13 percent of the annual outflow. It should be noted that the boundary condition used to simulate groundwater discharge to land surface (discussed in Section 3.2.4.1) represents surficial processes including groundwater discharge to low-lying topographic areas, such as riparian to streams, as well as small tributaries not explicitly simulated in SACFEM2013. For practical purposes, this component of the water budget can be considered groundwater discharge to streams.

Figure 38 presents the cumulative change in storage over the WY1970 through WY2010 simulation period. These SACFEM2013 results indicate that simulated changes in aquifer storage correlate to the hydrologic cycles. Periods of decrease in storage correspond to drought cycles, such as WY1976-WY1977 and WY1987-WY1992, and increases in aquifer storage correspond to wetter periods such as WY1982-WY1984 and WY1995-WY1999. Overall, the trends and magnitudes of SACFEM2013 are appropriate and consistent with the generally accepted water balance for the SVGB.

4.3 Potential Sources of Error

Calibration target values and simulated output each have associated errors or error potential, resulting in an overall uncertainty in results. The sources of uncertainty include transient effects, human errors, scaling effects, interpolation errors, and numerical errors (Anderson and Woessner, 1992).

4.3.1 Transient Effects

Groundwater-level measurements in wells could reflect the presence of transient effects in the groundwater system that might not be represented in SACFEM2013. The only available subsurface access for directly monitoring groundwater conditions is through groundwater wells. If transient effects of the groundwater system manifest in groundwater levels at timescales other than those represented in the numerical model, some portion of the residual error between the field-measured groundwater level and the simulated output could be due to these transient effects.

4.3.2 Human Errors

It is not possible to guarantee that the modeling results presented in this manual are free of human error. However, CH2M HILL strived to avoid introducing human errors by adhering to quality assurance protocols. The following are examples of potential sources of human errors:

- **Measurement Errors.** Calibration target values include measurement errors. Measurement errors relate to the accuracy and consistency of the measurement device or structure, the accuracy and consistency of the elevation survey datum, and the diligence of the field or laboratory technician who collects or analyzes the data. Thus, some portion of the residual error between the field-measured data and the simulated output could be due to measurement error in the calibration target value.
- **Data Management Errors.** Errors can be introduced as a result of data management activities. Examples of data management errors include, but are not limited to, associating input data with an incorrect location (resulting in spatial errors), assigning time-series data incorrectly (resulting in temporal errors), or otherwise inputting values incorrectly. Thus, some portion of the residual error between the field-measured data and the simulated output could be due to data management errors.
- **Conceptualization Errors.** Errors can be introduced as a result of inadequately conceptualizing the field problem. The absence of important Site information can lead to errors associated with assumptions that are necessary to perform predictive simulations. Thus, some portion of the residual error between the field-measured data and the simulated output could be due to conceptualization errors.

4.3.3 Scaling Effects

A numerical model uses discrete space to represent the hydrologic system. SACFEM2013 grid was built in an effort to strike a balance between maximizing the number of nodes in key areas of the domain and minimizing the numerical burden and associated model run times. However, numerical grids are subject to errors resulting from scaling effects. Errors associated with scaling effects result when and where significant spatial heterogeneities in the field problem are not represented at the scale of the numerical grid elements.

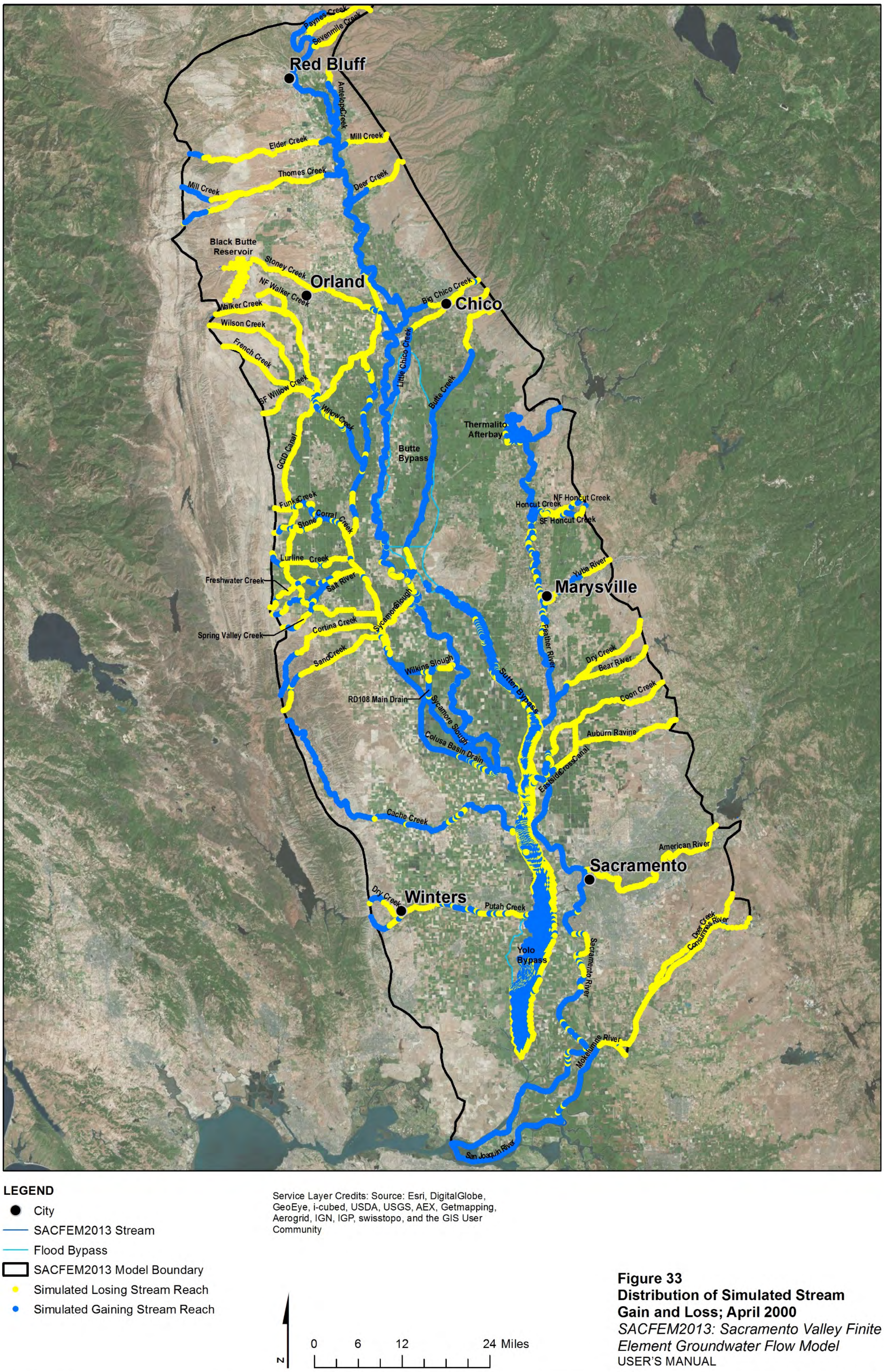

Figure 33
Distribution of Simulated Stream Gain and Loss; April 2000
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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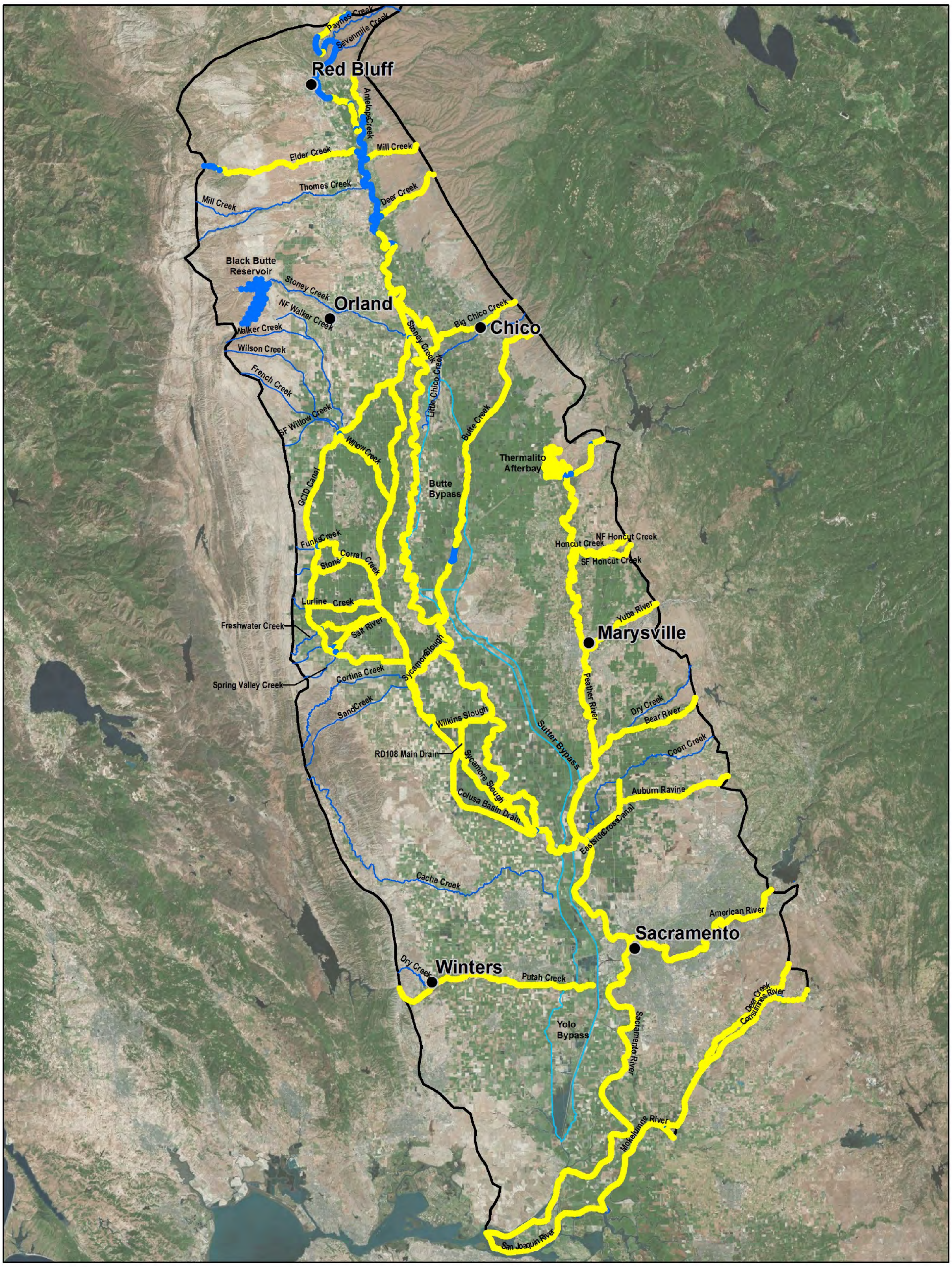

LEGEND

- City
- SACFEM2013 Stream
- Flood Bypass
- SACFEM2013 Model Boundary
- Simulated Losing Stream Reach
- Simulated Gaining Stream Reach

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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0 6 12 24 Miles

Figure 34
Distribution of Simulated Stream Gain and Loss; July 1977
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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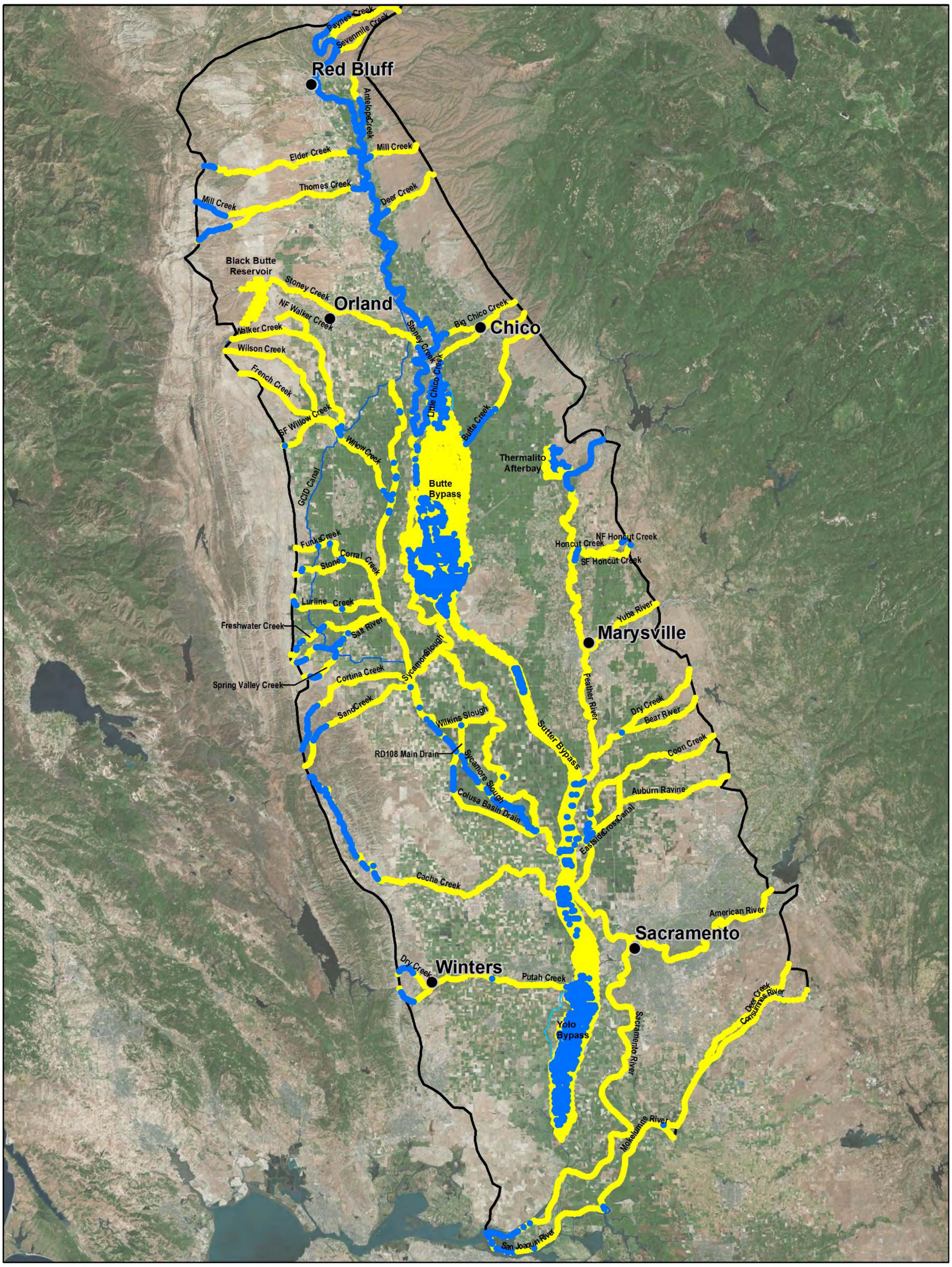

LEGEND
- City
- SACFEM2013 Stream
- Flood Bypass
- SACFEM2013 Model Boundary
- Simulated Losing Stream Reach
- Simulated Gaining Stream Reach

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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0 6 12 24 Miles

Figure 35
Distribution of Simulated Stream Gain and Loss; January 1983
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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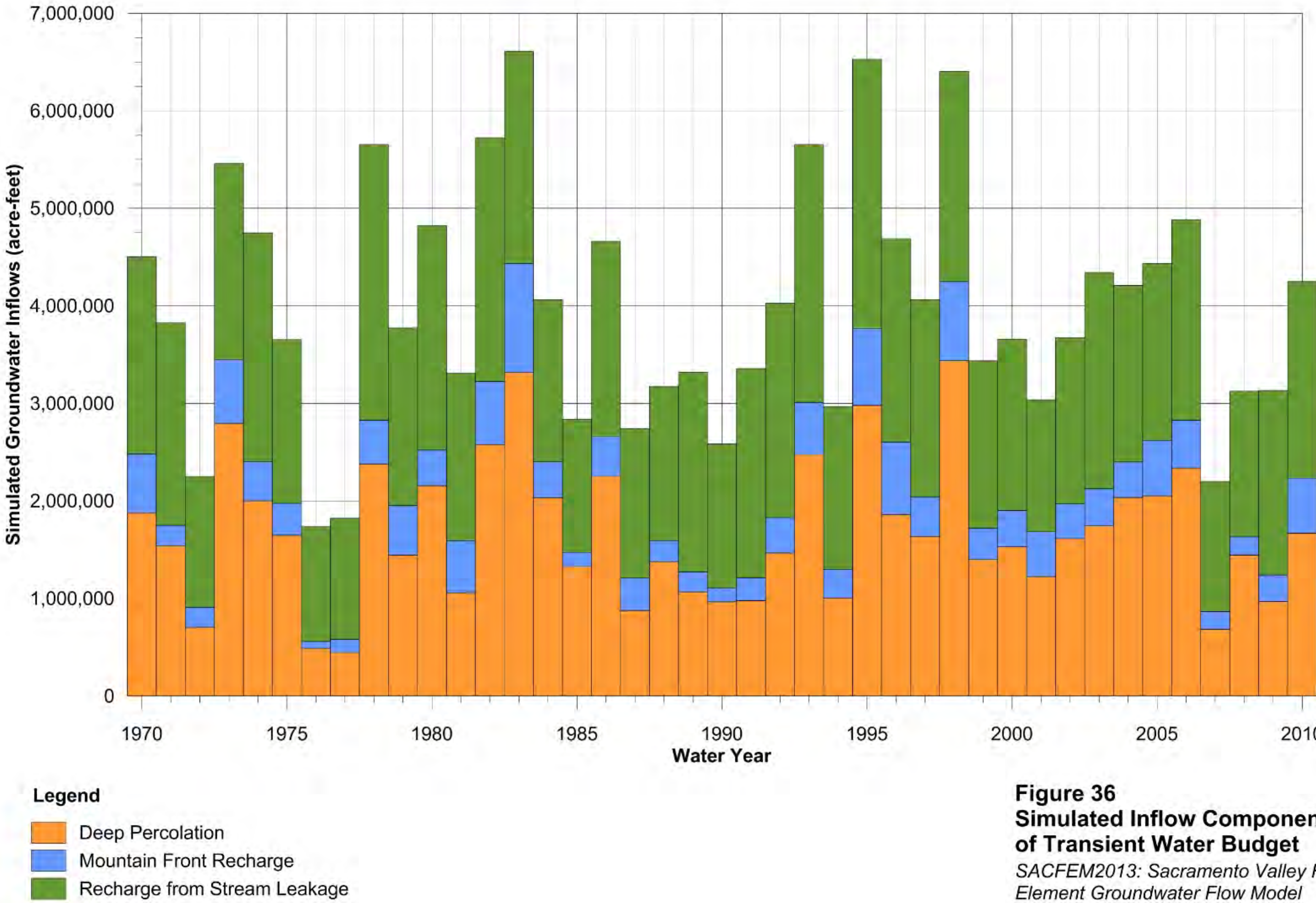

Figure 36
Simulated Inflow Components of Transient Water Budget
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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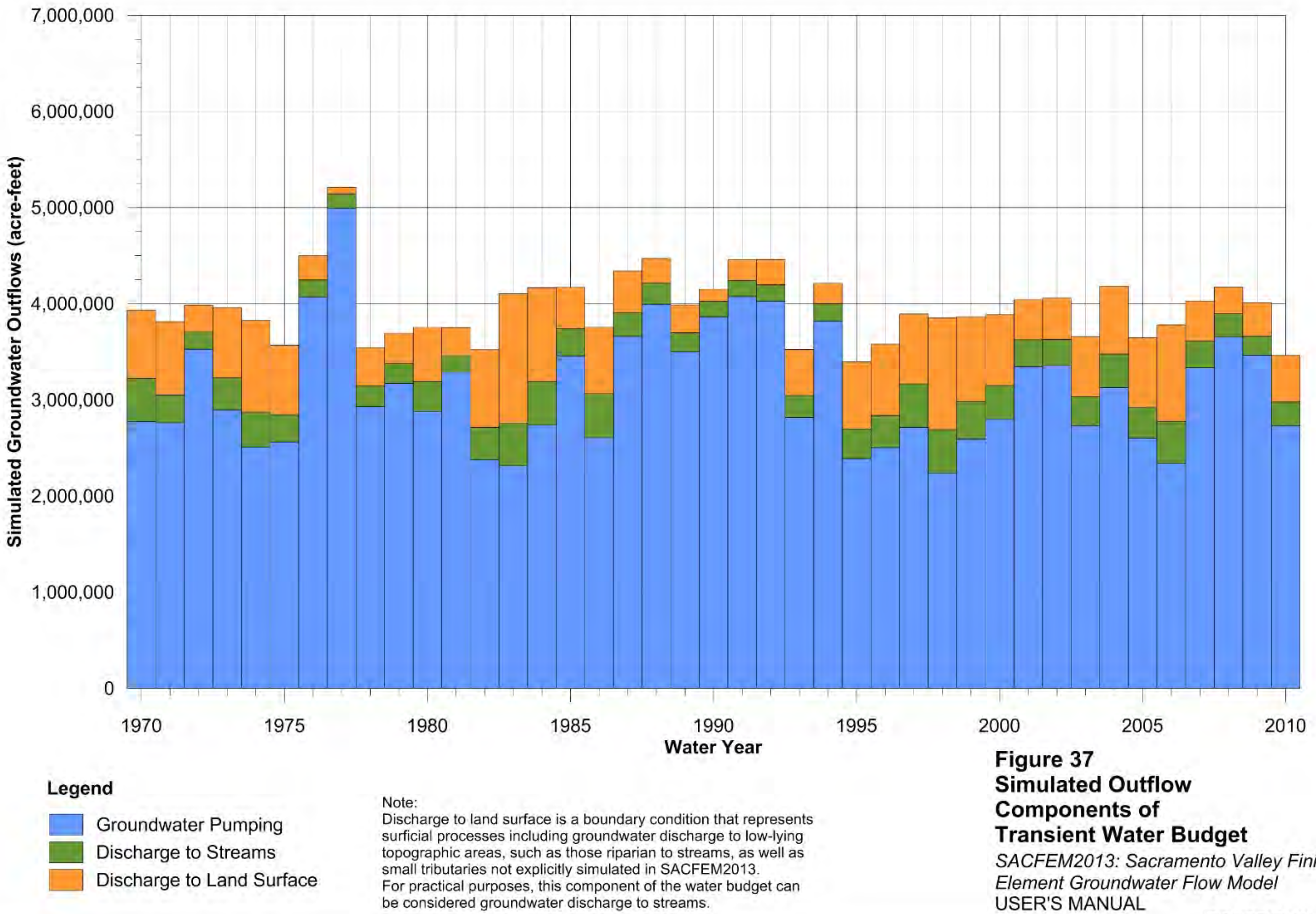

Note:
Discharge to land surface is a boundary condition that represents surficial processes including groundwater discharge to low-lying topographic areas, such as those riparian to streams, as well as small tributaries not explicitly simulated in SACFEM2013.
For practical purposes, this component of the water budget can be considered groundwater discharge to streams.

Figure 37
Simulated Outflow Components of Transient Water Budget
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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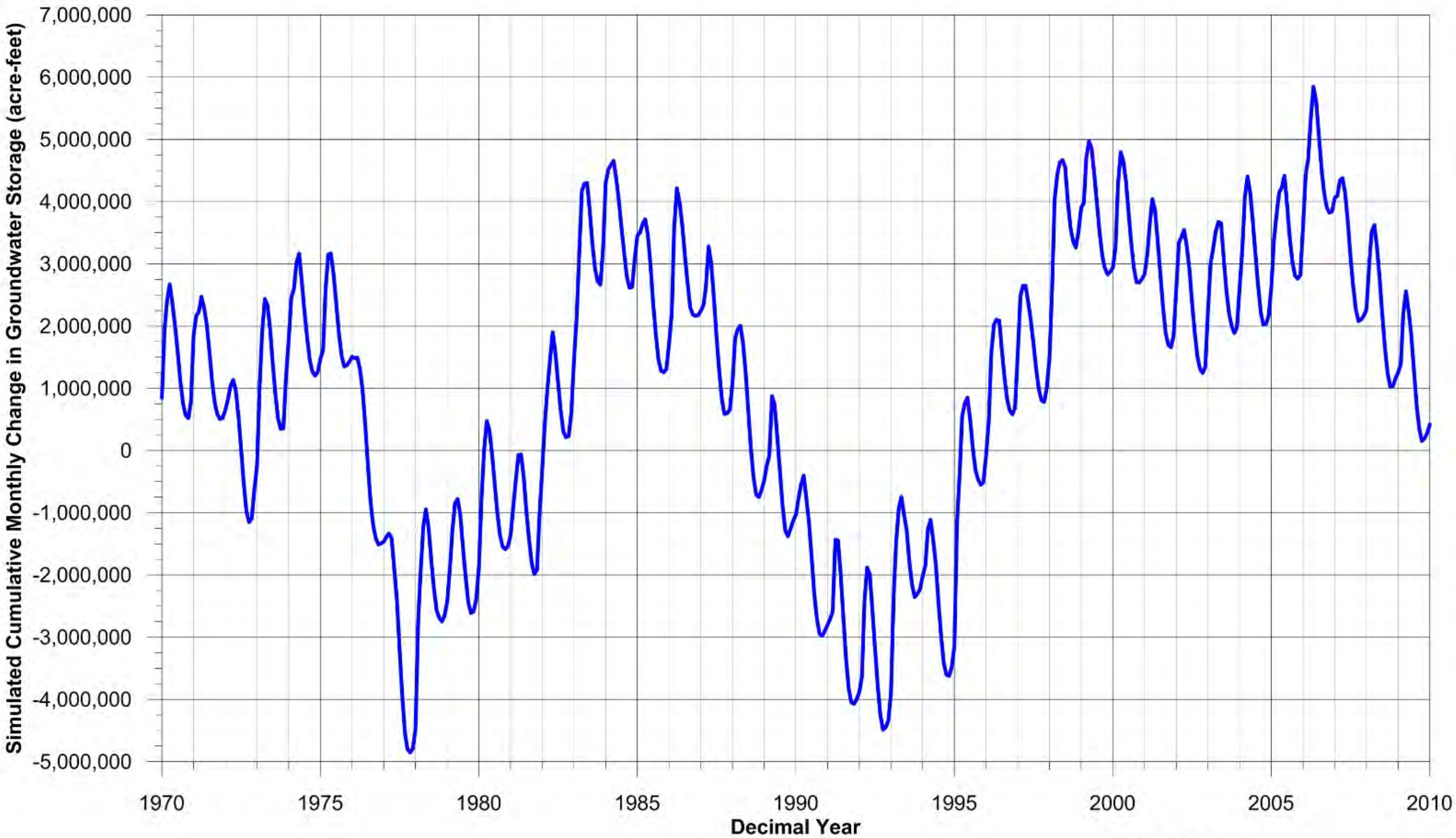

Figure 38
Simulated Cumulative Monthly Change in Groundwater Storage
SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
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4.3.4 Interpolation Effects

Interpolation errors can result from spatially distributing point values of parameters or stresses over the model domain. In an effort to manage interpolation errors, one of the goals for selecting calibration target locations for SACFEM2013 was to seek a relatively uniform spatial distribution of calibration targets over SACFEM2013 domain. Having a reasonable number of spatially distributed calibration targets and types of calibration targets (for example, qualitative and quantitative) helps make model output more reliable over a wide range of conditions for the entire domain.

4.3.5 Numerical Errors

Errors associated with the way a model solves the governing flow equations, coupled with the assumptions in the governing equations being solved, are inherent in numerical models. Numerical errors are also associated with the selection of convergence closure criteria by the user. User selection of convergence closure criteria is an iterative process during calibration that seeks to strike a balance between making calibration progress by completing as many simulations as possible within the project schedule and achieving adequate accuracy in the numerical solution. Selecting convergence closure criteria that are too low during initial stages of model calibration results in fewer simulations being completed because of longer run times and possible convergence problems. CH2M HILL minimized introduction of numerical errors by selecting convergence criteria that resulted in converged solutions that provided mass balances of flow.

4.4 Calibration Outcome

A relatively high-resolution, three-dimensional numerical groundwater flow model of the SVGB has been developed to support the evaluation of conjunctive water management projects across the Valley. Specifically, SACFEM2013 was developed to assess the transient effects of groundwater pumping on groundwater levels and to estimate changes in surface water/groundwater interaction.

The current finite-element groundwater flow model grid has a resolution on the order of 410 feet (125 meters) in areas where conjunctive water management projects are being considered and effects are being evaluated. The model has been constructed so that future project-specific grids can be developed, and the 41-year agricultural water budget can be projected onto the new grid using a semi-automated GIS-based tool. The vertical resolution of the model consists of seven model layers. The uppermost model layer was limited to 65 feet or less in thickness to allow assessment of impacts on streams as well as riparian habitat and wetlands. Model Layers 2 through 5 were selected to represent typical groundwater production zones within the Valley. Layers 6 and 7 were developed to represent the Lower Tuscan Formation, where it exists, within the northeastern and central portions of the Valley.

The surface water budget, including agricultural pumping and deep percolation of precipitation and applied water, was developed using a GIS-based analysis that considers land use, crop types, water source, seniority of water rights, and availability of surface water on a monthly time step. These deep percolation fluxes and agricultural pumping fluxes are independently computed for each element in the model. The fluxes associated with mountain-front recharge and urban pumping were also simulated on a monthly time-step. Time-variable surface stream and flood bypass stages were defined by using available data, including USGS topographic maps and stream gage elevations.

The SACFEM2013 model was calibrated to transient groundwater elevation data sets. Groundwater elevations recorded during the hydrologic period from water years 1970 through 2010 were used as transient calibration targets. More qualitative calibration targets such as the magnitude of the water budget components and the pattern and magnitude of surface water/groundwater interaction were also considered.

The SACFEM2013 model represents a valuable analytical tool to estimate the effects of groundwater pumping on both groundwater levels and changes in surface water/groundwater interaction within the SVGB.

SECTION 5
SACFEM Application

The following section describes the process of executing a SACFEM2013 model simulation, including preparation of input datasets, description of the SACFEM2013 model files, and post-processing of model output.

5.1 SACFEM2013 Project File

SACFEM2013 comprises numerous individual files, which will be described in more detail below. The primary file is the SACFEM2013 project file (*.fpr). A MicroFEM project file, such as SACFEM_2013.fpr is an ASCII file, which can be opened via a text editor or directly via the MicroFEM interface. When opened with a text editor, the project file is essentially a list of all data files (or parameter files) that make up a groundwater model. The following is a display of the file “SACFEM_2013.fpr” in text editor mode:

Base-model=SACFEM_2013.fem
Thickness=SACFEM_2013.thi
Storativity=SACFEM_2013.sto
Precipitation=SACFEM_2013.ppn
Drain system H1=SACFEM_2013.dh1
Drain system C1=SACFEM_2013.dc1
Wadi-recharge system L1=SACFEM_2013.wh1
Wadi-recharge system H1=SACFEM_2013.wh1
Wadi-recharge system C1=SACFEM_2013.wc1
Batch-file=SACFEM_2013.fpr[6]
Xtra=SACFEM_2013.xtr

Figure 39 presents the display of SACFEM_2013.fpr when opened directly via the MicroFEM interface. This figure presents the SACFEM2013 model grid (note: nodal points rather than model elements are displayed) in the main body of the display window with the MicroFEM file “tabs” located along the right-hand margin. Each MicroFEM tab contains a different set of data, as described in the following subsections. MicroFEM files can be loaded directly into registers on each of the model tabs or can be loaded via the MicroFEM project manager (see Figures 40 and 41).

[6] The MicroFEM batch file is discussed in detail in Section 5.2.2.

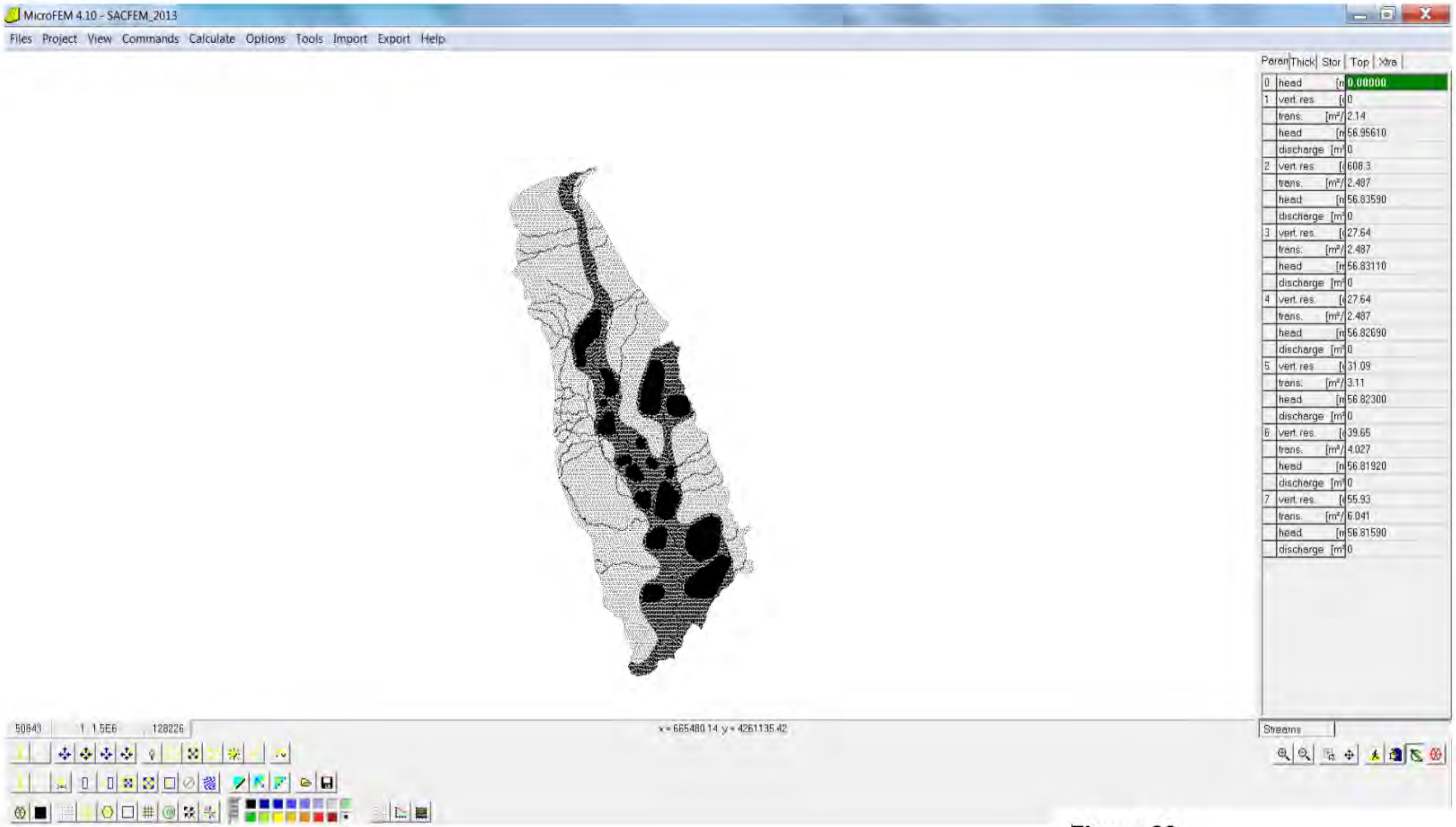


Figure 39
View of SACFEM2013.fpr
via MicroFEM Interface

SACFEM2013: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

CH2MHILL.

FIGURE 40
MicroFEM Project Manager, Main Window

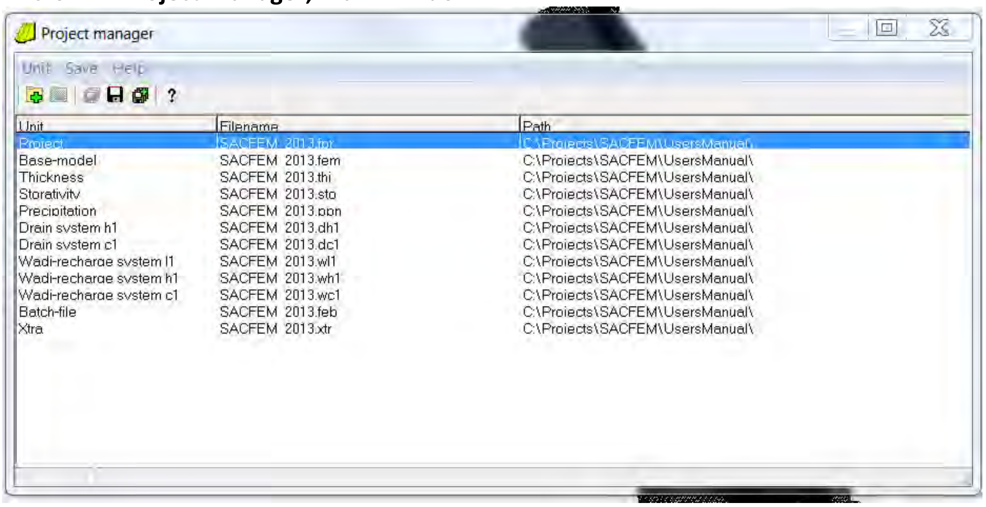
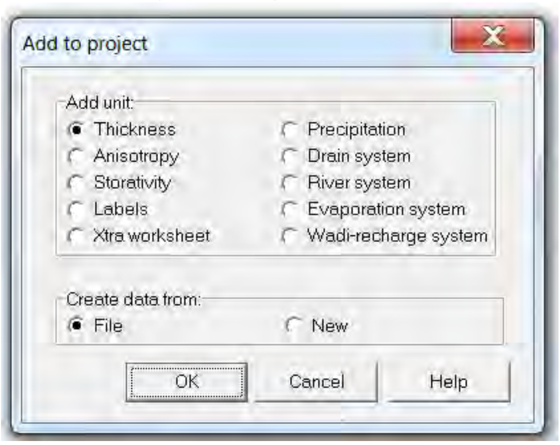


FIGURE 41
MicroFEM Project Manager, Load File Window



5.1.1 SACFEM2013 Base-model ("Param" tab)

The first tab displayed in the MicroFEM interface, as presented on Figure 39, is the Parameter tab. The parameter tab is essentially a display of all data included in the MicroFEM Base-model (*.fem file). A MicroFEM Base-model is an ASCII file[7] containing both network (grid) information, and basic groundwater model information. As shown on Figure 39, SACFEM_2013.fem contains nodal values of vertical resistance, transmissivity, head, and discharge for each of the seven model layers. The base-model also retains the "label 1" register; in the example provided on Figure 39, this is a stream label file. Individual parameter files (that is, files containing a list of numerical values for every model node) can be loaded for any of the registers either directly in the MicroFEM interface or via a batch file during transient simulation (as will be discussed in a subsequent section).

**Note – the "head 0" and "vert. resist. 1" registers at the top of the Parameter tab can be used to simulate leakage from a feature, such as a lake, into model Layer 1. These registers are similar to the top system boundary conditions (i.e., there are specified head and resistance terms). In SACFEM_2013.fem, these registers have value of zeros at every node. Non-zero values should NOT be loaded into these registers when running SACFEM2013.*

[7]All MicroFEM files are in ASCII format and can be opened in a text editor. The reader is directed to the MicroFEM help menu or User's Manual for additional format/structure of raw data files.

5.1.2 SACFEM2013 Thickness File (“Thick” Tab)

The thickness file (SACFEM_2013.thi) contains the nodal saturated thickness values for all model layers. A display of the thickness tab via the MicroFEM interface is included on Figure 42. As shown on Figure 40, the thickness tab (*.thi file) contains registers for both aquifer and aquitard saturated thickness for all model layers. SACFEM2013 does not include explicit simulation of aquitards; therefore, the values in these registers is zero for all model layers. Individual parameter files (that is, files containing a list of numerical values for every model node) can be loaded for any of the registers either directly in the MicroFEM interface or via a batch file during transient simulation (as will be discussed in a subsequent section).

**Note – the top level register can be populated with water table elevations (H1 values) so that model layer elevations are internally calculated/displayed when viewing the model in profile or when running groundwater flowlines. For the purposes of the current analysis, the top level values in SACFEM2013 are zero for all nodes.*

FIGURE 42
SACFEM2013 Thickness Tab

Parar | Thick | Stor | Top | Xtra

0	top level	[r	0.00000
1	aquitard	[r	0.00000
	aquifer	[n	18.46144
2	aquitard	[r	0.00000
	aquifer	[n	29.53829
3	aquitard	[r	0.00000
	aquifer	[n	29.53829
4	aquitard	[r	0.00000
	aquifer	[n	29.53829
5	aquitard	[r	0.00000
	aquifer	[n	40.61520
6	aquitard	[r	0.00000
	aquifer	[n	49.23040
7	aquitard	[r	0.00000
	aquifer	[n	73.57520

5.1.3 SACFEM2013 Storativity File (Stor Tab)

The storativity file (SACFEM_2013.sto) contains the storage values for all model nodes. This includes the specific yield of model Layer 1 and the specific storage values for model Layers 2 through 7. A display of the thickness tab via the MicroFEM interface is included on Figure 43. Individual parameter files (that is, files containing a list of numerical values for every model node) can be loaded for any of the registers either directly in the MicroFEM interface or via a batch file during transient simulation (as will be discussed in a subsequent section).

FIGURE 43
SACFEM2013 Storage Tab

Parar | Thick | Stor | Top | Xtra

1	coefficient	0.12
2	coefficient	0.002458
3	coefficient	0.002458
4	coefficient	0.002458
5	coefficient	0.003606
6	coefficient	0.003941
7	coefficient	0.005421

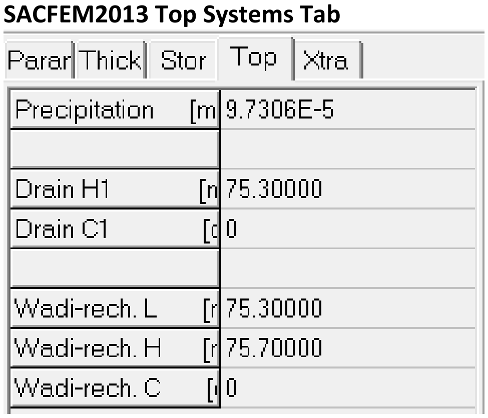
5.1.4 SACFEM2013 Top Systems ("Top" Tab)

The top systems tab comprises the data for boundary conditions that are applied to the "top" of the SACFEM2013 model. This means that the data are either head-dependent boundary conditions that are calculated relative to the simulated groundwater elevations in model Layer 1 or specified flux conditions that are applied to the top of the water table. SACFEM2013 contains the following top systems, as shown on Figure 44:

- Precipitation file (*.ppn) – includes a linear rate representing groundwater recharge from precipitation and applied irrigation water at every model node.
- Drainage file (*.dh1 and *.dc1) – contains the drain elevation and resistance term for every model node for a given stress period.
- Wadi System (*.wh1, *.wl1, and *.wc1) – contains the stream stage (*.wh1) and streambed (*.wl1) elevations and streambed resistance term (*.wc1) for all active stream nodes for a given stress period.

**Note: In the Example on Figure 44, both the drain and wadi resistance terms are 0, denoting that there are no active head-dependent boundary conditions for this particular node during this stress period (i.e., likely a dry or critical stress period).*

FIGURE 44
SACFEM2013 Top Systems Tab



As will be discussed in more detail in a subsequent section, the transient SACFEM2013 simulation includes the loading of a new and unique set of top system data files for every stress-period in the 41-year model simulation.

5.1.5 SACFEM2013 Extra Register ("Xtra" Tab)

The extra file (SACFEM_2013.xtr) contains 99 registers that are used to store numerical data for every model node. The data stored in the extra register are not used directly by MicroFEM when running the model; however, the data stored in a particular register can be referenced in a calculation during a transient simulation. The first 38 registers of SACFEM_2013.xtr are shown on Figure 45. The use of the extra register during SACFEM2013 simulations is discussed in a subsequent section.

5.1.6 Other MicroFEM Files

There are two other basic types of files used in MicroFEM, label files (*.lb) and parameter files (*.par). These are ASCII files that contain a MicroFEM header line followed by lines containing data for every model node. Label files contain text strings (alpha/numeric characters), and parameter files contain numerical values. Both text and numeric data can be assigned to each of the respective file types for all or a subset of the model nodes. In the event that data are assigned to a subset of the model domain, nodes without data will have null lines in the label file and a value of zero in a parameter file (that is the ASCII file will still have a line for every model node).

FIGURE 45
SACFEM2013 Xtra Register

Parar | Thick | Stor | Top | Xtra

x1	mdist (meters)	6533.006
x2	...	0
x3	NODE NUMBI	2639
x4	Nodal Area (m	391707.6
x5	GSE combine	75.3
x6	Kx 1 m/d	10.55371
x7	Kx 2-5 m/day	10.55371
x8	Kx 6-7 m/day	10.55371
x9	...	0
x10	Kh:Kv	500
x11	...	0
x12	wl1 (mNAVD8	75.3
x13	...	0
x14	DEM min mNA	76.241
x15	DEM mean ml	77.5118
x16	...	0
x17	wc1 nearest n	484.733
x18	wc1 old grid	0
x19	...	0
x20	UrbanQ	0
x21	...	0
x22	Mtn Front Recl	0
x23	Mtn Front Fact	0
x24	...	0
x25	temp wc1	484.733
x26	...	0
x27	09/86 h1 ft NA	235.4629
x28	DTW_ftbgs	11.59637
x29	L1Bottom_ftbg	77.21637
x30	L2 Bottom ft bg	193.2653
x31	L3 Bottom ft bg	309.3143
x32	L4 Bottom ft bg	425.3633
x33	L5 Bottom ft bg	591.6729
x34	L6 Bottom ft bg	854.2366
x35	L7 Bottom ft bg	1454.076
x36	...	0
x37	Orig wc1	484.733
x38	Run02 WC1	484.733

5.2 Preparation of Input Data-Sets

As discussed in Sections 3.2.4 and 3.2.5, detailed evaluations have been performed to develop transient surface water and agricultural water budgets as well as distributions of stream stage and flood bypass inundation. This section describes the utility that processes these raw data into monthly SACFEM2013 input files. Monthly model input files and the SACFEM2013 transient batch file are generated with the pre-processing utility "*PPN_Q_Generator_SACFEM_2013.xlsm.*" This utility is an Excel-based file containing several macros to generate the various SACFEM2013 files.

5.2.1 SACFEM2013 Input File Generation – The "Input" Worksheet

The Input worksheet of the pre-processing utility contains three macros that are used to generate the monthly deep percolation of precipitation/applied water (*.PPN), pumping (*.q), and wadi/drain (*.wh1, *.wc1, and *.dc1) files.

5.2.1.1 Water Budget Input File Information

This portion of the worksheet (see Figure 46) directs the macros to the water budget and stream stage files. In the first row, the user should enter the complete file path to the folder in which the files are saved. The file names for the deep percolation, agricultural pumping, and stream stage files are entered on the following lines. The files are in a space-delimited ASCII format where rows represent data for each SACFEM2013 model node and columns represent each month of the simulation period. The data contained in the deep percolation and agricultural pumping files are in units of acre-feet per month (ac-ft/month). As will be discussed below, the pre-processing utility converts these arrays to the appropriate units for input to SACFEM2013, m/day (*.PPN) and m^3/day (*.q). The surface water stage file contains data representing the stream, bypass, or reservoir stage (in units of meters [m] NAVD88) for each SACFEM2013 model node. A flag of -99 is assigned to non-surface water nodes (for all stress periods) and to surface water nodes for stress periods when the stream or bypass is dry. The use of this flag in the SACFEM2013 input file generation will be discussed further below.

Note: If any of the water budget or stream input files are revised in the future, it is important that they be formatted consistently with the ASCII text files included in the SACFEM2013 release. Any differences in number of header rows, column spacing/number, etc. could result in generation of input files with incorrect values or failure of the macro to run successfully.

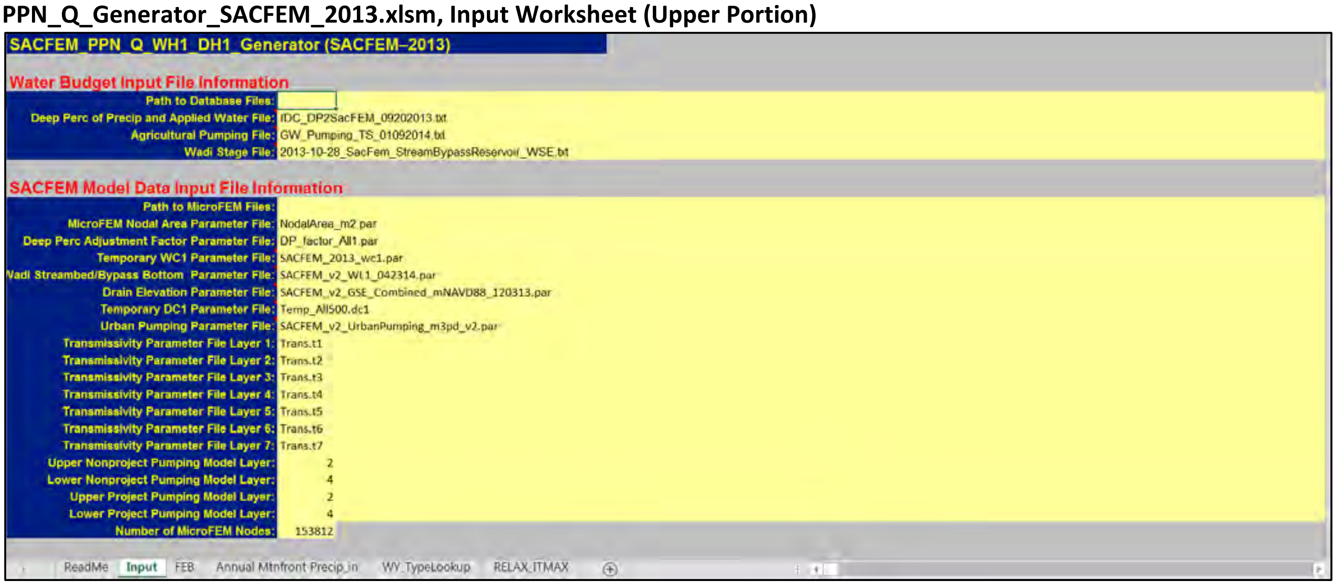
5.2.1.2 SACFEM2013 Model Data Input File Information

This portion of the worksheets (see Figure 46) directs the macros to generate the SACFEM2013 parameter files necessary for the various calculations and conversions. The first line is where the user inputs the file path to the parameter files. The necessary parameter files include the following:

- **MicroFEM nodal area**: a parameter file that contains the area of every SACFEM2013 model node (m^2)
- **Deep percolation adjustment factor**: a parameter file that can be used to assign multipliers to the groundwater recharge arrays for all or a subset of the model domain. For SACFEM2013, the adjustment factors are 1 for all model nodes, meaning that no adjustments are made to the IDC deep percolation values.
- **Temporary wc1**: a parameter file containing the streambed resistance term ($days^{-1}$) for stream, bypass, and reservoir nodes (calculated using Equation 6) and a value of 0 for all non-surface water nodes. These data are used when generating *.wc1 files.
- **Wadi streambed/bypass bottom**: a parameter file containing the stream, bypass, and reservoir bottom elevations (mNAVD88) and a value of 0 for all non-surface water nodes. These data are used to assign *.wl1 values.
- **Drain elevation**: a parameter file containing ground surface elevations (mNAVD88) for all SACFEM2013 model nodes. These data are used when generating *.dh1 files.

- **Temporary dc1**: a parameter file containing the drain resistance term (for SACFEM2013 this value is 500 for all nodes). This file is used when generating *.dc1 files.
- **Urban pumping**: a parameter file containing total annual urban pumping (described in Section 3.2.4.2) values (m^3/day). These data are combined with the agricultural pumping data when generating *.q files.
- **Transmissivity parameter**: parameter files containing nodal transmissivity values (m^2/day) for all SACFEM2013 nodes for each model layer. These data are used to apportion pumping to model layers based on relative transmissivity.
- **Upper and lower nonproject pumping model layer**: these rows are where the user specifies the upper and lower layers to which agricultural and urban pumping will be assigned. For SACFEM2013, agricultural and urban pumping are assigned to model Layers 2 through 4.
- **Upper/lower project pumping model layer**: these rows are where the user specifies the upper and lower layers to which any additional pumping (for a "with project" simulation) will be assigned. This user's manual assumes a no-action simulation; however, it is necessary to populate these rows for the macros to run.
- **Number of MicroFEM nodes**: the user inputs the total number of model nodes in this cell.

FIGURE 46
PPN_Q_Generator_SACFEM_2013.xlsm, Input Worksheet (Upper Portion)



Note: Agricultural and or project pumping should never be assigned to model Layer 1 using this pre-processing utility, as the data will be over-written with the mountain-front recharge data calculated/ assigned during the transient model simulation. If shallow pumping is desired, these data should be manually assigned in the SACFEM2013 batch file.

Note: The user-defined upper/lower pumping model layers cannot vary by stress periods. This means that the user-defined layers for agricultural/urban and pumping model layers are the same for the entire simulation period (i.e., pumping will always be assigned to model Layers 2 through 4 in this example on Figure 46 and will not shift to shallower or deeper layers for individual stress periods).

5.2.1.3 Output File Information

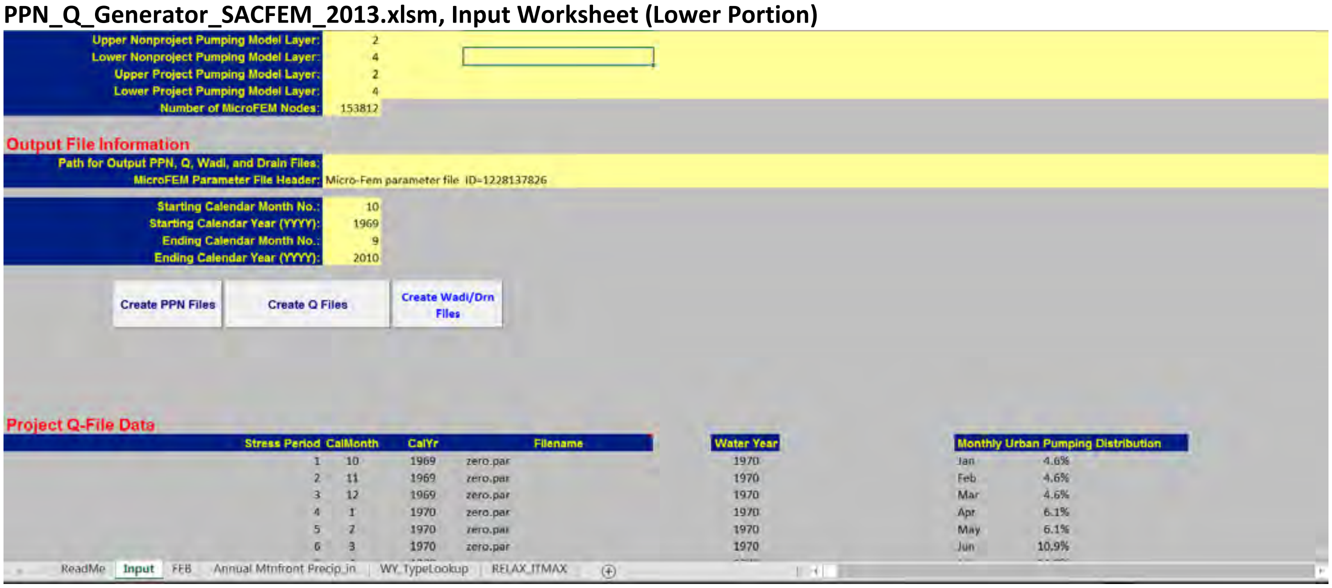
This section of the worksheet (see Figure 47) provides the macros to generate the output file information. The first row is where the user inputs the file path to the folder where all SACFEM2013 input files created by the macros will be stored. The next row is where the user specifies the MicroFEM header information that the macros include when generating the parameter files. The final set of rows is where the user defines the beginning and ending month/year for the simulation period. The macros use this information when naming the parameter files.

5.2.1.4 Project Q-File Data

As previously discussed, this user's manual describes the construction and calibration of a no-action version of SACFEM2013. Should the user wish to perform simulations that include additional project pumping (for example, to evaluate potential impacts of conjunctive water management projects), this Project Q-File Data section of the worksheet (see Figure 47) is where these data are incorporated. Although not completely displayed on Figure 47, this section of the worksheet includes rows for each of the 492 SACFEM2013 stress periods, with columns for the stress period number, the calendar month of the stress period, the calendar year of the stress period, and project pumping file name. The last column is where the user can input the name of a file containing nodal project pumping data (m^3/day). This file should contain pumping data only for nodes representing wells/project areas and should contain a value of 0 for all other nodes. The file name is entered only in cells representing stress periods when this additional pumping will occur (for example, during the irrigation season of dry or critical water years). The pumping information will then be apportioned vertically based on the model layer assignments defined in the preceding section and will be added to the agricultural/urban pumping data. In the example included in Figure 47, the parameter file zero.par is assigned to all stress periods. This means that when the macro is run, a value of 0 extra pumping will be added to the agricultural/urban pumping data.

This portion of the worksheet also includes the monthly distribution factors that the macro uses to distribute the annual urban pumping information (see Table 8).

FIGURE 47
PPN_Q_Generator_SACFEM_2013.xlsm, Input Worksheet (Lower Portion)



5.2.1.5 Create PPN Files Macro

The "Create PPN Files" button on the Input worksheet runs the macro that generates the monthly *.PPN input files. The macro reads the deep percolation of precipitation/applied water array, multiplies the data by the deep percolation adjustment factor (all 1 for SACFEM2013), and converts the data from values in units of ac-ft/month to linear rates of m/day. The macro then generates parameter files for each of the 492 stress periods with the naming convention of mm_yy.ppn, where mm represents the calendar month and yy represents the last two digits of the calendar year.

5.2.1.6 Create Q Files Macro

The "Create Q Files" button on the Input worksheet runs the macro that generates the monthly *.q input files. In general, the macro performs the following for each stress period:

- Reads the agricultural pumping array and converts the data from values in units of ac-ft/month to rates of m^3/day
- Apportions the annual urban pumping data based on the monthly distribution (see Table 8)
- Combines the agricultural and project-specific pumping data and apportions vertically based on the user-defined upper/lower model layers. The macro uses a weighting factor based on the relative transmissivity at each node for each model layer to apportion the pumping data. For example, the weighting factor for model Layer 2 is as follows:

$$Factor = \frac{\bar{A}_2}{\bar{A}_2 + \bar{A}_3 + \bar{A}_4} \quad (12)$$

Where T is the transmissivity (L^2/T) for a given model layer (2 through 4).

- Reads the project pumping parameter file and apportions vertically to the user-defined upper/lower “project” model layers using a similar factor as that defined in Equation 12 (modified as appropriate for the assigned model layers)
- Combines the agricultural, urban, and project (if included) pumping for all stress periods

The macro then generates parameter files for each of the 492 stress periods with the naming convention of mm_yy.q_x, where mm represents the calendar month, yy represents the last two digits of the calendar year, and x represents the model layer.

5.2.1.7 Create Wadi/Drain Files Macro

The “Create Wadi/Drn Files” button on the Input worksheet runs the macro that generates the monthly *.wh1, *.wc1, and *.dc1 input files. As will be discussed in Section 5.3.2, the streambed elevation (*.wl1) and drain elevation (*.dh1) values are assigned during the first stress period and do not vary throughout the SACFEM2013 simulation. This macro reads the stream/bypass/reservoir elevation array and writes the values to *.wh1 files for each of the SACFEM2013 stress periods. The macro also uses this array to generate stream (wc1) and drain (dc1) conductance files as follows:

- If the flag “-99” is present for any node/stress period, the macro will output a value of 0 to the corresponding *.wc1 file (meaning that the stream/bypass/reservoir is inactive at that node for that stress period) and will write the corresponding value from the user-specified temporary dc1 file (defined in the SACFEM2013 Model Data Input File Information section of the worksheet) to the *.dc1 file at that node for that stress period.
- If the flag “-99” is **not** present (i.e., a “true” elevation value is present) for any node/stress period, the macro will output the corresponding value from the user-specified temporary wc1 file (defined in the SACFEM2013 Model Data Input File Information section of the worksheet) to the *.wc1 file (meaning that the stream/bypass/reservoir is active at that node for that stress period) and will write a value of 0 (meaning that the drain boundary condition is inactive for that node/stress period) to the corresponding *.dc1 file at that node for that stress period.

Similar to the deep percolation and pumping files, the naming conventions for the wadi and drain files are mm_yy.wh1, mm_yy.wc1, and mm_yy.dc1.

5.2.2 SACFEM2013 Batch File Generation – The “FEB” Worksheet

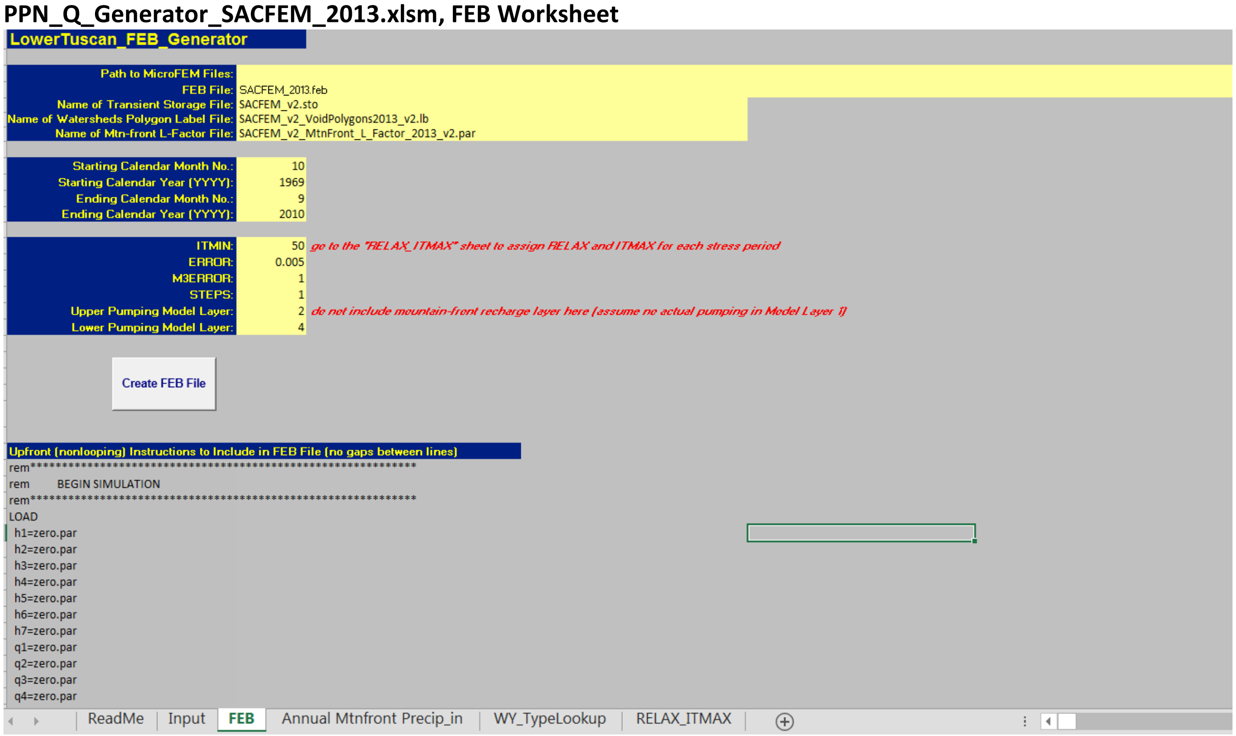
The FEB worksheet of the pre-processing utility contains one macro that is used to generate the batch file (*.feb) that runs the transient SACFEM2013 simulation. The SACFEM_2013.feb file is included as Appendix D for reference and is discussed in detail in Section 5.3.

5.2.2.1 User-Defined Information

The first section of the FEB worksheet includes cells where the user can define specific model input files as follows (see Figure 48):

- **Path to MicroFEM Files**: The user specifies the file path to the folder where the *.feb file will be saved in this cell.
- **FEB File**: The user specifies the name of the *.feb file in this cell.
- **Name of Transient Storage File**: The user specifies the name of the SACFEM2013 storage file in this cell. The file will not be accessed by the macro; however, the file name will be written to the *.feb file in the appropriate locations where it will be accessed during the transient simulation.
- **Name of Watersheds Polygon Label File**: The user specifies the name of the SACFEM2013 label file containing for the mountain-front recharge polygons in this cell. The file will not be accessed by the macro; however, the file name will be written to the *.feb file in the appropriate locations where it will be accessed during the transient simulation.
- **Name of Mtn-front L-Factor File**: The user specifies the name of SACFEM2013 parameter file used to scale the total mountain-front recharge for each polygon in this cell. The file will not be accessed by the macro; however, the file name will be written to the *.feb file in the appropriate locations where it will be accessed during the transient simulation.

FIGURE 48
PPN_Q_Generator_SACFEM_2013.xlsm, FEB Worksheet



The next section of the FEB worksheet includes cells where the user defines the beginning and ending calendar months and years for the simulation period (see Figure 48). The following section includes cells where the user defines criteria that are written to the TIME and RUN statements for each stress period. These include ITMIN (minimum number of iterations for each stress period), ERROR (closure criteria for error in heads, m), M3ERROR (closure criteria for water budget error for all stress periods, m^3/day), and STEPS (number of time steps for all stress periods). The assignment of ITMAX (maximum number of iterations for each stress period) and RELAX (solver relaxation factor) will be discussed in the macro execution section. The upper and lower pumping model layer cells are used to define the shallowest and deepest model layers where pumping (agricultural, urban, or project) occurs. The macro uses this information to determine how many *.q files for which to write load statements for all stress periods.

5.2.2.2 Non-Looping Batch File Text

The section of the FEB worksheet (following the cell containing the text "Upfront [non-looping] Instructions to include in FEB File ["no gaps between lines"]) includes syntax that is written verbatim directly to the batch file (See Figure 48). A detailed discussion of this portion of the batch file is provided in Section 5.3.1. In general, this portion of the batch file assigns initial model input parameters and opens model output files. If the user would like to change any input our output files, the file names and calculations can be updated in this portion of the pre-processor. Refer to Appendix D for an example of the SACFEM_2013.feb file and to Section 5.3.1 for a complete discussion of the syntax.

*Note: There can be no blank rows in this portion of the worksheet. The macro will only write text to the *.feb file up to the first blank row.*

5.2.2.3 Other Worksheets

There are three other worksheets accessed by the macro that generates the SACFEM2013 batch file, including "*Annual Mtnfront Precip_in,*" "*WY_TypeLookup,*" and "*RELAX_ITMAX*" (see Figure 48). The "*Annual Mtnfront Precip_in*" worksheet contains the data written to the *.feb file to estimate subsurface inflow along the margin of the model domain (see Figures 49a through 49d). The worksheet contains a column for each of the 34 mountain-front recharge polygons shown on Figure 22. The first three rows list the polygon number, the adjustment factor (multiplier to increase or decrease recharge for each polygon), and the area (in acres) of each polygon. The worksheet contains the following "blocks" of data that progress through the calculation of deep percolation for each calendar year and mountain front recharge polygons:

- Average precipitation (inches) across each polygon based on the PRISM dataset (see Box 47a)
- Deep percolation of precipitation (inches) for each polygon calculated using Equation 9 (see Figure 49b)
- Volumetric deep percolation of precipitation (m^3), calculated using the deep percolation values in the previous bullet and the polygon areas (see Figure 49c)
- Monthly distribution factors for mountain front recharge based on the distribution of unimpaired runoff of Deer Creek at the Vina stream gage (see Figure 49d).

The "*WY_TypeLookup*" worksheet contains data related to the water year index for the Sacramento and San Joaquin Valleys (see Figure 50). These data include unimpaired runoff, water year index, and water year classification. In SACFEM2013, this information is written as the header for each stress period of the simulation period for informational purposes only.

The "*RELAX_ITMAX*" worksheet is where the user can paste the simulation summary information from a previous simulation (see Figure 51) from the SACFEM2013 Run Log Reader (discussed below in Section 5.5.1). This information is used to determine if additional iterations or solver relaxation are needed for any stress periods.

FIGURE 49A

PPN_Q_Generator_SACFEM_2013.xlsm, Annual Mtnfront Precip_in Worksheet, PRISM Data

Subwatershed >	1	2	3	4	5	6	7	8	9	10	11
Mountain-front Adj Factor >	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	1
Acreage >	6,612	28,490	52,512	30,281	79,440	441	1,319	49,227	637	16,749	6,939
Calendar Year											
Annual Mountain-front Precipitation from PRISM/GIS (inches)											
1969	37.04	37.21	42.48	58.42	64.43	52.73	57.33	54.62	40.32	39.51	39.98
1970	38.29	38.70	43.87	59.13	64.90	50.45	54.95	52.63	39.51	38.06	38.58
1971	21.01	20.95	23.36	30.08	29.16	20.96	22.77	23.19	18.61	18.41	19.95
1972	28.17	27.56	29.43	37.08	37.98	29.12	31.41	30.62	23.45	23.29	24.17
1973	41.09	41.09	46.05	63.26	72.27	57.37	62.00	60.34	47.53	46.50	47.40
1974	30.46	30.23	33.62	45.59	49.16	38.74	42.55	40.10	28.47	28.07	28.52
1975	28.77	28.93	32.23	42.25	45.27	35.86	39.14	37.76	28.91	29.48	30.53
1976	13.40	13.12	14.14	17.12	16.92	13.24	14.18	12.87	9.31	9.61	9.55
1977	25.38	25.26	26.37	31.38	32.27	23.93	25.67	24.58	17.66	17.97	19.13
1978	36.06	36.19	39.34	51.17	58.29	45.99	49.37	46.63	33.49	33.26	34.14
1979	37.91	37.90	40.94	51.60	56.27	44.20	47.55	45.50	34.19	34.61	35.13
1980	27.18	27.28	30.10	40.45	45.77	34.66	37.52	34.94	22.68	23.05	24.54
1981	40.68	41.10	45.46	59.50	65.03	48.82	52.63	49.92	34.14	35.22	38.19
1982	36.22	36.62	40.96	55.04	60.33	47.63	51.72	51.37	39.45	39.87	43.09
1983	59.53	59.89	65.80	85.50	92.46	73.30	77.89	75.72	62.42	60.27	59.88
1984	24.05	23.71	25.91	33.31	35.08	27.26	29.45	28.88	22.57	21.93	22.50
1985	19.37	19.19	20.46	26.18	28.77	23.08	24.80	24.38	19.68	19.74	20.76
1986	32.68	33.21	37.22	50.70	54.54	41.97	45.43	44.97	36.86	34.57	33.12
1987	25.31	25.55	28.54	38.94	44.36	36.39	40.02	38.03	26.78	25.99	26.22
1988	24.96	24.68	26.20	33.16	36.20	28.32	31.08	30.63	22.68	22.57	24.23
1989	27.35	27.17	29.36	38.24	39.80	30.61	32.91	31.37	23.27	24.81	26.64
1990	20.11	19.81	21.09	27.05	30.22	24.11	26.64	26.91	21.29	21.14	22.74
1991	22.93	23.16	25.46	33.43	38.89	32.17	34.95	34.31	27.63	27.54	28.19
1992	26.62	27.76	30.50	38.63	44.42	35.57	38.08	37.50	30.20	29.96	30.06
1993	39.40	38.95	41.79	53.57	58.78	48.71	52.90	52.02	41.64	39.88	39.13
1994	25.79	25.52	26.79	32.92	37.34	31.02	33.33	32.61	26.26	25.06	25.10

FIGURE 49B

PPN_Q_Generator_SACFEM_2013.xlsm, Annual Mtnfront Precip_in Worksheet, Deep Percolation (inches)

Subwatershed >	1	2	3	4	5	6	7	8	9	10	11
Mountain-front Adj Factor >	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	1
Acreage >	6,612	28,490	52,512	30,281	79,440	441	1,319	49,227	637	16,749	6,939
Calendar Year											
Annual Deep Percolation of Mountain-front Precipitation via Turner Equation (inches)											
1969	11.88	11.97	14.93	24.43	28.16	20.96	23.75	22.10	13.71	13.25	13.52
1970	12.57	12.80	15.73	24.86	28.46	19.59	22.30	20.90	13.25	12.44	12.73
1971	3.70	3.68	4.80	8.14	7.67	3.68	4.52	4.72	2.63	2.55	3.22
1972	7.16	6.85	7.81	11.90	12.40	7.65	8.84	8.43	4.84	4.76	5.18
1973	14.14	14.14	17.00	27.43	33.15	23.78	26.64	25.61	17.86	17.26	17.79
1974	8.34	8.22	10.01	16.73	18.82	12.82	14.97	13.58	7.32	7.11	7.34
1975	7.47	7.55	9.27	14.80	16.54	11.23	13.04	12.27	7.54	7.83	8.38
1976	0.54	0.43	0.81	2.00	1.92	0.48	0.83	0.34	0.00	0.00	0.00
1977	5.77	5.71	6.26	8.82	9.29	5.07	5.92	5.38	2.23	2.36	2.86
1978	11.34	11.40	13.15	20.02	24.34	16.96	18.95	17.33	9.94	9.82	10.29
1979	12.36	12.35	14.05	20.28	23.11	15.92	17.87	16.67	10.32	10.54	10.83
1980	6.67	6.72	8.15	13.78	16.83	10.57	12.14	10.73	4.47	4.65	5.36
1981	13.91	14.15	16.65	25.09	28.54	18.62	20.90	19.28	10.29	10.87	12.51
1982	11.43	11.64	14.06	22.36	25.61	17.92	20.35	20.14	13.21	13.45	15.28
1983	25.11	25.33	29.03	41.79	46.43	33.81	36.79	35.37	26.90	25.57	25.33
1984	5.12	4.96	6.03	9.85	10.80	6.71	7.82	7.53	4.42	4.12	4.39
1985	2.97	2.88	3.45	6.16	7.47	4.66	5.49	5.28	3.10	3.13	3.59
1986	9.51	9.79	11.98	19.74	22.05	14.64	16.63	16.36	11.78	10.52	9.75
1987	5.74	5.85	7.35	12.93	16.01	11.52	13.54	12.42	6.46	6.07	6.19
1988	5.56	5.43	6.17	9.77	11.41	7.24	8.67	8.43	4.48	4.42	5.21
1989	6.75	6.66	7.77	12.54	13.41	8.42	9.63	8.82	4.75	5.49	6.39
1990	3.29	3.16	3.74	6.60	8.22	5.15	6.39	6.53	3.83	3.76	4.50
1991	4.59	4.70	5.81	9.91	12.90	9.24	10.73	10.38	6.89	6.85	7.18
1992	6.39	6.96	8.36	12.76	16.05	11.07	12.45	12.13	8.21	8.08	8.13
1993	13.19	12.94	14.54	21.46	24.64	18.56	21.06	20.53	14.45	13.46	13.04
1994	5.97	5.84	6.47	9.64	12.04	8.64	9.86	9.47	6.20	5.61	5.63

FIGURE 49C

PPN_Q_Generator_SACFEM_2013.xlsm, Annual Mtnfront Precip_in Worksheet, Deep Percolation (cubic meters)

Subwatershed >	1	2	3	4	5	6	7	8	9	10	11
Mountain-front Adj Factor >	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	1
Acreage >	6,612	28,490	52,512	30,281	79,440	441	1,319	49,227	637	16,749	6,939
Calendar Year											
Annual Volumetric Deep Percolation of Mountain-front Precipitation via Turner Equation (m³)											
1969	8,071,480	35,050,083	80,605,692	76,028,964	229,983,341	949,454	3,220,633	111,833,985	897,801	22,812,497	9,639,695
1970	8,540,053	37,478,822	84,904,385	77,394,633	232,419,920	887,594	3,023,540	105,745,704	867,913	21,415,694	9,077,969
1971	2,514,789	10,762,618	25,894,427	25,346,695	62,628,598	166,697	612,367	23,868,833	172,431	4,385,048	2,298,967
1972	4,868,526	20,071,262	42,148,923	37,034,436	101,218,583	346,541	1,198,707	42,633,113	317,006	8,202,694	3,695,924
1973	9,611,016	41,405,970	91,739,838	85,387,637	270,678,006	1,077,150	3,612,435	129,581,549	1,170,179	29,711,012	12,686,701
1974	5,671,034	24,073,294	54,051,945	52,062,486	153,711,320	580,557	2,030,326	68,704,380	479,358	12,246,062	5,237,541
1975	5,076,445	22,107,389	50,033,016	46,059,780	135,048,448	508,549	1,768,261	62,106,245	493,996	13,487,115	5,975,688
1976	364,180	1,270,798	4,371,530	6,216,931	15,643,786	21,708	112,292	1,732,334	0	0	0
1977	3,922,187	16,735,807	33,782,660	27,461,024	75,898,513	229,521	802,062	27,233,785	145,809	4,057,033	2,040,307
1978	7,704,806	33,398,259	70,990,153	62,312,836	198,791,587	768,284	2,569,035	87,707,900	651,265	16,905,719	7,339,410
1979	8,399,181	36,160,859	75,858,293	63,113,538	188,686,579	721,149	2,423,463	84,374,426	676,092	18,152,619	7,721,904
1980	4,530,364	19,666,373	44,005,930	42,887,189	137,424,347	479,008	1,645,796	54,282,984	292,992	8,006,408	3,825,351
1981	9,452,107	41,423,908	89,869,165	78,091,343	233,084,406	843,629	2,833,713	97,540,479	674,270	18,722,112	8,922,968
1982	7,765,646	34,092,872	75,913,344	69,593,014	209,089,117	811,982	2,759,548	101,910,316	865,577	23,155,986	10,899,293
1983	17,067,438	74,178,240	156,674,788	130,083,151	379,133,110	1,531,712	4,988,155	178,994,011	1,762,346	44,019,941	18,063,191
1984	3,482,213	14,530,594	32,560,686	30,653,605	88,206,781	303,817	1,060,246	38,087,114	289,638	7,100,445	3,130,109
1985	2,015,730	8,446,822	18,635,763	19,187,783	61,010,114	211,153	743,781	26,741,988	203,096	5,388,490	2,558,045
1986	6,463,058	28,681,604	64,640,404	61,450,113	180,071,696	663,300	2,255,280	82,806,498	771,442	18,118,156	6,950,492
1987	3,899,282	17,145,857	39,683,449	40,242,453	130,753,610	521,718	1,835,205	62,843,763	423,466	10,455,525	4,412,129
1988	3,782,340	15,897,637	33,329,303	30,405,928	93,180,662	328,086	1,175,221	42,656,604	293,155	7,615,765	3,717,639
1989	4,587,624	19,505,064	41,953,255	39,024,206	109,519,337	381,508	1,306,154	44,613,700	311,201	9,455,969	4,558,933
1990	2,237,427	9,249,149	20,175,056	20,540,861	67,099,018	233,406	866,674	33,044,837	250,815	6,474,223	3,212,291
1991	3,121,374	13,759,252	31,367,924	30,848,415	105,354,343	418,467	1,454,818	52,543,534	451,297	11,785,025	5,117,497
1992	4,340,502	20,375,485	45,145,519	39,703,341	131,035,548	501,361	1,688,332	61,370,967	537,726	13,916,972	5,801,050
1993	8,962,523	37,888,549	78,462,276	66,811,794	201,232,422	840,727	2,855,416	103,898,597	946,792	23,165,189	9,298,666
1994	4,060,245	17,105,728	34,922,717	30,006,312	98,328,646	391,194	1,336,880	47,926,602	406,316	9,663,304	4,016,904

FIGURE 49D

PPN_Q_Generator_SACFEM_2013.xlsm, Annual Mtnfront Precip_in Worksheet, Monthly Distribution

Subwatershed >	1	2	3	4	5	6	7	8	9	10	11
Mountain-front Adj Factor >	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	1
Acreage >	6,612	28,490	52,512	30,281	79,440	441	1,319	49,227	637	16,749	6,939
Calendar Year											
Assumed Monthly Distribution of Deep Percolation of Mountain-front Precipitation from Mean of Monthly Streamflows for Deer Creek Near Vina (percent)											
Jan	14.2%										
Feb	15.2%										
Mar	15.4%										
Apr	13.6%										
May	10.3%										
Jun	5.1%										
Jul	3.1%										
Aug	2.6%										
Sep	2.4%										
Oct	3.0%										
Nov	4.9%										
Dec	10.2%										
Sum	100.0%										

FIGURE 50

PPN_Q_Generator_SACFEM_2013.xlsm, WY_TypeLookup Worksheet

	Sacramento Valley					San Joaquin Valley				
WY	Oct-Mar (maf)	Apr-Jul (maf)	WYsum (maf)	Index	Yr-type	Oct-Mar (maf)	Apr-Jul (maf)	WYsum (maf)	Index	Yr-type
1970	18.87	4.35	24.06	10.4	W	2.55	2.96	5.61	3.18	AN
1971	12.71	8.9	22.57	10.37	W	1.56	3.23	4.91	2.89	BN
1972	7.61	5.02	13.43	7.29	BN	1.25	2.22	3.57	2.16	D
1973	12.8	6.38	20.05	8.58	AN	1.87	4.48	6.47	3.5	AN
1974	21.69	9.78	32.5	12.99	W	2.43	4.53	7.12	3.9	W
1975	9.24	8.95	19.23	9.35	W	1.37	4.65	6.18	3.85	W
1976	4.63	2.75	8.2	5.29	C	0.78	1.07	1.97	1.57	C
1977	2.49	1.93	5.12	3.11	C	0.22	0.8	1.05	0.84	C
1978	14.9	8.12	23.92	8.65	AN	2.57	6.5	9.65	4.58	W
1979	6.06	5.64	12.41	6.67	BN	1.87	3.99	5.98	3.67	AN
1980	15.49	6	22.33	9.04	AN	3.74	5.41	9.47	4.73	W
1981	6.81	3.63	11.1	6.21	D	0.85	2.29	3.22	2.44	D
1982	20.56	11.82	33.41	12.76	W	3.78	7	11.41	5.45	W
1983	22.75	13.66	37.68	15.29	W	5.42	8.73	15.01	7.22	W
1984	15.98	5.52	22.35	10	W	3.51	3.48	7.13	3.69	AN
1985	6.24	4	11.04	6.47	D	1.11	2.41	3.6	2.4	D
1986	19.45	5.45	25.83	9.96	W	4.36	4.92	9.5	4.31	W
1987	5.85	2.8	9.27	5.86	D	0.55	1.48	2.08	1.86	C
1988	5.78	2.9	9.23	4.65	C	0.86	1.55	2.48	1.48	C
1989	9.03	5.07	14.82	6.13	D	1.07	2.42	3.56	1.96	C
1990	4.94	3.72	9.26	4.81	C	0.83	1.59	2.46	1.51	C
1991	3.9	4.01	8.44	4.21	C	0.56	2.57	3.2	1.96	C
1992	5.41	2.93	8.87	4.06	C	0.86	1.66	2.58	1.56	C
1993	12.44	8.98	22.21	8.54	AN	2.49	5.65	8.38	4.2	W
1994	4.55	2.73	7.81	5.02	C	0.66	1.8	2.54	2.05	C
1995	19.83	13.6	34.55	12.89	W	3.67	8.01	12.32	5.95	W
1996	13.05	8.37	22.29	10.26	W	2.57	4.51	7.22	4.12	W
1997	20.22	4.39	25.42	10.82	W	5.75	3.59	9.51	4.13	W
1998	17.65	12.54	31.4	13.31	W	2.82	7.11	10.43	5.65	W

Source: http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST

ReadMe | Input | FEB | Annual Mtnfront Precip_in | WY_TypeLookup | RELAX_ITMAX

FIGURE 51

PPN_Q_Generator_SACFEM_2013.xlsm, RELAX_ITMAX Worksheet

Stress Period -1	Sim Time	Time Units	Month	CalYr	DecYr	Iterations	Max Head Diff (m)	Max Flux Diff (m³)	Node of Max Head Change	Layer of Max Head Change	Relax	Itmax	NewRelax	NewItmax
0	31	days	9	1969	1969.75	399	0.002608	0.9976	45850	4	1	1000	1	1000
1	61	days	10	1969	1969.833333	131	0.004949	0.737	43548	1	0	600	0	600
2	92	days	11	1969	1969.916667	128	0.0041	0.9641	56065	1	0	600	0	600
3	123	days	12	1969	1970	131	0.003624	0.9822	56065	1	0	600	0	600
4	151	days	1	1970	1970.083333	123	0.002967	0.9893	56065	1	0	600	0	600
5	182	days	2	1970	1970.166667	126	0.002978	0.9665	56065	1	0	600	0	600
6	212	days	3	1970	1970.25	118	0.004924	0.9967	56065	1	0	600	0	600
7	243	days	4	1970	1970.333333	126	0.002797	0.9878	87289	7	0	600	0	600
8	273	days	5	1970	1970.416667	126	0.002521	0.9906	84930	7	0	600	0	600
9	304	days	6	1970	1970.5	131	0.002365	0.9859	87289	7	0	600	0	600
10	335	days	7	1970	1970.583333	119	0.001876	0.9969	88471	7	0	600	0	600
11	365	days	8	1970	1970.666667	94	0.00181	0.9648	87337	7	0	600	0	600
12	396	days	9	1970	1970.75	343	0.002854	0.9979	45849	4	1	1000	1	1000
13	426	days	10	1970	1970.833333	122	0.004281	0.9745	56065	1	0	600	0	600
14	457	days	11	1970	1970.916667	129	0.003085	0.9812	56065	1	0	600	0	600
15	488	days	12	1970	1971	126	0.002772	0.9669	56065	1	0	600	0	600
16	516	days	1	1971	1971.083333	115	0.00281	0.9997	56065	1	0	600	0	600
17	547	days	2	1971	1971.166667	117	0.003296	0.9762	56065	1	0	600	0	600
18	577	days	3	1971	1971.25	116	0.003933	0.9648	56065	1	0	600	0	600
19	608	days	4	1971	1971.333333	125	0.002472	0.9698	84930	7	0	600	0	600
20	638	days	5	1971	1971.416667	129	0.002367	0.981	84930	7	0	600	0	600
21	669	days	6	1971	1971.5	133	0.002037	0.9813	84930	7	0	600	0	600
22	700	days	7	1971	1971.583333	121	0.001801	0.9673	89645	7	0	600	0	600
23	730	days	8	1971	1971.666667	96	0.001704	0.9689	88450	7	0	600	0	600
24	761	days	9	1971	1971.75	121	0.002808	0.9706	84930	7	0	600	0	600
25	791	days	10	1971	1971.833333	205	0.003164	0.999	12308	4	1	1000	1	1000
26	822	days	11	1971	1971.916667	122	0.003222	0.9737	56065	1	0	600	0	600
27	853	days	12	1971	1972	118	0.003397	0.9798	56065	1	0	600	0	600
28	881	days	1	1972	1972.083333	113	0.002897	0.9904	56065	1	0	600	0	600
29	912	days	2	1972	1972.166667	109	0.004912	0.9697	56065	1	0	600	0	600

ReadMe | Input | FEB | Annual Mtnfront Precip_in | WY_TypeLookup | RELAX_ITMAX

5.2.2.4 Create FEB File Macro

The "Create FEB File" button on the FEB worksheet runs the macro that generates the SACFEM2013 transient batch file. As described above, the static (non-looping) text included on the FEB worksheet is written directly to the batch file. For each stress period, the macro performs the following:

- Writes statements for each mountain front polygon to assign the annual volumetric deep percolation of precipitation (from the *Annual Mtnfront Precip*_worksheet) along the mountain front to an extra register
- Writes equations for each mountain front polygon to calculate the daily volumetric flux for the stress period, incorporating the monthly distribution factor and the mountain-front recharge adjustment factor (from the *Annual Mtnfront Precip*_worksheet) as well as the number of days in the month
- Writes a statement to apportion the mountain-front recharge among the nodes for each polygon and loads/saves the volumetric flux as a *.q1 (model Layer 1 pumping file)
- Writes a header specifying the water year type (from the *WY_TypeLookup* worksheet)
- Writes statements to load the *.ppn, *.wh1, *.wc1, *.dc1, and *.q files (based on the user-defined upper/lower pumped layers on the FEB worksheet)
- Writes the TIME and RUN statements populated with the user-defined time steps, iterations, and closure criteria. For ITMAX and RELAX, the macro reads the specified number of iterations and the actual number of iterations used on the *RELAX_ITMAX* worksheet. If the model failed to converge for a given stress period for a previous simulation, the macro increases the ITMAX from 600 to 1,000 and assigns a RELAX value of 1.
- Writes statements to save the head files at the end of the stress period

5.3 Running SACFEM2013 – The MicroFEM Batch File

Model calculations can be performed in two manners by MicroFEM. The first is by direct steady-state calculation in the MicroFEM calculation window (see Figure 52). The second is by loading a batch file (*.feb) into the MicroFEM project (either by adding a batch file to the *.fpr file name in a text editor or by opening an *.fpr file through the calculation window [see Figure 53]). The MicroFEM batch file (*.feb) is an ASCII file that can be opened and edited either in the MicroFEM calculation window or in a text editor. The *.feb file contains all commands necessary to perform a given model simulation (loading, calculating, and assigning model input parameters; executing the run statement; managing model output). Refer to the MicroFEM User's Manual or help menu for a list of commands available for use in a *.feb file.

**Note: if storage values of zero are assigned, a steady-state simulation can be executed via a MicroFEM batch file.*

An example batch file, SACFEM_2013.feb, is included in Appendix D. This is the batch file currently used for the baseline condition (no project) SACFEM2013 calibration simulation. As discussed in the preceding section, SACFEM_2013.feb is generated with the pre-processing utility "*PPN_Q_Generator_SACFEM_2013.xlsm*." The following sections describe and explain the syntax used in each portion of the batch file.

FIGURE 52
MicroFEM Calculation Window, Options Tab

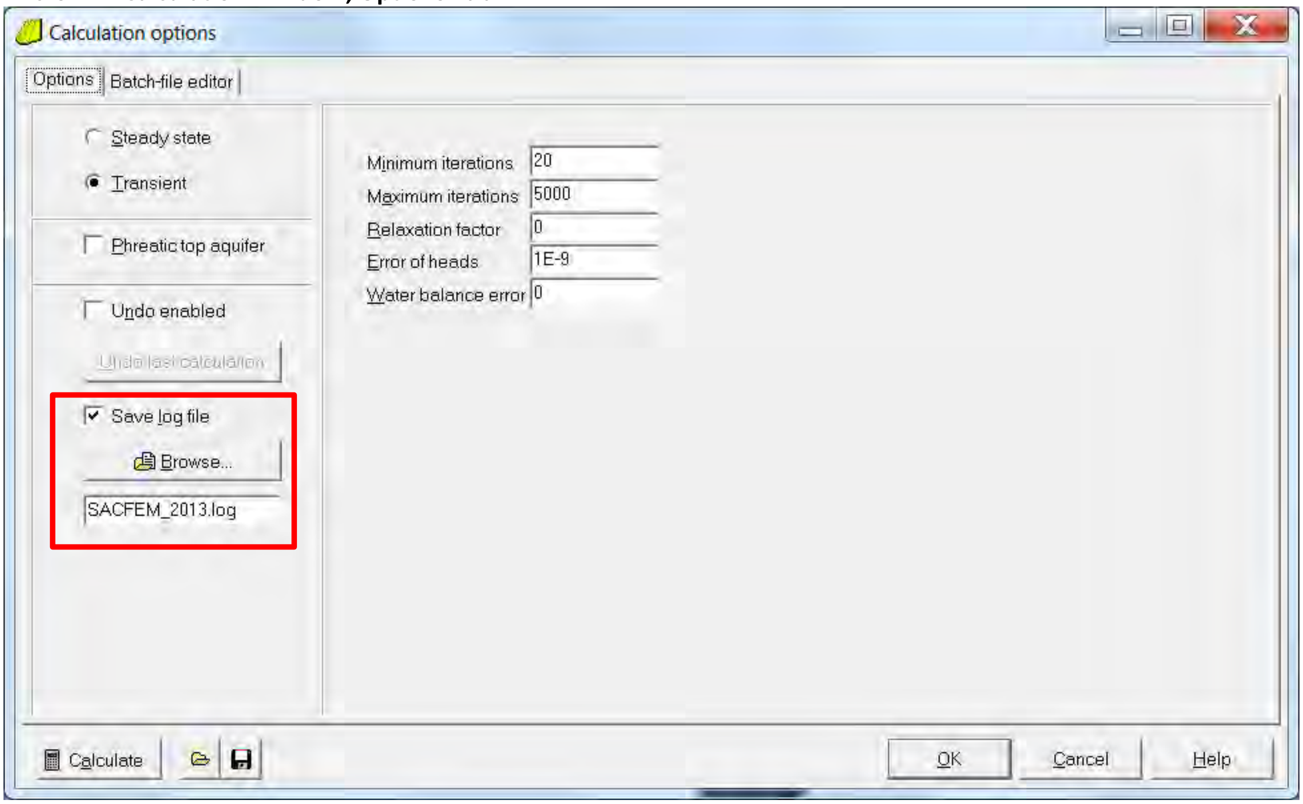
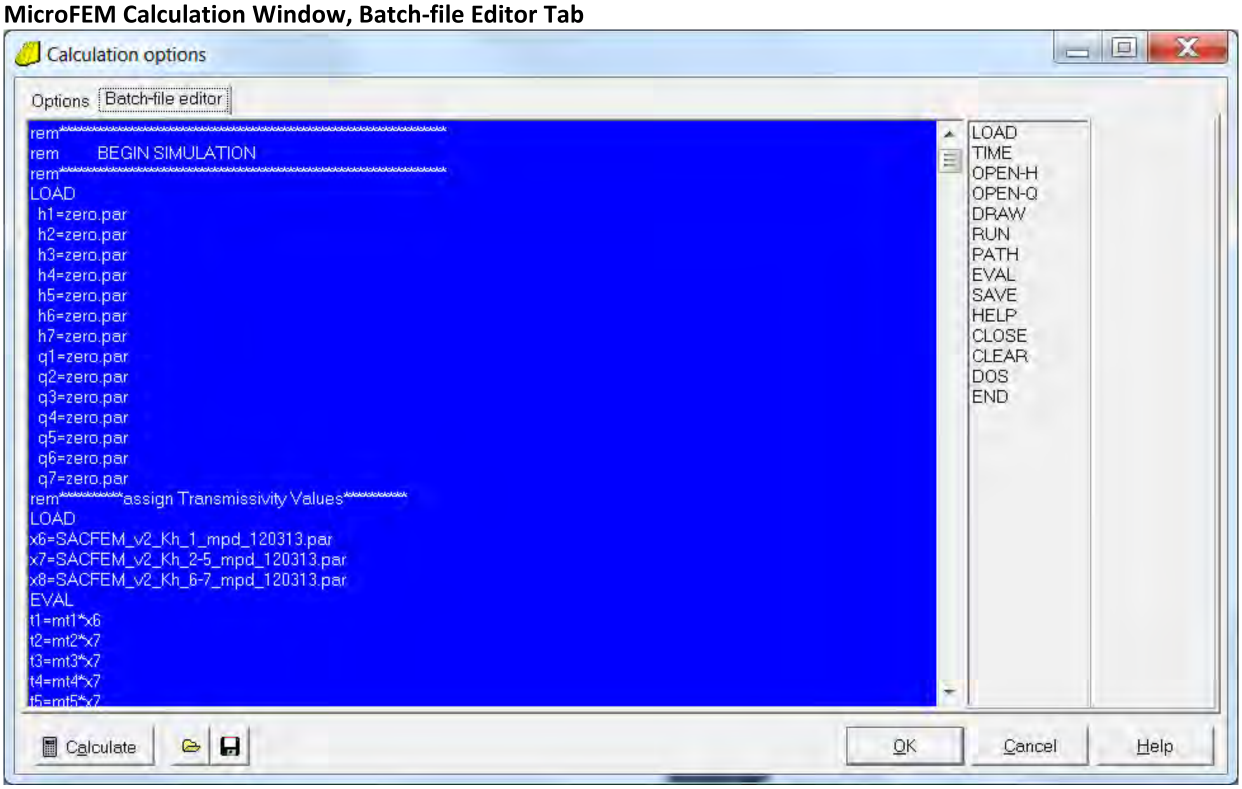


FIGURE 53
MicroFEM Calculation Window, Batch-file Editor Tab



5.3.1 Non-Looping Batch File

5.3.1.1 Assignment of Model Input Parameters

The non-looping portion of SACFE_2013.feb is responsible for assigning initial model parameters and opening of model output files.

*Note: Each line of a *.feb file that begins with "rem" represents remarks (i.e., notes) for the reader. MicroFEM does not read/consider "rem" statements in the model calculation.*

The first section of the non-looping batch file (following the "BEGIN SIMULATION" header) zeros out the initial head and pumping parameters for all nodes/layers. This is done by loading (via the LOAD command) a parameter file, Zero.par, containing a value of zero for every model node into each head and discharge register.

The next section of the batch file (following the rem**********assign Transmissivity Values********** header) calculates the transmissivity values for all model nodes/layers. The first step in the process involves loading parameter files containing horizontal hydraulic conductivity values for each "grouping" of model layers (described in Section 3.2.2) into extra registers. In the case of SACFEM_2013, these are registers x3, x4, and x5. The MicroFEM "Eval" command is then used to directly calculate and assign the transmissivity for each model layer (t1 through t7) by multiplying the model layer thickness (mt1 through mt7) by the horizontal hydraulic conductivity contained in the extra register. For example, the formula to calculate the transmissivity of t1 is as follows:

$$\bar{A}1 = \bar{A}\bar{A}1 \times \bar{A}3 \qquad (13)$$

Where:

t1 = transmissivity of model layer 1 (L^2/T)
mt1 = thickness of model layer 1 (L)
x3 = extra register containing the horizontal hydraulic conductivity of model layer 1 (L/T)

*Note: The current version of SACFEM2013 assumes that the thickness register has been populated with the appropriate thickness values for each model layer (i.e., SACFEM_2013.thi is loaded into the *.fpr); therefore, thickness values are not directly assigned in the batch file.*

The batch file then saves (using the SAVE command) parameter files for each model layer containing transmissivity values for all model nodes.

As previously discussed, SACFEM2013 does not explicitly simulate aquitards between model layers; however, vertical resistance to groundwater flow across model layer interfaces is simulated using the vertical resistance term. The next portion of the batch file (following the rem**********assign vertical resistance values ********** header) calculates the vertical resistance terms for each model layer (c2 through c7). The first step involves loading a parameter file (SACFEM_v2_KhKv_Ratio_500.par) containing the Kh:Kv values for each model node into extra register x6. The values included in the parameter file are those described in Section 3.2.2. The batch file then calculates the vertical resistance term using Equation 2 and the previously assigned model transmissivity, thickness, and Kh:Kv values. The calculations use a Kh:Kv of 50:1 for model Layer 1 and the anisotropy factors loaded into x6 for all other model layers.

Following assignment of vertical resistance terms, the batch file loads two parameter files (ground surface elevation and streambed elevation) into the extra register. This process loads the data for user review; however, the extra registers are not used for subsequent calculations in the SACFEM2013 simulation.

5.3.1.2 Opening Transient Water Budget Files

The final section of the batch file (following the rem**********open ftq files********** header) opens transient head (*.fth) and flux (*.ftq) files that can be used to evaluate model calibration and potential impacts (in the case of a "with project" simulation). Transient head files are used to save time series (for each stress period) simulated head data for a user-defined set of model nodes. Transient flux files save volumetric flux data for all water budget components for a user-defined set of model nodes. Refer to the MicroFEM User's Manual or Help menu for more information about these files.

The first transient water budget file opened in the batch file is the "all.ftq" file. The first step in the process is to load a label file into the Label 1 register (default register included in the *.fem file) that contains the text "all" at every node within the SACFEM2013 model domain. Next, the transient flux file "all.ftq" is opened using the syntax "open-q all=all.ftq upper=1 lower=7." MicroFEM opens the transient flux file and aggregates the water budget components for every node containing the text "all" in the label register (in this case, every node in the model domain). This file ultimately contains the total volumetric fluxes (i.e., summed for all model nodes) for each of the water budget components for each stress period. MicroFEM saves the volumetric fluxes for each model layer separately. The "upper=1 lower=7" syntax tells MicroFEM to open the transient flux file for model Layers 1 through 7.

The second set of transient water budget files opened in the batch file (following rem**********open ftq files for Water Budget Areas**********) are for sub-areas of the model domain representing the WBAs presented on Figure 25. The first step involves loading the label file *SACFEM_v2_WBAs_121013.lb* into the label 1 register. Each model node has a text string in this label file corresponding to the appropriate water budget area (i.e., all model nodes that are located within the spatial extent of Water Budget Area 2 are assigned the label WBA_2). Next, separate transient water budget files are opened for each group of nodes containing common text strings. Similar to the all.ftq file, the water budget area *.ftq files are opened for all model layers.

The final set of transient water budget files opened in SACFEM_2013.feb (following rem**********open ftq files for streams**********) are for streams simulated in SACFEM2013. A label file, *SACFEM_v2_Streams_FTQ_042314.lb*, is loaded into the label 1 register. This file contains text representing the name of each stream, bypass, and reservoir included in SACFEM2013. The text strings are assigned only to those nodes representing the spatial location of each surface water feature (i.e., non-stream nodes are blank). Separate transient water budget files are then opened for each group of nodes containing common text (i.e., each stream, bypass, or reservoir). FTQ files for surface water features are only opened for model Layer 1, as this is the only model layer that interacts with MicroFEM top system boundary conditions.

As previously described, transient head files save time series simulated groundwater elevation data for a user-defined set of nodes. The portion of the SACFEM2013 batch file following ********open fth for WDL wells******** opens a *.fth file for wells contained in the DWR Water Data Library. A label file containing the unique state well number (SWN) for each well, *SACFEM_v2_WDL_Wells.lb*, is loaded into the label 1 register. Each SWN included in the label file is preceded by the character "^". A single transient head file is then opened for all nodes that contain a "^". Although a single *.fth file is opened, simulated head data are saved and can be read for each individual model node containing a "^" in the label file. As indicated by the "upper=1 lower=7" syntax, head data are saved for all model layers.

Prior to the onset of the transient (looping) portion of the batch file (following ********assign initial heads********), initial head files are loaded into SACFEM2013. This set of initial heads were selected from a previous SACFEM2013 simulation. September 1986 was chosen as the representative stress period for the initial head condition.

5.3.2 Looping Batch File

As described in Section 5.2, Model Pre-processing, the looping portion of SACFEM_2013.feb represents the transient model simulation. A similar set of model commands is executed for each of the 492 model stress periods, following:

```
rem**********************************************
rem            BEGIN TRANSIENT SIMULATION
rem**********************************************
```

5.3.2.1 Mountain-Front Recharge

As discussed in Section 3.2.4.2, deep percolation of precipitation within the Sacramento Hydrologic Region in areas outside of the SACFEM2013 model domain is incorporated as a specified-flux boundary condition along the model boundary, mountain-front recharge. The first set of syntax in the *.feb for each stress period of the transient SACFEM2013 simulation (following rem*************assign mountain-front recharge**********) includes calculations to assign the mountain front recharge for each of the 34 polygons presented on Figure 22.

The first step in the process involves loading a label file containing text strings associated with each of the mountain front recharge polygons into the label 1 register, *SACFEM_v2_VoidPolygons2013_v2.lb*. The label file contains text associated with the spatial location of each polygon along the SACFEM2013 model boundary; all other nodes are blank. The batch file then zeros out pumping for all nodes in each model layer by loading a parameter file, Zero.par, containing values of zero for all nodes into each pumping register. This is done to avoid carry-over pumping between model stress periods.

In the next step, the total annual volumetric deep percolation of precipitation (in units of cubic meters) is assigned to all nodes corresponding to each of the mountain-front polygons. This is accomplished using the MicroFEM "EVAL" command to directly assign the deep percolation values to extra register x22. For example, for stress period 1 (October 1969) the syntax EVAL; x22=8071480 label=1 indicates that a value of 8,071,480 m^3 is assigned to all nodes containing the text "1" in the label 1 register.

The next section of the *.feb file (following rem*************adjust mountain-front recharge**********) contains syntax to convert the total annual volumetric deep percolation values to daily rates. The batch file firsts loads a parameter file, SACFEM_v2_MtnFront_L_Factor_2013_v2.par, into the x23 register. This parameter file contains a weighting factor for each node of a given polygon to scale the total deep percolation values. For each node in a polygon the weighting factor is calculated as follows:

$$Scaling\ Factor = \frac{Lengt\,h\ \text{ĀĀ}\ Individual\ \ Node}{Total\ \ Lengt\,h\ \text{ĀĀ ĀĀĀ}Nodes\ \ \text{ĀĀ}Mountain\ \ Front\ \ Polygon} \tag{14}$$

The total volumetric values are then converted to daily rates given the following:

$$Daily\ Rate = \frac{Total\ \ Annual\ \ Volume\ *Mont\,h\text{ĀĀ}Distribution\ \ \ Factor\ *Adjustment\ \ \ Factor}{Days\ \ \text{ĀĀ}Mont\,h} \tag{15}$$

As previously discussed in Section 3.2.4.2, the "Monthly Distribution Factor" apportions the annual deep percolation values for each month based on monthly distribution of streamflow measured in ungaged sections of Deer Creek (see Table 5). The "adjustment factors" for each mountain-front polygon are multipliers for each polygon developed during the calibration process. An example of the SACFEM_2013.feb syntax is as follows: EVAL; x22=p*0.030*0.50/31 label=1. For this process, MicroFEM takes the p (present value, total annual volumetric flux), multiplies by the monthly distribution factor of 3 percent for October and the calibration adjustment factor of 0.5 for mountain-front polygon 1, and divides by 31 (the number of days in October). As the end of this calculation, the total volumetric deep percolation value is converted to a daily rate, but the total daily rate is assigned to each node of a given polygon.

*Note: when running a batch file that includes performing calculations for subsets of the model domain based on a label file, it is important to have only the label 1 register active (i.e., have no labels loaded into the label 2 through 5 registers). If a label is accidentally loaded twice (that is, the label is present in any of the label 2 through 5 registers and is loaded into label 1 as part of a *.feb file), MicroFEM will perform the calculation multiple times (each time it "sees" the specified text string in any of the label registers).*

Note: Leap years are not considered in SACFEM; therefore, February stress periods are always 28 days long.

The final set of syntax in this portion of the *.feb file scales the deep percolation based on the factors described in Equation 14. The syntax included in the *.feb file is "q1=x22*x23*-1." This means that for all nodes in the model, the Layer 1 pumping register is assigned a value representing the total daily deep percolation rate multiplied by the nodal scaling factor. The "-1" indicates that the specified flux is an inflow value (i.e., in MicroFEM, negative pumping values represent injection and positive values represent extraction).

5.3.2.2 Model Calculation

The final section of the looping batch file contains syntax to conduct the model calculation for each of the 492 monthly stress periods. The first section loads several parameter files specific to each stress period. These include the deep percolation of applied water/precipitation file (*.PPN), the wadi head file (*.wh1), the wadi conductance file (*.wc1), the drain conductance file (*.dc1), and the pumping files for each model layer (*.q).

Note: For stress period, one these additional parameter files is loaded: model storage file (SACFEM_v2.sto), streambed elevation file (SACFEM_v2_WL1_042314.par, wl1), and drain elevation file (SACFEM_v2_GSE_Combined_mNAVD88_120313.par, dh1). These parameters remain constant throughout the model simulation period.

The next section of the batch file defines the time discretization for each stress period. For stress period 1, the syntax is as follows:

```
TIME
days=31
steps=1
```

The duration of each stress period is 1 month; therefore, the number of days in a given month is specified (as assigned during model pre-processing described in Section 5.2). A single time step is used in each stress period. The time-step duration is variable, but always equates to the length of the month being simulated.

The next section of the batch file contains the run statement. For stress period 1, the syntax is as follows:

```
RUN
  itmin=50
  itmax=600
  relax=0
  error=0.005
  m3error=1
```

The syntax “itmin” represents the minimum number of iterations, specified as 50 for all stress periods. “Itmax” represents the maximum number of iterations for each stress period. The default value is 600 iterations; however, as discussed in Section 5.2.2.3, a value of 1000 is assigned during model preprocessing if the model failed to converge for a given stress period for a previous simulation. The “relax” is an adjustment factor used by the MicroFEM solver (successive over-relaxation, SOR). The default value of 0 is assigned; however, as with the maximum iterations, a value of 1 is assigned if the model failed to converge for a given stress period during a previous simulation. The “error” term defines the closure criteria for the heads, specified as 0.005 meter for all stress periods, while the “m3error” defines the closure criterion for the model water budget (1 m^3/day for all stress periods). Model convergence is only achieved for a given stress period if these error criteria are met.

5.4 The MicroFEM LOG File

The *.log file contains the details of a given model simulation. The *.log file is opened by checking a box in the MicroFEM calculation window and specifying a file name (see Figure 52). The *.log file essentially follows the format of the *.feb file for a given simulation, but includes additional information regarding model calculations and summary of model calculation for each stress period. It is important to note that a transient MicroFEM simulation will stop if MicroFEM is unable to load a specified parameter or label file. The MicroFEM *.log file is essential to verify the success of a model simulation.

When calculations are included in a batch file (with the EVAL command), the *.log file will include syntax such as “New values assigned to X nodes”, where X represents the number of nodes to which a given parameter is assigned. If MicroFEM is not successful in implementing a calculation, syntax such as “New values assigned to 0 nodes” or “Cannot Evaluate” will be written to the *.log file, ***but the model simulation will continue with the incorrect parameter values***.

At the end of each stress period, a summary of the stress period calculation is written to the *.log file. This includes the current time (cumulative number of days for the simulation to that point), number of iterations used for the stress period, the maximum change in head for the stress period (in meters), the water budget error for the stress period (in m^3/day), the node containing the maximum change in head, and the layer containing the maximum change in head. This summary information should be examined to confirm that the closure criteria were met for each stress period. MicroFEM will continue a simulation regardless of whether the criteria are met and does not write an error message to the *.log file to designate stress periods that failed to converge. A post-processor has been developed to facilitate evaluation of the *.log file and is discussed in the following section.

5.5 Model Post-processing

Several transient output files are generated during the SACFEM2013 simulation. Two pre-processors have been developed to process and summarize these data, *RunLogReader_SACFEM_2013.xls* and *Hydrographs_SummaryStatsTool_SACFEM_2013.xlsm*.

5.5.1 Run Log Reader

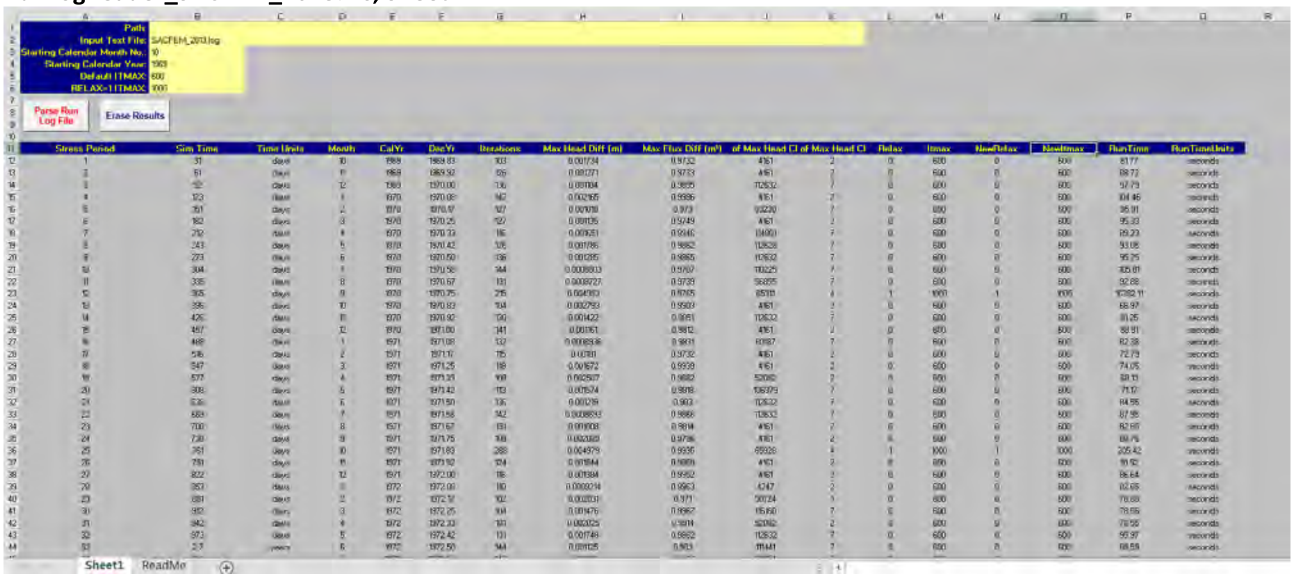
The SACFEM2013 run log reader summarizes the simulation information for each stress period from the *.log file. The user inputs SACFEM2013 file information in the first six rows including: path in *.log file, file name (including extension), starting month (calendar month), starting year (calendar year), default maximum number of iterations, and number of iterations to include if the model fails to converge for a given stress period (see Figure 54). The run log reader contains two macros. The “Erase Results” button clears the summary information from the previous simulation, if present. The “Parse Run Log File” button reads through the SACFEM_2013.log file and searches for the text string below (which is written to the *.log file at the end of each stress period).

CurrentTime   Iterations   MaxHeadChange (m)   M3Error (m^3/d)   NodeMaxHeadChange   LayerMaxHeadChange

The macro then writes summary information for each stress period to the “Sheet 1” worksheet (see Figure 54). Finally, the macro compares the number of iterations used to the user-specified default number of maximum iterations. If the number used is greater than or equal to the default, the macro populates the “NewItmax” column with the user-specified value in row 6, and the “NewRelax” column with a 1. The summary information included in “Sheet 1” can be pasted into the “RELAX_ITMAX” of the pre-processing utility “PPN_Q_Generator_SACFEM_2013.xlsm.” As discussed in Section 5.2.2.3, the new itmax and relax values for stress periods that failed to converge will be modified in the *.feb file for the next simulation.

FIGURE 54

RunLogReader_SACFEM_2013.xls, Sheet 1



*Note: The number of characters (spaces) in the text string above (that the macro searches the *.log file for) periodically changes with new MicroFEM releases. If the macro fails to run, open the VBA module and the log file, highlight the entire text string from the log file (see Figure 55), and paste into the VBA module (see Figure 56).*

FIGURE 55

SACFEM2013.log Syntax to Search/Replace

```
SACFEM_2013.log  ×
0.......10........20........30........40........50........60........70........80........90.......100.......110.......120.......130.......
SAVE
  Q1 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.q1
  rem************Normal/Wet Water Year**********
LOAD
  C:\Projects\SACFEM\SACFEM_2013\SACFEM_v2.sto is loaded into STORATIVITY
  C:\Projects\SACFEM\SACFEM_2013\SACFEM_v2_WL1_042314.par is loaded into WL1
  C:\Projects\SACFEM\SACFEM_2013\SACFEM_v2_GSE_Combined_mNAVD88_120313.par is loaded into DH1
  C:\Projects\SACFEM\SACFEM_2013\10_69.ppn is loaded into PPN
  C:\Projects\SACFEM\SACFEM_2013\10_69.wh1 is loaded into WH1
  C:\Projects\SACFEM\SACFEM_2013\10_69.wc1 is loaded into WC1
  C:\Projects\SACFEM\SACFEM_2013\10_69.dc1 is loaded into DC1
  C:\Projects\SACFEM\SACFEM_2013\10_69.q1 is loaded into Q1
  C:\Projects\SACFEM\SACFEM_2013\10_69.q2 is loaded into Q2
  C:\Projects\SACFEM\SACFEM_2013\10_69.q3 is loaded into Q3
  C:\Projects\SACFEM\SACFEM_2013\10_69.q4 is loaded into Q4
TIME
  DAYS=31
  STEPS=1
RUN
  ITMIN=50
  ITMAX=600
  RELAX=0
  ERROR=0.005
  M3ERROR=1
  Calculating stress period 1
  7 aquifers   153812 nodes   306813 elements
  CurrentTime        Iterations      MaxHeadChange (m)    M3Error (m³/d)    NodeMaxHeadChange    LayerMaxHeadChange
  31.0 days                103              0.001734           0.9732                 4161                     2
  Running time : 81.77 seconds
SAVE
  H1 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.h1
  H2 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.h2
  H3 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.h3
  H4 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.h4
  H5 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.h5
  H6 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.h6
  H7 is saved as C:\Projects\SACFEM\SACFEM_2013\10_69.h7
  rem*************assign mountain-front recharge**********
LOAD
  C:\Projects\SACFEM\SACFEM_2013\SACFEM_v2_VoidPolygons2013_v2.lb is loaded into LB1
  C:\Projects\SACFEM\SACFEM_2013\zero.par is loaded into Q1
  C:\Projects\SACFEM\SACFEM_2013\zero.par is loaded into Q2
  C:\Projects\SACFEM\SACFEM_2013\zero.par is loaded into Q3
  C:\Projects\SACFEM\SACFEM_2013\zero.par is loaded into Q4
  C:\Projects\SACFEM\SACFEM_2013\zero.par is loaded into Q5
  C:\Projects\SACFEM\SACFEM_2013\zero.par is loaded into Q6
  C:\Projects\SACFEM\SACFEM_2013\zero.par is loaded into Q7
```

FIGURE 56
RunLogReader_SACFEM_2013.xls, Visual Basic Code to Search/Replace

```
Do While Not EOF(1)
  icnt = icnt + 1
  Line Input #1, strLine
  If Mid(strLine, 2, 5) = "RELAX" Then
    sRelax = Val(Trim(Mid(strLine, 8, 15)))
  End If
  If Mid(strLine, 2, 5) = "ITMAX" Then
    iItmax = Val(Trim(Mid(strLine, 8, 15)))
  End If
  If strLine = Chr(9) + "CurrentTime      Iterations     MaxHeadChange (m)    M3Error (m³/d)    NodeMaxHeadChange    LayerMaxHeadChange" Then
    iSP = iSP + 1
    If iMonth < 12 Then
      iMonth = iMonth + 1
    Else
      iYear = iYear + 1
      iMonth = 1
    End If
```

5.5.2 Hydrograph and Summary Statistics Utility

As discussed in Section 5.3, transient heads files are opened for all monitoring wells included in the DWR water data library database at the beginning of the SACFEM2013 simulation (WDL_Hydrographs.fth). The post-processing utility "*Hydrographs_SummaryStatsTool_SACFEM_2013.xlsm*" is used to examine simulated-versus-measured groundwater elevation data for SACFEM2013 calibration target wells. Worksheets in this utility include the following:

ReadMe: Contains information about the processing utility and disclaimer on use

- **Inputs:** Contains macros to populate and erase data on the "*SimHeads*" worksheet as well as to generate hydrographs.
- **SimHeads:** Worksheet is populated with simulated groundwater elevation data for each SACFEM2013 target well listed on the "*Inputs*" worksheet.
- **ObsHeads:** Contains measured groundwater elevation data for target wells. The date range for the data is limited to the SACFEM2013 simulation period (that is, no data earlier/later than WY1970 and WY2010 can be included). Data should only be included for SACFEM2013 calibration target wells (i.e., the same list of wells included on the "*Inputs*" worksheet and in ReadFTH.inp).
- **NodeNoLayerLookup:** Contains look-up information for SACFEM2013 calibration target wells, including SACFEM2013 model node number, SACFEM2013 model layer number, well coordinates, and ground surface elevation at the well.
- **TemplatePlot:** Worksheet contains the template plot used to format hydrographs. The user can modify the format of the graph (axes, series format, etc.) on this worksheet, and the changes will be propagated to all hydrographs when the "Create Hydrographs" macro is run.
- **Hydrographs:** When the "Create Hydrographs" macro on the "*Inputs*" worksheet is run, this worksheet is populated with hydrographs for all SACFEM2013 calibration target wells.
- **PairedMeasSimHeads:** Contains macros to erase previous simulation results, pair simulated/measured groundwater elevation data for all SACFEM2013 calibration targets, and calculate calibration statistics.
- **C.Scatterplot:** Contains a scatterplot of all data from the "*PairedMeasSimHeads*" worksheets, including calibration statistics for the entire calibration dataset.
- **CalibrationStats_L1……L7:** When the "Compute Calibration Stats" macro is run on the "*PairedMeasSimHeads*" worksheet, these worksheets are populated with calibration statistics for SACFEM2013 target wells for each respective layer.

5.5.2.1 ReadFTH

Prior to running any macros in the Excel utility, the *.fth file is converted to a format that is easier for the utility to process. This is done with the utility, ReadFTH.exe. This utility consists of an executable and an input file, which should be located in the same folder as the *.fth file. The input file (ReadFTH.inp) is an ASCII file that can be read/modified via a text editor. The file contains four header rows that include the following information: name of the *.fth file, name of the output file (*.csv file format), starting date of the model simulation, and number of target wells. This information is followed by the list of calibration targets. Each calibration target is listed on its own row with the following information: SACFEM2013 model node number, SACFEM2013 model layer, SWN. This information should be comma-delimited and sorted by ascending SACFEM2013 model node number (see Figure 57). The utility will write the simulated head information for the specified model layer for each well listed in the *.inp file to an Excel *.csv file. This *.csv file is read by the "*Hydrographs_SummaryStatsTool_SACFEM_2013.xlsm*" utility.

*Note: The utility ReadFTH.exe will write the initial heads information to the *.csv output file. The user should open the *.csv file, manually delete the stress period 0 data rows (as this does not represent converged simulated heads to be considered in calibration statistics), and resave the file.*

FIGURE 57
ReadFTH.inp File

```
ReadFTH.inp
WDL_Hydrographs.fth    'FTH filename
Target_Hydrographs.csv    'Output CSV filename with FTH results in database flat-file format
10/01/1969              'Starting date of simulation
210                     'No. of sim hydrograph datasets (n) wanted; the next n lines must contain the node, layer, and LOCID sorted by node then layer
584,1,27N03W10B001M
835,2,27N04W35E001M
901,2,27N03W20K001M
1738,2,25N03W10L004M
1738,4,25N03W10L003M
2144,1,25N02W09G001M
2563,1,24N03W17M001M
2854,3,24N02W12P001M
2854,6,24N02W12P002M
2922,3,24N02W30P002M
3505,1,23N01W09E001M
3569,2,23N02W16B001M
3783,2,23N01W14R002M
4004,2,22N02W08B002M
4059,1,23N01E29P001M
4059,2,23N01E29P002M
4303,2,22N03W21F002M
4365,1,22N02W21D001M
4418,1,22N01E09J002M
4447,1,22N02W20Q001M
4486,6,22N02E17E001M
4546,1,22N02W30H004M
4546,2,22N02W30H003M
4546,6,22N02W30H002M
4626,2,22N01W05M001M
4864,2,22N02W36D001M
5055,1,22N01E20K001M
5081,1,21N02W05M004M
5081,2,21N02W05M002M
5081,4,21N02W05M001M
5327,3,22N01E28J003M
5327,6,22N01E28J001M
5327,7,22N01E28J005M
5329,6,22N01E29R001M
5661,2,21N02W09M002M
5960,3,22N01E33N002M
6298,1,22N01E33N001M
6299,2,21N01E05G001M
6631,4,21N01E12K001M
7439,5,21N03W33A004M
7871,2,21N02W31M001M
7931,1,21N01W04N001M
7974,1,17N03E05C001M
```

5.5.2.2 Inputs Worksheet

The "Inputs" worksheet of the post-processing utility contains macros to clear simulated data from a previous simulation, read the simulated heads files, and generate hydrographs of simulated and measured data. There are several rows at the top of the worksheet (see Figure 58) where the user defines the following categories of information:

- **FTH-CSV File Path and File**: path to the *.csv file, including the file name
- **Starting Date**: starting date of the simulation
- **Desired Number of Plots Per Row**: number of hydrographs to plot on a given row
- **Desired Plot Width (characters)**: width of each hydrograph

- **Desired Plot Height (characters)**: height of each hydrograph
- **Desired Y-Range on Plots**: y-axis range on hydrographs – if a value is populated in this cell, all hydrographs will have the user-specified range (the macro will select the axis minimum/maximum). If the cell is left blank, all hydrographs will have the exact y-axis value/range as the template plot

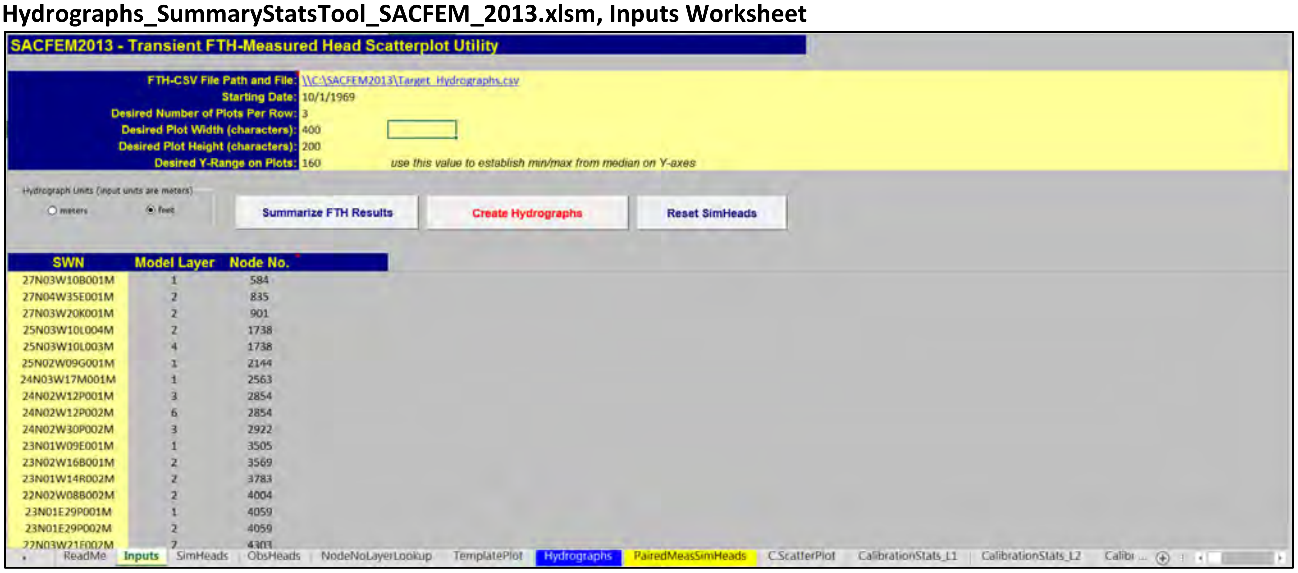
Below the user-specified information is a toggle box for the desired output units as well as buttons for each of the macros. The last section of the "*Inputs*" worksheet contains the list of calibration targets, including SWN, SACFEM2013 model layer, and SACFEM2013 model node number. The list should contain the same calibration target wells as ReadFTH.inp and should be sorted in ascending order by SACFEM2013 node number (see Figures 57 and 58).

As previously discussed, three macros are included on the "Inputs" worksheet.

- **ResetSimHeads**: clears the data from the "SimHeads" worksheet.
- **Summarize FTH Results**: reads user-defined *.csv file and writes the simulated groundwater elevation data for all SACFEM2013 calibration target wells listed on the "*Inputs*" worksheet to the "SimHeads" worksheet.
- **Create Hydrographs**: generates hydrographs of simulated and measured groundwater elevations for all SACFEM2013 calibration target wells listed on the "*Inputs*" worksheet. Simulated groundwater elevation data are read from the "*SimHeads*" worksheet, and measured groundwater elevation data are read from the "*ObsHeads*" worksheet. The macro formats the hydrographs consistent with the graph included on the "*TemplatePlot*" worksheet.

Note: the utility is designed to process data between WY1970 and WY2010. Modifications are required to process data for a different simulation period.

FIGURE 58
Hydrographs_SummaryStatsTool_SACFEM_2013.xlsm, Inputs Worksheet



5.5.2.3 PairedMeasSimHeads Worksheet

The "*PairedMeasSimHeads*" worksheet of the post-processing utility contains macros to clear data from a previous simulation and to calculate calibration statistics (see Figure 59). The "Clear Stats Sheets" macro clears the data from the "*PairedMeasSimHeads*" worksheet as well as the calibration statistics worksheets for each model layer. The "Compute Calibration Stats" macro performs the following functions:

- For each measured groundwater elevation on the "ObsHeads" worksheet, the macro pairs a quasi-contemporaneous simulated groundwater elevation from the "SimHeads" worksheet. The macro interpolates the simulated groundwater elevation data between stress periods to matches the date of the measured groundwater elevation data. The simulated, measured, and residual error in heads are written to the "*PairedMeasSimHeads*" worksheet for each data point (see Figure 59).
- The macro computes the summary calibration statistics (ME, RMSE, range in measured heads, RMS divided by range in measured heads, R^2, and count) for the entire "paired" dataset, which are computed and written to the worksheet.
- The graph on the "*C.Scatterplot*" worksheet automatically updates with the simulated and measured data and the calibration statistics included on the "*PairedMeasSimHeads*" worksheet (see Figure 60).
- For each SACFEM2013 target well listed on the "*Inputs*" worksheet, the macro computes the calibration statistics for the entire "paired" dataset and writes this information to the calibration statistics worksheet corresponding to the model layer for each of the target wells (CalibrationStats_L1 through CalibrationStats_L7).

FIGURE 59
Hydrographs_SummaryStatsTool_SACFEM_2013.xlsm, PairedMeasSimHeads Worksheet

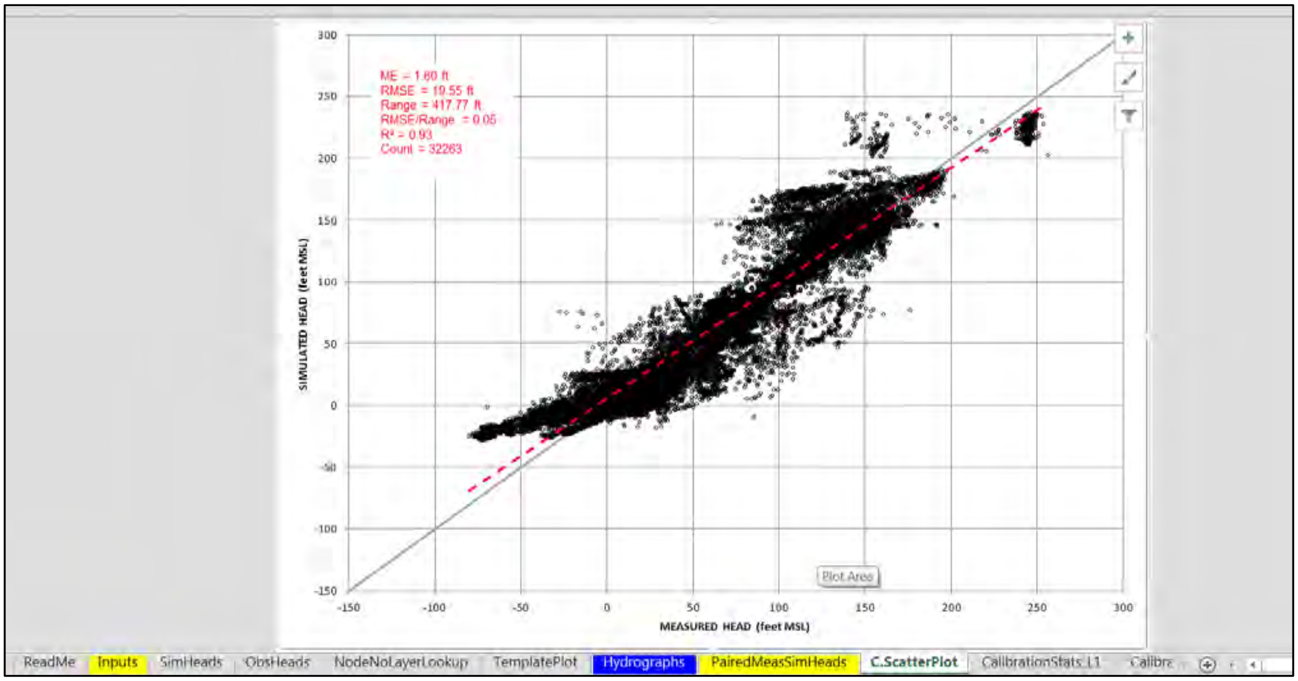
Compute Calibration Stats | Clear Stats Sheets

13N02W04G004M
10666

SWN	Layer	Date	CalYr	Month	DecYr	MeasHead_ft-msl	SimHead_ft-msl	Residual_ft	10904		
05N02E05C001M	1	3/21/1972	1972	3	1972.22	6.703546039	13.18	6.48		All	Text For ScatterPlot ME = 1.60 ft RMSE = 19.55 ft Range = 417.77 ft RMSE/Range = 0.05 R^2 = 0.93
05N02E05C001M	1	3/29/1972	1972	3	1972.24	6.503546039	13.18	6.68		32263	Count = 32263
05N02E05C001M	1	4/24/1972	1972	4	1972.31	6.803546039	13.03	6.23		1.60	
05N02E05C001M	1	5/31/1972	1972	5	1972.42	6.803546039	12.62	5.81		19.55	
05N02E05C001M	1	6/28/1972	1972	6	1972.49	6.703546039	12.16	5.46		417.766033	
05N02E05C001M	1	7/28/1972	1972	7	1972.57	7.403546039	11.43	4.02		0.05	
05N02E05C001M	1	8/30/1972	1972	8	1972.66	7.803546039	10.84	3.03		0.93	
05N02E05C001M	1	9/28/1972	1972	9	1972.74	7.603546039	10.37	2.77			
05N02E05C001M	1	10/30/1972	1972	10	1972.83	7.603546039	10.24	2.64			
05N02E05C001M	1	11/28/1972	1972	11	1972.91	8.103546039	10.93	2.82			
05N02E05C001M	1	12/29/1972	1972	12	1972.99	8.603546039	11.67	3.07			
05N02E05C001M	1	1/30/1973	1973	1	1973.08	10.40354604	13.63	3.22			
05N02E05C001M	1	2/27/1973	1973	2	1973.16	11.30354604	15.05	3.75			
05N02E05C001M	1	3/27/1973	1973	3	1973.24	11.20354604	15.63	4.43			
05N02E05C001M	1	4/27/1973	1973	4	1973.32	10.20354604	15.25	5.05			
05N02E05C001M	1	5/31/1973	1973	5	1973.41	9.103546039	14.64	5.53			
05N02E05C001M	1	6/28/1973	1973	6	1973.49	8.603546039	14.04	5.44			
05N02E05C001M	1	7/27/1973	1973	7	1973.57	8.103546039	13.44	5.34			
05N02E05C001M	1	8/29/1973	1973	8	1973.66	8.003546039	12.87	4.87			
05N02E05C001M	1	9/28/1973	1973	9	1973.74	8.403546039	12.49	4.08			
05N02E05C001M	1	10/30/1973	1973	10	1973.83	7.703546039	12.22	4.52			
05N02E05C001M	1	11/27/1973	1973	11	1973.91	8.003546039	12.54	4.54			

ReadMe | Inputs | SimHeads | ObsHeads | NodeNoLayerLookup | TemplatePlot | Hydrographs | PairedMeasSimHeads | C.ScatterPlot | CalibrationStats_L1 | Calibra ...

FIGURE 60
Hydrographs_SummaryStatsTool_SACFEM_2013.xlsm, C.Scatterplot Worksheet



5.5.3 Transient Water Budget Files

As discussed in Section 5.3.1, several transient water budget files are opened at the beginning of the SACFEM2013 simulation. These are tab-delimited ASCII 2 files that can be opened in a text editor or copied into a spreadsheet for further analysis. There are several header rows followed by simulated data (in m^3/day) for all components of the water balance. The first “block” of data represents the uppermost specified model layer (“upper=” in the open-q statements) and is displayed with header titles for the water balance component (which are in columns). Rows in the *.ftq files represent data for each stress period (in ascending order). Successive “blocks” of data represent additional model layers (i.e., model layers between “upper=” and “lower=” in the open-q statements) and are displayed without column headers. The user is referred to the MicroFEM help menu or user’s manual for additional information about transient water budget files.

SECTION 6
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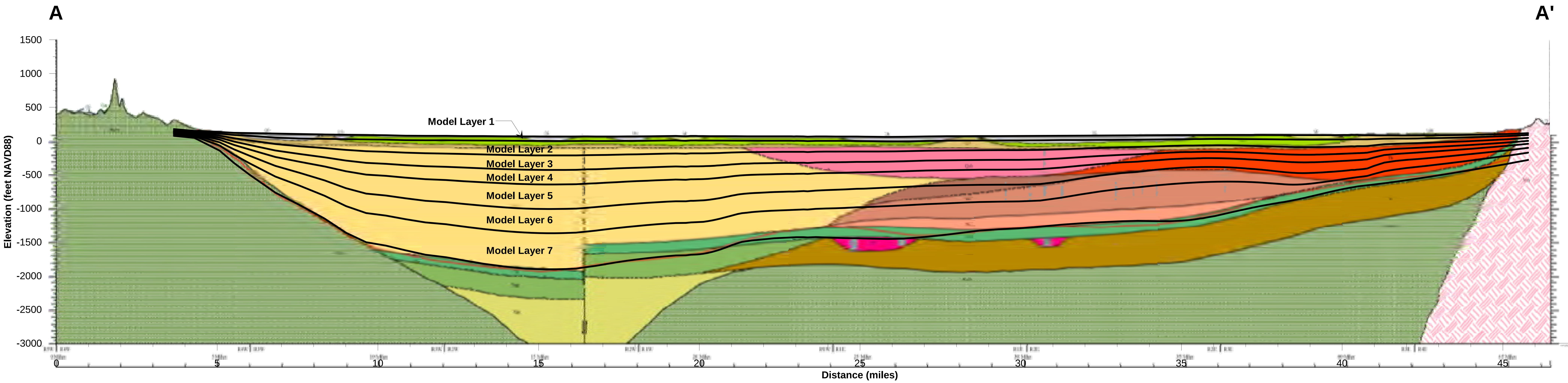
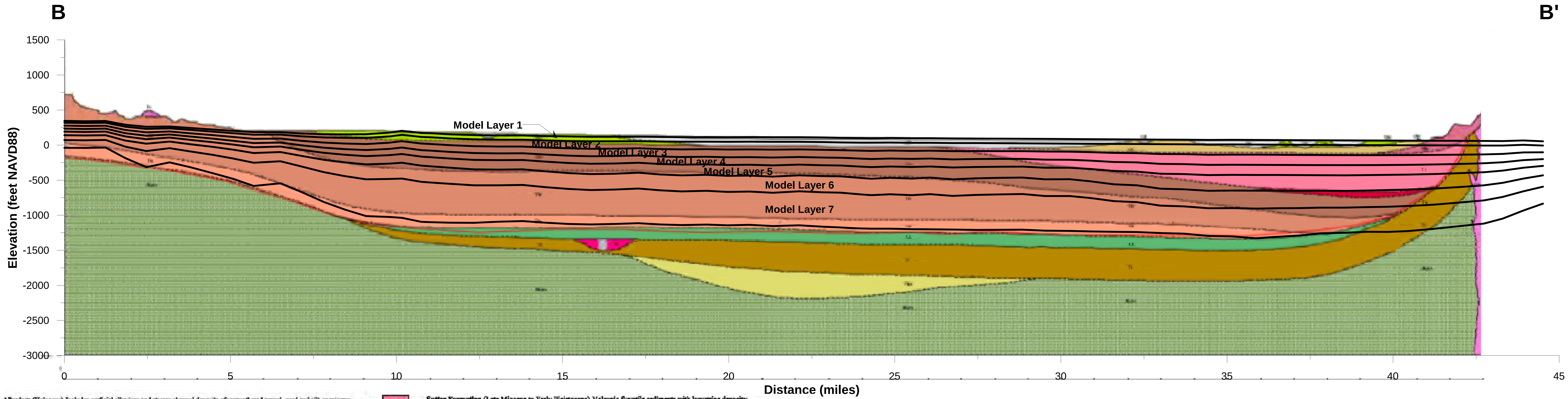


Symbol	Description
Qa	**Alluvium** (Holocene)-Includes surficial alluvium and stream channel deposits of unweathered gravel, sand and silt, maximum thickness 80 ft. *(adapted from Helley & Harwood, 1985)*.
Qb	**Basin Deposits** (Holocene)-Fine-grained silt and clay derived from adjacent mountain ranges, maximum thickness up to 200 ft. *(adapted from Helley & Harwood, 1985)*.
Qm	**Modesto Formation**, undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated weathered and unweathered gravel, sand, silt and clay; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood , 1985)*.
Qr	**Riverbank Formation**, undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated to semi-consolidated gravel, sand and silt; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood, 1985)*.
Qtl	**Turlock Lake** (Pleistocene)-Weathered and dissected arkosic gravels with minor amounts of resistant metamorphic rock fragments and quartz pebbles, sand and silt; maximum thickness approximately 100 ft. *(adapted from Helley & Harwood, 1985)*.
Qvb	**Volcanic Basalts**, undifferentiated (Pleistocene)-Younger basalt flows found primarily on the east side of the Sacramento Valley, includes minor exposures of andesite; maximum thickness 100 ft. *(adapted from Helley & Harwood, 1985)*.
Qtm	**Tuff Breccia** (Plio-Pleistocene)-Tuff breccia forming outer ring surrounding the Sutter Buttes *(adapted from Helley & Harwood, 1985)*.
Qta	**Volcanic Andesites**, undifferentiated (Plio-Pleistocene)-Younger andesites forming the center of the Sutter Buttes *(adapted from Helley & Harwood, 1985)*.
Tte	**Tehama Formation** (Plio-Pleistocene)-Includes Red Bluff Formation on west side. Pale green, gray and tan sandstone and siltstone with lenses of pebble and cobble conglomerate; maximum thickness 2,000 ft. *(adapted from Helley & Harwood, 1985)*.
Ttd	**Tuscan Unit D** (Plio-Pleistocene)-Fragmental flow deposits characterized by monolithic masses containing gray hornblende and basaltic andesites and black pumice, maximum thickness 160 ft. *(adapted from Helley & Harwood, 1985)*.
Ttc	**Tuscan Unit C** (Plio-Pleistocene)-Includes Red Bluff Formation on east side. Volcanic lahars with some interbedded volcanic conglomerate and sandstone, and reworked sediments; maximum thickness 600 ft. *(adapted from Helley & Harwood, 1985, DWR Bulletin 118-7, 2001, draft report)*.
Ttb	**Tuscan Unit B** (Pliocene)-Layered, interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone; maximum thickness 600 ft. *(adapted from Helley and Harwood, 1985; DWR Bulletin 118-7, 2001, draft report)*.
Tta	**Tuscan Unit A** (Pliocene)-Interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone containing metamorphic rock fragments; maximum thickness 400 ft. *(adapted from Helley & Harwood, 1985; DWR Bulletin 118-7 (in progress), 2001)*.
Tla	**Laguna Formation** (Pliocene)-Interbedded alluvial gravel, sand and silt; maximum thickness 450 feet. *(adapted from Helley & Harwood, 1985; Olmsted and Davis, 1961; DWR Bulletin 118-6, 1978)*.
Tv	**Basalts and Andesites**, undifferentiated (Pliocene)-Older basalts and andesites found on the northeastern portion of the Sacramento Valley and southwest of Winters; maximum thickness up to 230 ft. *(adapted from Helley & Harwood, 1985)*.
Ts	**Sutter Formation** (Late Miocene to Early Pleistocene)-Volcanic fluvatile sediments with lacustrine deposits; maximum thickness approximately 1,800 ft. *(adapted from Garrison, 1962)*.
Tn	**Neroly Formation** (Miocene)-Marine to non-marine sediments, tuffaceous andesitic sandstone with interbeds of tuff and tuffaceous shales and occasional conglomerate lenses; max. thickness 500 ft. *(adapted from Redwine, 1972; Wagner and Saucedo, 1990)*.
Tl	**Lovejoy Basalt** (Miocene)-Black, dense, hard microcrystalline basalt; maximum thickness 65 ft. *(adapted from Helley & Harwood, 1985)*.
Tupg	**Upper Princeton Valley Fill** (Late Oligocene to Early Miocene)-Non-marine sediments composed of sandstone with interbeds of mudstone and occasional conglomerate and conglomerate sandstone; maximum thickness 1,400 ft. *(adapted from Redwine, 1972)*.
Ti	**Ione Formation** (Eocene)-Marine to non-marine deltaic sediments, light colored, commonly white conglomerate, sandstone and siltstone, which is soft and easily eroded; max. thickness 650 ft. *(adapted from DWR Bulletin 118-6, 1978; Creely, 1965)*.
Tlpg	**Lower Princeton Submarine Valley Fill** (Eocene)-includes Capay Formation. Marine sandstone, conglomerate and interbedded silty shale, maximum thickness 2,400 ft. (*adapted from Redwine, 1972*)
JKgvs	**Great Valley Sequence** (Late Jurassic to Upper Cretaceous)-Marine clastic sedimentary rock consisting of siltstone, shale, sandstone and conglomerate; maximum thickness 15,000 ft.
m	**Mixed Rocks** (pre-Cenozoic)-Undivided metasedimentary and metavolcanic rocks of greatly varying types *(adapted from Jennings, 1977)*.
Mzv	**Volcanic and Metavolcanic Rocks** (Mesozoic)-Undivided volcanic and metavolcanic rocks, andesite rhyolite flow rocks, greenstone and volcanic breccia *(adapted from Jennings, 1977)*.
um	**Ultramafic Rocks** (Mesozoic)-Primarily composed of serpentine, with peridotite, gabbro and diabase *(adapted from Jennings, 1977)*.
gb	**Gabbro** (Mesozoic)-Gabbro and dark diotric rocks *(adapted from Jennings, 1977)*.
gr	**Undifferentiated Granitic Plutons** (Mesozoic-Paleozoic)-Undivided granitic plutons and related rocks *(adapted from Jennings, 1977)*.
Pz	**Paleozoic Metasedimentary Rocks** (Paleozoic)-Undivided metasedimentary rocks including slate, shale, sandstone, chert, conglomerate, limestone, dolomite, marble, phyllite,schist, hornfels and quartzite *(adapted from Jennings, 1977)*.
Pzv	**Paleozoic Metavolcanic Rocks** (Paleozoic)-Undivided metavolcanic rocks, primarily flows, breccia, and tuff, including greenstone, diabase and pillow lavas *(adapted from Jennings, 1977)*.

Notes:
1. Modified from DWR (2005)
2. NAVD88 = North American Vertical Datum of 1988

Figure 10
East-West Cross-Section of SACFEM2013 Model Layering

SACFEM: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL



- **Qa** — **Alluvium** (Holocene)-Includes surficial alluvium and stream channel deposits of unweathered gravel, sand and silt, maximum thickness 80 ft. *(adapted from Helley & Harwood, 1985)*.
- **Qb** — **Basin Deposits** (Holocene)-Fine-grained silt and clay derived from adjacent mountain ranges, maximum thickness up to 200 ft. *(adapted from Helley & Harwood, 1985)*.
- **Qm** — **Modesto Formation**, undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated weathered and unweathered gravel, sand, silt and clay; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood, 1985)*.
- **Qr** — **Riverbank Formation**, undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated to semi-consolidated gravel, sand and silt; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood, 1985)*.
- **Qtl** — **Turlock Lake** (Pleistocene)-Weathered and dissected arkosic gravels with minor amounts of resistant metamorphic rock fragments and quartz pebbles, sand and silt; maximum thickness approximately 100 ft. *(adapted from Helley & Harwood, 1985)*.
- **Qvb** — **Volcanic Basalts**, undifferentiated (Pleistocene)-Younger basalt flows found primarily on the east side of the Sacramento Valley, includes minor exposures of andesite; maximum thickness 100 ft. *(adapted from Helley & Harwood, 1985)*.
- **Qtm** — **Tuff Breccia** (Plio-Pleistocene)-Tuff breccia forming outer ring surrounding the Sutter Buttes *(adapted from Helley & Harwood, 1985)*.
- **Qta** — **Volcanic Andesites**, undifferentiated (Plio-Pleistocene)-Younger andesites forming the center of the Sutter Buttes *(adapted from Helley & Harwood, 1985)*.
- **Tte** — **Tehama Formation** (Plio-Pleistocene)-Includes Red Bluff Formation on west side. Pale green, gray and tan sandstone and siltstone with lenses of pebble and cobble conglomerate; maximum thickness 2,000 ft. *(adapted from Helley & Harwood, 1985)*.
- **Ttd** — **Tuscan Unit D** (Plio-Pleistocene)-Fragmental flow deposits characterized by monolithic masses containing gray hornblende and basaltic andesites and black pumice, maximum thickness 160 ft. *(adapted from Helley & Harwood, 1985)*.
- **Ttc** — **Tuscan Unit C** (Plio-Pleistocene)-Includes Red Bluff Formation on east side. Volcanic lahars with some interbedded volcanic conglomerate and sandstone, and reworked sediments; maximum thickness 600 ft. *(adapted from Helley & Harwood, 1985, DWR Bulletin 118-7, 2001, draft report)*.
- **Ttb** — **Tuscan Unit B** (Pliocene)-Layered, interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone; maximum thickness 600 ft. *(adapted from Helley and Harwood, 1985; DWR Bulletin 118-7, 2001, draft report)*.
- **Tta** — **Tuscan Unit A** (Pliocene)-Interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone containing metamorphic rock fragments; maximum thickness 400 ft. *(adapted from Helley & Harwood, 1985; DWR Bulletin 118-7 (in progress), 2001)*.
- **Tla** — **Laguna Formation** (Pliocene)-Interbedded alluvial gravel, sand and silt; maximum thickness 450 feet. *(adapted from Helley & Harwood, 1985; Olmsted and Davis, 1961; DWR Bulletin 118-6, 1978)*.
- **Tv** — **Basalts and Andesites**, undifferentiated (Pliocene)-Older basalts and andesites found on the northeastern portion of the Sacramento Valley and southwest of Winters; maximum thickness up to 230 ft. *(adapted from Helley & Harwood, 1985)*.
- **Ts** — **Sutter Formation** (Late Miocene to Early Pleistocene)-Volcanic fluvatile sediments with lacustrine deposits; maximum thickness approximately 1,800 ft. *(adapted from Garrison, 1962)*.
- **Tn** — **Neroly Formation** (Miocene)-Marine to non-marine sediments, tuffaceous andesitic sandstone with interbeds of tuff and tuffaceous shales and occasional conglomerate lenses; max. thickness 500 ft. *(adapted from Redwine, 1972; Wagner and Saucedo, 1990)*.
- **Tl** — **Lovejoy Basalt** (Miocene)-Black, dense, hard microcrystalline basalt; maximum thickness 65 ft. *(adapted from Helley & Harwood, 1985)*.
- **Tupg** — **Upper Princeton Valley Fill** (Late Oligocene to Early Miocene)-Non-marine sediments composed of sandstone with interbeds of mudstone and occasional conglomerate and conglomerate sandstone; maximum thickness 1,400 ft. *(adapted from Redwine, 1972)*.
- **Ti** — **Ione Formation** (Eocene)-Marine to non-marine deltaic sediments, light colored, commonly white conglomerate, sandstone and siltstone, which is soft and easily eroded; max. thickness 650 ft. *(adapted from DWR Bulletin 118-6, 1978; Creely, 1965)*.
- **Tlpg** — **Lower Princeton Submarine Valley Fill** (Eocene)-includes Capay Formation. Marine sandstone, conglomerate and interbedded silty shale, maximum thickness 2,400 ft. *(adapted from Redwine, 1972)*
- **JKgvs** — **Great Valley Sequence** (Late Jurassic to Upper Cretaceous)-Marine clastic sedimentary rock consisting of siltstone, shale, sandstone and conglomerate; maximum thickness 15,000 ft.
- **m** — **Mixed Rocks** (pre-Cenozoic)-Undivided metasedimentary and metavolcanic rocks of greatly varying types *(adapted from Jennings, 1977)*.
- **Mzv** — **Volcanic and Metavolcanic Rocks** (Mesozoic)-Undivided volcanic and metavolcanic rocks, andesite rhyolite flow rocks, greenstone and volcanic breccia *(adapted from Jennings, 1977)*.
- **um** — **Ultramafic Rocks** (Mesozoic)-Primarily composed of serpentine, with peridotite, gabbro and diabase *(adapted from Jennings, 1977)*.
- **gb** — **Gabbro** (Mesozoic)-Gabbro and dark diotric rocks *(adapted from Jennings, 1977)*.
- **gr** — **Undifferentiated Granitic Plutons** (Mesozoic-Paleozoic)-Undivided granitic plutons and related rocks *(adapted from Jennings, 1977)*.
- **Pz** — **Paleozoic Metasedimentary Rocks** (Paleozoic)-Undivided metasedimentary rocks including slate, shale, sandstone, chert, conglomerate, limestone, dolomite, marble, phyllite,schist, hornfels and quartzite *(adapted from Jennings, 1977)*.
- **Pzv** — **Paleozoic Metavolcanic Rocks** (Paleozoic)-Undivided metavolcanic rocks, primarily flows, breccia, and tuff, including greenstone, diabase and pillow lavas *(adapted from Jennings, 1977)*.

Notes:
1. Modified from DWR (2005)
2. NAVD88 = North American Vertical Datum of 1988

Figure 11
North-South Cross-Section of SACFEM2013 Model Layering
SACFEM: Sacramento Valley Finite Element Groundwater Flow Model
USER'S MANUAL

Appendix A
Historical Surface Water Diversion Data and IDC Applied Water Demand Comparisons

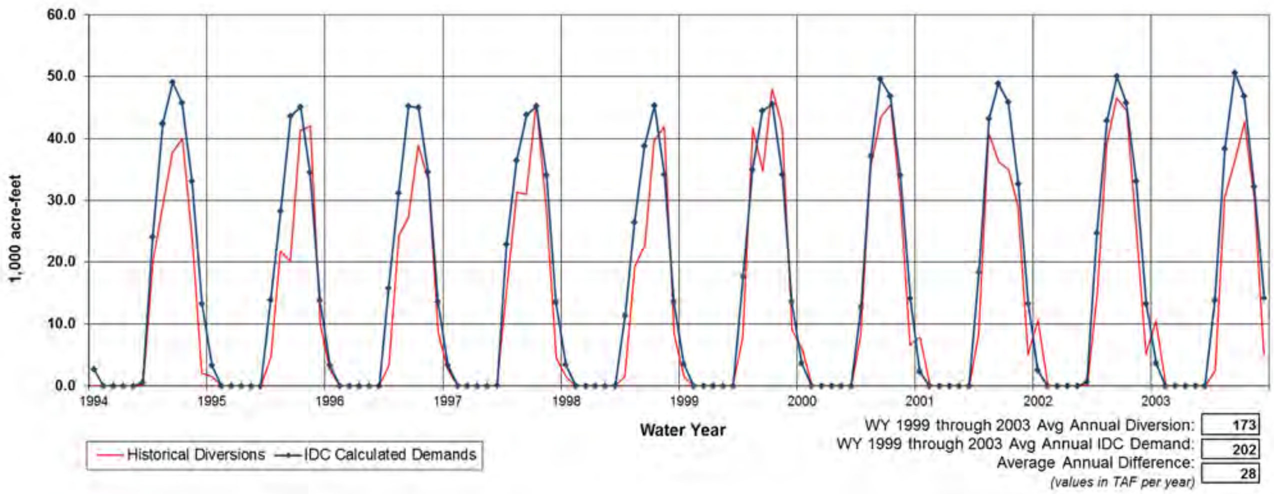


Figure A-1 Annual Historical Diversions and IDC Calculated Demands for RD 108 and River Garden Farms

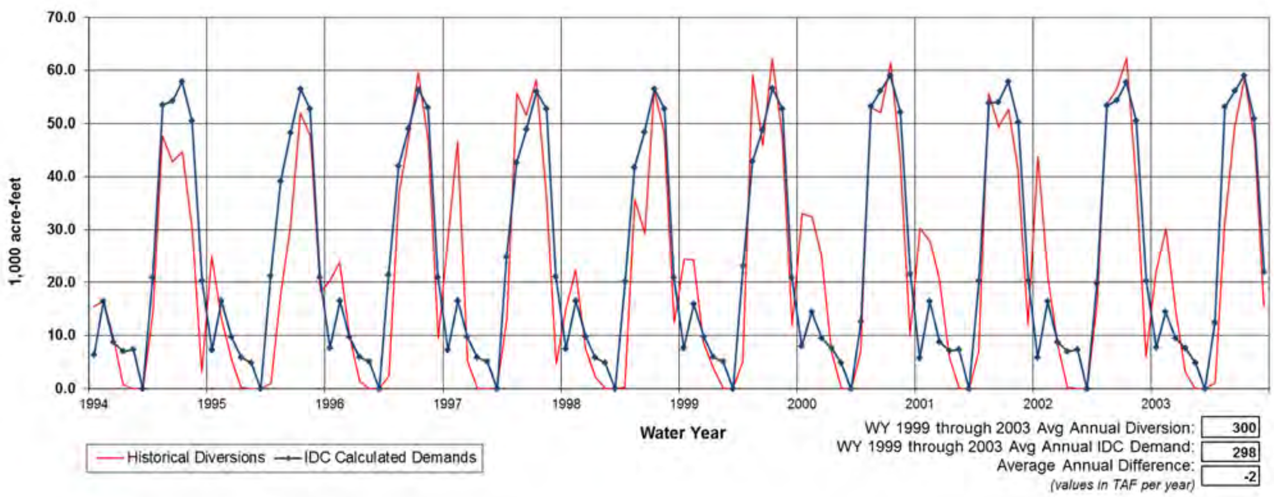


Figure A-2 Annual Historical Diversions and IDC Calculated Demands for Western Canal

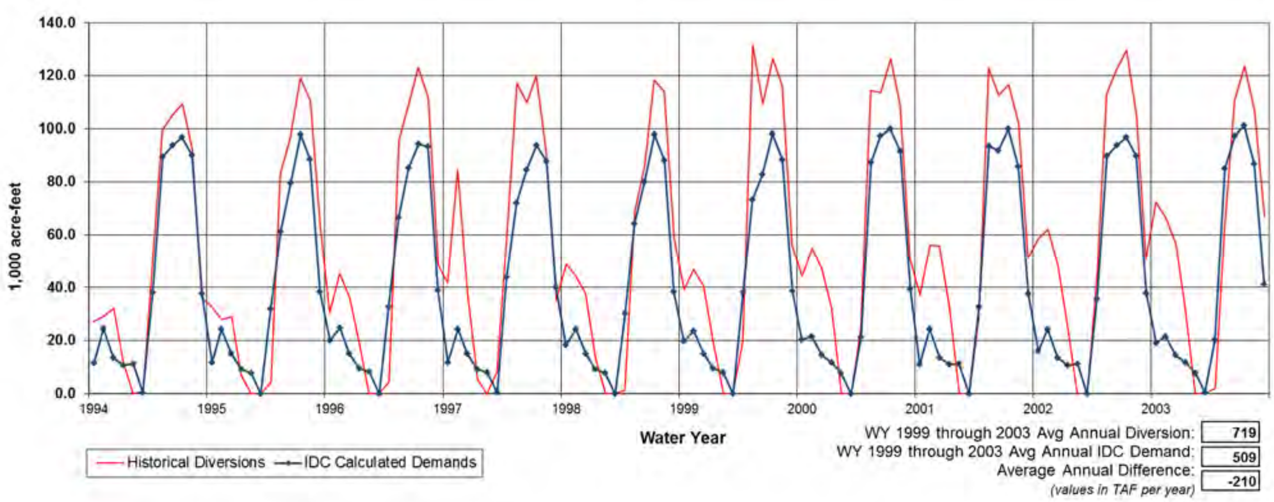


Figure A-3 Annual Historical Diversions and IDC Calculated Demands for Joint Water District

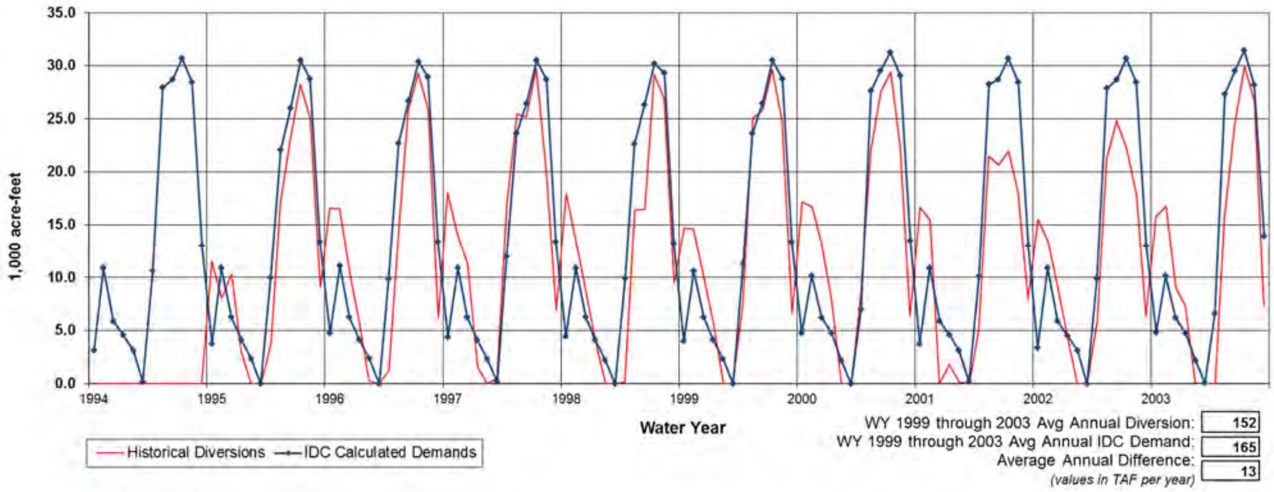


Figure A-4 Annual Historical Diversions and IDC Calculated Demands for YCWA

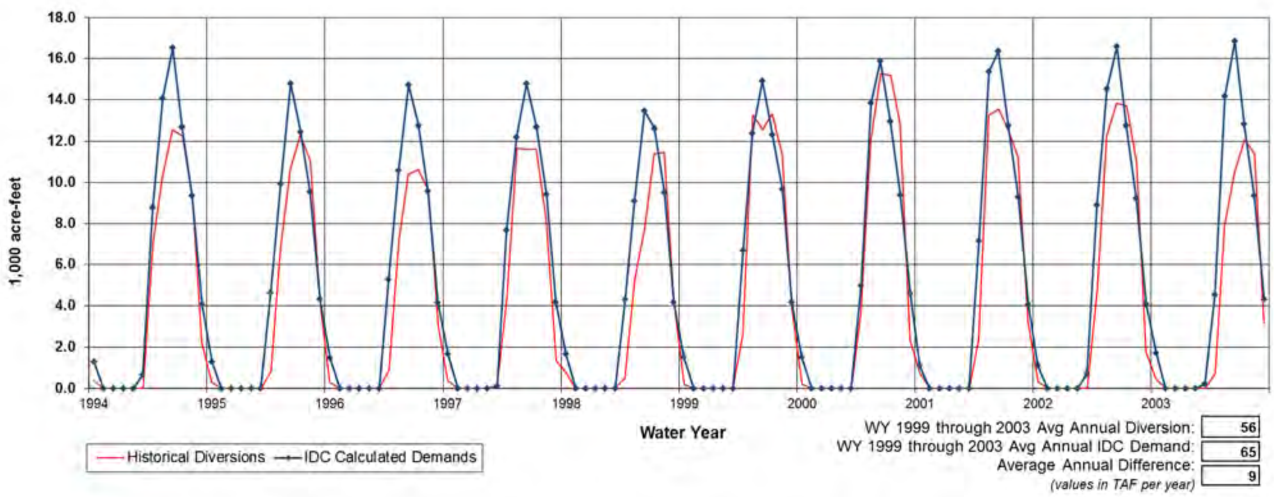


Figure A-5 Annual Historical Diversions and IDC Calculated Demands for Meridian, Newhall, Tisdale, and Short Form Contractors in WBA 18

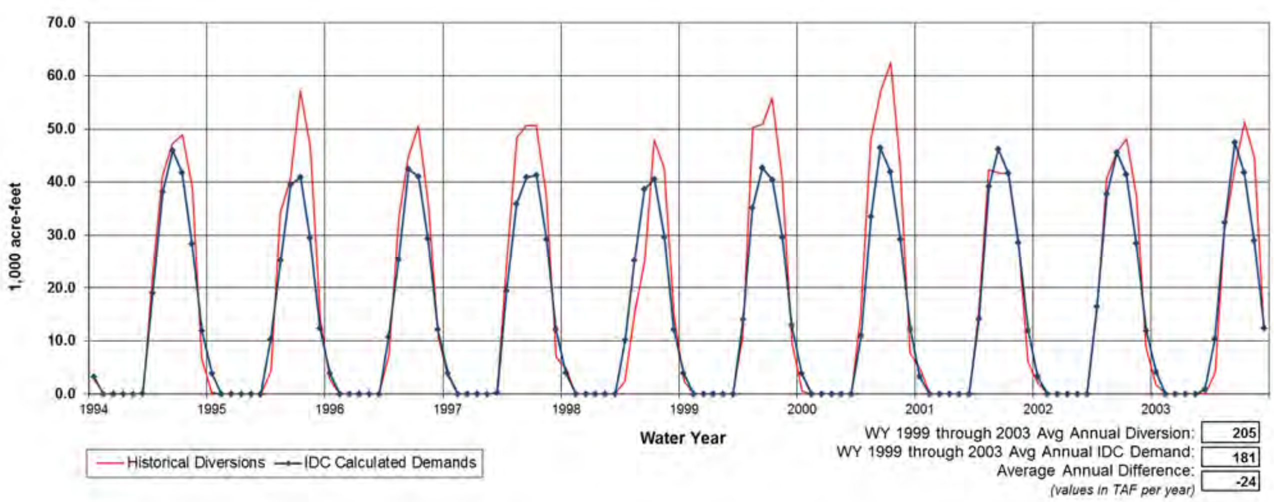


Figure A-6 Annual Historical Diversions and IDC Calculated Demands for Sutter Mutual

Appendix B
Summary of Quantitative Calibration Targets

APPENDIX B
Summary of Quantitative Calibration Targets by Well
SACFEM2013: Sacramento Valley Finite Element Groundwater Model; User's Manual

State Well Number	SACFEM 2013 Model Layer	Earliest Year with Measured Data	Latest Year with Measured Data	Minimum Measured Groundwater Elevation (feet NAVD88)	Maximum Measured Groundwater Elevation (feet NAVD88)	Range in Measured Groundwater Elevation (feet)	Number of Measurements	Mean Error (feet)	Root Mean Squared Error (feet)
05N02E05C001M	1	1972.22	1999.76	2.2	14.3	12.1	318.0	-0.3	4.9
05N05E04C001M	2	1969.9	2002.35	-55.5	-22.5	33.0	335.0	30.2	30.7
05N05E10C003M	2	1969.87	2010.57	-42.5	-10.6	31.9	94.0	19.7	21.1
06N01E24L003M	2	1970.24	2010.25	14.4	33.0	18.6	75.0	-1.4	4.9
06N02E02M003M	2	1970.24	2010.24	-8.3	24.3	32.6	72.0	-8.6	14.6
06N05E01C001M	1	1969.9	2006.7	-80.1	-42.8	37.3	425.0	43.9	44.3
07N01E08N002M	2	1972.64	1994.63	64.6	87.5	22.9	235.0	-24.5	25.0
07N01E11K001M	4	1994.09	1998.42	-17.5	51.9	69.4	51.0	-26.4	33.0
07N01E25J001M	3	1991.6	1999.25	-69.3	33.4	102.7	77.0	-10.4	19.8
07N05E26C001M	4	1970.21	2008.9	-63.9	-31.0	32.9	75.0	31.5	32.0
07N05E32D001M	5	1978.79	1991.2	-51.3	-27.1	24.2	26.0	26.1	26.4
07N06E23P001M	2	1969.9	1998.94	-38.1	1.4	39.5	317.0	-0.8	4.8
08N03E04R001M	2	1970.28	2010.67	-35.8	17.9	53.7	414.0	8.2	10.0
08N04E24M001M	1	1969.9	2001.41	-12.6	3.0	15.6	142.0	13.9	14.1
08N05E07P001M	2	1970.21	2010.7	-5.5	5.7	11.2	349.0	3.3	3.6
08N06E21N002M	2	1969.81	2004.17	-28.4	1.6	30.0	122.0	3.7	6.9
08N06E25J002M	2	1970.21	2010.57	-14.7	85.5	100.2	79.0	-13.8	19.2
08N07E18E002M	3	1984.2	2010.58	-28.9	28.7	57.6	51.0	-8.7	15.8
09N02E16N001M	2	1969.9	2010.67	-27.0	48.1	75.1	461.0	-2.5	11.0
09N04E01R001M	1	1970.82	2010.31	-18.5	13.1	31.6	70.0	0.4	4.6
09N04E22E001M	2	1969.9	2007.83	2.9	15.1	12.2	162.0	1.9	2.8
09N05E14B001M	3	1980.77	2010.57	-49.6	-20.8	28.8	61.0	24.0	24.7
09N05E25J001M	2	1977.5	2010.7	-45.7	-7.4	38.3	346.0	18.3	19.4
09N05E28K001M	2	1970.21	2010.57	-37.4	-4.8	32.6	81.0	20.4	21.4
10N01E26E003M	2	1970.26	2010.32	-20.2	55.5	75.7	86.0	15.7	19.5
10N01E33L002M	2	1972.55	2010.3	2.0	74.6	72.6	88.0	-0.3	13.6
10N02E08E001M	2	1970.84	2010.32	-20.2	51.5	71.7	82.0	5.9	12.2
10N04E27R002M	5	1996.77	2010.67	-32.5	-16.0	16.5	110.0	26.1	26.3
10N04E27R003M	4	1996.77	2010.67	-6.1	7.1	13.2	111.0	-0.6	2.2
10N04E27R004M	2	1996.77	2010.67	6.7	18.2	11.5	111.0	-10.9	11.3

APPENDIX B
Summary of Quantitative Calibration Targets by Well
SACFEM2013: Sacramento Valley Finite Element Groundwater Model; User's Manual

State Well Number	SACFEM 2013 Model Layer	Earliest Year with Measured Data	Latest Year with Measured Data	Minimum Measured Groundwater Elevation (feet NAVD88)	Maximum Measured Groundwater Elevation (feet NAVD88)	Range in Measured Groundwater Elevation (feet)	Number of Measurements	Mean Error (feet)	Root Mean Squared Error (feet)
10N04E31M001M	5	1997.19	2010.67	-18.5	-9.9	8.6	109.0	22.8	23.0
10N04E31M002M	4	1997.52	2010.67	-8.4	4.9	13.3	106.0	9.5	9.7
10N04E31M003M	3	1997.52	2010.67	2.4	15.1	12.7	106.0	1.9	2.9
10N04E31M004M	2	1997.52	2010.67	5.2	13.7	8.5	106.0	2.0	2.7
10N05E05E001M	2	1970.21	2010.57	-39.2	-13.2	26.0	80.0	18.6	19.4
10N05E22G001M	3	1969.87	1995.36	-43.1	4.4	47.5	283.0	9.9	12.8
10N06E05H001M	2	1969.9	2010.7	-17.7	28.2	45.9	450.0	-3.2	8.2
11N01E03E001M	2	1970.21	2010.25	-21.7	37.1	58.8	118.0	-1.6	10.8
11N02E20K004M	2	1970.23	2010.67	-20.1	37.3	57.4	405.0	-5.4	8.6
11N03E15C001M	1	1970.22	2010.67	7.5	32.2	24.7	123.0	3.7	5.5
11N03E20H003M	2	1970.23	2010.55	14.0	29.3	15.3	83.0	2.5	4.7
11N04E04N001M	7	1994.02	2010.71	-8.6	15.1	23.7	209.0	-2.2	4.2
11N04E04N002M	3	1994.1	2010.71	4.4	27.2	22.8	208.0	-13.2	13.6
11N04E04N003M	2	1994.1	2010.71	11.6	28.7	17.1	208.0	-11.2	11.5
11N06E15C004M	1	1970.23	2008.77	33.3	62.7	29.4	147.0	-40.6	42.2
12N01E06D002M	5	1997.77	2010.73	-7.0	28.7	35.8	95.0	10.4	12.2
12N01E06D003M	4	1997.77	2010.73	-29.3	29.2	58.5	94.0	15.7	20.6
12N01E06D004M	3	1997.77	2010.73	-11.6	29.6	41.2	95.0	8.5	11.4
12N01E16A001M	5	1997.77	2010.73	-14.9	28.4	43.3	85.0	11.0	13.6
12N01E16A002M	3	1997.77	2010.73	-15.1	29.9	45.1	86.0	16.0	20.5
12N01E26A001M	4	1996.85	2010.73	-18.6	21.1	39.7	103.0	19.6	21.7
12N01E26A002M	3	1996.85	2010.73	-21.5	23.0	44.5	104.0	21.0	24.0
12N01E26A003M	2	1996.85	2010.73	-0.3	22.6	22.9	104.0	14.1	15.3
12N02E23K001M	6	1969.78	2009.95	15.5	20.9	5.4	93.0	4.1	4.7
12N04E03N002M	7	1996.77	2010.67	-6.5	44.7	51.2	113.0	-13.8	16.1
12N04E03N003M	6	1996.77	2010.67	-1.5	41.3	42.8	112.0	-11.1	13.7
12N04E03N004M	2	1996.77	2010.67	10.1	45.0	34.9	113.0	-18.7	19.7
12N04E05R004M	1	1970.22	2010.71	-0.3	37.7	38.0	398.0	-9.0	10.5
12N04E26J002M	7	1996.77	2010.67	-17.8	24.4	42.2	114.0	-5.3	9.1
12N04E26J003M	5	1996.77	2010.67	-17.5	24.6	42.1	113.0	-7.2	9.9

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SACFEM2013: Sacramento Valley Finite Element Groundwater Model; User's Manual

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12N04E26J004M	2	1996.77	2010.67	2.6	38.3	35.8	114.0	-21.4	22.6
12N05E01D002M	2	1970.21	2010.57	49.6	77.3	27.7	91.0	-32.6	35.2
12N05E06R001M	1	1970.21	2010.57	-7.5	52.5	60.0	86.0	-22.4	24.8
12N05E12Q001M	1	1969.83	2007.68	22.8	73.0	50.2	446.0	-24.7	31.4
12N05E17A002M	1	1970.21	2010.7	-1.9	41.4	43.3	402.0	-13.9	16.9
12N06E27D002M	3	1969.9	2003.83	39.4	95.0	55.6	160.0	-6.6	22.3
13N01E11A001M	2	1970.19	2010.59	18.7	31.8	13.1	98.0	5.2	6.0
13N01E12J002M	2	1970.22	2010.67	23.8	32.8	9.0	135.0	6.3	6.9
13N01E32K001M	4	1997.77	2010.73	-24.7	23.3	48.0	94.0	23.7	27.0
13N01E32K002M	3	1997.77	2010.73	-13.1	20.4	33.5	94.0	20.4	21.9
13N02W04G001M	3	1969.81	2010.59	38.1	120.0	81.9	449.0	-17.5	32.4
13N02W04G004M	1	1978.45	2010.59	97.3	148.0	50.7	239.0	-51.3	53.7
13N02W15J001M	2	1975.25	2010.59	31.0	111.9	80.9	215.0	-27.8	34.8
13N02W22H001M	1	1970.21	2010.27	106.8	176.0	69.2	77.0	-61.3	63.3
13N04E07L001M	3	1996.3	2010.72	26.1	39.7	13.6	115.0	-2.3	3.1
13N04E23A002M	1	1970.22	2010.57	15.0	57.9	42.9	99.0	-8.6	12.5
13N04E36E001M	1	1969.79	1995.47	-25.9	43.4	69.3	199.0	-10.0	16.0
13N05E06R004M	4	1996.3	2010.72	27.5	61.9	34.4	116.0	3.2	6.3
14N01W03L002M	3	1970.19	1983.76	-21.1	40.8	61.9	84.0	-10.8	16.6
14N01W04K003M	1	1970.19	2010.59	25.8	36.2	10.4	96.0	-26.0	28.2
14N02W16N002M	1	1969.81	1988.19	46.5	87.8	41.3	142.0	13.3	16.1
14N02W29J001M	5	1970.82	2010.59	57.5	107.2	49.7	225.0	-33.2	38.2
14N03E05C001M	1	1970.21	2004.8	3.1	42.5	39.4	66.0	-5.0	7.6
14N03E17A003M	2	1970.23	2010.58	2.0	38.1	36.1	345.0	-0.8	4.2
14N03W11A001M	4	1970.21	2010.59	48.5	107.6	59.1	95.0	-5.1	16.3
14N04E30N003M	2	1995.74	2010.72	4.7	33.4	28.7	152.0	4.0	6.6
15N01E16R001M	3	1969.78	2003.22	29.7	40.3	10.6	72.0	-2.7	6.4
15N01W05G001M	1	1976.19	2010.59	26.2	47.6	21.4	88.0	-6.7	9.0
15N02E35D001M	3	1970.24	2010.57	31.5	44.7	13.2	87.0	-11.8	13.5
15N03E05D002M	2	1970.22	2004.21	30.7	58.7	28.0	63.0	-14.8	15.6

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15N03E15H004M	2	1970.22	2010.67	32.0	46.7	14.7	137.0	0.7	2.4
15N04E13A001M	2	1970.8	2010.59	13.4	88.1	74.6	90.0	21.4	28.2
15N04E16G002M	3	1996.29	2010.72	31.1	59.1	28.0	114.0	4.8	5.9
15N04E27A001M	4	1970.23	2006.28	-13.5	61.4	74.9	82.0	28.4	34.2
16N01W20F001M	1	1970.19	2010.59	24.7	55.7	31.0	114.0	16.1	17.1
16N02E26Q001M	1	1970.22	2010.58	39.3	60.9	21.6	91.0	-17.4	18.5
16N02W25B002M	2	1969.88	2010.59	28.1	51.4	23.3	335.0	-3.8	5.6
16N03E21D002M	1	1970.22	2010.58	44.6	69.1	24.5	115.0	-16.4	17.0
16N03W07Q001M	1	1975.25	2010.59	105.7	111.3	5.6	90.0	-11.4	11.7
16N03W35N002M	4	1970.19	2010.22	60.6	70.5	9.9	97.0	0.8	5.0
16N04E17R002M	2	1988.84	2010.69	37.1	79.4	42.3	122.0	-2.2	8.0
16N04E22B001M	3	1995.74	2010.72	41.9	85.1	43.2	154.0	10.0	13.2
17N01E10A001M	2	1970.22	2010.59	28.1	60.7	32.6	124.0	4.9	7.1
17N01E17F001M	2	1992.89	2010.59	51.9	59.8	7.9	69.0	5.8	8.2
17N01E17F002M	3	1992.89	2010.59	51.9	62.6	10.7	69.0	3.5	5.8
17N01E17F003M	5	1992.89	2010.59	51.6	62.3	10.7	69.0	3.1	5.0
17N02E14A001M	1	1970.22	2010.69	56.2	84.2	28.0	140.0	-16.6	18.3
17N02W09H002M	5	2004.06	2010.59	24.4	68.7	44.4	64.0	10.9	16.5
17N02W09H003M	4	2004.06	2010.59	11.1	68.0	56.9	63.0	11.8	21.0
17N02W09H004M	2	2004.06	2010.59	53.4	67.3	13.9	64.0	2.2	4.2
17N03E03D001M	1	1970.22	2010.59	61.9	89.8	27.9	139.0	3.4	5.2
17N03E05C001M	1	1970.22	2002.79	75.6	95.6	20.0	105.0	-13.0	13.7
17N03E16N001M	2	1970.22	2010.69	66.4	82.6	16.2	141.0	-15.8	16.7
17N03W08R001M	2	1975.25	2010.59	86.6	98.1	11.5	139.0	4.1	5.0
17N03W10C001M	1	1970.19	2010.59	85.9	93.3	7.4	226.0	-4.8	5.5
17N04E30R001M	4	1970.21	2010.69	-26.4	82.4	108.8	129.0	4.2	10.6
18N01E13M001M	2	1970.23	2002.79	61.1	75.5	14.4	90.0	1.9	4.7
18N01E17D001M	1	1970.21	2001.56	63.8	71.6	7.8	80.0	5.5	11.6
18N01W17G001M	1	1970.21	2010.22	50.4	79.4	29.0	137.0	13.3	14.7
18N01W22L001M	2	1970.21	2009.81	32.0	70.2	38.2	136.0	5.5	11.5

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18N01W35K001M	1	1970.19	2001.78	58.4	62.2	3.8	86.0	7.2	11.9
18N02E16F001M	1	1970.76	2010.59	74.2	79.1	4.9	138.0	4.3	7.1
18N02E32Q002M	1	1970.23	2002.79	69.3	74.8	5.5	267.0	-2.3	6.2
18N02W18D001M	6	2007.33	2010.59	77.1	81.7	4.6	17.0	4.8	5.1
18N02W18D002M	5	2007.33	2010.59	73.7	78.5	4.8	17.0	7.9	7.9
18N02W18D003M	4	2007.33	2010.59	74.3	78.6	4.3	18.0	6.7	6.8
18N02W18D004M	2	2007.33	2010.59	40.5	77.4	36.9	17.0	24.2	27.8
18N02W18K001M	2	1975.25	2010.59	-27.8	78.2	106.0	63.0	13.1	32.0
18N02W36B001M	1	1970.19	2010.59	60.5	73.2	12.7	100.0	0.8	3.3
18N03E05K001M	1	1970.22	2002.79	89.3	106.3	17.0	104.0	9.9	10.3
18N03E18F001M	5	1970.22	2010.59	86.2	98.6	12.4	139.0	-4.8	6.3
18N03E21G001M	1	1970.22	2010.59	80.5	96.9	16.4	140.0	-0.2	3.5
18N03W10L001M	1	1969.88	2010.59	89.5	95.6	6.1	222.0	1.1	3.1
18N04E16C001M	3	1970.22	2010.59	93.3	136.3	43.0	135.0	-11.3	16.5
18N04W12A001M	1	1970.21	2010.22	98.9	129.0	30.1	124.0	-7.1	12.4
18N04W23F001M	7	1970.21	2010.59	128.0	149.0	21.0	130.0	7.8	11.9
19N01E09Q001M	2	1991.66	2010.59	48.1	92.6	44.5	93.0	5.1	10.0
19N01E27Q001M	4	1978.39	2010.59	60.1	86.8	26.7	172.0	-1.3	5.0
19N01W15D001M	1	1970.21	2010.59	66.8	89.7	22.9	142.0	9.7	12.8
19N02W13J001M	1	1969.88	2010.59	73.6	88.3	14.7	223.0	6.2	7.3
19N02W29Q001M	2	1970.21	2010.59	77.5	92.4	14.9	130.0	-2.5	4.3
19N02W36H001M	1	1970.21	2010.59	70.6	83.9	13.3	130.0	-1.1	3.9
19N03W26P001M	3	1974.19	2010.59	91.6	102.3	10.7	122.0	-3.1	4.7
19N04W12E001M	4	1969.88	2010.59	63.5	170.0	106.5	355.0	-5.6	25.6
20N01E10C002M	2	1973.26	2010.59	70.3	126.8	56.5	130.0	0.0	9.2
20N01E18L001M	6	2000.12	2010.59	99.8	113.8	13.9	102.0	-3.8	4.3
20N01E18L002M	5	2001.89	2010.59	100.8	108.0	7.1	75.0	-2.1	2.9
20N01E18L003M	2	2001.89	2010.59	103.5	108.1	4.5	74.0	-3.1	3.7
20N01E35C001M	1	1970.23	2010.59	93.8	101.0	7.2	137.0	4.2	4.6
20N02E06Q001M	4	1970.23	2010.59	97.6	134.3	36.7	141.0	6.7	8.9

APPENDIX B
Summary of Quantitative Calibration Targets by Well
SACFEM2013: Sacramento Valley Finite Element Groundwater Model; User's Manual

State Well Number	SACFEM 2013 Model Layer	Earliest Year with Measured Data	Latest Year with Measured Data	Minimum Measured Groundwater Elevation (feet NAVD88)	Maximum Measured Groundwater Elevation (feet NAVD88)	Range in Measured Groundwater Elevation (feet)	Number of Measurements	Mean Error (feet)	Root Mean Squared Error (feet)
20N02E07H001M	3	1990.84	1997.84	91.1	128.7	37.6	99.0	4.6	6.2
20N02E24C001M	2	2000.01	2010.59	105.8	130.6	24.8	81.0	15.5	16.0
20N02E24C002M	5	2000.01	2010.59	105.9	130.6	24.7	84.0	16.2	16.6
20N02E24C003M	7	2000.01	2010.59	105.6	130.7	25.1	85.0	18.1	18.5
20N02E28N001M	1	1969.89	2010.59	112.8	121.6	8.8	400.0	-5.4	7.0
20N02W02J001M	1	1970.21	2010.59	114.8	125.6	10.8	131.0	1.5	3.9
20N02W11A001M	1	1976.88	2010.59	110.4	124.6	14.2	633.0	-1.7	4.5
20N02W11A002M	2	1978.24	2010.59	91.2	121.4	30.2	313.0	0.2	4.2
20N02W11A003M	4	1978.24	2010.59	75.1	123.1	48.0	320.0	3.7	6.5
20N02W29G001M	1	1969.88	2010.59	110.4	116.7	6.3	161.0	-2.3	4.5
21N01E05G001M	2	1969.98	1997.56	113.5	144.9	31.4	116.0	-3.3	4.3
21N01E12K001M	4	1970.23	2010.52	81.1	165.2	84.1	108.0	15.7	21.7
21N01E27D001M	1	1970.23	2010.59	87.0	132.1	45.2	169.0	0.1	9.1
21N01W04N001M	1	1970.21	2010.59	106.6	129.2	22.6	152.0	9.1	9.6
21N01W23J001M	1	1970.23	2010.59	104.2	120.2	16.0	168.0	0.5	3.1
21N01W24B001M	6	1995.29	2010.59	96.0	127.4	31.4	122.0	1.0	4.9
21N02E26F001M	7	1970.23	2008.19	102.0	146.7	44.7	119.0	27.0	29.9
21N02W05M001M	4	2002.41	2010.59	117.3	167.8	50.5	95.0	-3.6	6.4
21N02W05M002M	2	2002.41	2010.59	133.5	181.1	47.6	96.0	-11.8	13.3
21N02W05M004M	1	2002.41	2006.89	159.1	178.4	19.3	63.0	-12.1	12.6
21N02W09M002M	2	1970.21	2010.23	118.3	172.0	53.7	128.0	-8.7	12.8
21N02W23G001M	2	1970.21	2010.59	107.4	147.9	40.5	149.0	-5.5	7.9
21N02W31M001M	2	1970.21	2010.23	94.7	155.5	60.8	126.0	-8.4	13.4
21N03W31R002M	3	1969.81	2008.19	68.2	166.1	97.9	488.0	30.0	40.2
21N03W31R004M	2	1969.81	2008.19	76.3	166.9	90.6	480.0	32.3	42.6
21N03W31R005M	1	1969.81	2008.19	92.4	166.0	73.6	482.0	30.3	39.4
21N03W33A004M	5	1970.21	2010.27	99.3	169.0	69.7	75.0	9.3	22.0
22N01E09J002M	1	1970.23	2002.79	133.8	165.4	31.6	91.0	-1.8	13.8
22N01E20K001M	1	1969.89	2010.59	112.5	154.9	42.4	229.0	-3.2	9.4
22N01E28J001M	6	1972.24	2010.59	115.0	162.2	47.2	326.0	-1.5	10.5

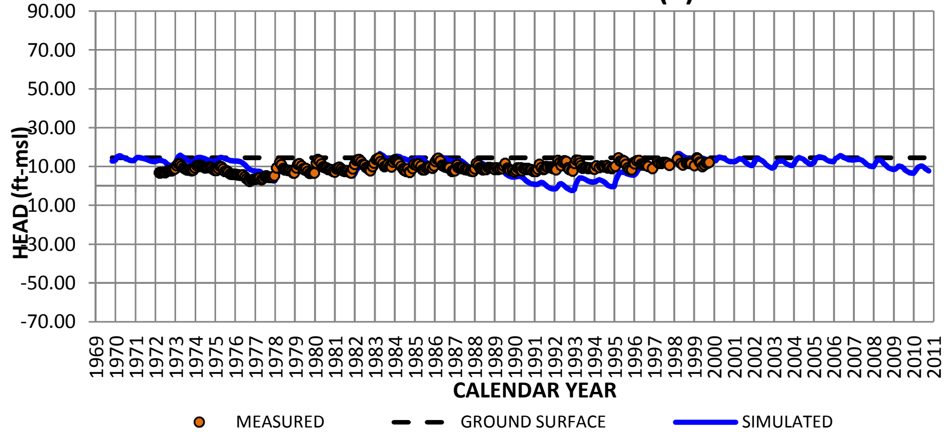
APPENDIX B
Summary of Quantitative Calibration Targets by Well
SACFEM2013: Sacramento Valley Finite Element Groundwater Model; User's Manual

State Well Number	SACFEM 2013 Model Layer	Earliest Year with Measured Data	Latest Year with Measured Data	Minimum Measured Groundwater Elevation (feet NAVD88)	Maximum Measured Groundwater Elevation (feet NAVD88)	Range in Measured Groundwater Elevation (feet)	Number of Measurements	Mean Error (feet)	Root Mean Squared Error (feet)
22N01E28J003M	3	1971.99	2010.59	122.1	164.4	42.3	329.0	-2.8	7.5
22N01E28J005M	7	1971.99	2010.59	116.1	160.2	44.1	330.0	3.7	12.0
22N01E29R001M	6	1970.23	2010.59	106.5	156.4	49.9	137.0	-5.4	10.3
22N01E33N001M	1	1994.28	1997.54	121.4	150.5	29.1	19.0	-0.5	10.1
22N01E33N002M	3	1994.28	1997.54	105.8	143.4	37.6	19.0	2.6	4.8
22N01W05M001M	2	1970.23	2010.59	115.4	148.3	32.9	117.0	3.4	6.4
22N02E17E001M	6	1971.19	2003.57	138.5	256.0	117.5	140.0	57.1	60.4
22N02W08B002M	2	1969.88	2010.59	117.1	201.6	84.5	211.0	9.4	17.5
22N02W20Q001M	1	1973.8	2010.59	165.4	198.2	32.8	146.0	-8.0	9.4
22N02W21D001M	1	1970.21	2010.59	145.8	191.2	45.4	122.0	3.3	8.7
22N02W30H002M	6	2004.39	2010.59	86.3	140.8	54.5	48.0	46.7	48.3
22N02W30H003M	2	2004.39	2010.59	144.5	193.1	48.6	47.0	0.3	8.9
22N02W30H004M	1	2004.39	2010.59	183.5	195.5	12.0	46.0	-11.2	11.4
22N02W36D001M	2	1970.21	2010.59	128.3	162.0	33.7	150.0	-2.8	6.2
22N03W21F002M	2	1977.49	2010.59	223.1	253.9	30.8	321.0	-19.2	20.2
23N01E29P001M	1	1969.89	1990.18	141.3	192.0	50.7	129.0	-12.7	19.7
23N01E29P002M	2	1991.18	2010.59	129.8	164.9	35.1	97.0	33.9	35.2
23N01W09E001M	1	1970.23	2010.59	131.9	170.1	38.2	293.0	20.0	21.7
23N01W14R002M	2	1986.17	2010.59	137.9	171.1	33.2	116.0	26.6	27.3
23N02W16B001M	2	1970.22	2010.22	114.5	170.8	56.3	93.0	31.9	33.5
24N02W12P001M	3	1999.99	2010.59	194.4	202.9	8.6	62.0	13.1	13.6
24N02W12P002M	6	1999.99	2010.59	194.6	202.9	8.3	62.0	21.5	21.6
24N02W30P002M	3	1993.21	2010.22	111.9	196.0	84.1	56.0	33.9	38.1
24N03W17M001M	1	1973.18	2010.59	236.0	286.4	50.4	144.0	5.4	11.3
25N02W09G001M	1	1973.19	2010.59	219.0	234.4	15.4	176.0	6.9	7.7
25N03W10L003M	4	1969.89	2010.59	179.7	248.5	68.8	344.0	19.6	23.1
25N03W10L004M	2	1969.89	2010.59	236.6	269.1	32.5	321.0	-10.8	12.0
27N03W10B001M	1	1970.55	2010.59	243.1	269.3	26.2	331.0	6.5	7.1
27N03W20K001M	2	1969.84	1975.25	249.6	257.4	7.8	34.0	7.0	7.5
27N04W35E001M	2	1970.23	2010.59	297.3	337.7	40.4	133.0	-21.9	23.9

Appendix C
Simulated and Measured Groundwater Hydrographs

E15037553

05N02E05C001M (1)



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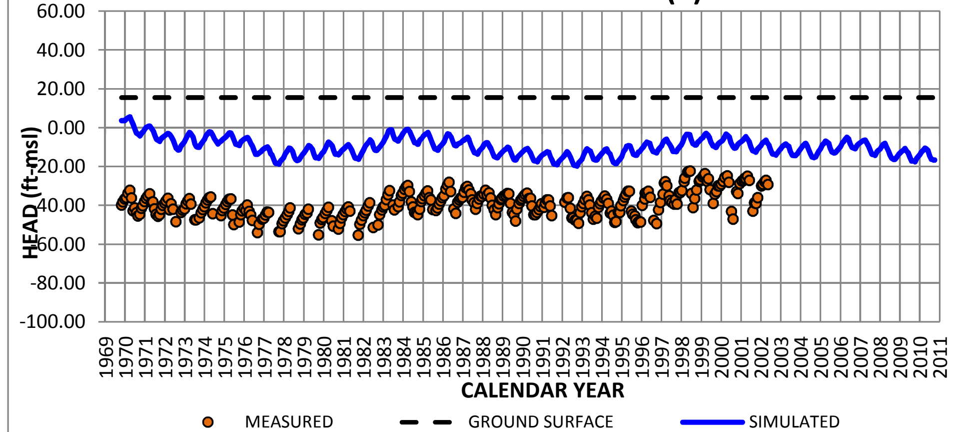

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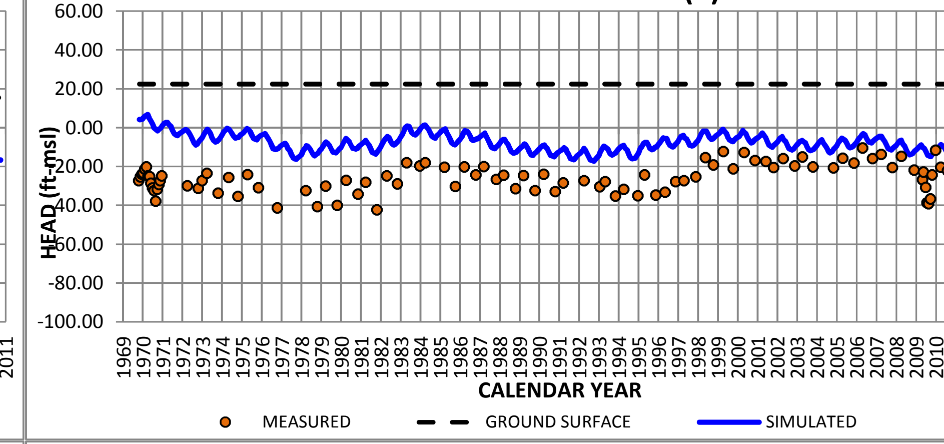

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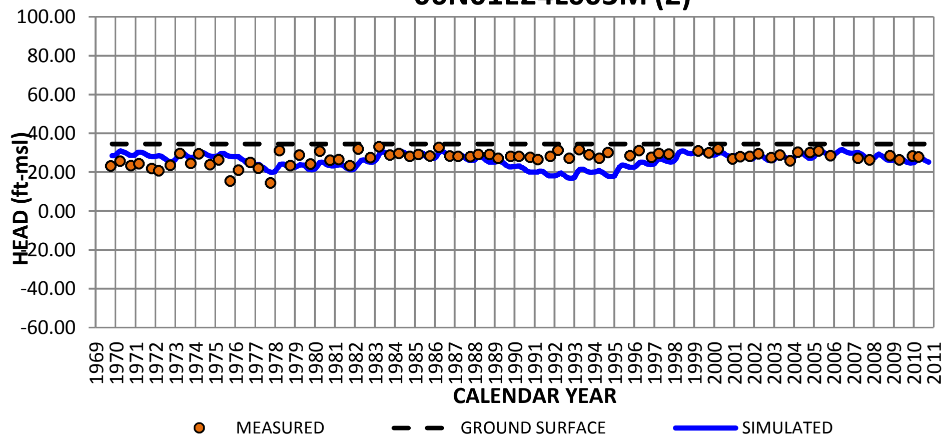

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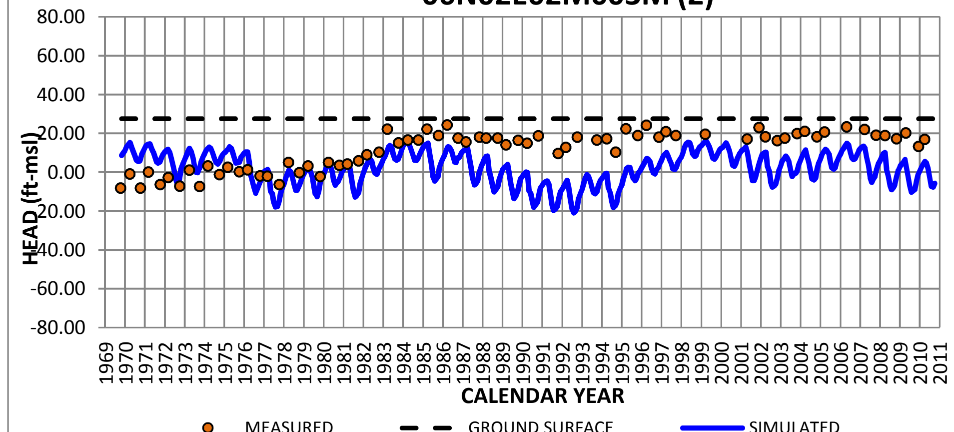

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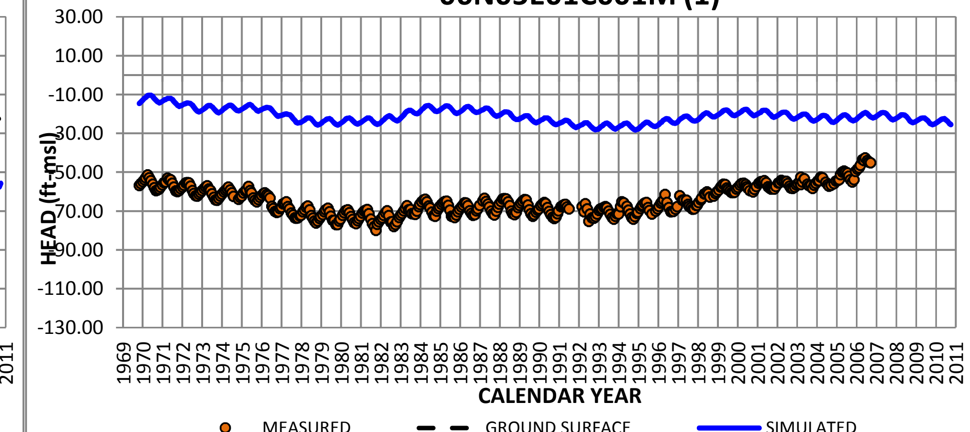

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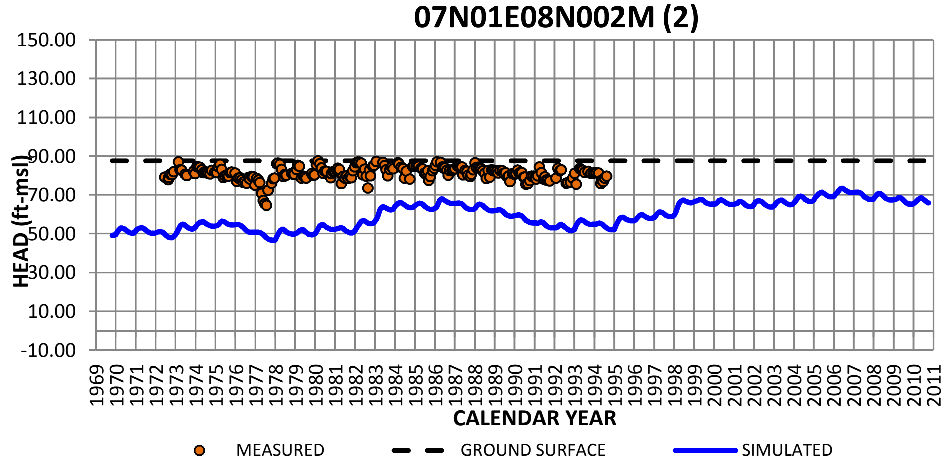

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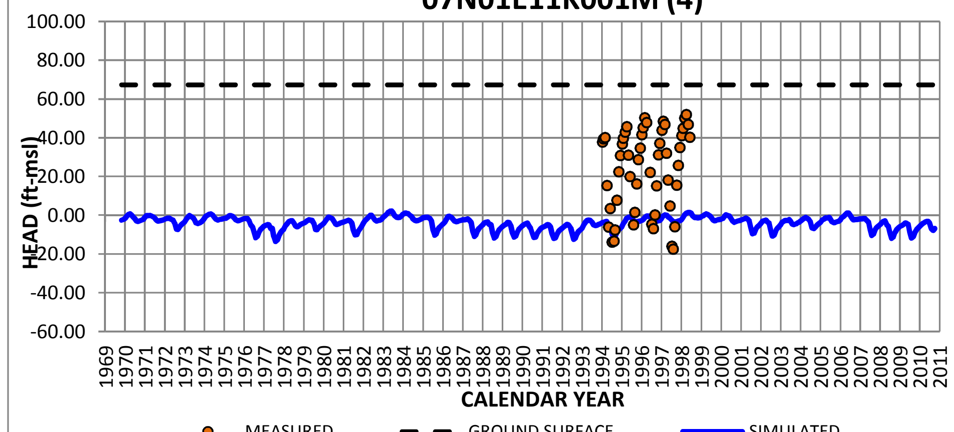

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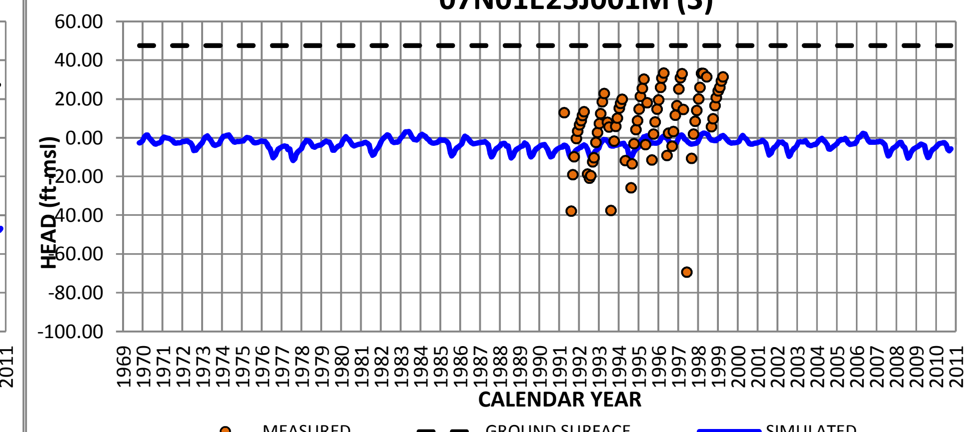

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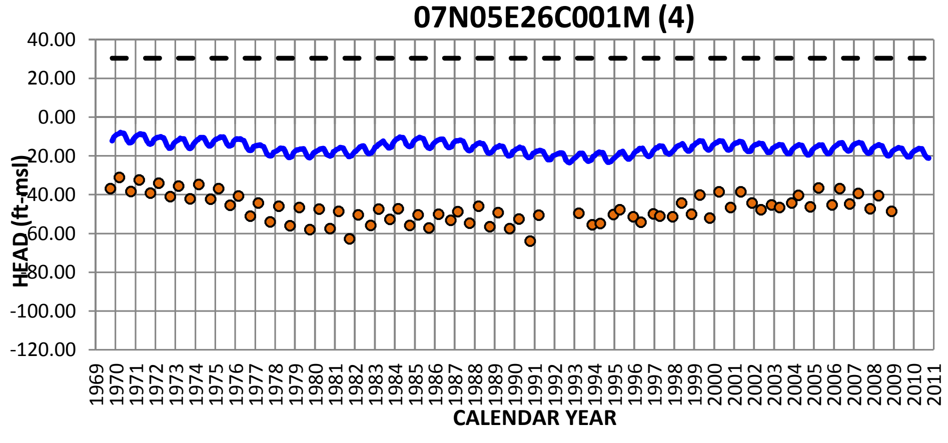

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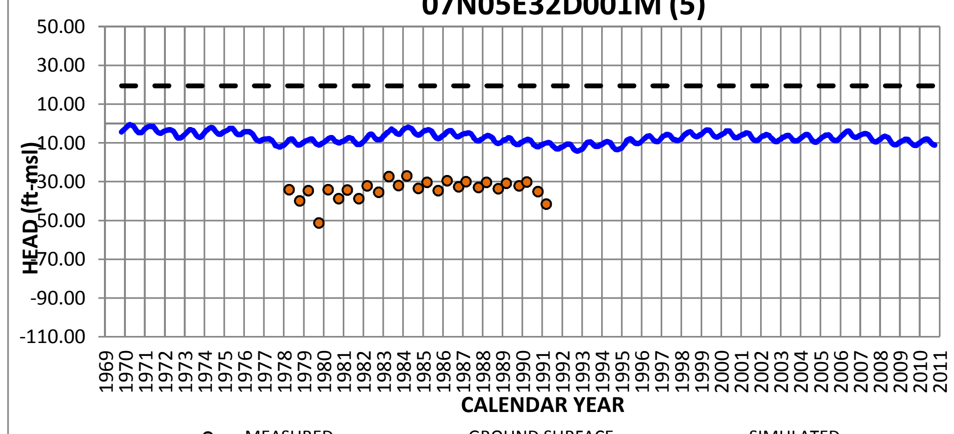

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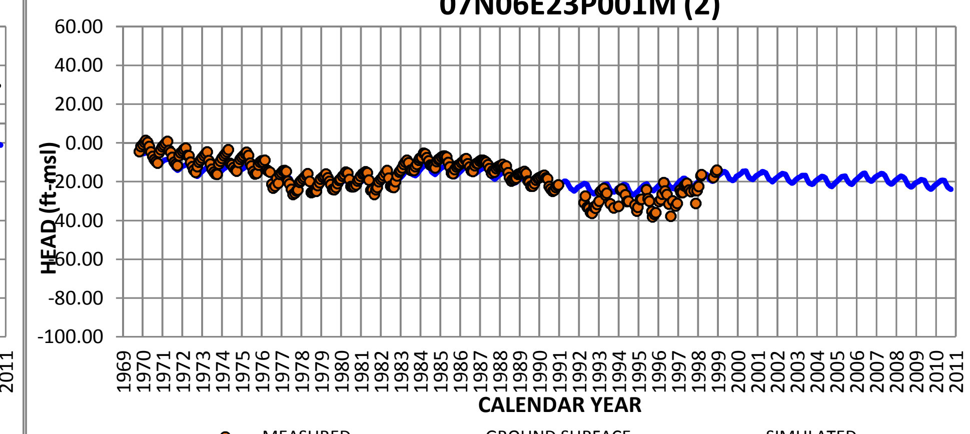

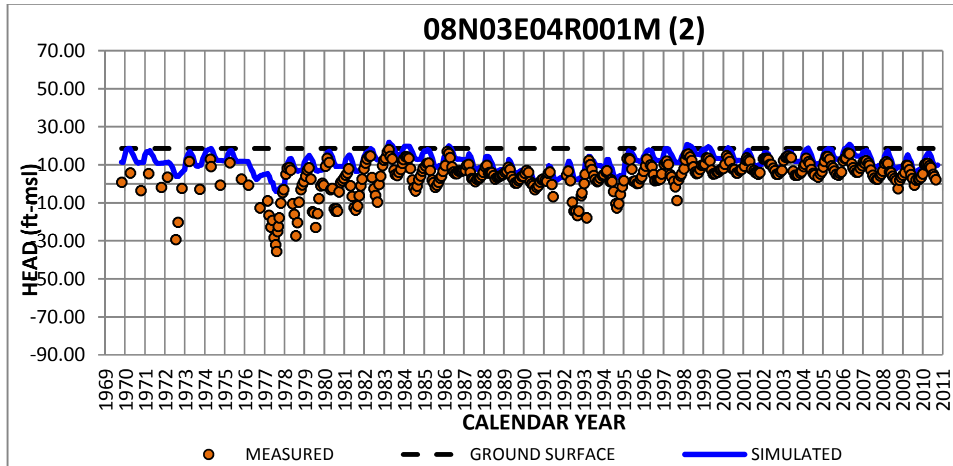
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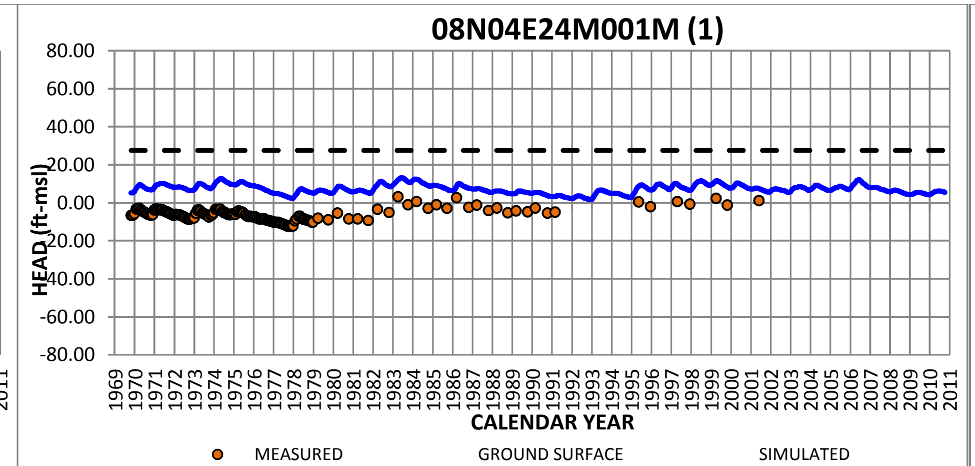
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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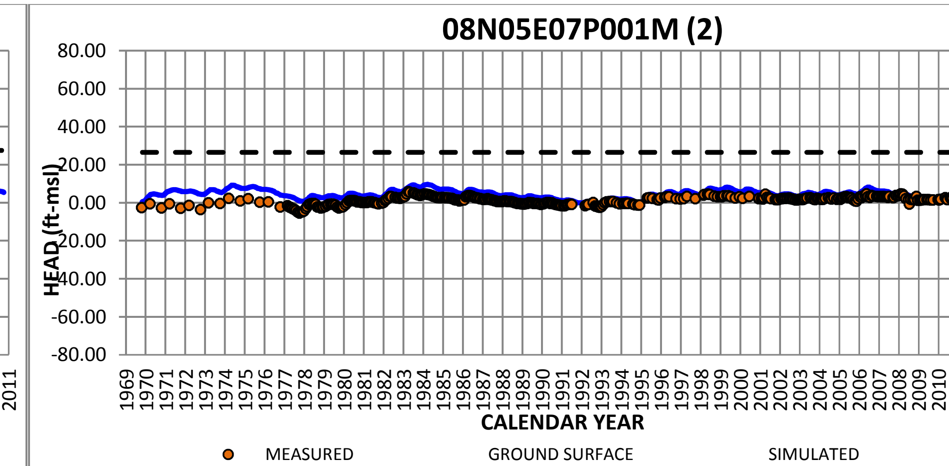
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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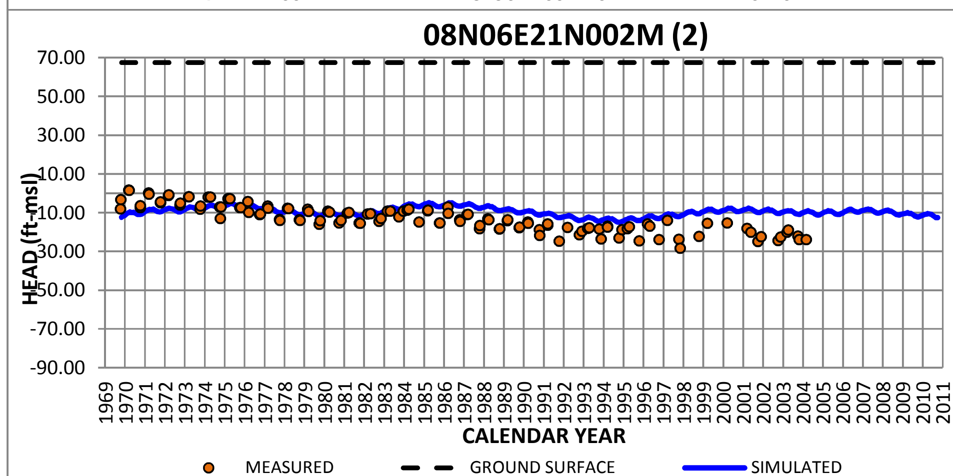
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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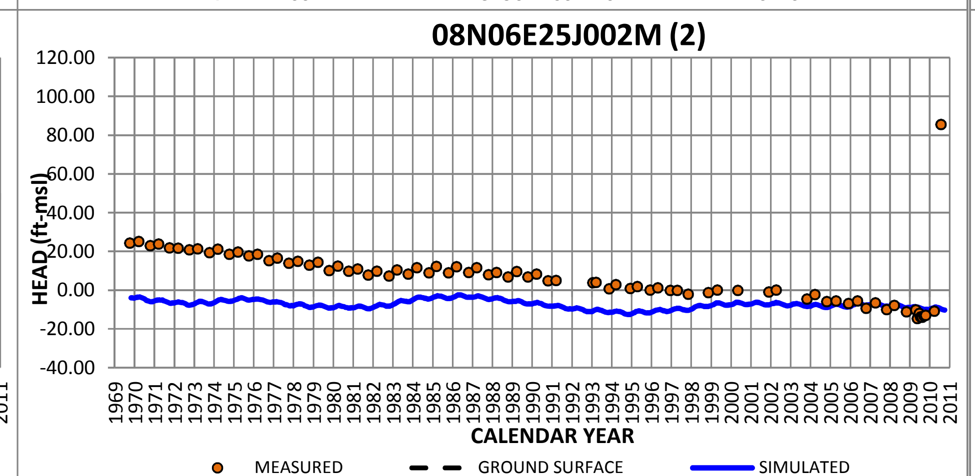
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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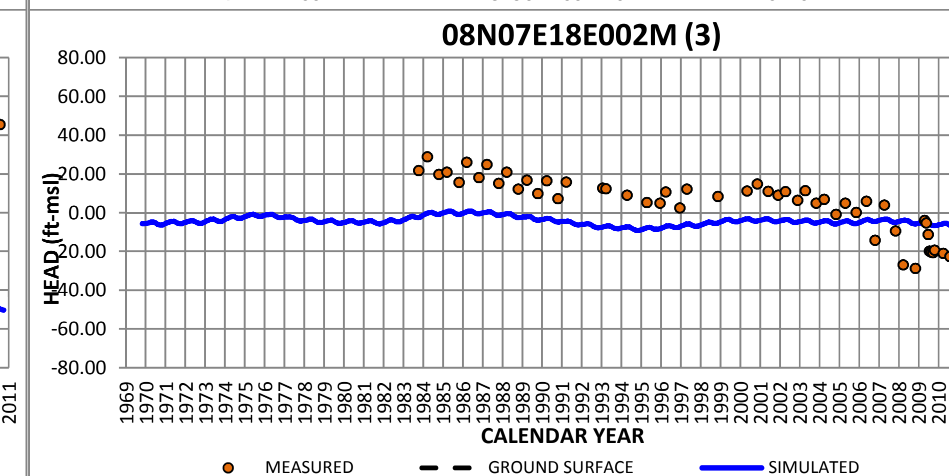
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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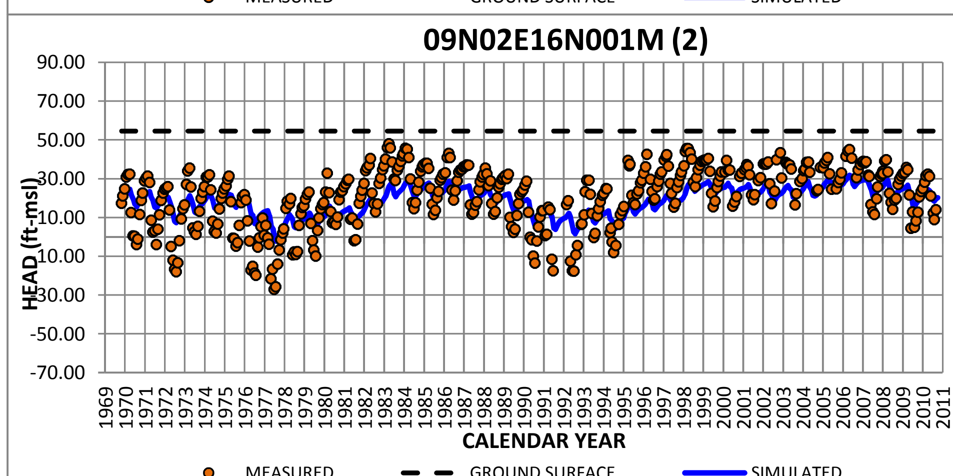
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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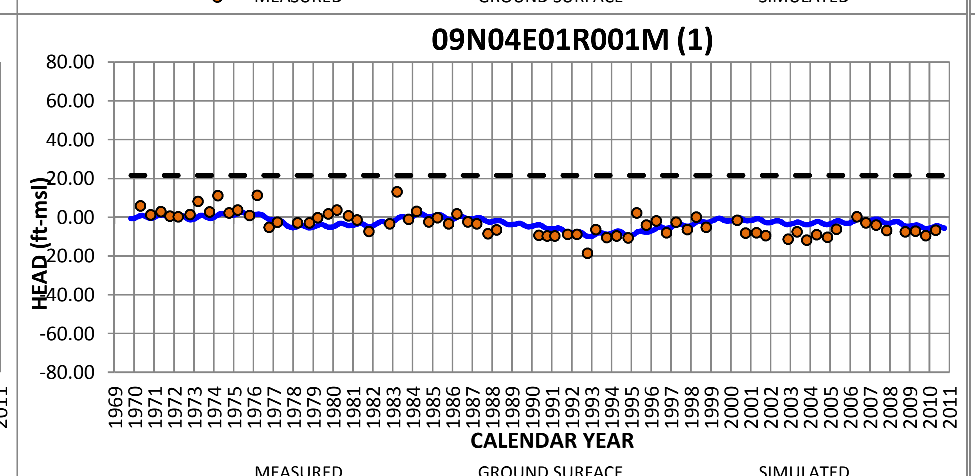
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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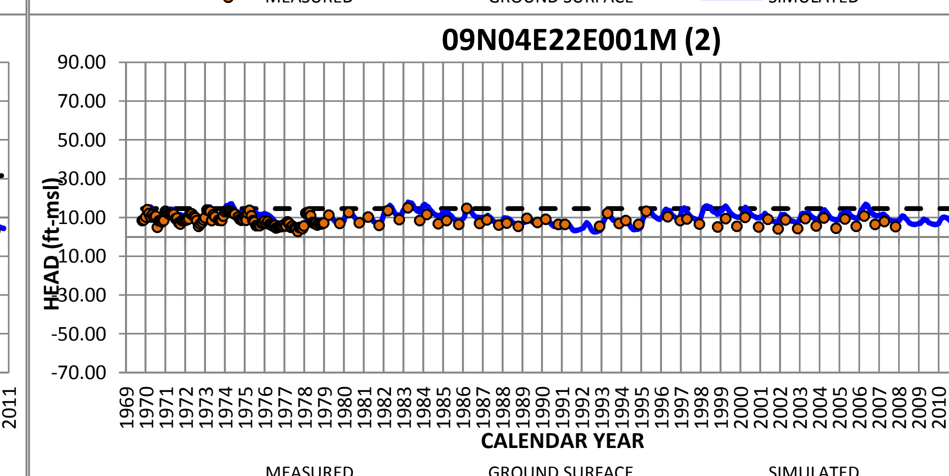
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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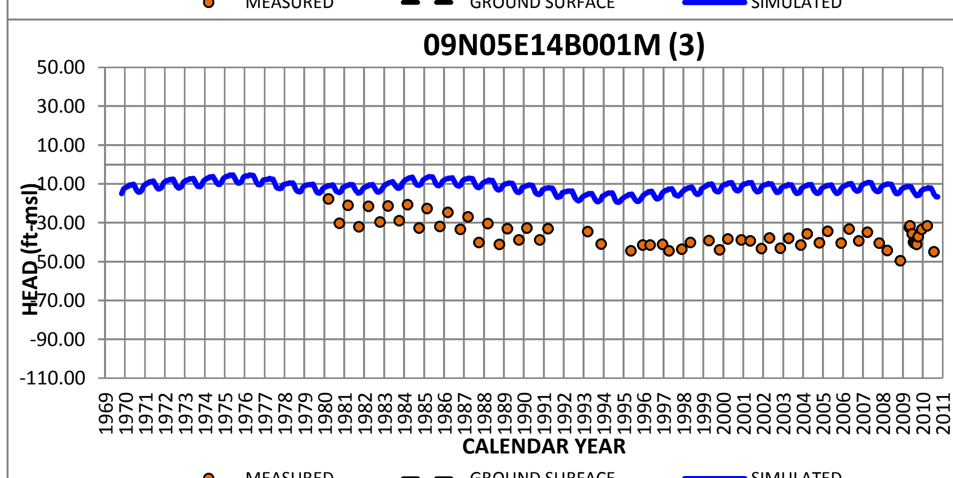
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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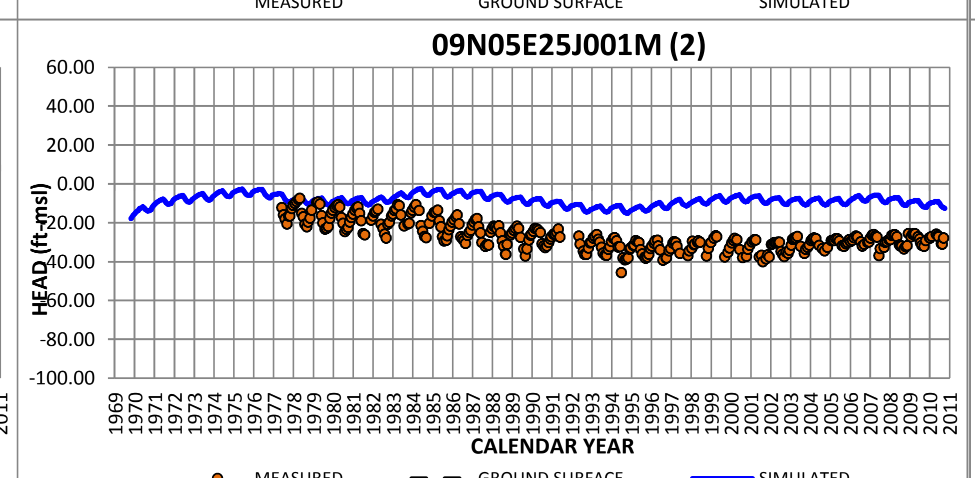
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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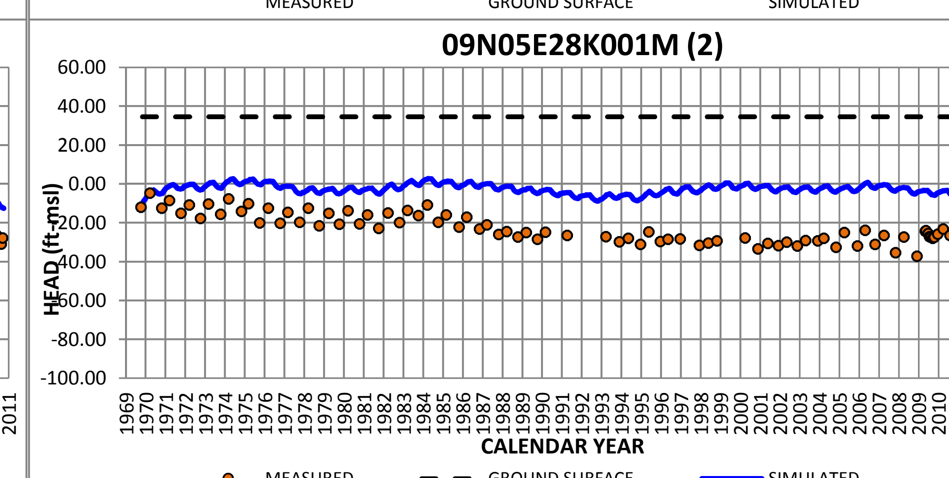
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

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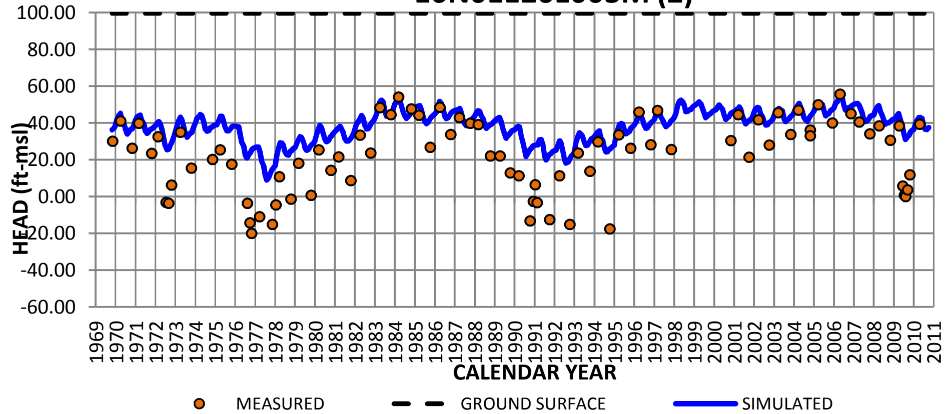

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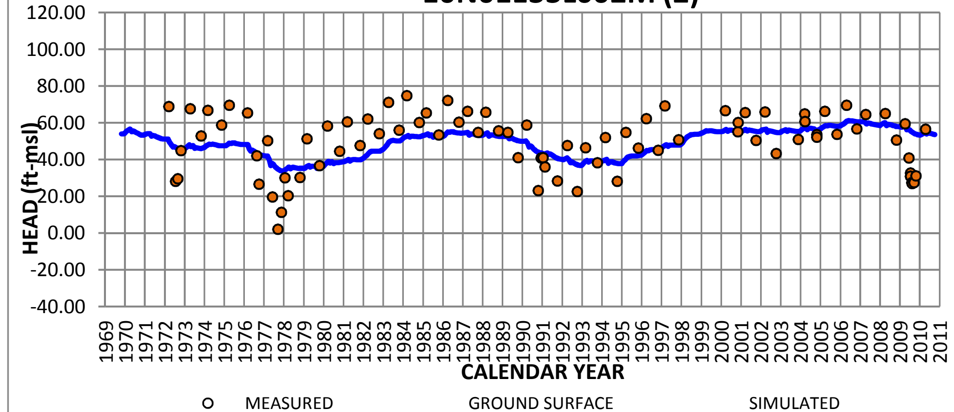

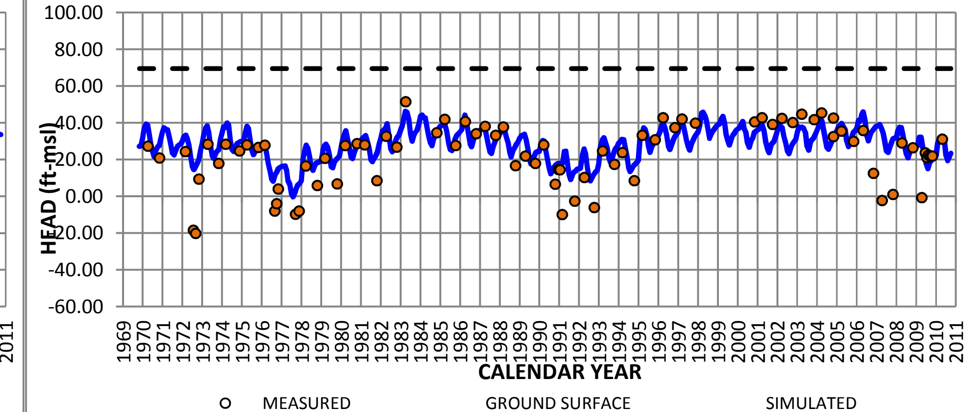

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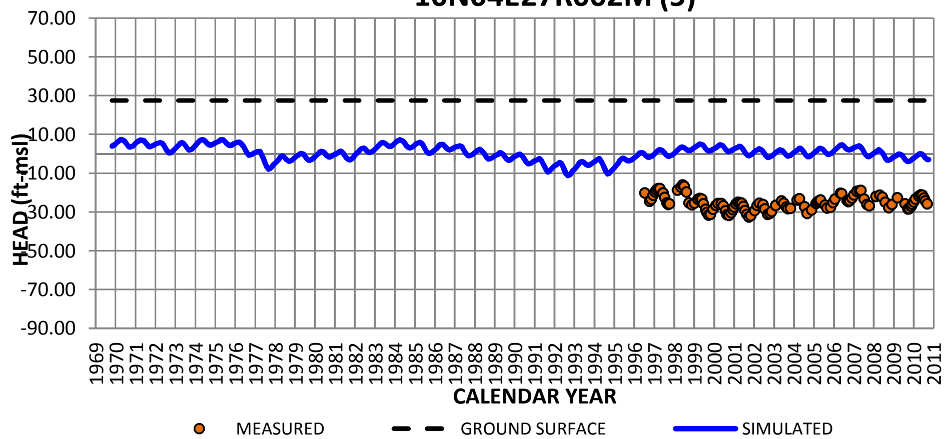

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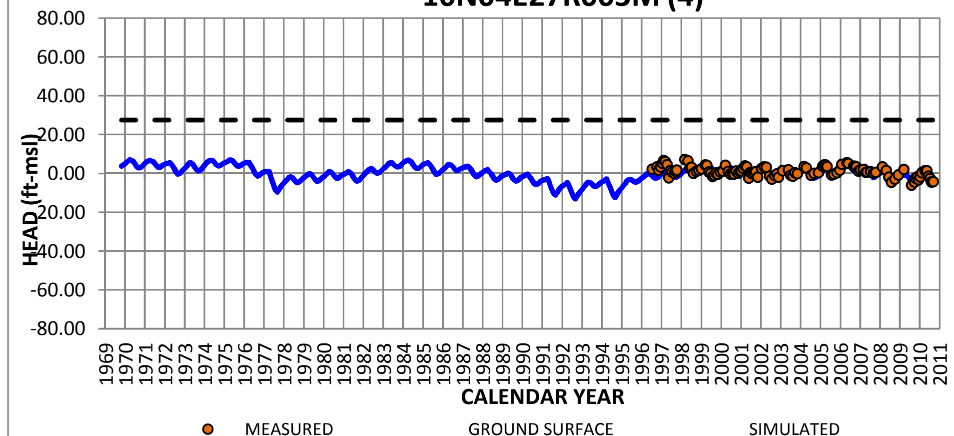

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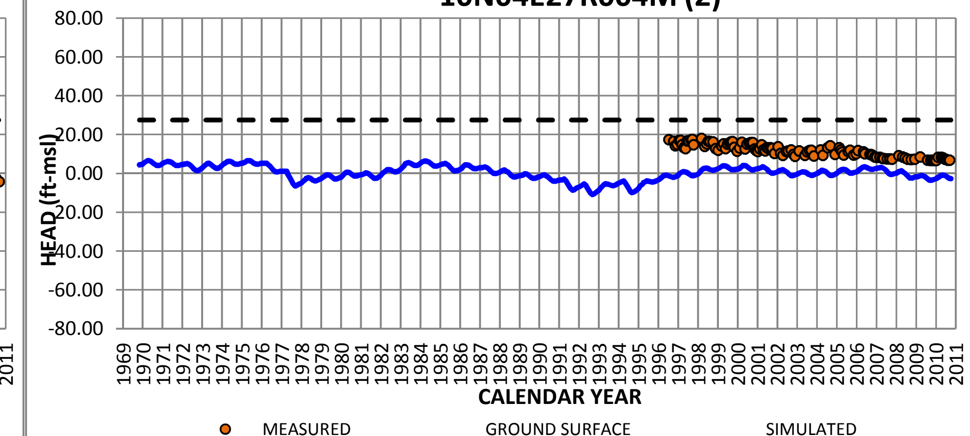

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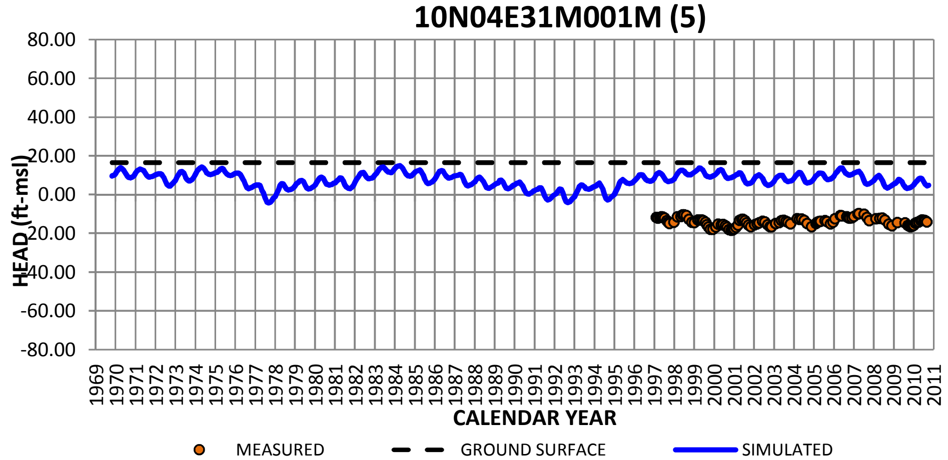

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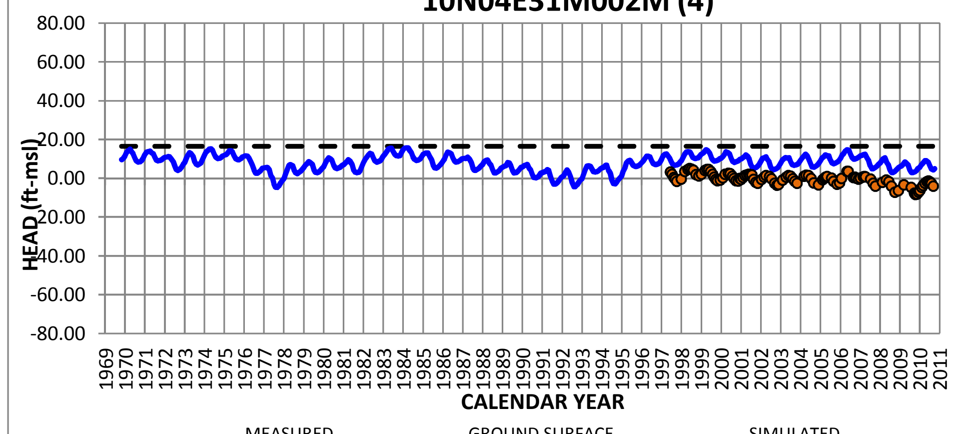

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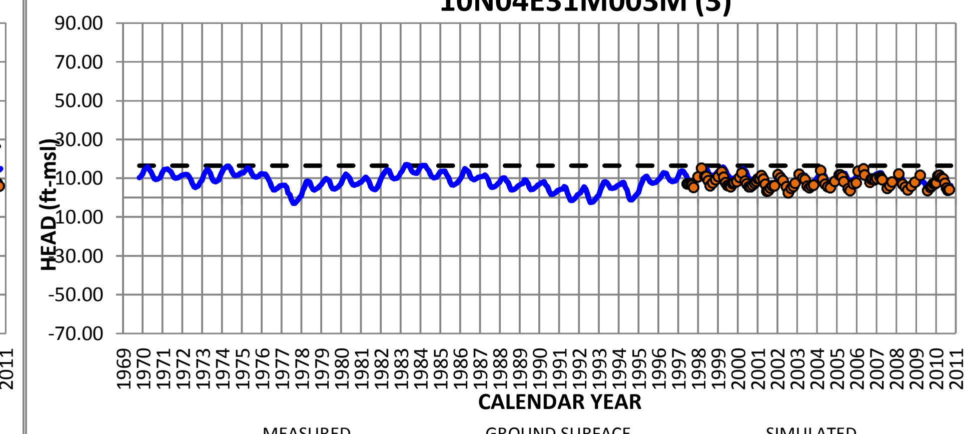

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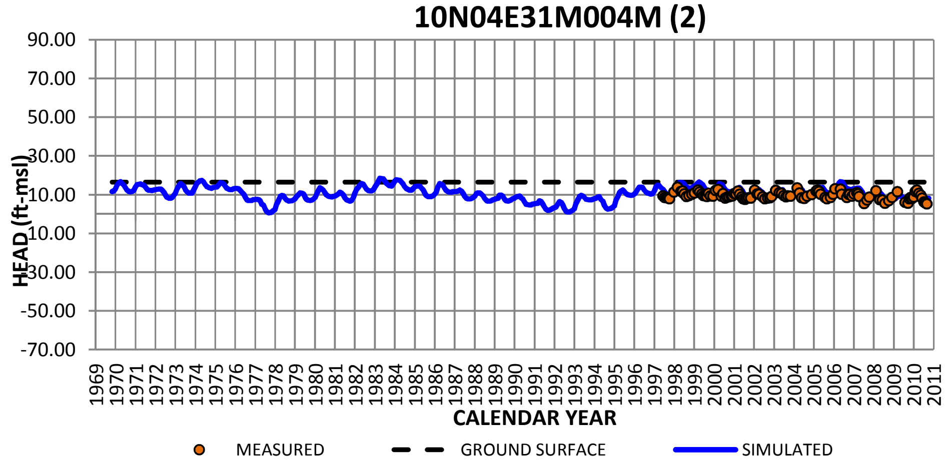

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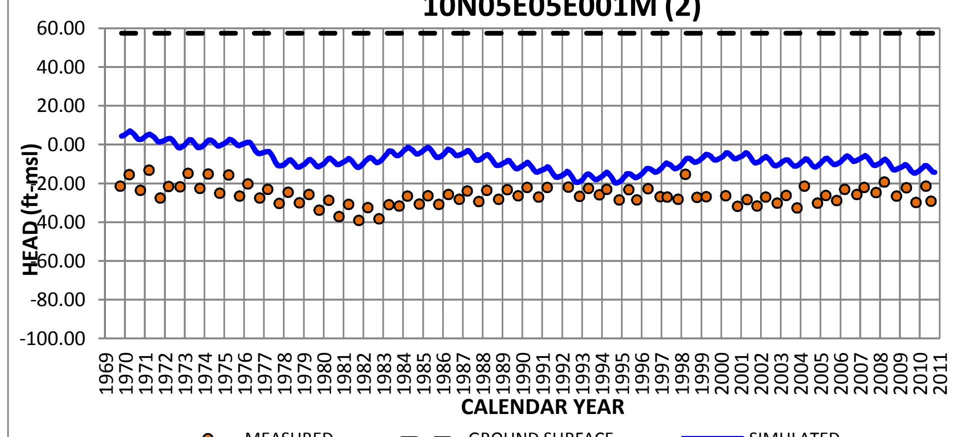

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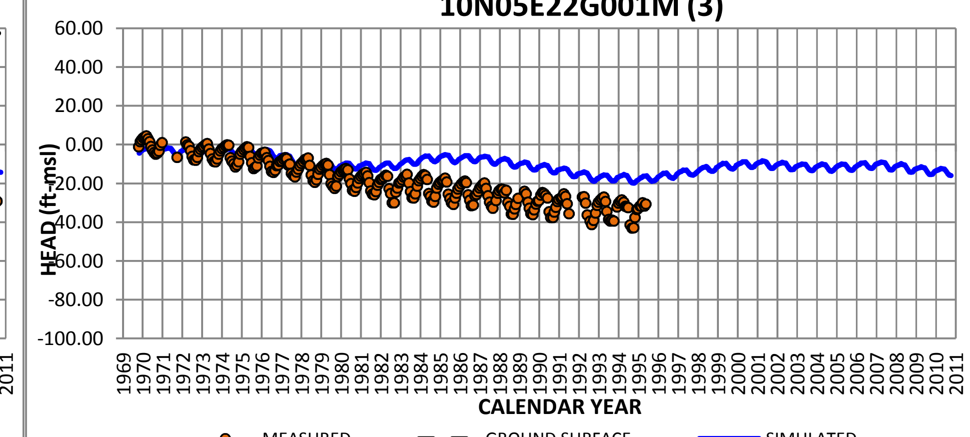
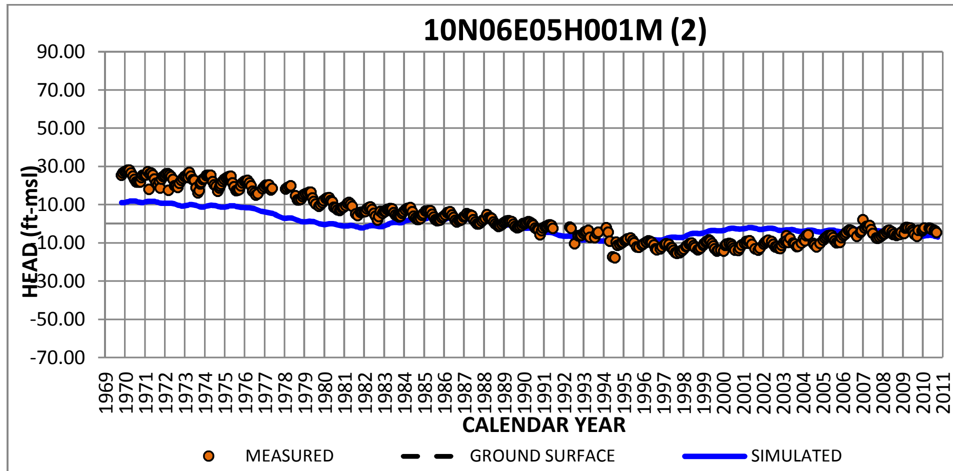
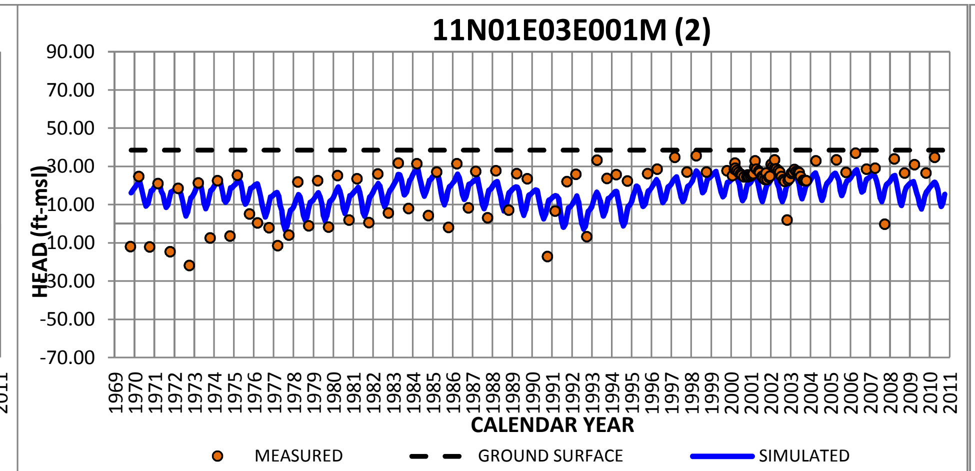
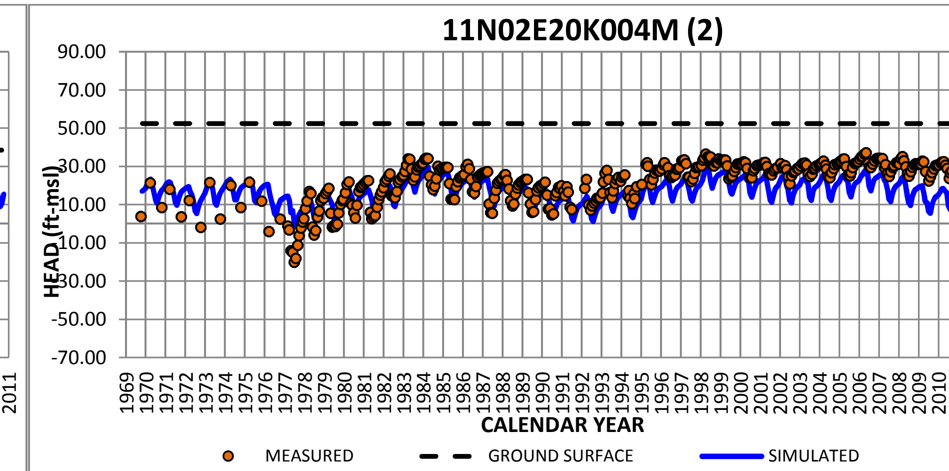
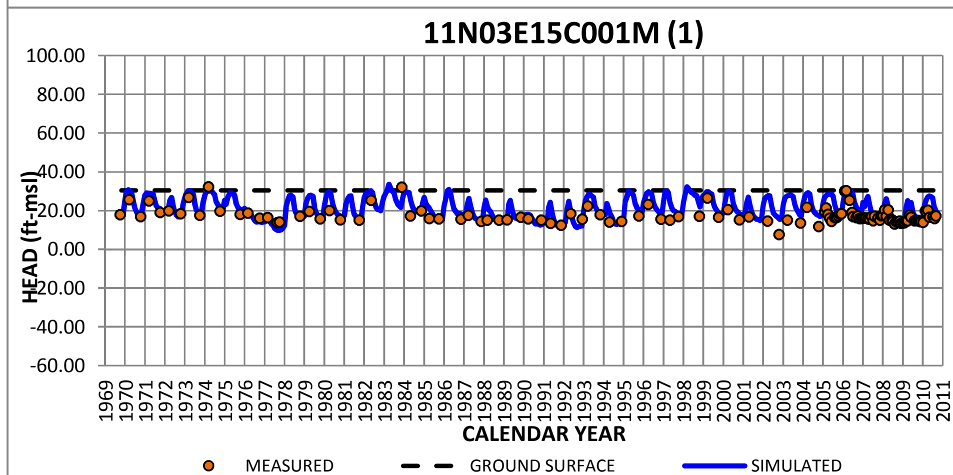
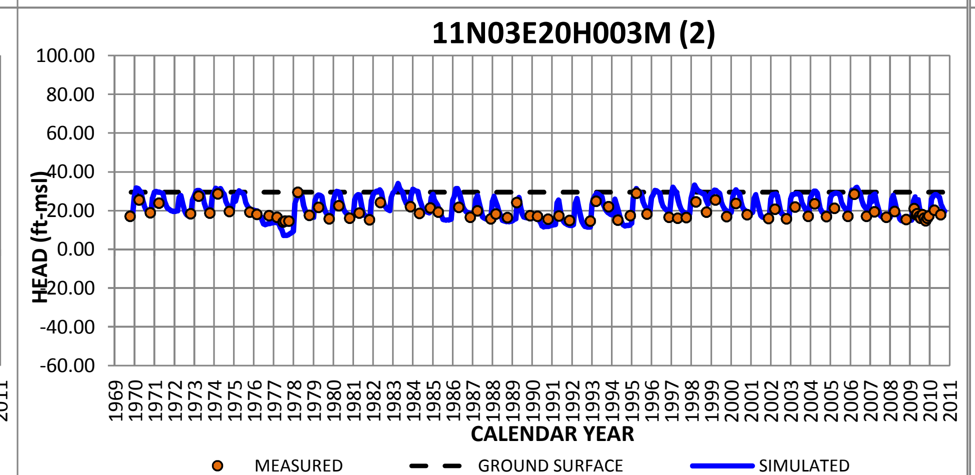


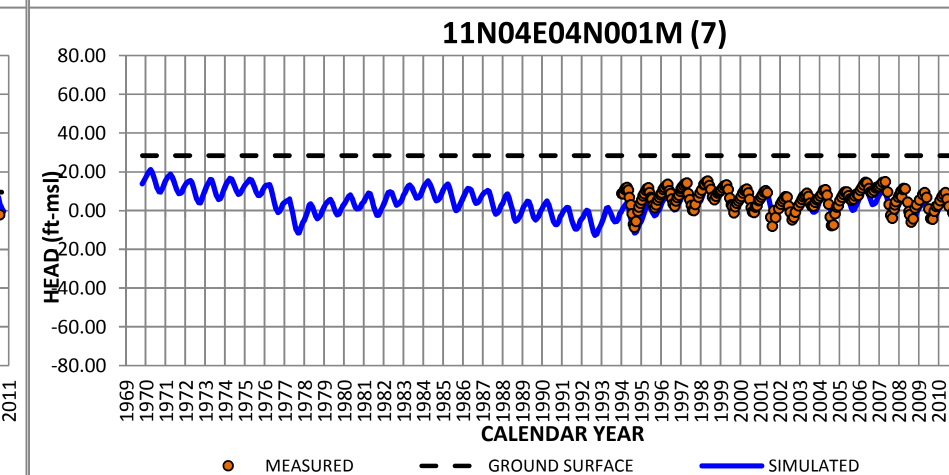

10N06E05H001M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

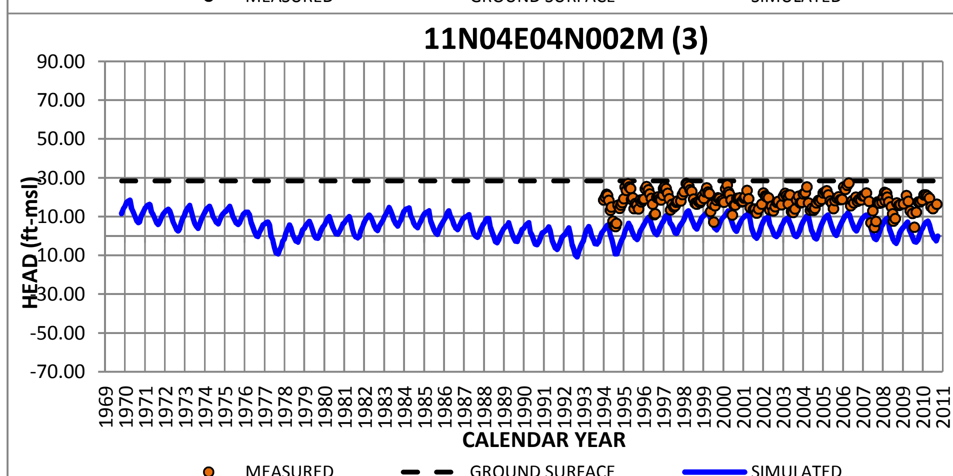

11N01E03E001M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

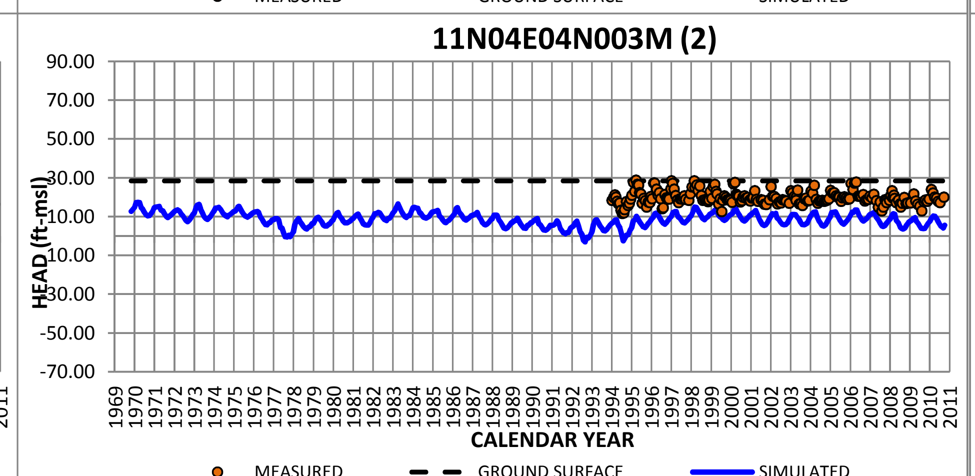

11N02E20K004M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

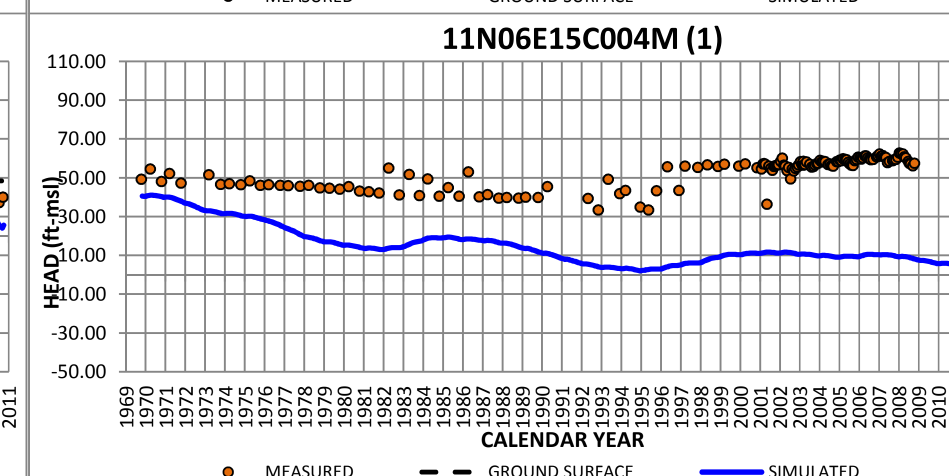

11N03E15C001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

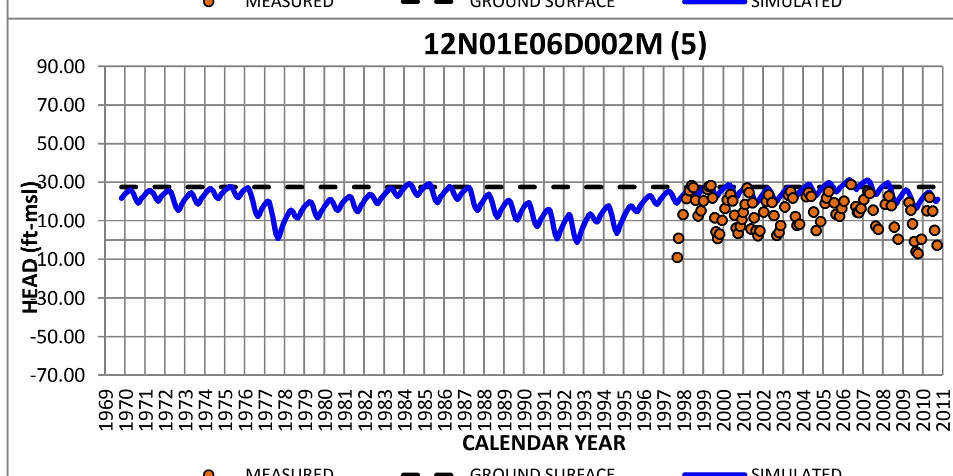

11N03E20H003M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

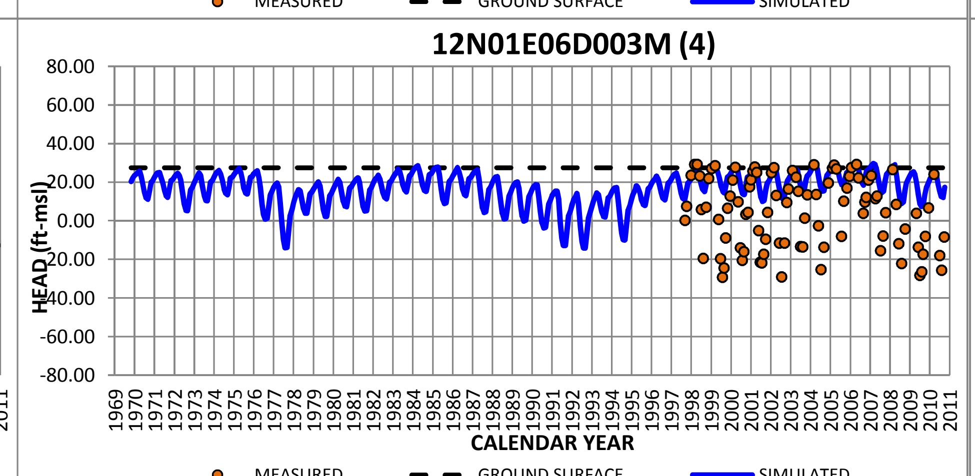

11N04E04N001M (7)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

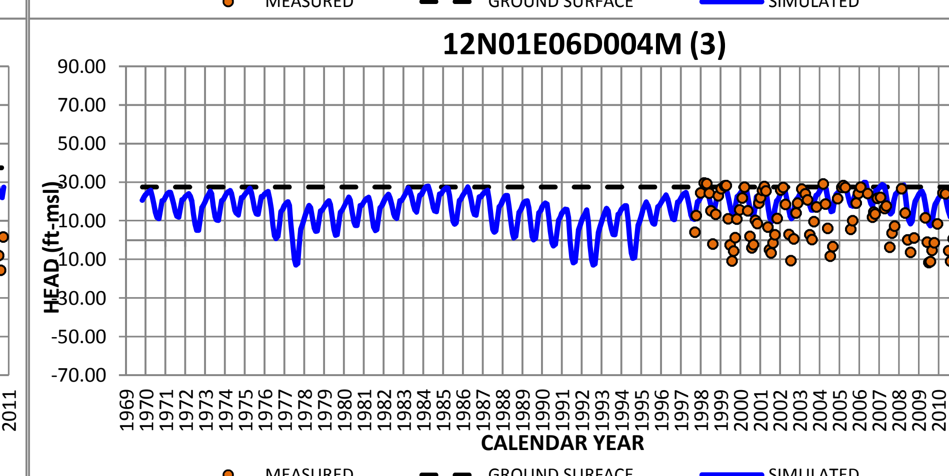

11N04E04N002M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

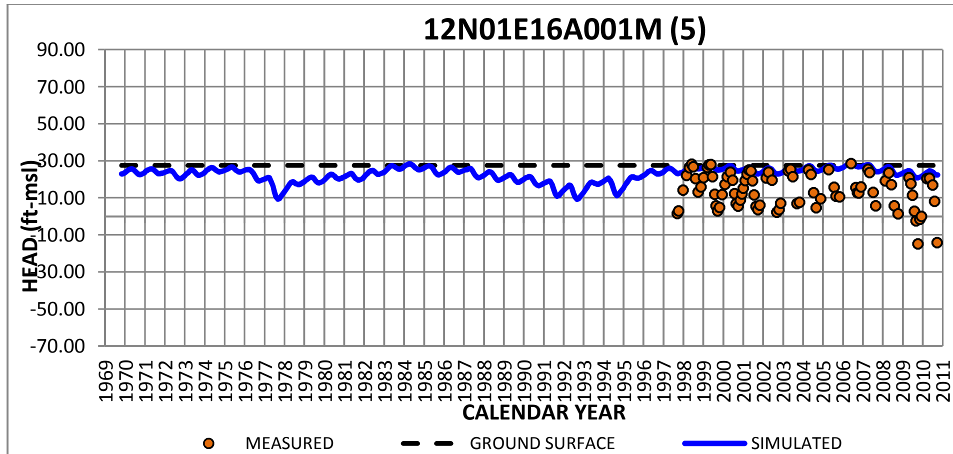

11N04E04N003M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

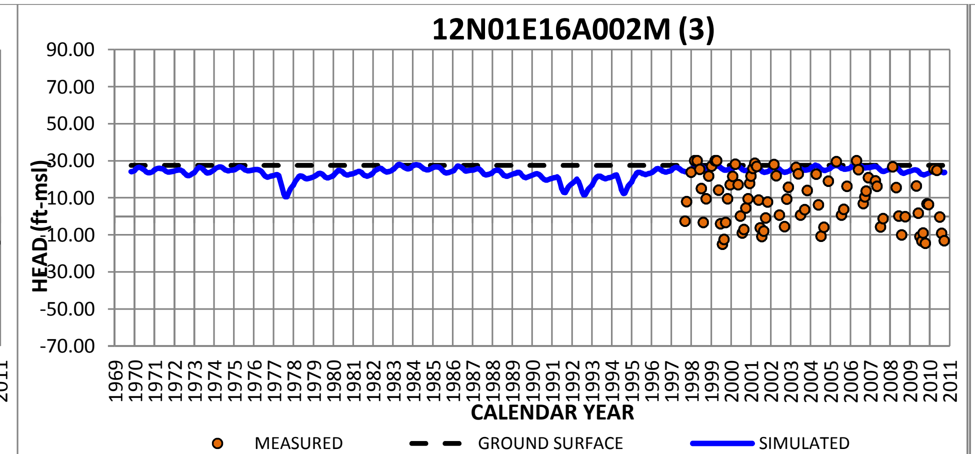

11N06E15C004M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

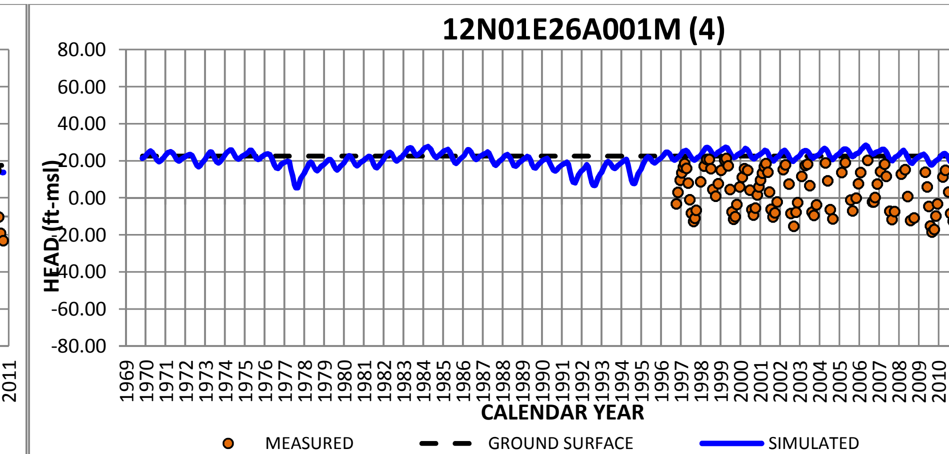

12N01E06D002M (5)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

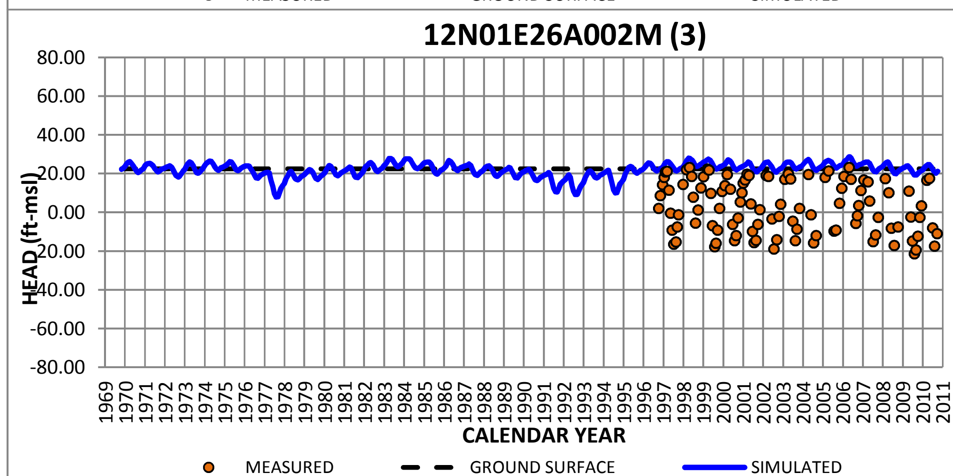

12N01E06D003M (4)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

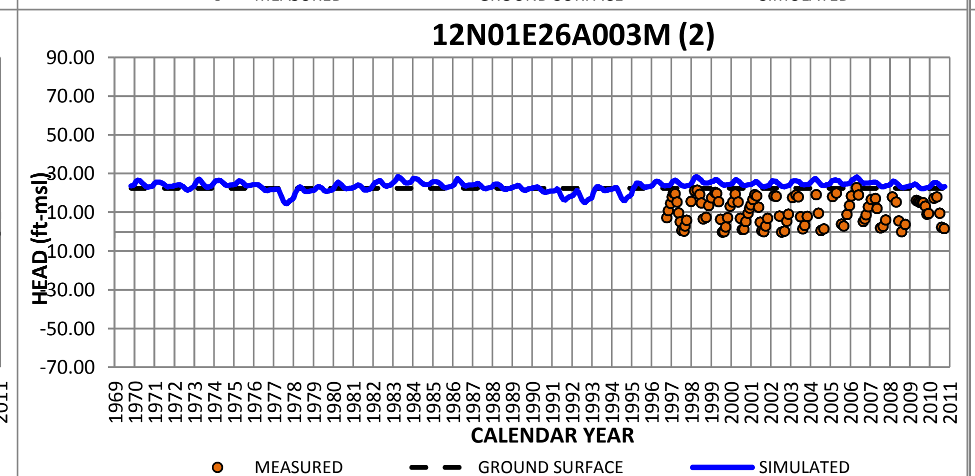

12N01E06D004M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

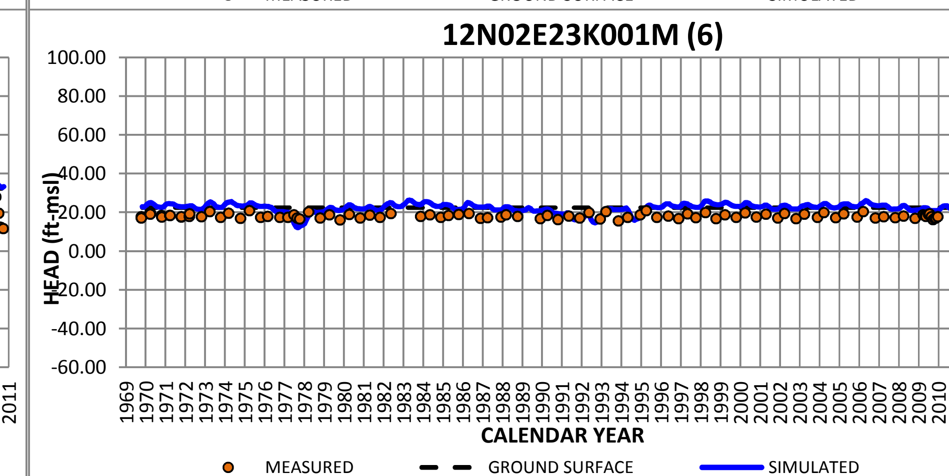

12N01E16A001M (5)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

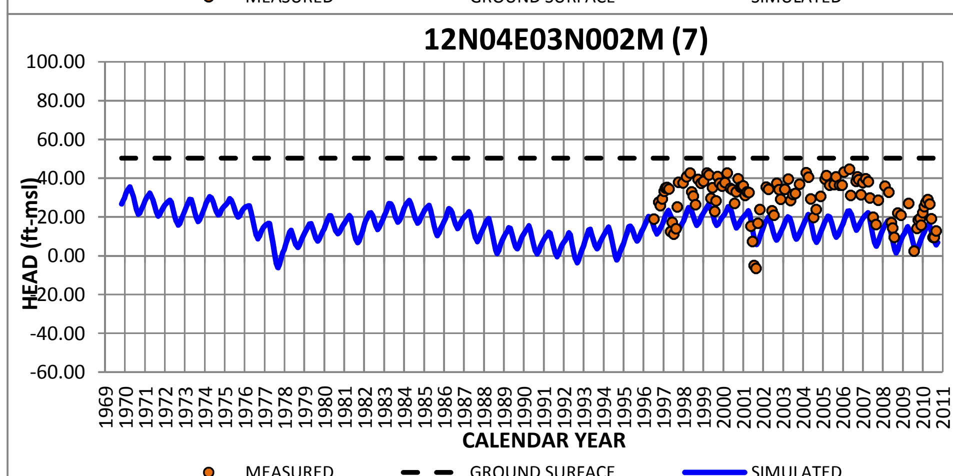

12N01E16A002M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

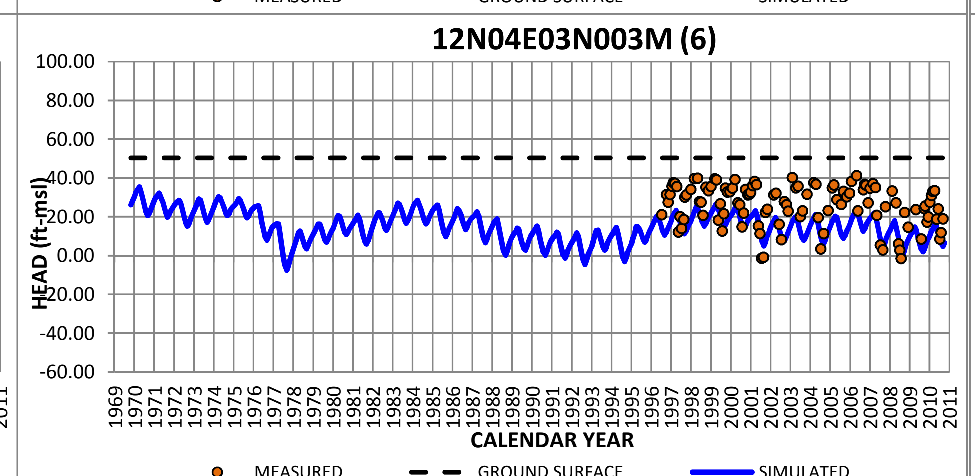

12N01E26A001M (4)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

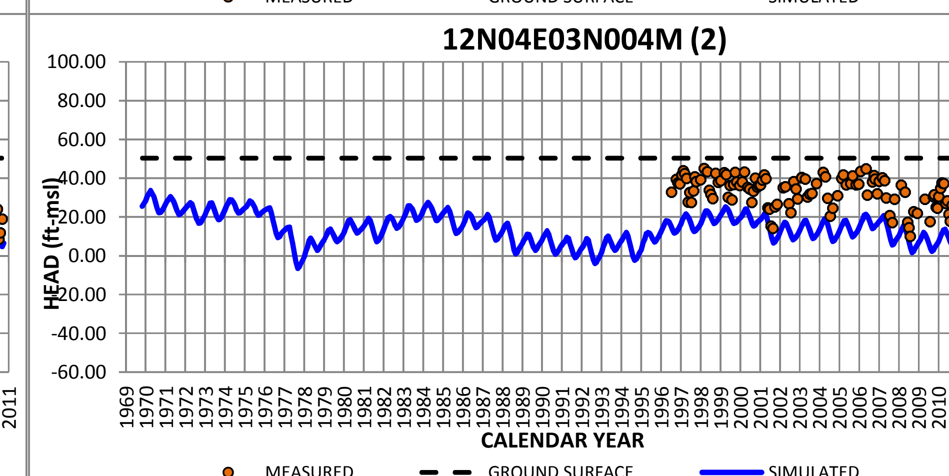

12N01E26A002M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

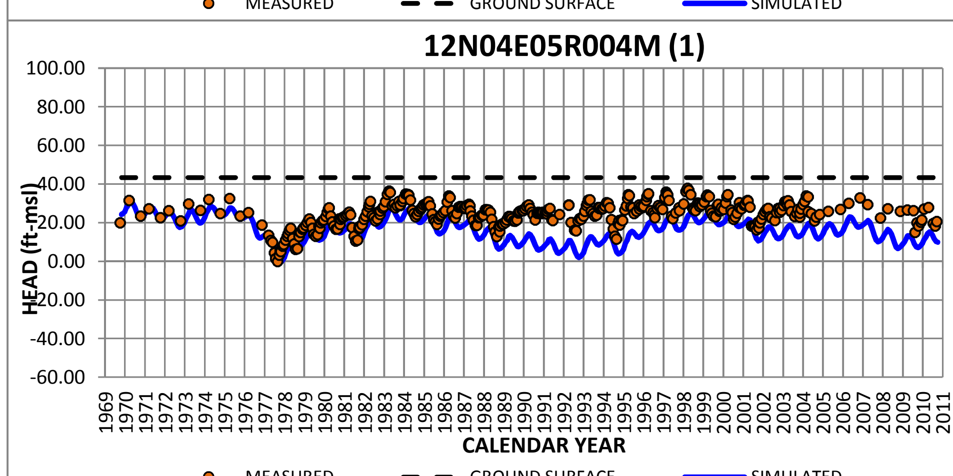

12N01E26A003M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

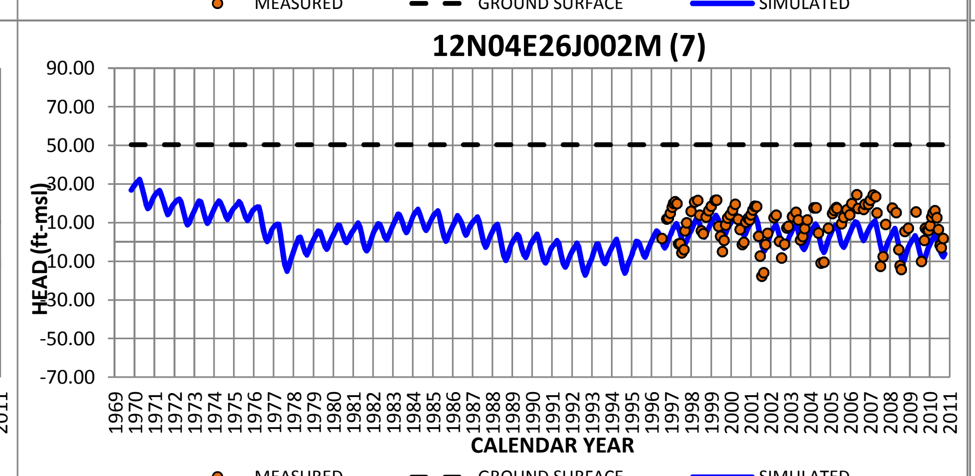

12N02E23K001M (6)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

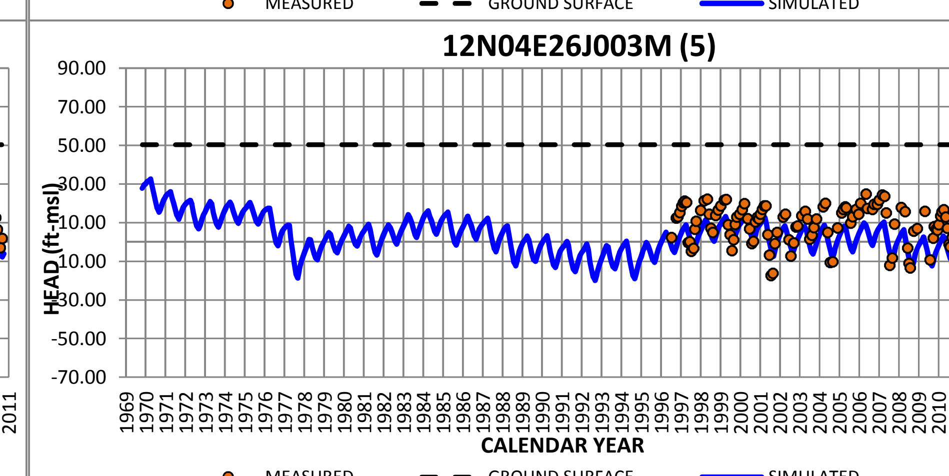

12N04E03N002M (7)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

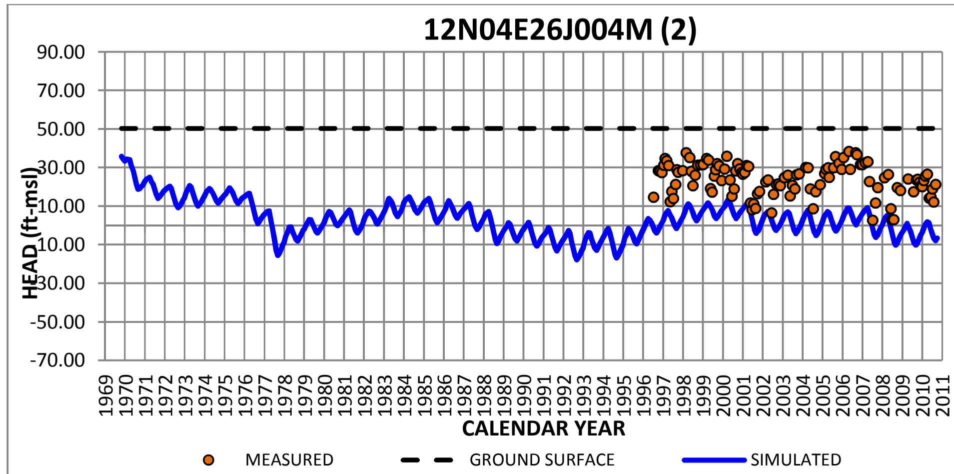

12N04E03N003M (6)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

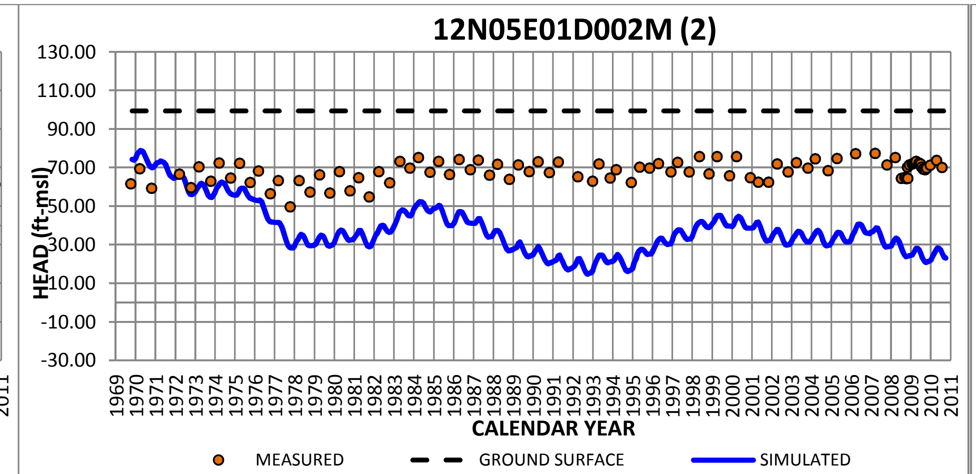

12N04E03N004M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

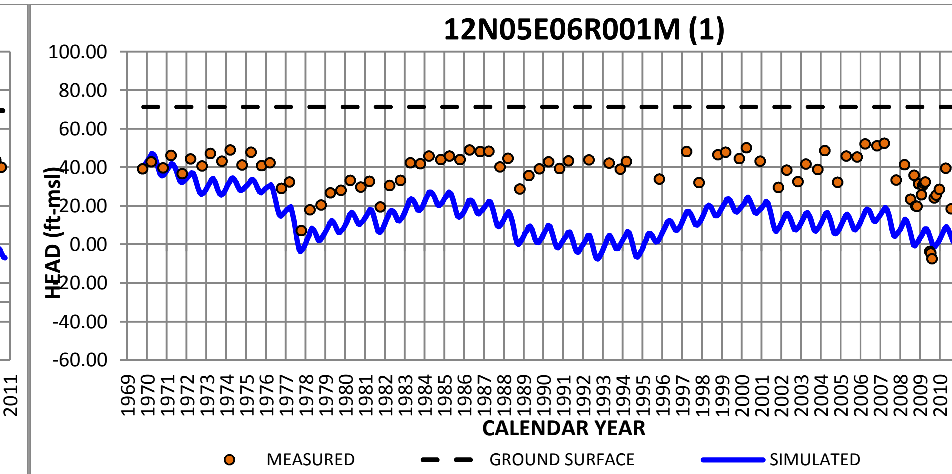

12N04E05R004M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


12N04E26J002M (7)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


12N04E26J003M (5)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


12N04E26J004M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


12N05E01D002M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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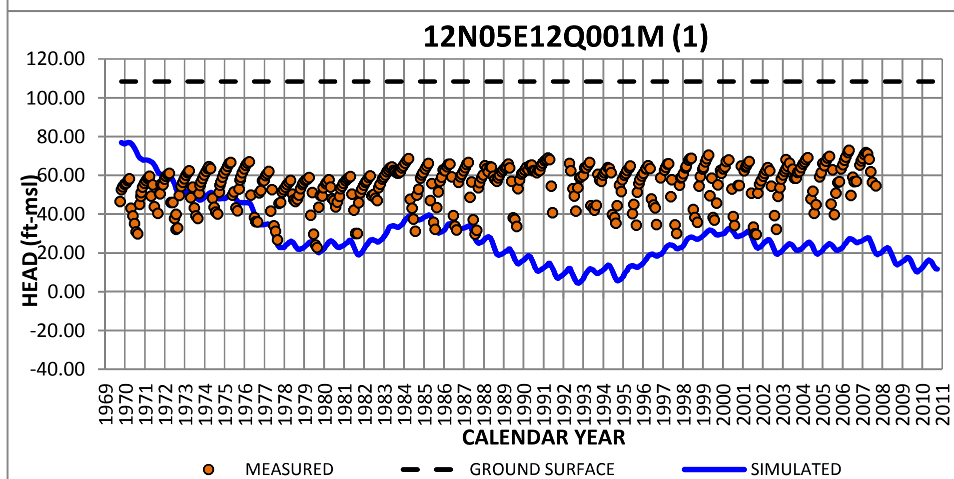
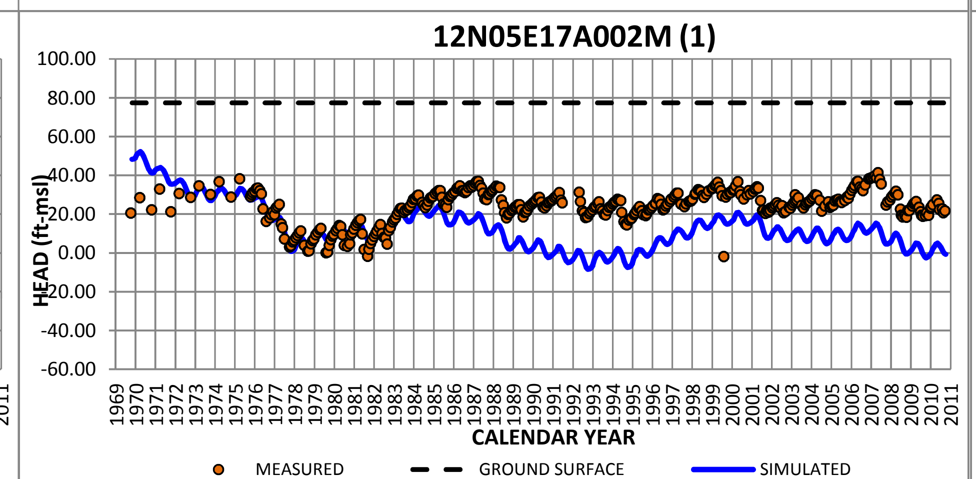
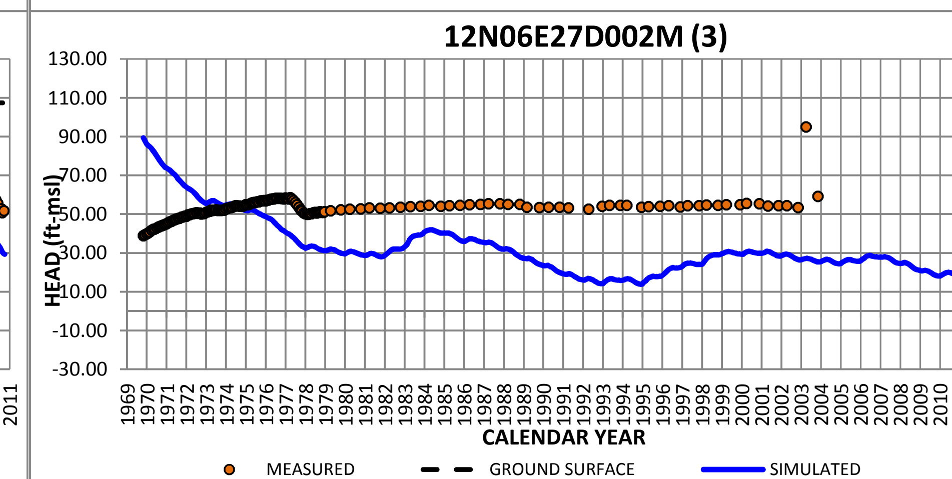
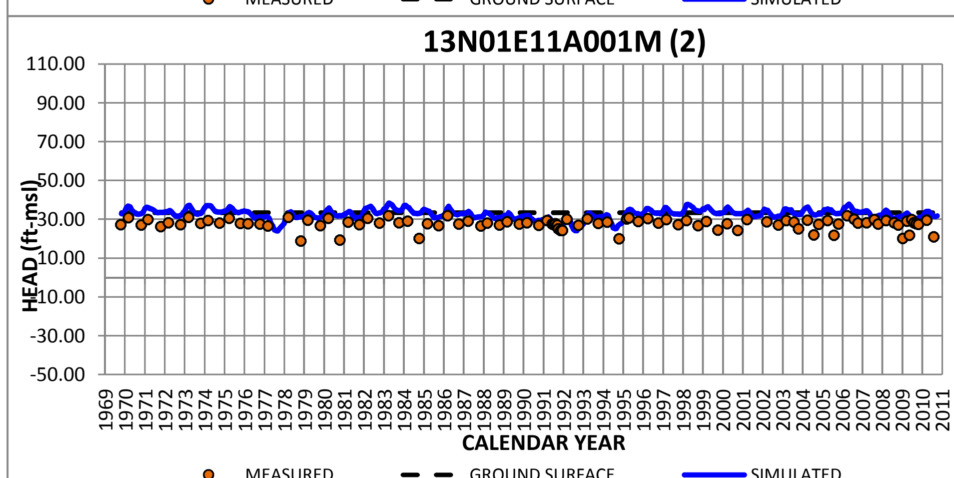
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


12N05E12Q001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


12N05E17A002M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


12N06E27D002M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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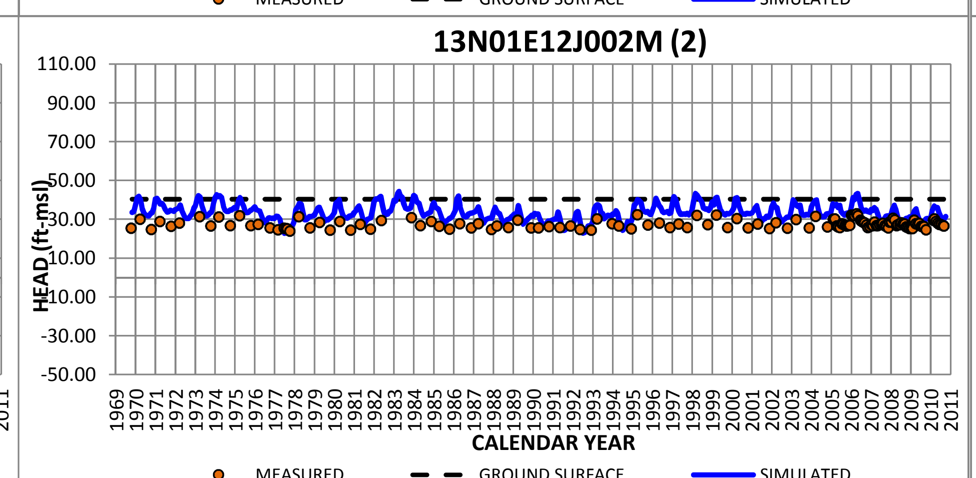
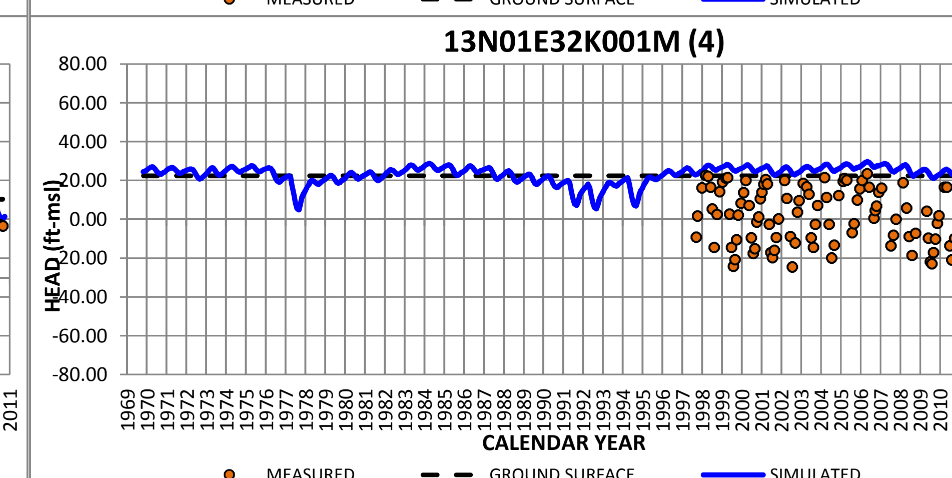
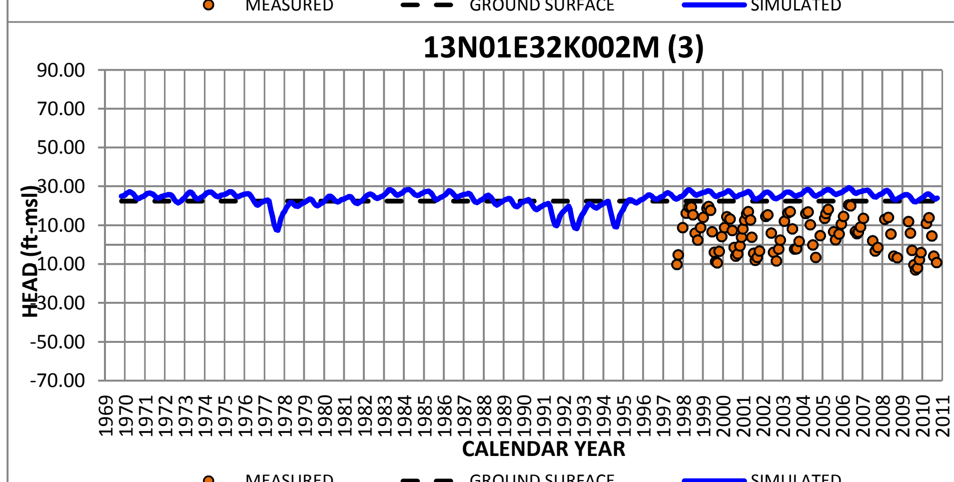
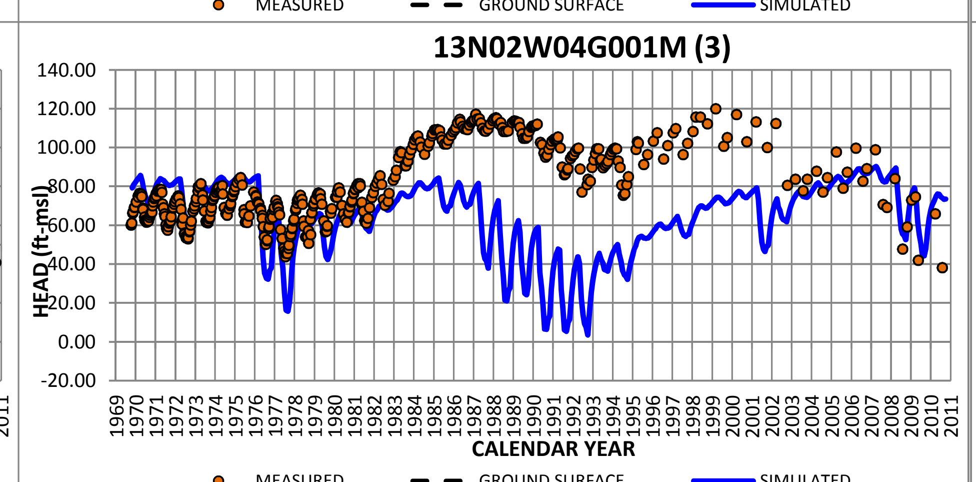
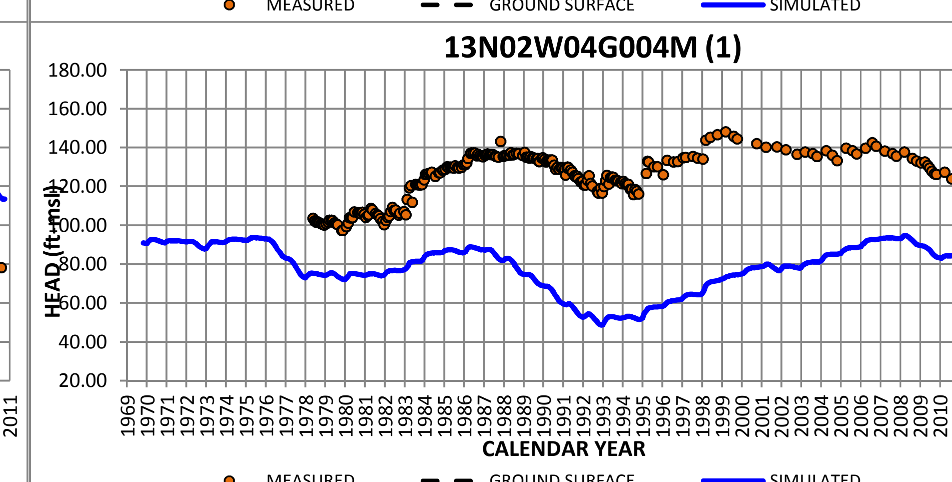
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

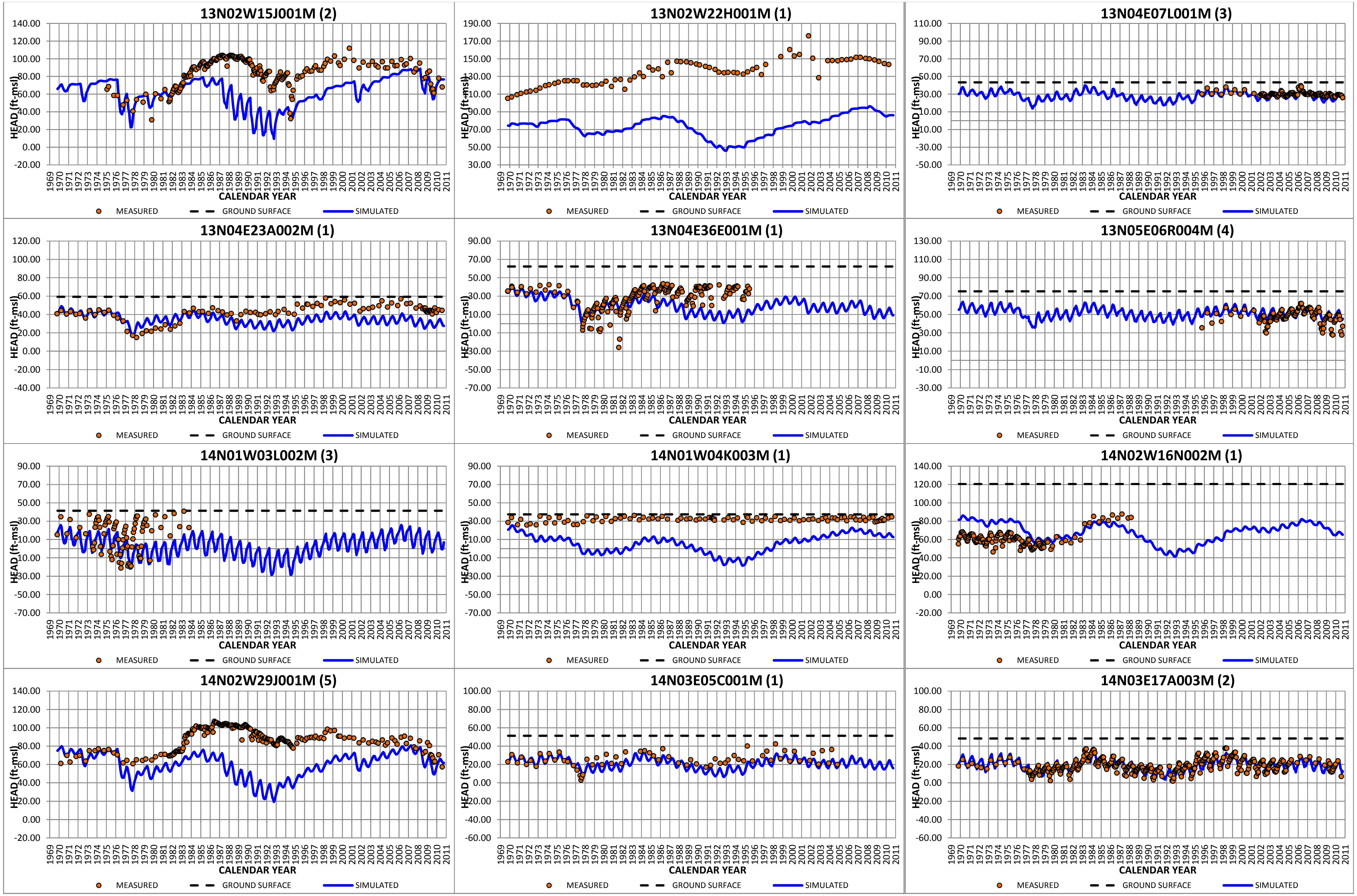

13N01E12J002M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


13N01E32K001M (4)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


13N01E32K002M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


13N02W04G001M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


13N02W04G004M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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13N02W22H001M (1)
13N04E07L001M (3)
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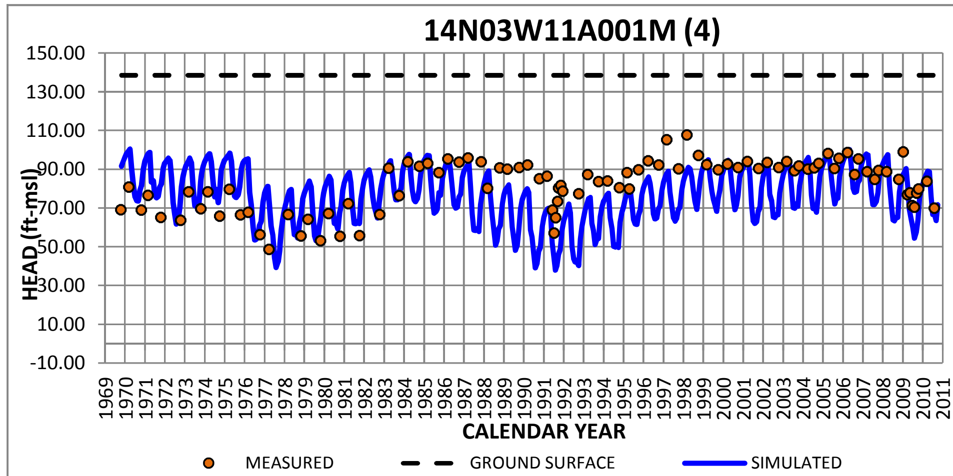
13N05E06R004M (4)
14N01W03L002M (3)
14N01W04K003M (1)
14N02W16N002M (1)
14N02W29J001M (5)
14N03E05C001M (1)
14N03E17A003M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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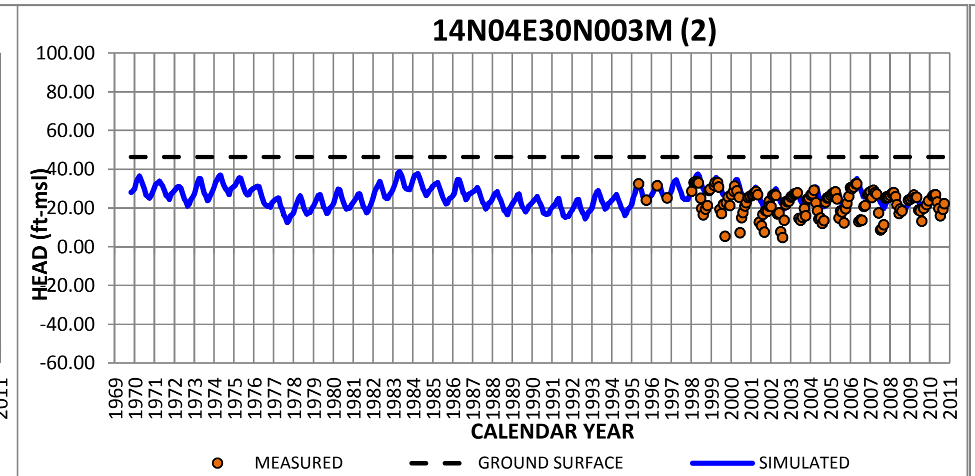
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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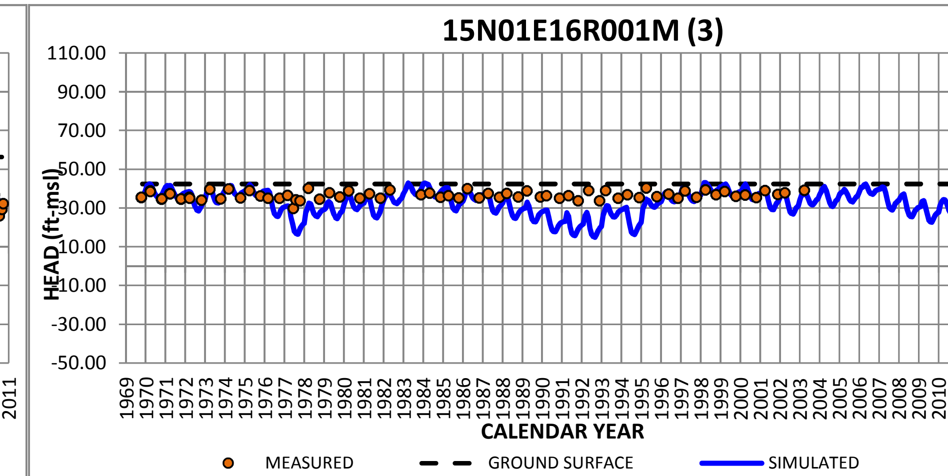
100.00 80.00 60.00 40.00 20.00 0.00 -20.00 -40.00 -60.00
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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HEAD (ft-msl)
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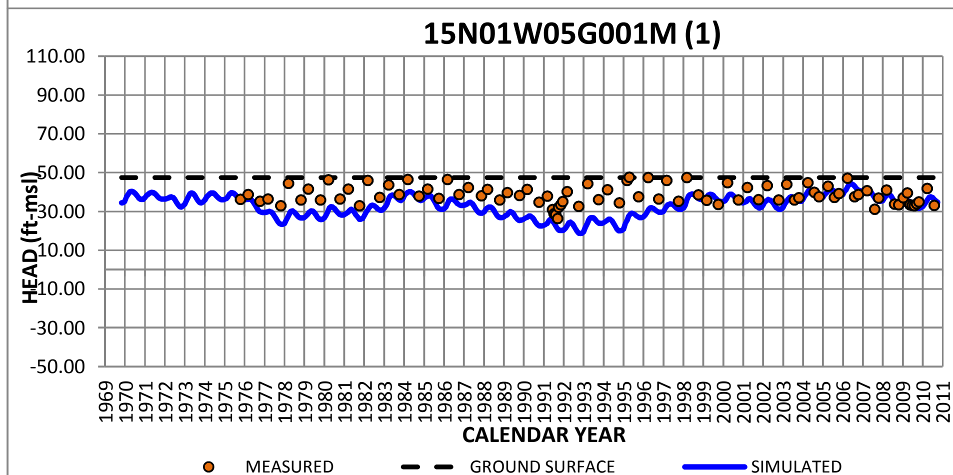
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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HEAD (ft-msl)
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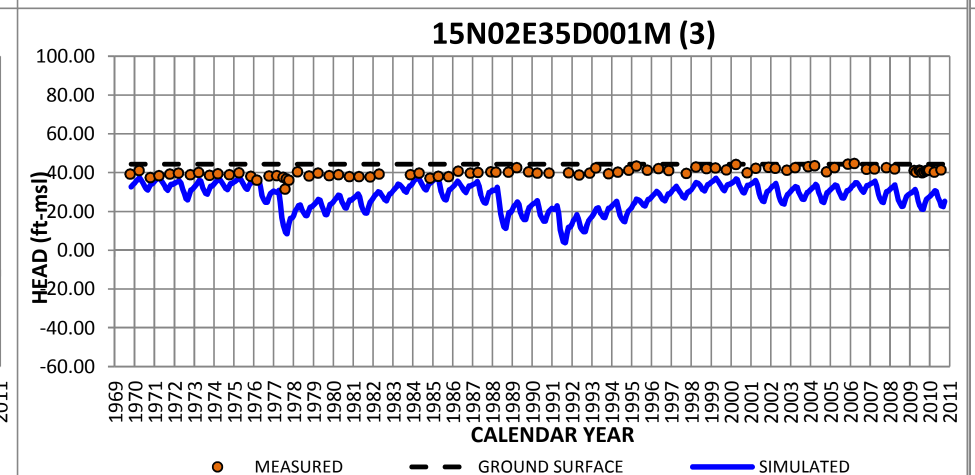
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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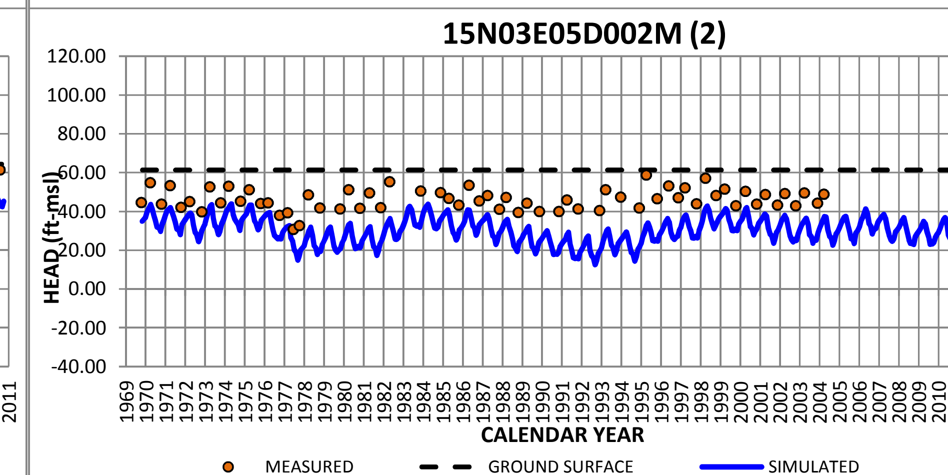
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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HEAD (ft-msl)
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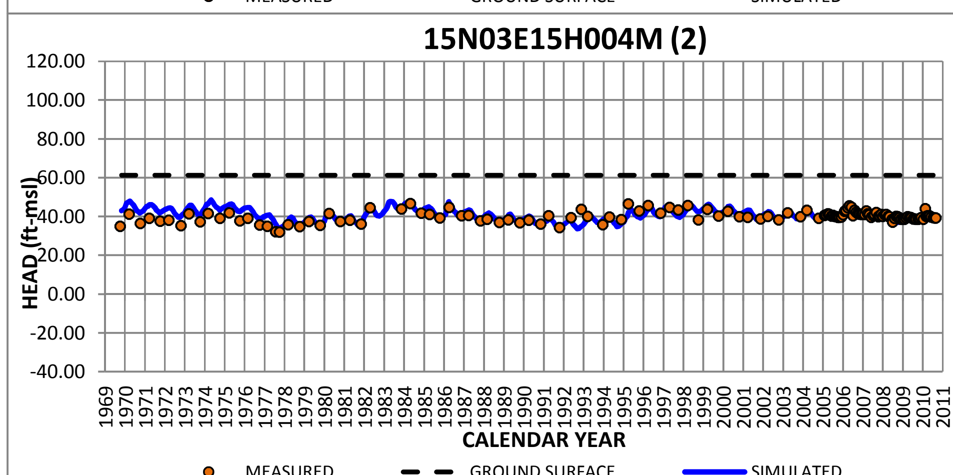
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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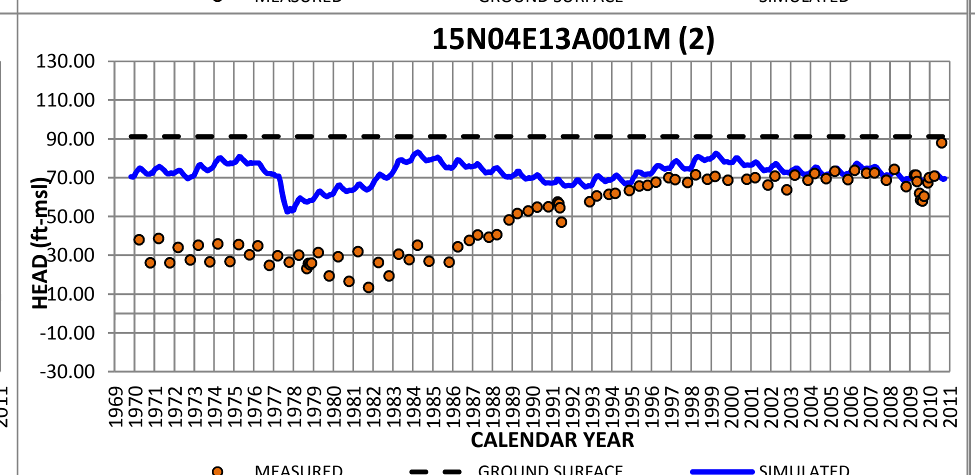
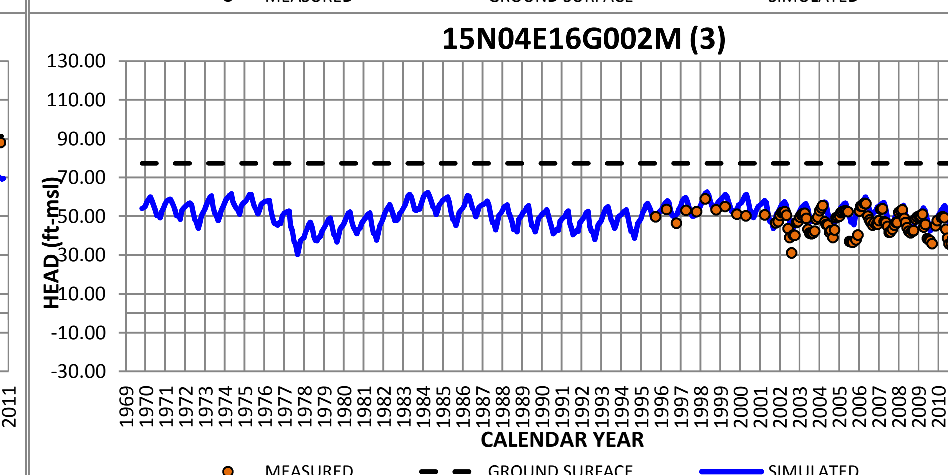
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


15N04E13A001M (2)
130.00 110.00 90.00 70.00 50.00 30.00 10.00 -10.00 -30.00
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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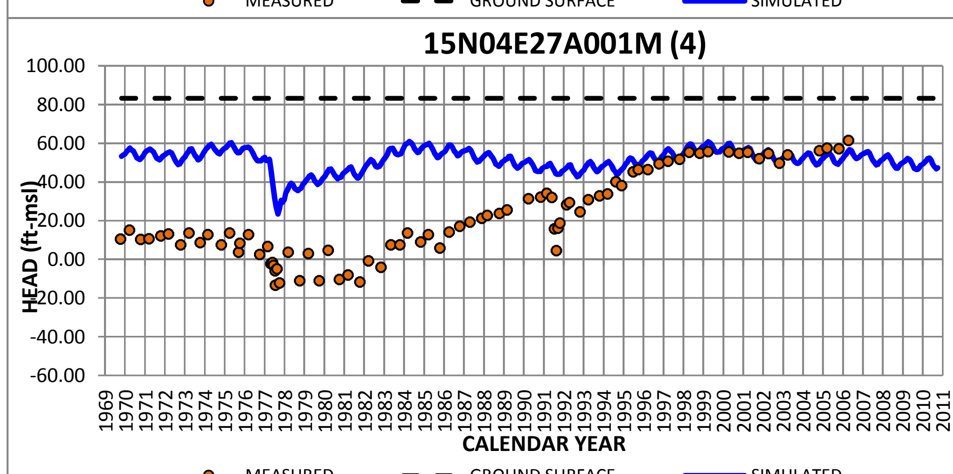
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


15N04E27A001M (4)
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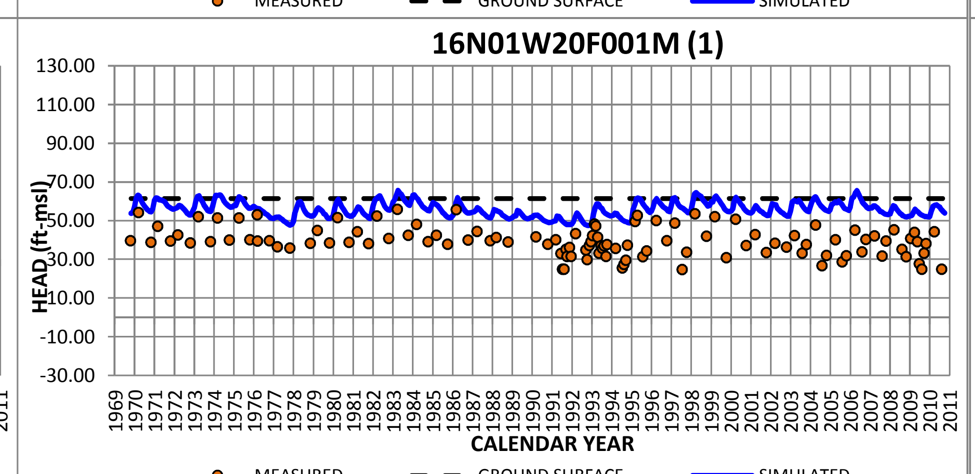
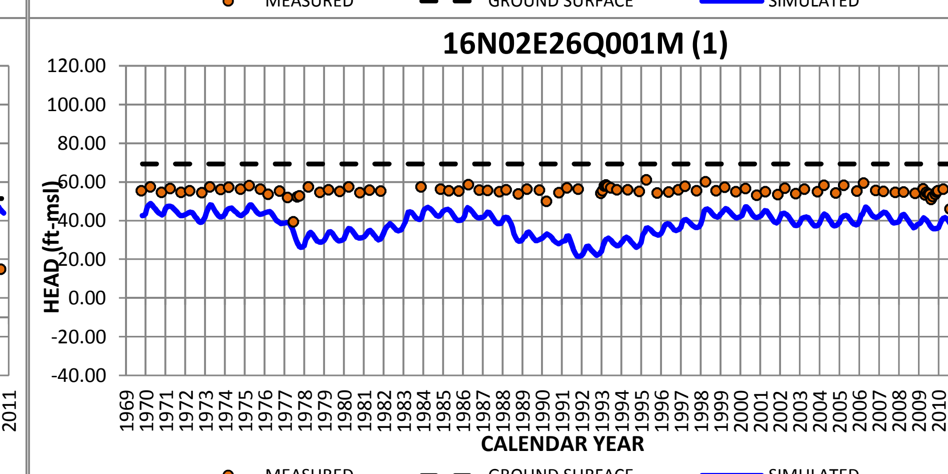
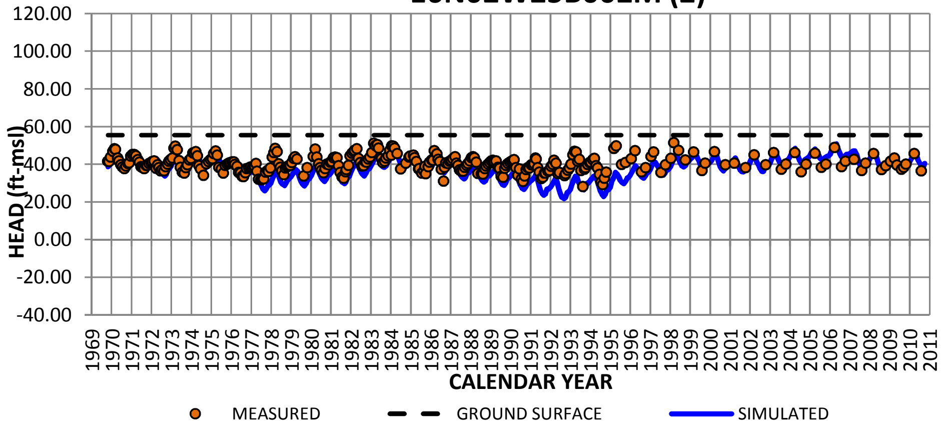
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

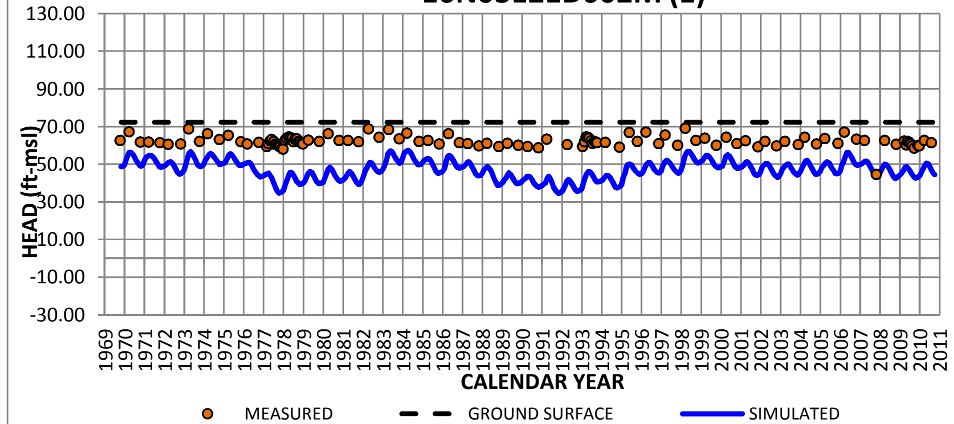

16N01W20F001M (1)
130.00 110.00 90.00 70.00 50.00 30.00 10.00 -10.00 -30.00
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


16N02E26Q001M (1)
120.00 100.00 80.00 60.00 40.00 20.00 0.00 -20.00 -40.00
HEAD (ft-msl)
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

16N02W25B002M (2)



16N03E21D002M (1)



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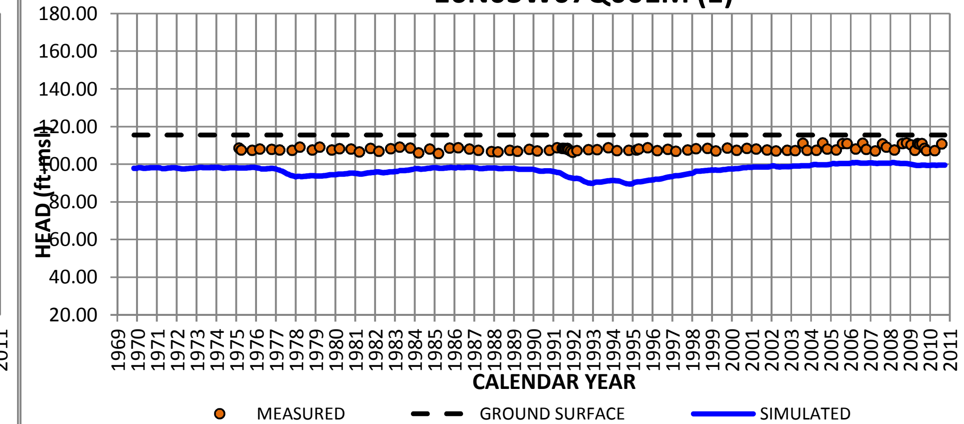
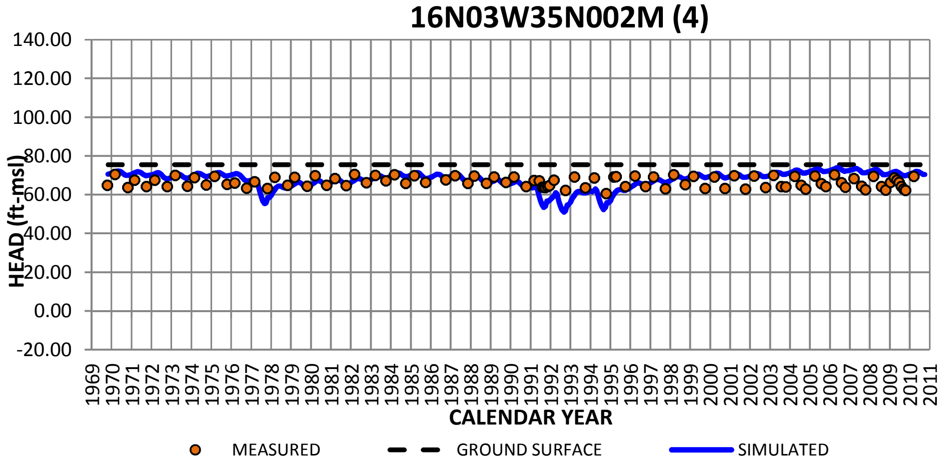


16N03W35N002M (4)



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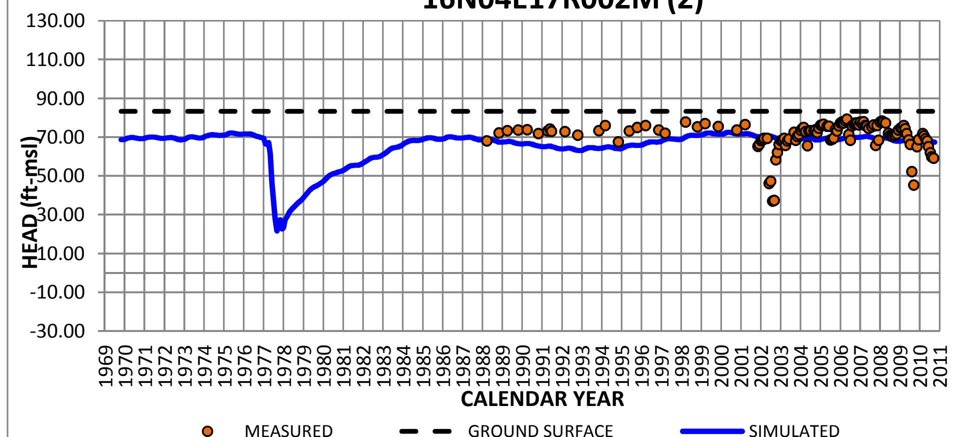

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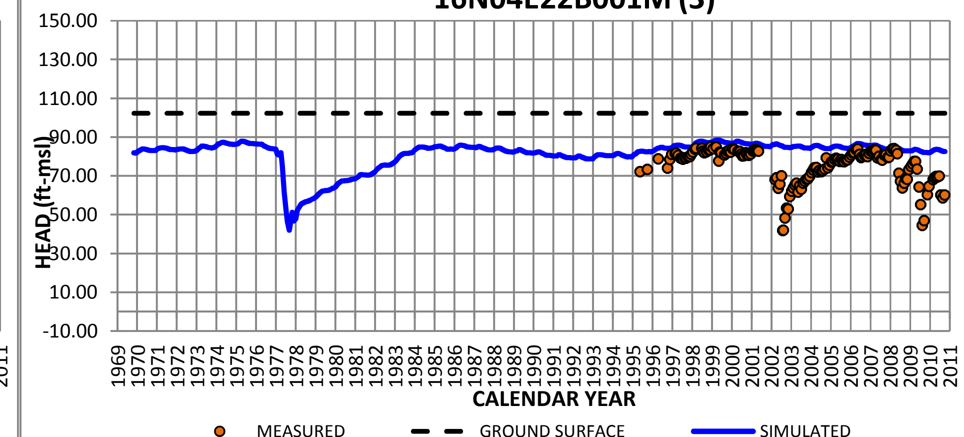

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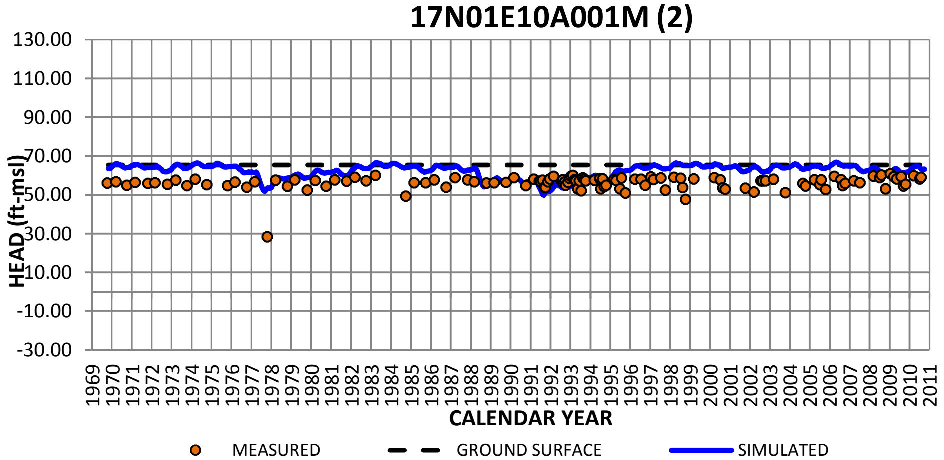

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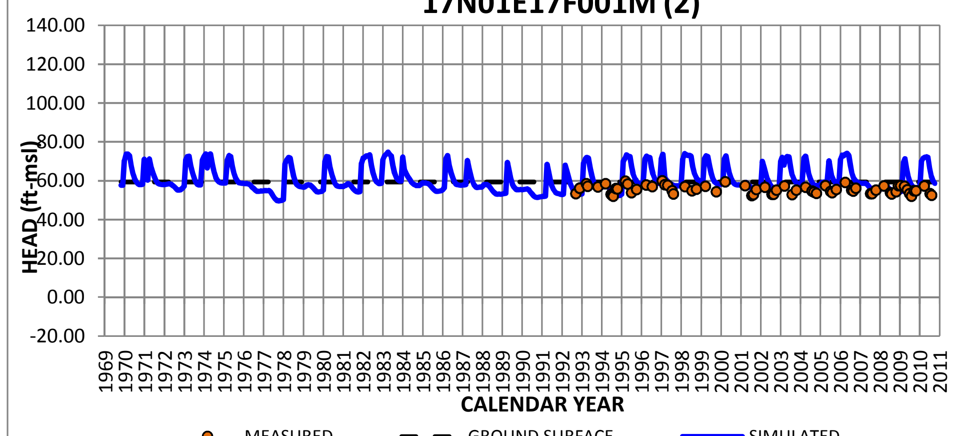

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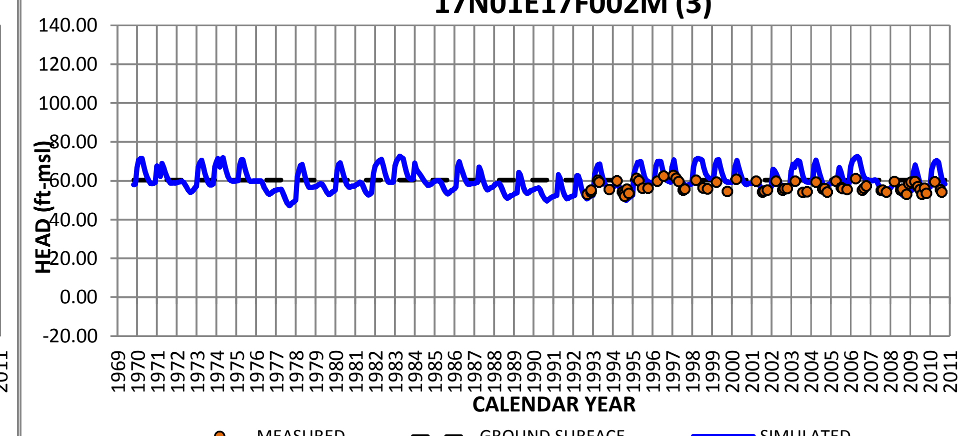

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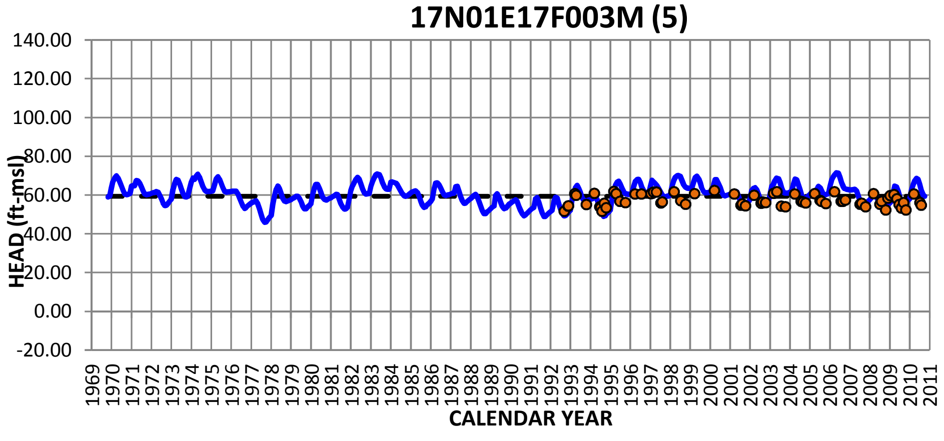

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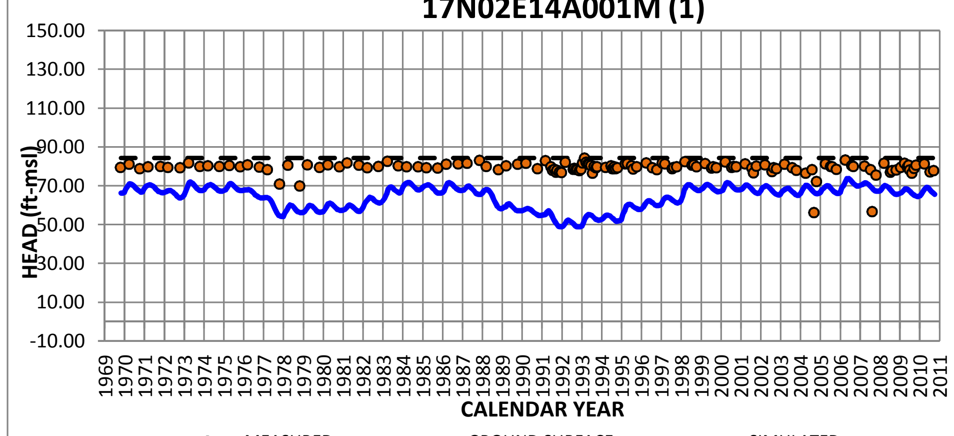

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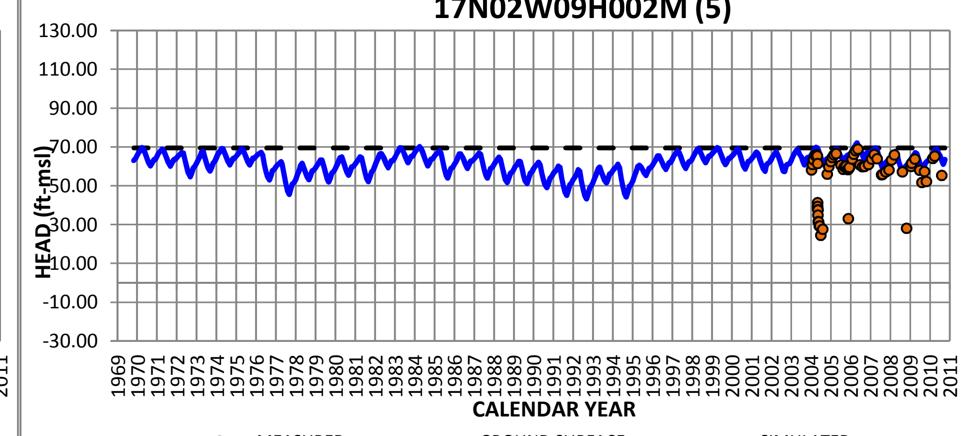

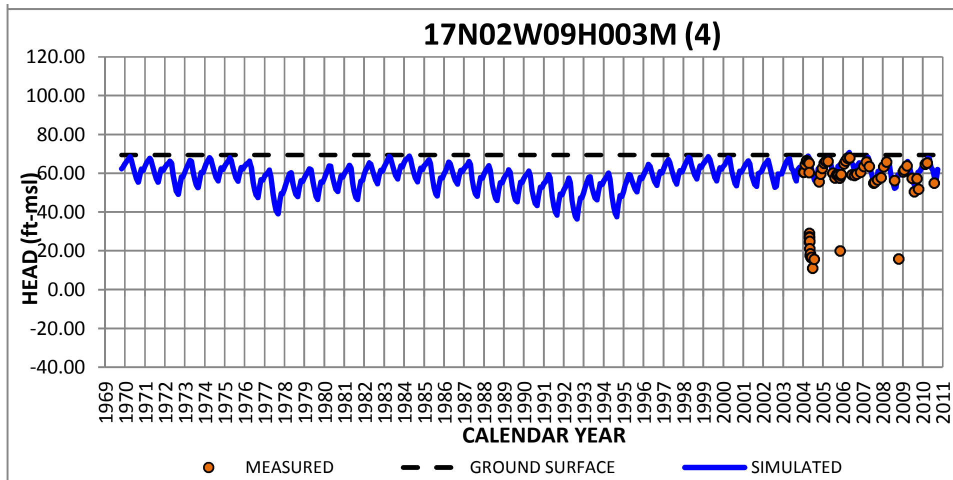
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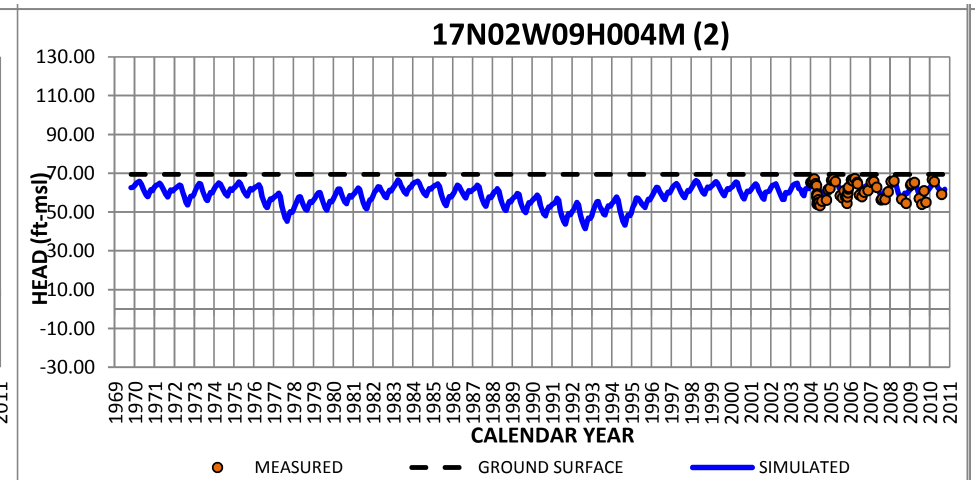
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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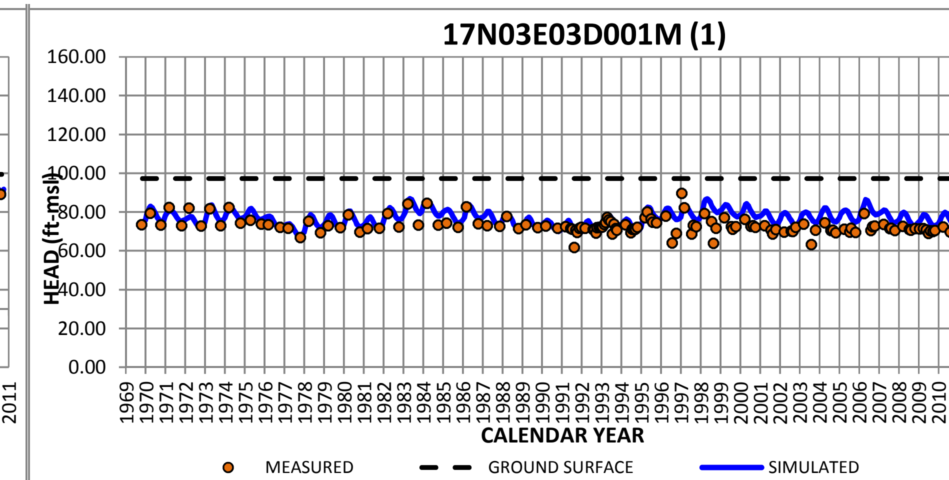
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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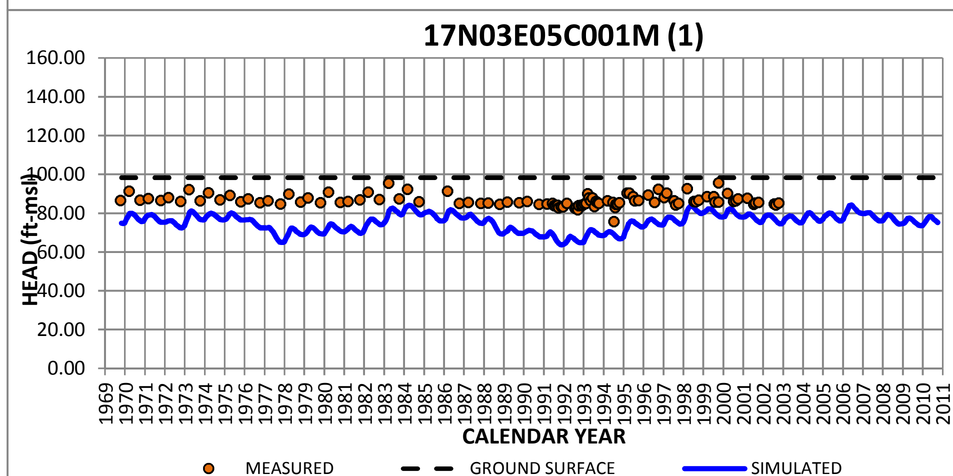
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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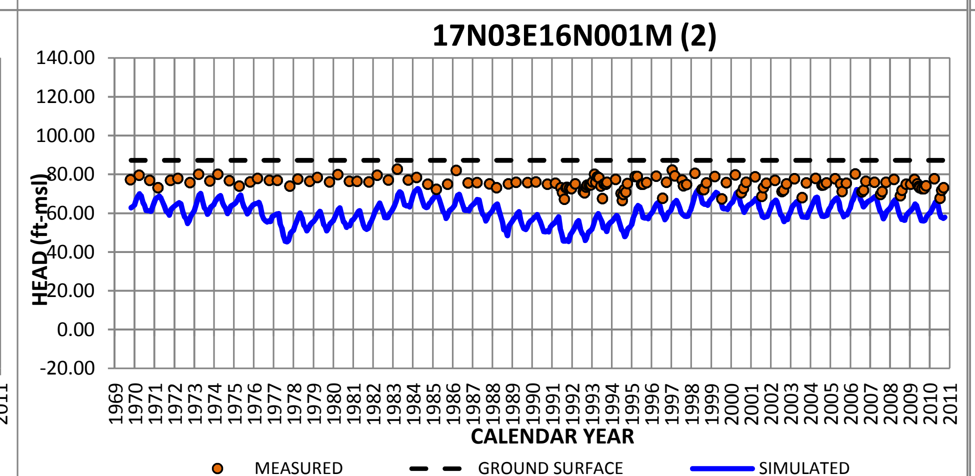
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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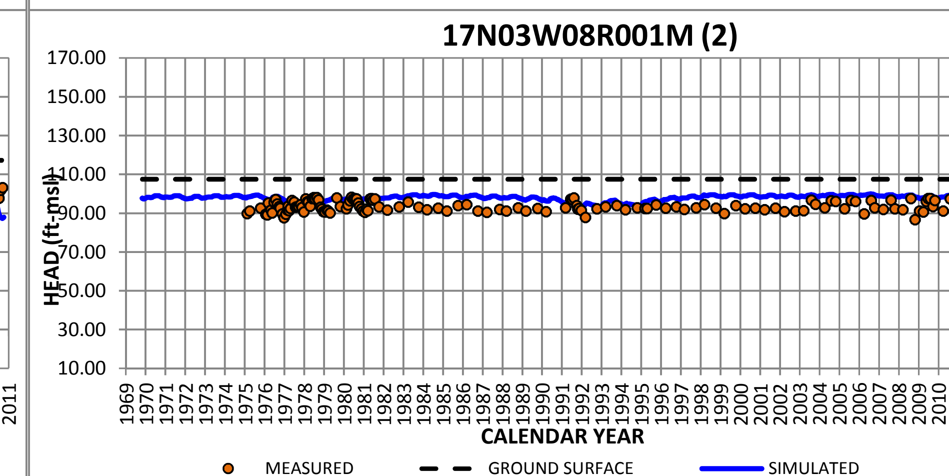
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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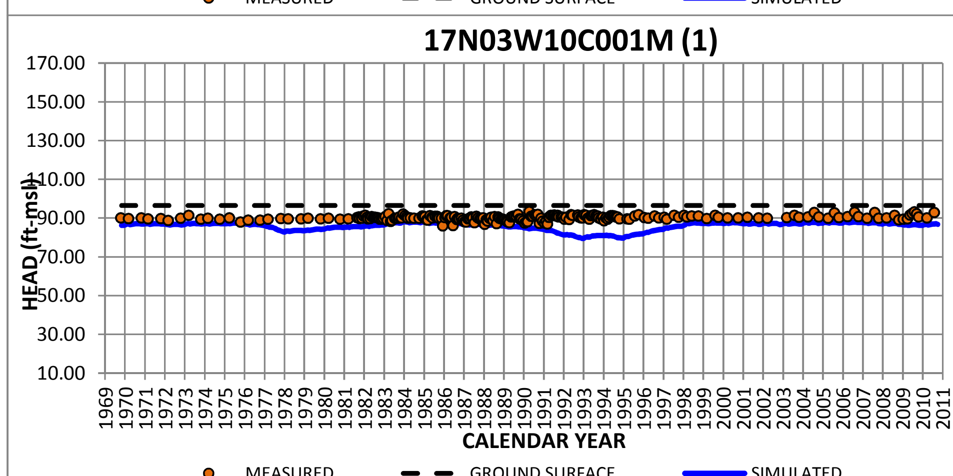
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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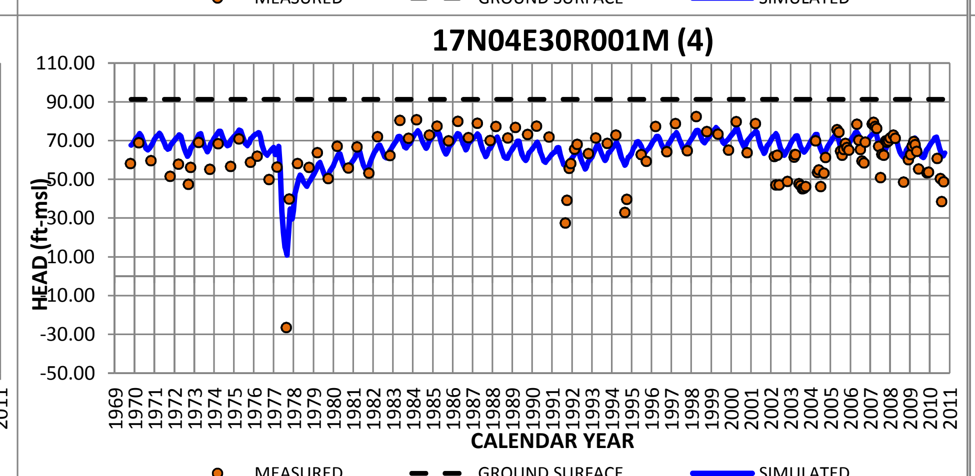
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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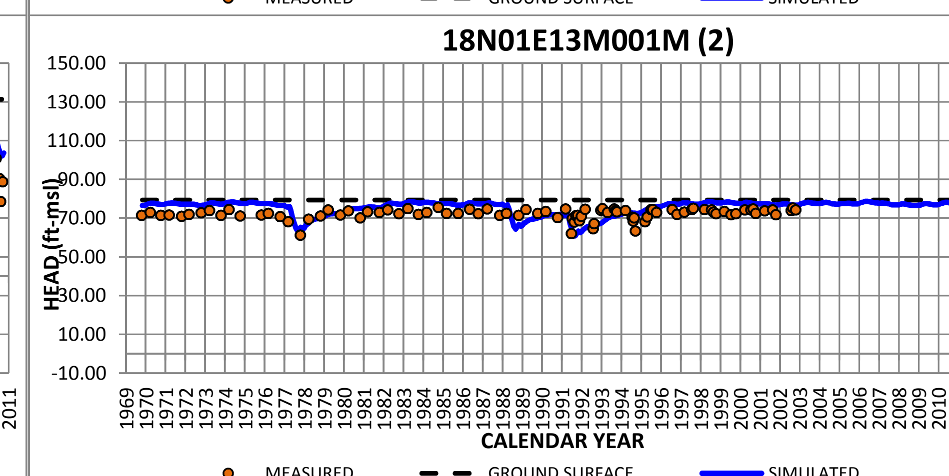
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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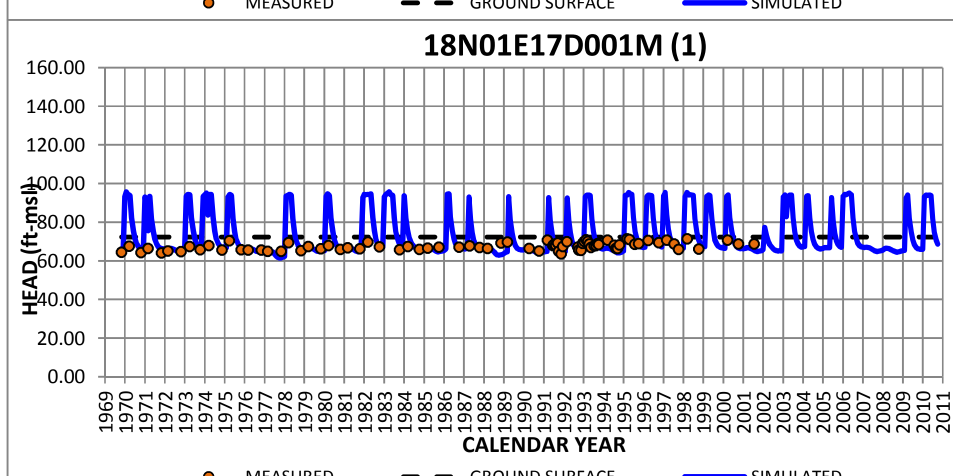
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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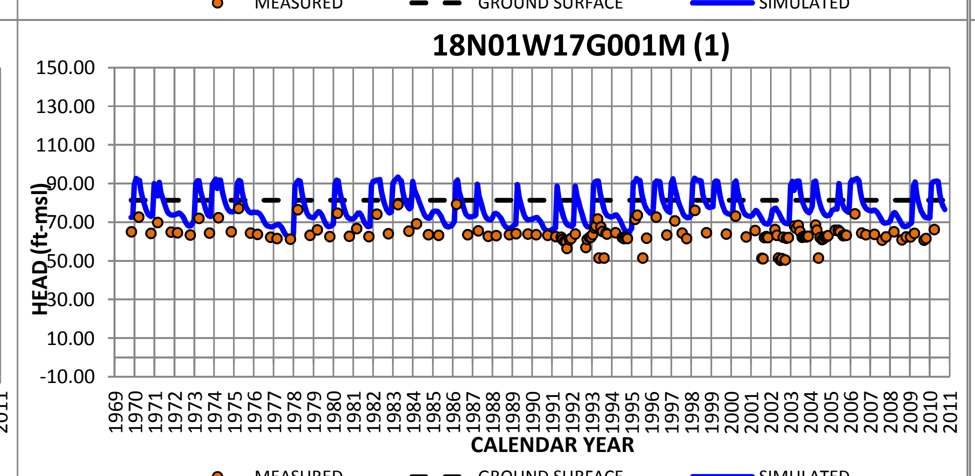
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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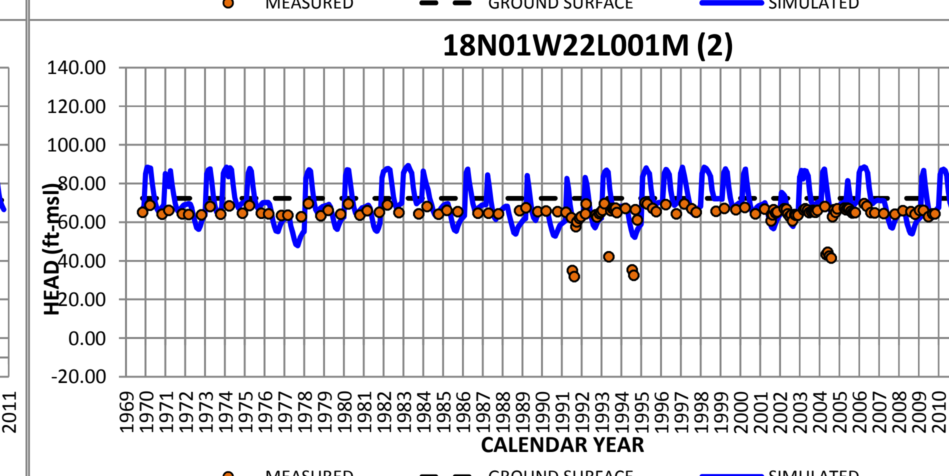
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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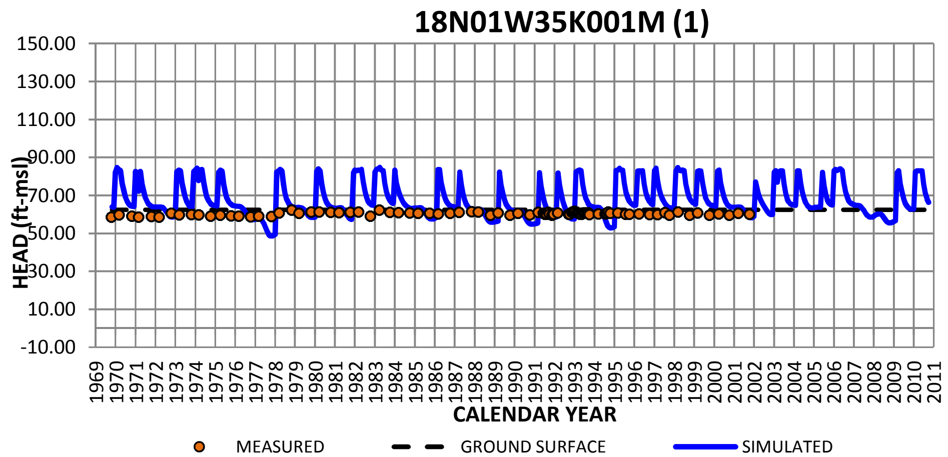
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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CALENDAR YEAR
MEASURED
GROUND SURFACE
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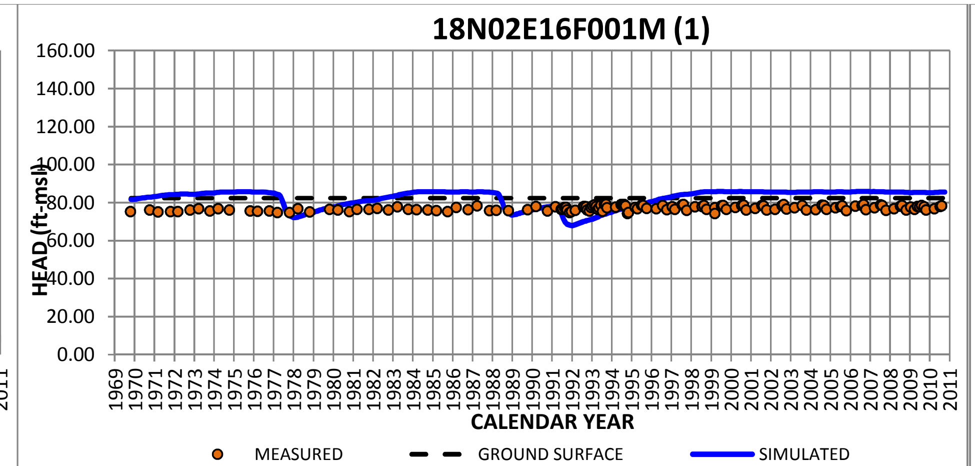
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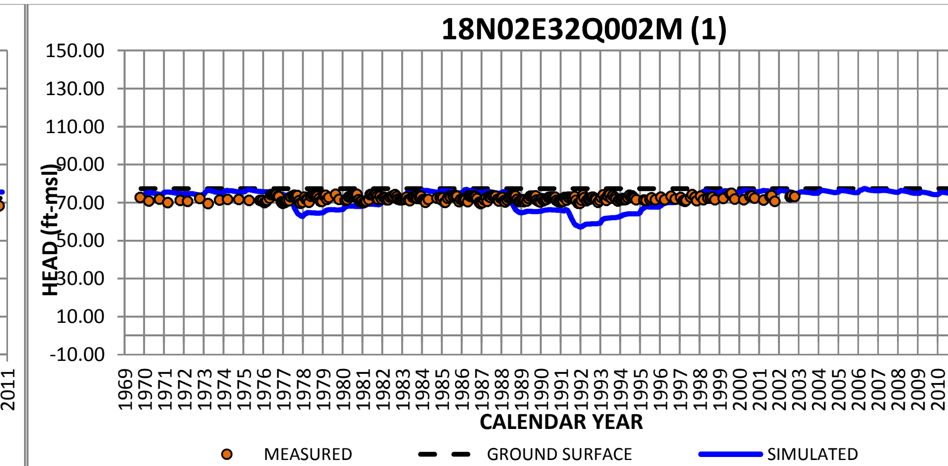
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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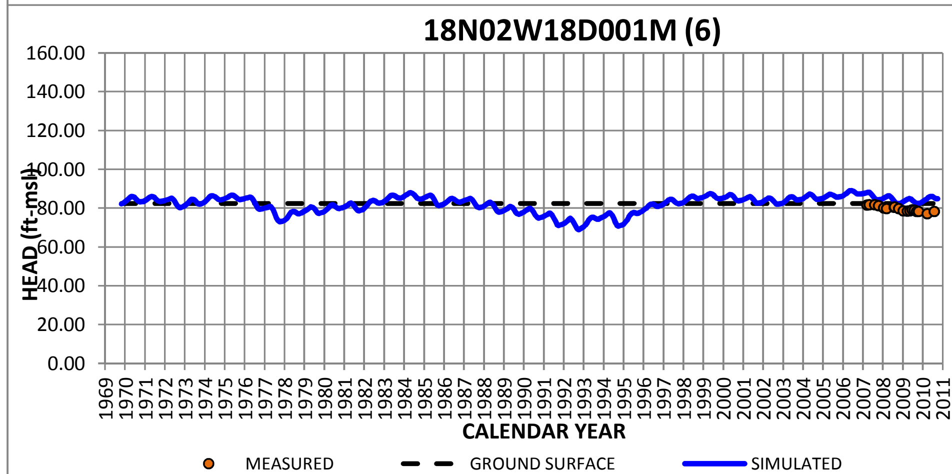
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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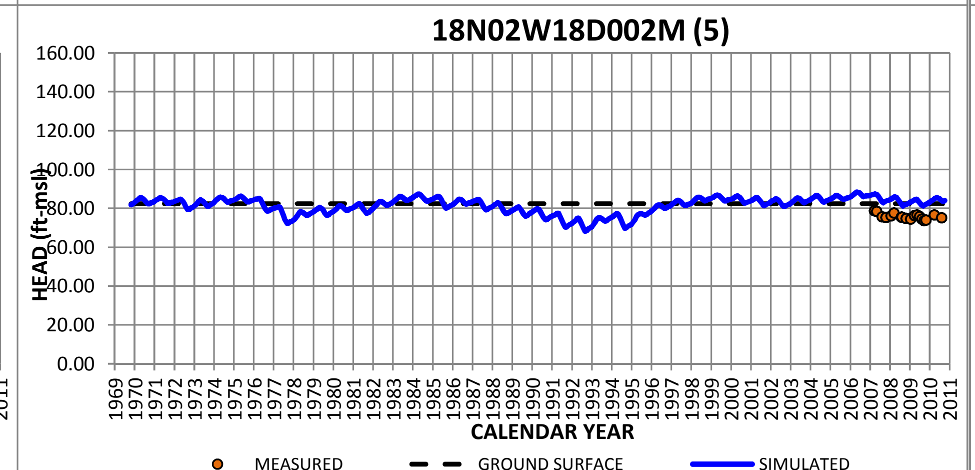
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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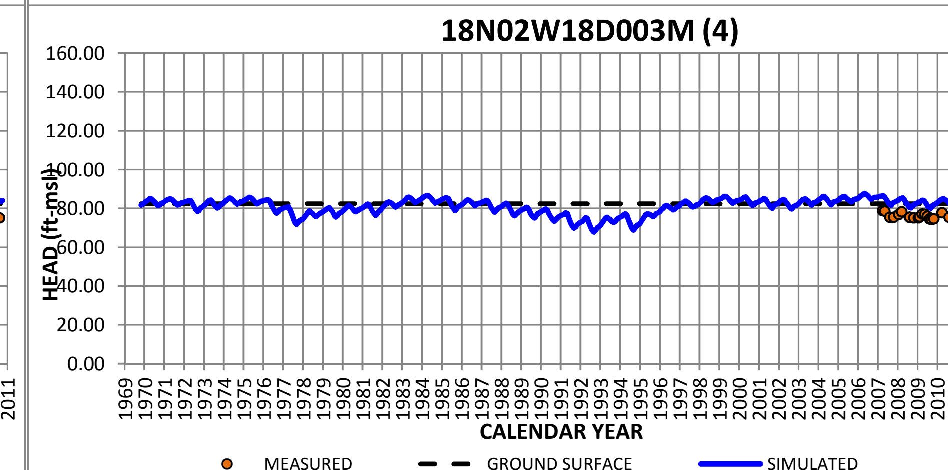
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
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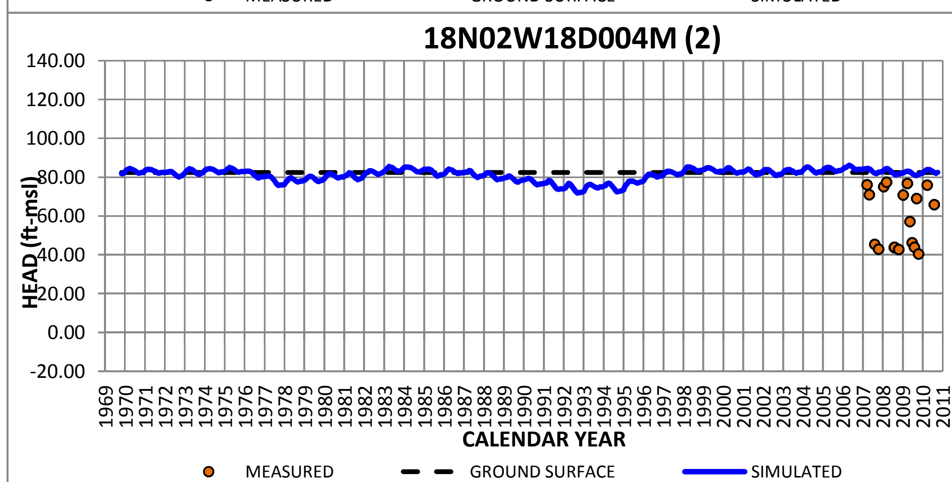
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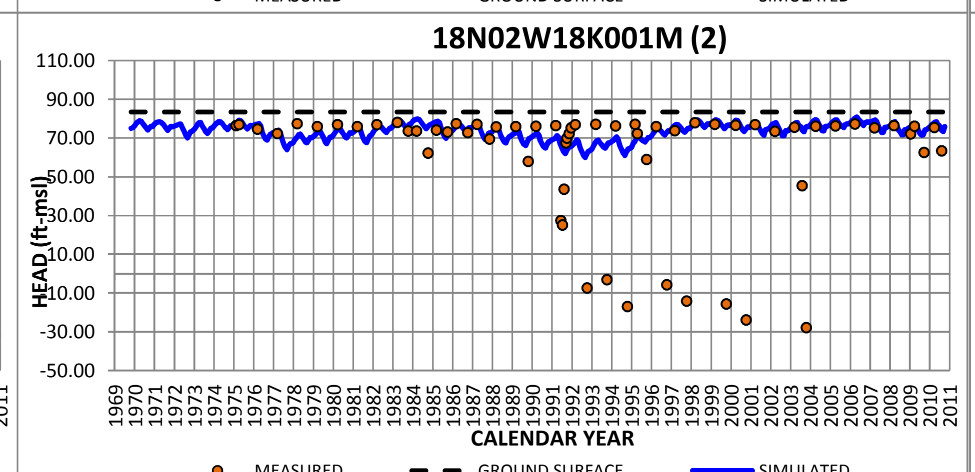
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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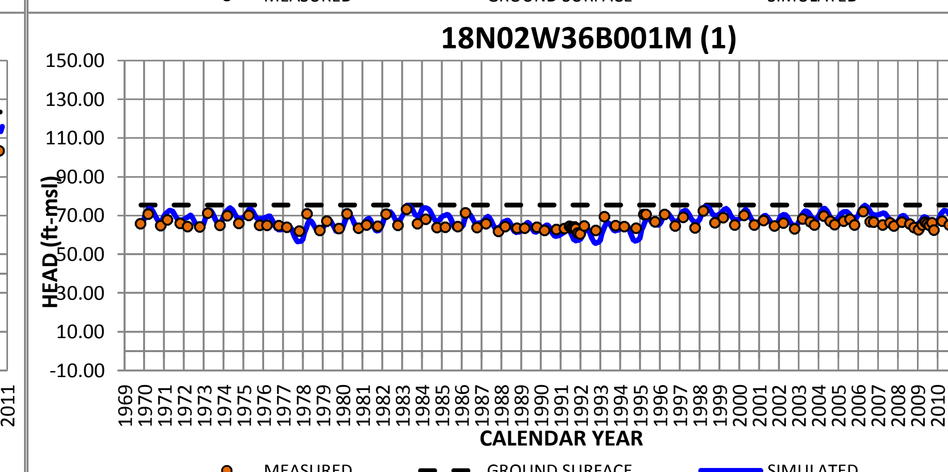
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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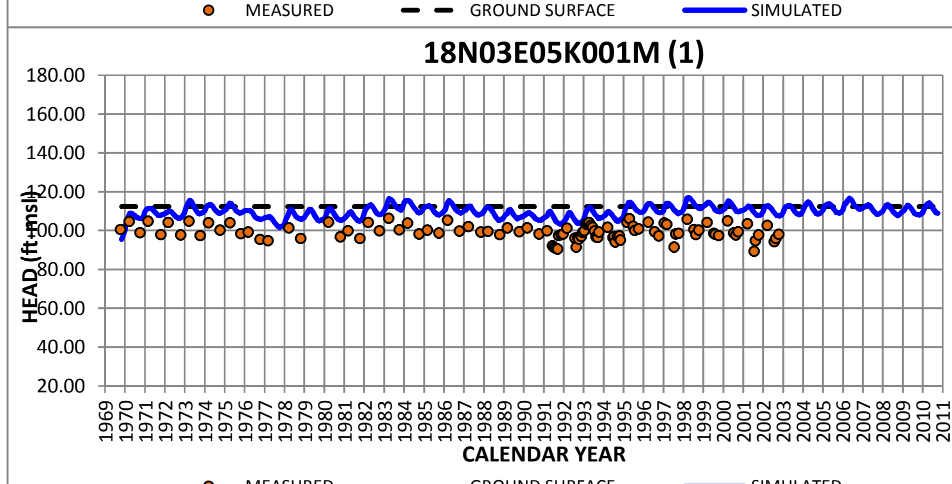
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
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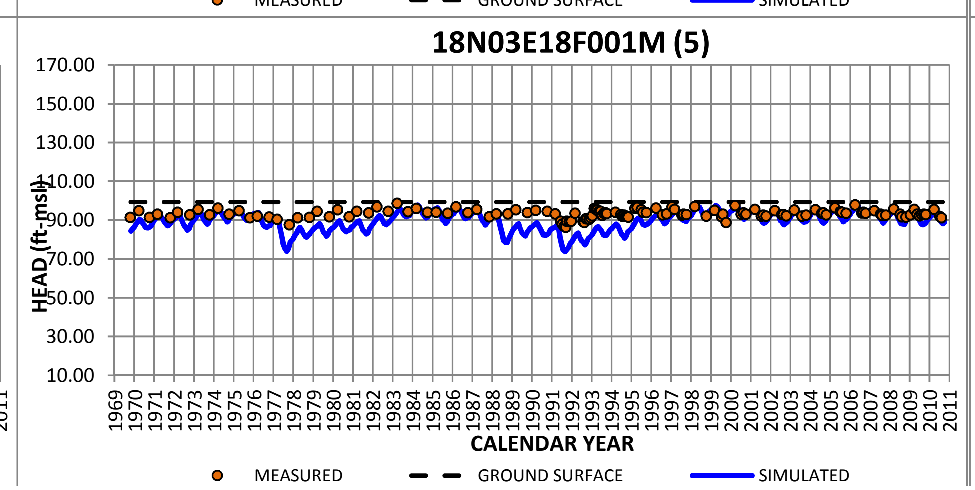
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CALENDAR YEAR
MEASURED
GROUND SURFACE
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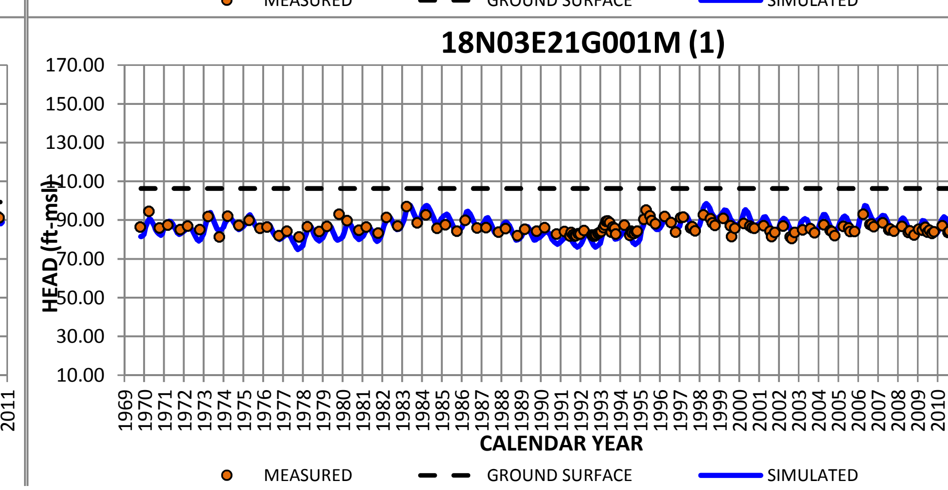
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CALENDAR YEAR
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GROUND SURFACE
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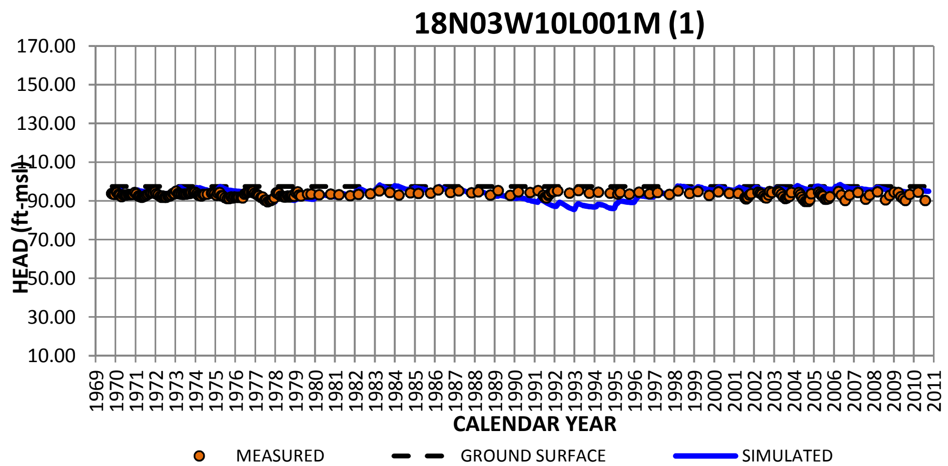
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CALENDAR YEAR
MEASURED
GROUND SURFACE
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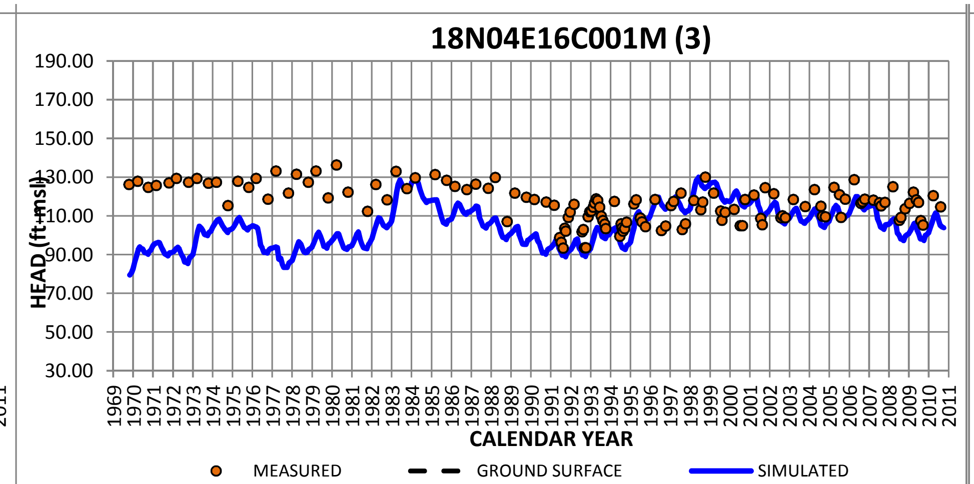
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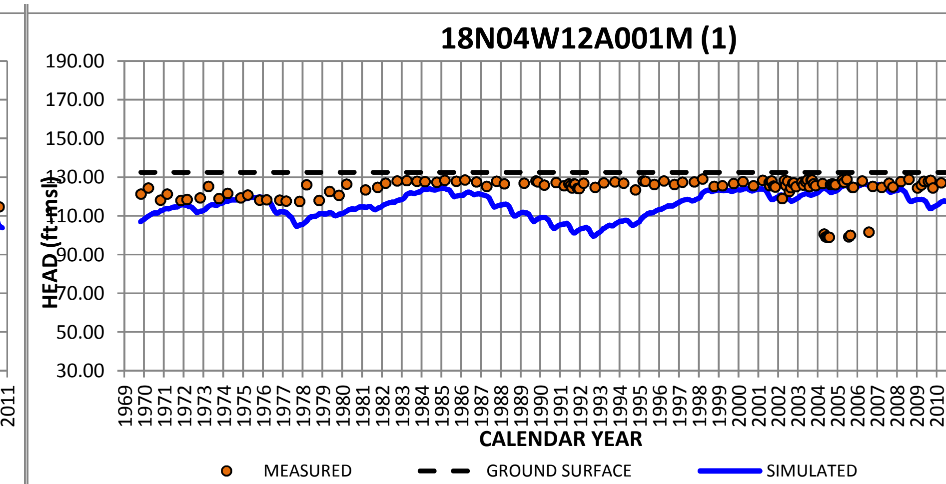
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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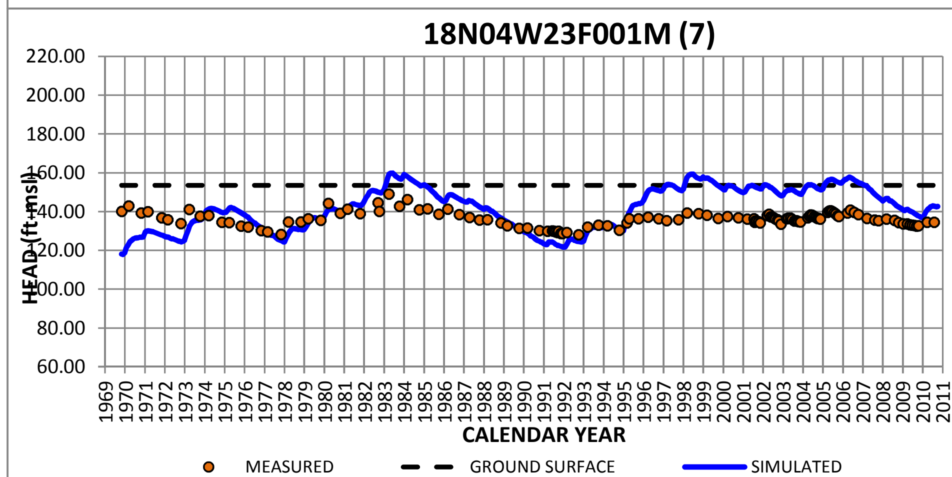
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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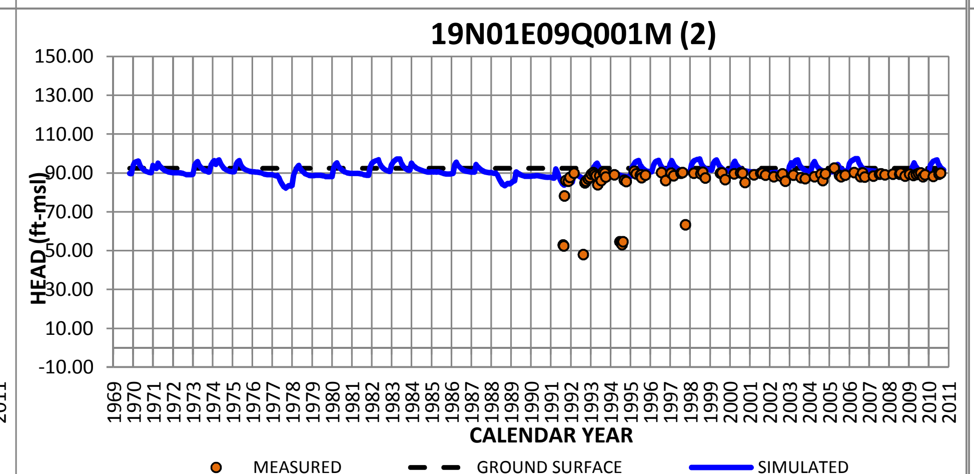
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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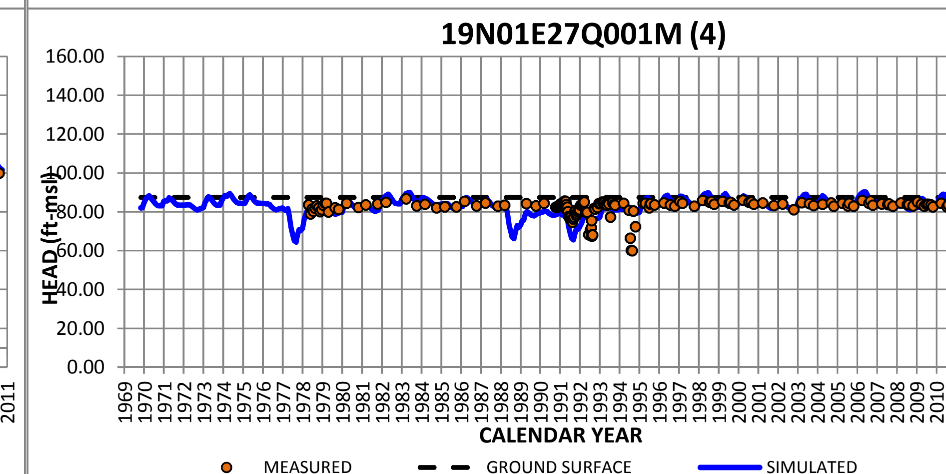
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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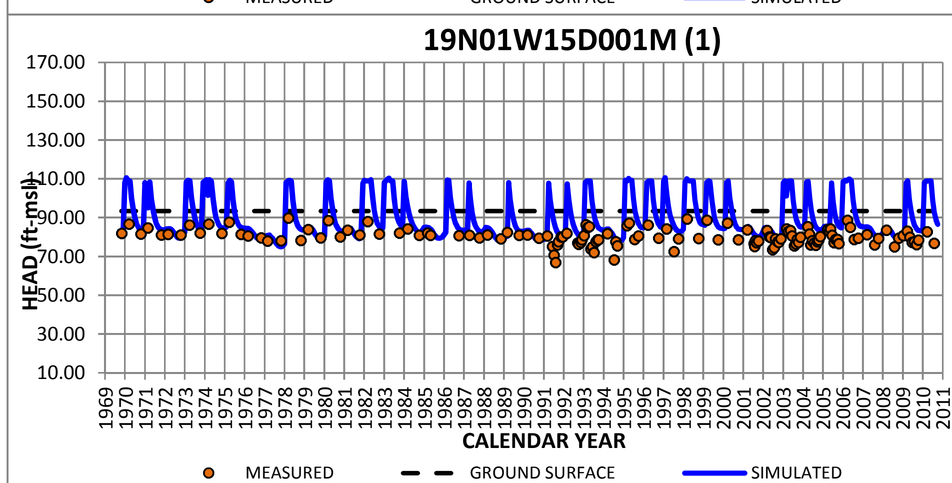
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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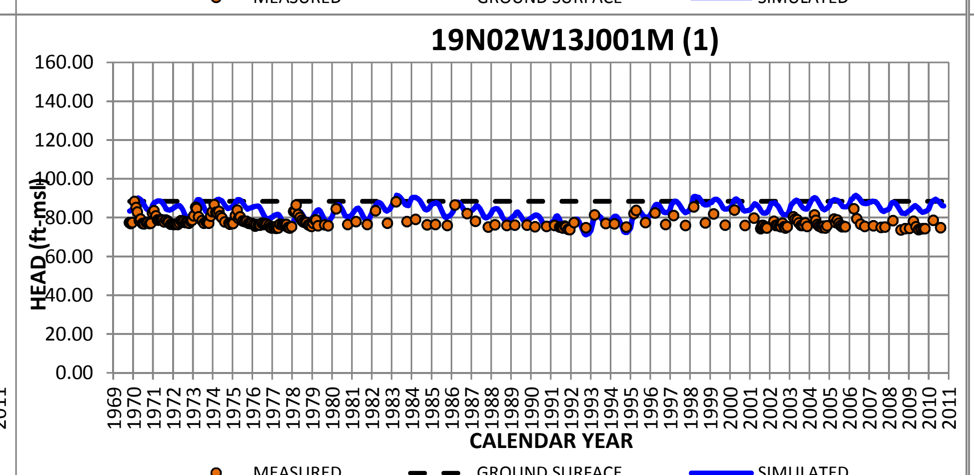
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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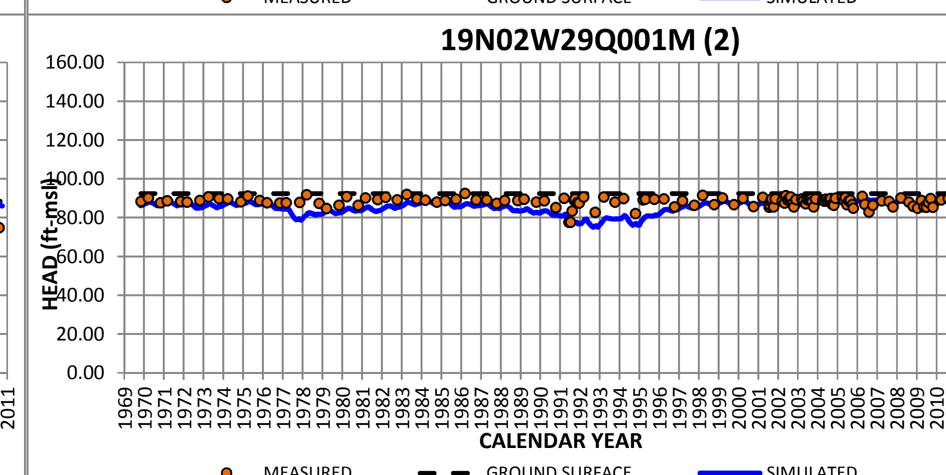
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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CALENDAR YEAR
MEASURED
GROUND SURFACE
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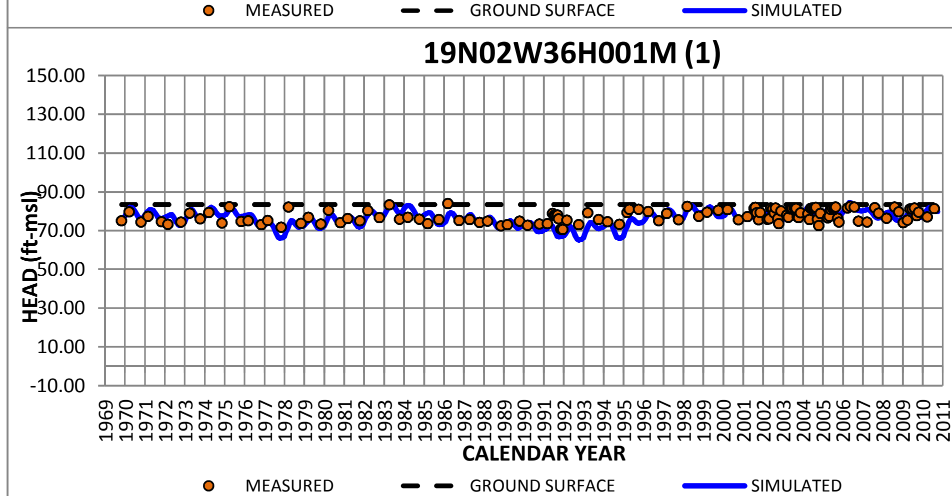
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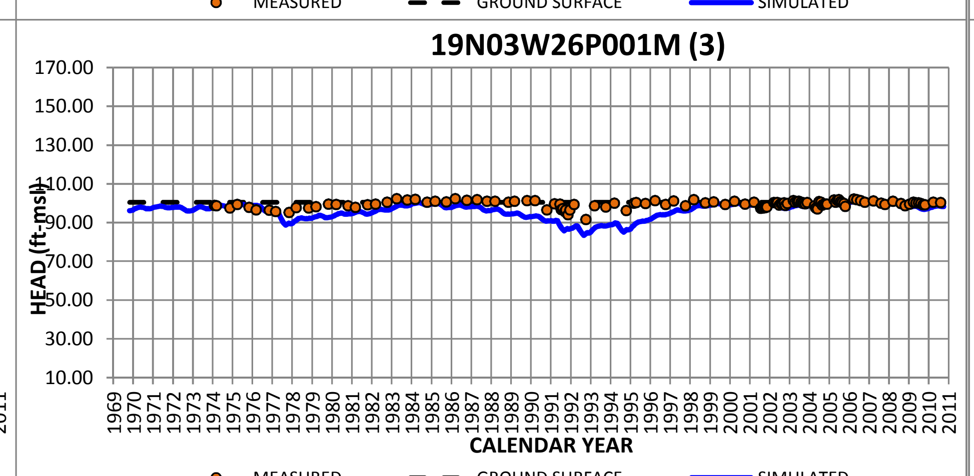
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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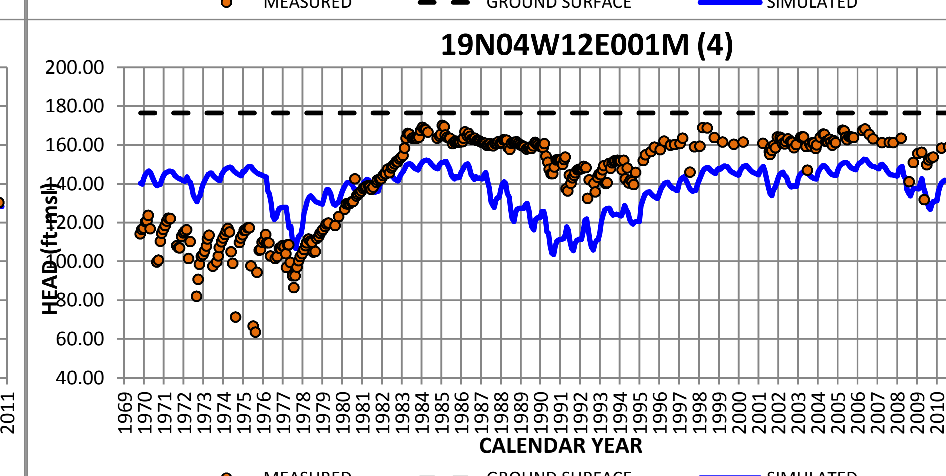
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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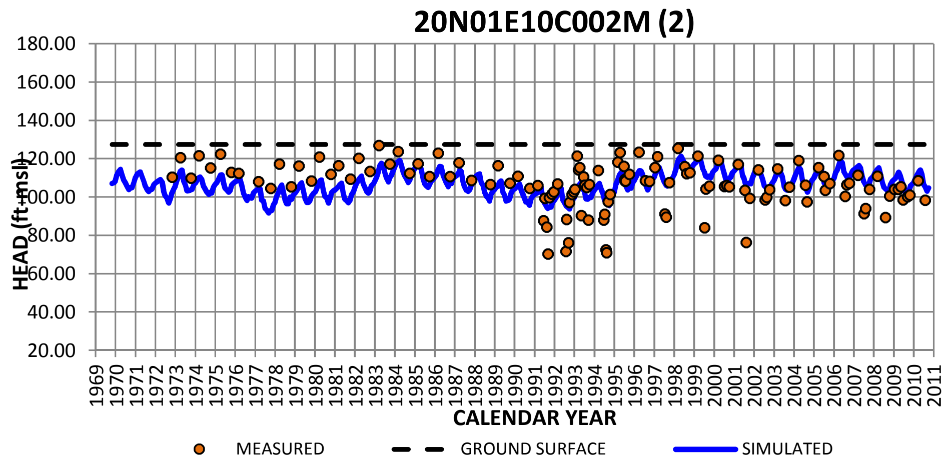
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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CALENDAR YEAR
MEASURED
GROUND SURFACE
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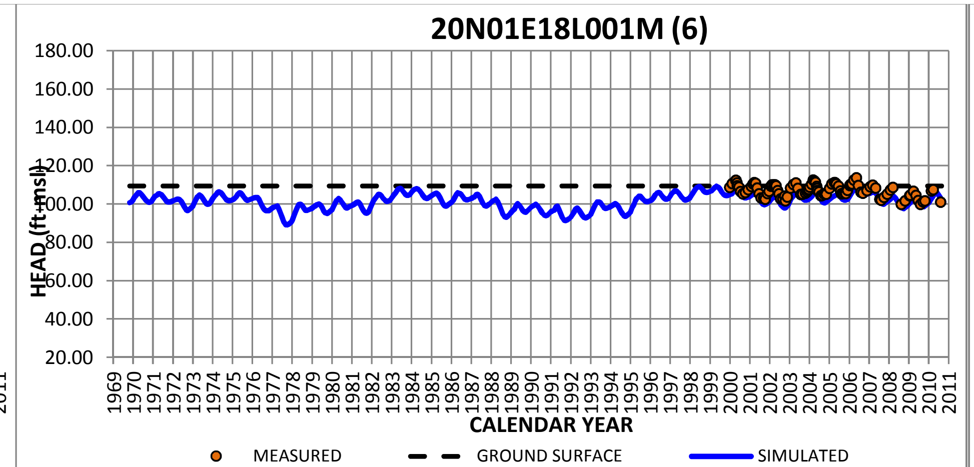
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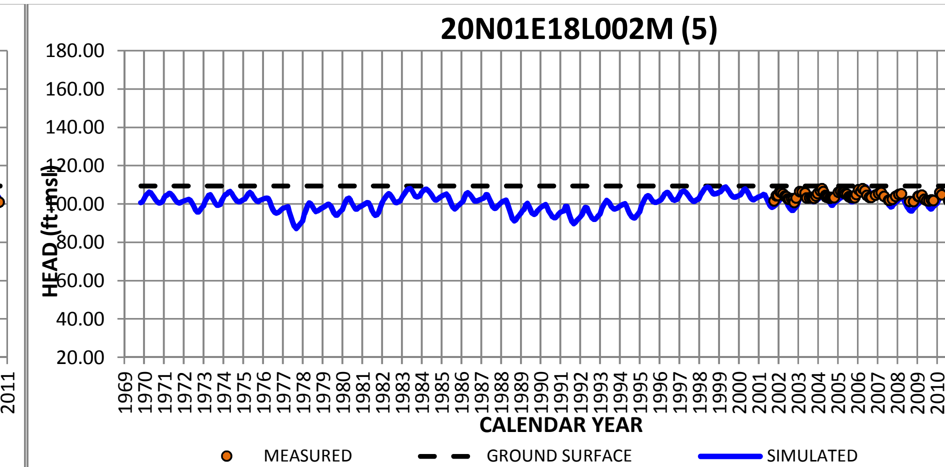
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
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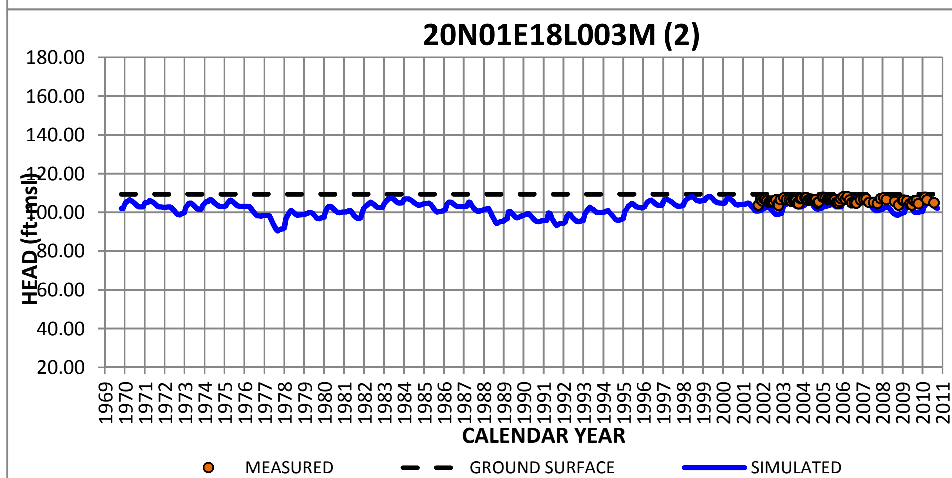
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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
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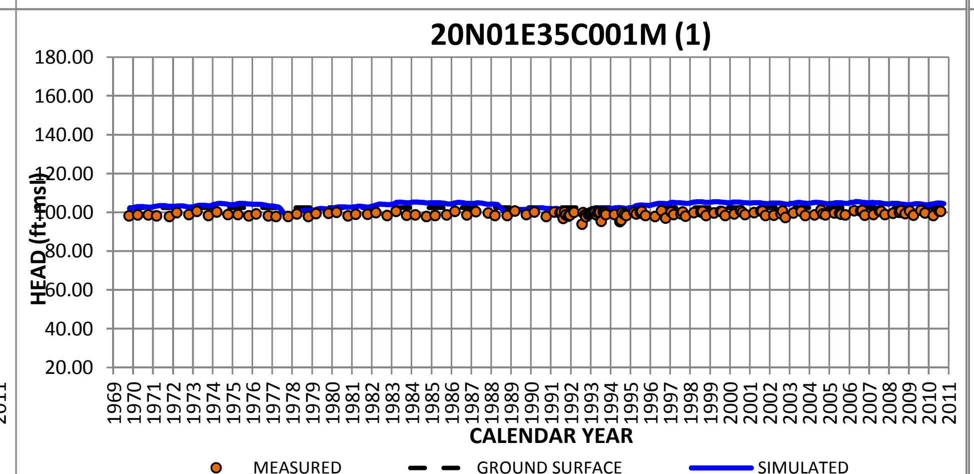
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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
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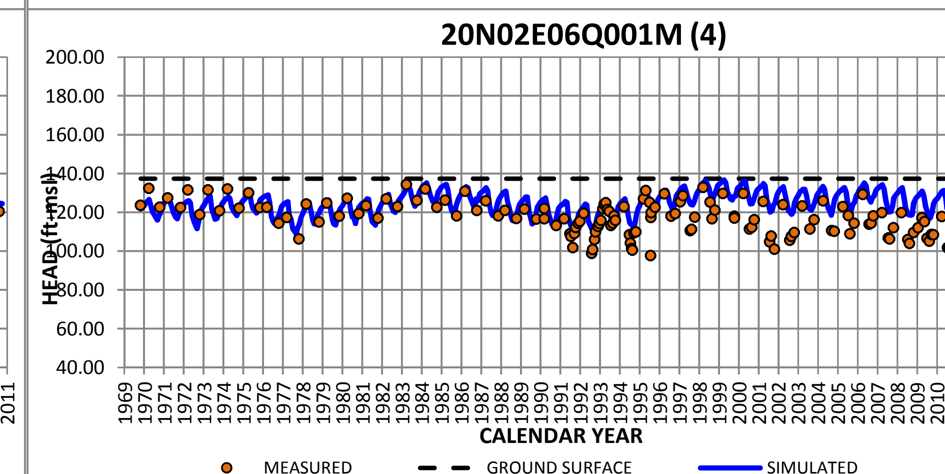
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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
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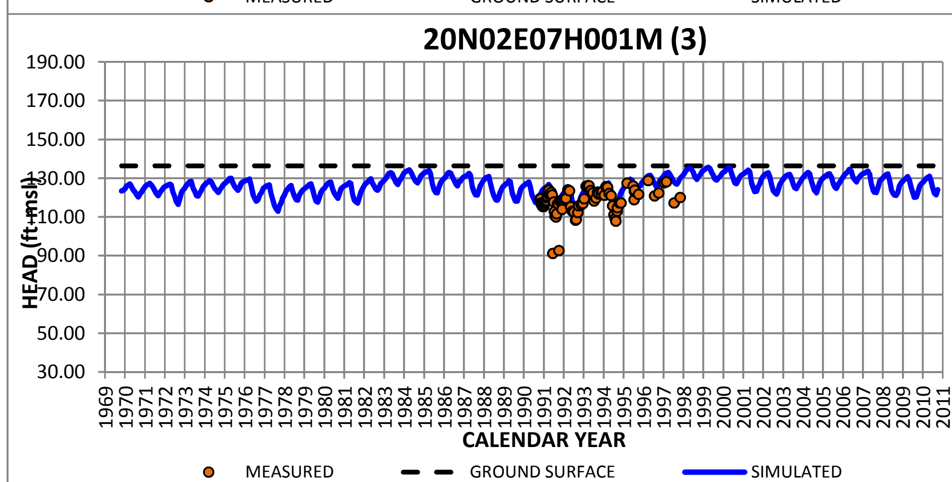
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HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
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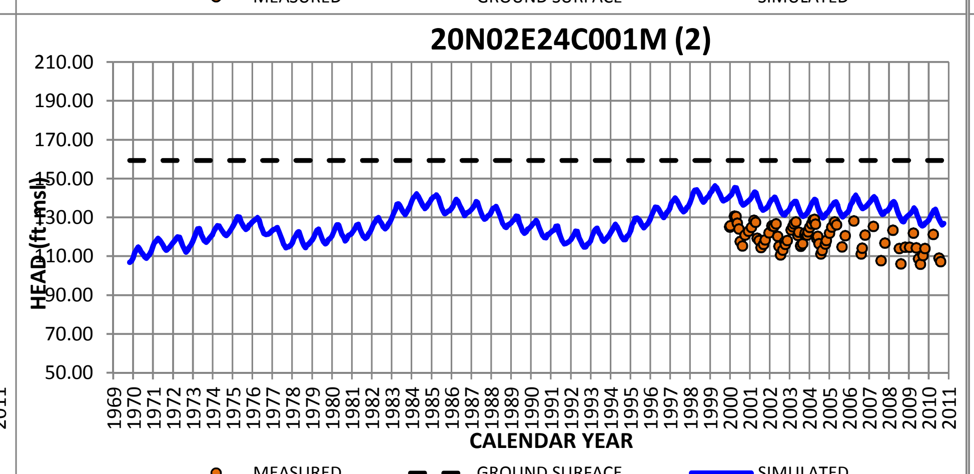
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CALENDAR YEAR
MEASURED
GROUND SURFACE
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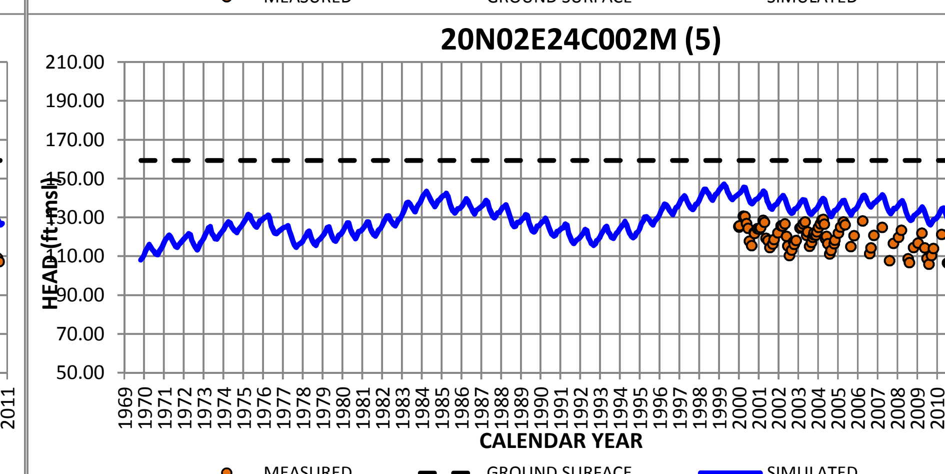
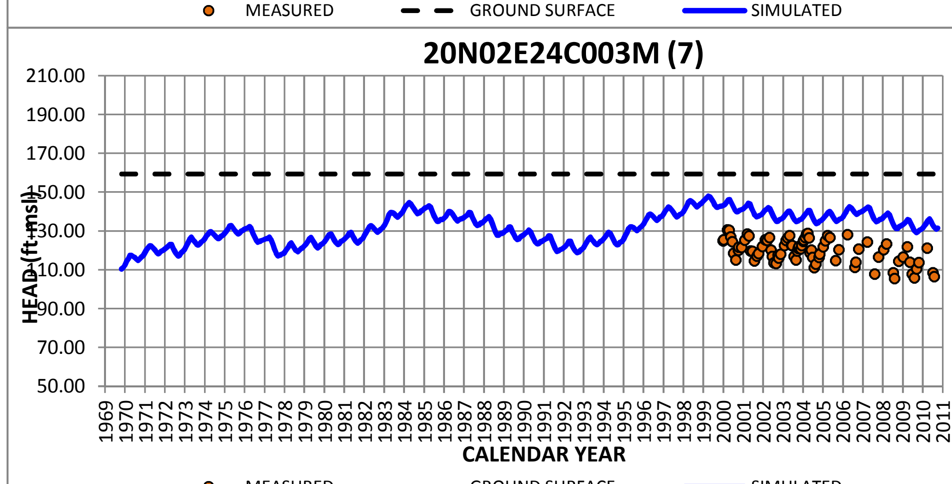
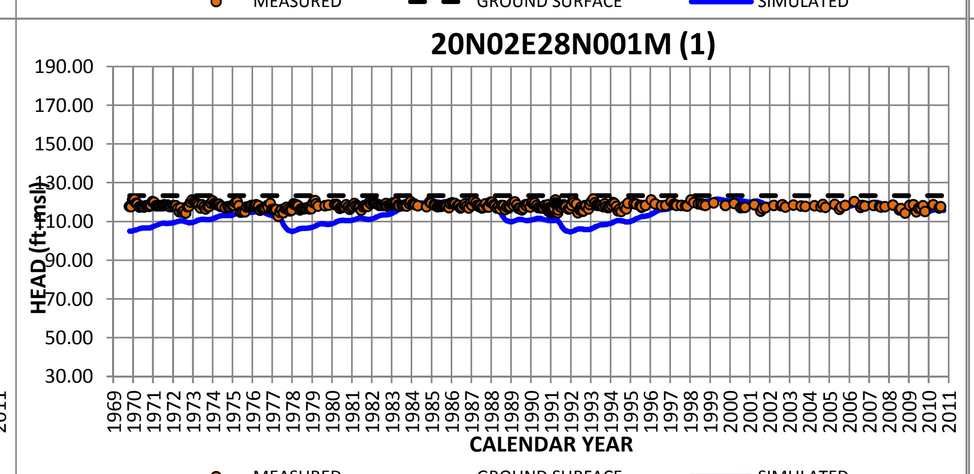
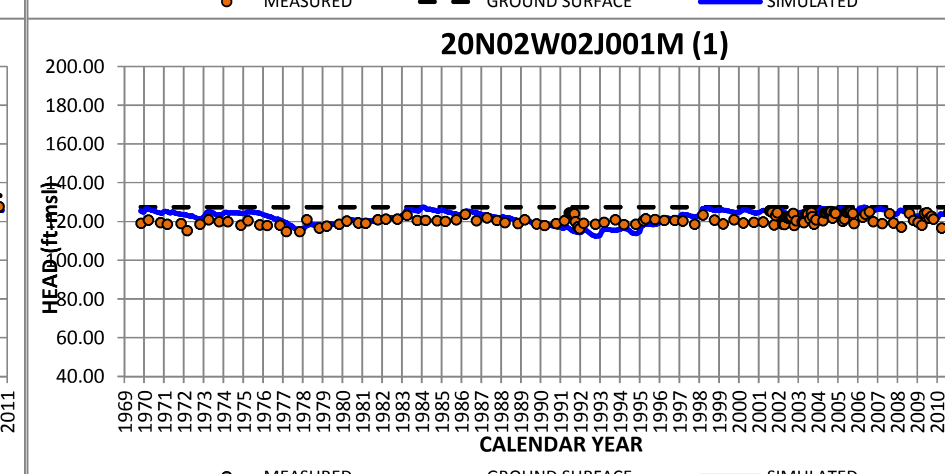
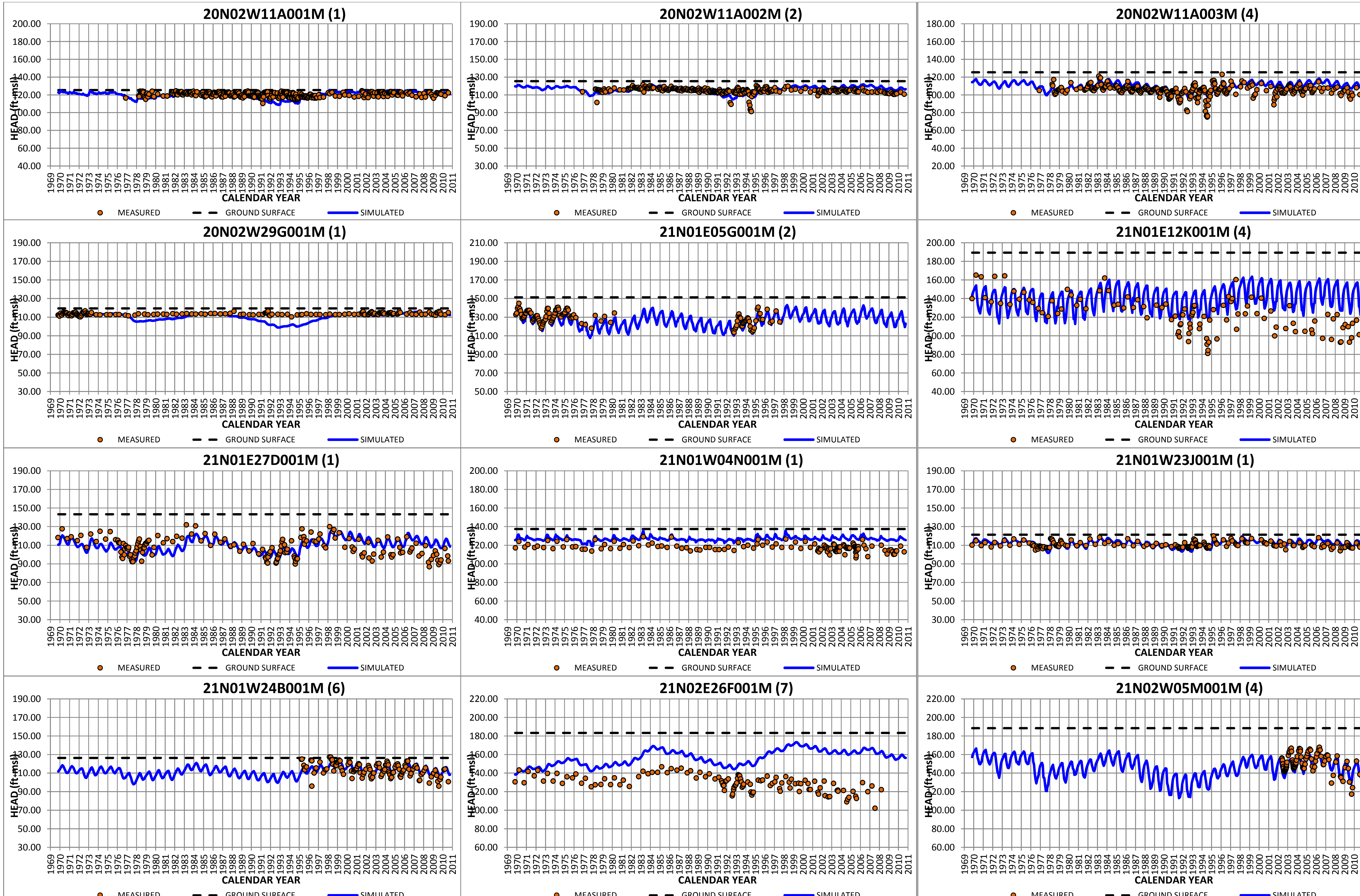
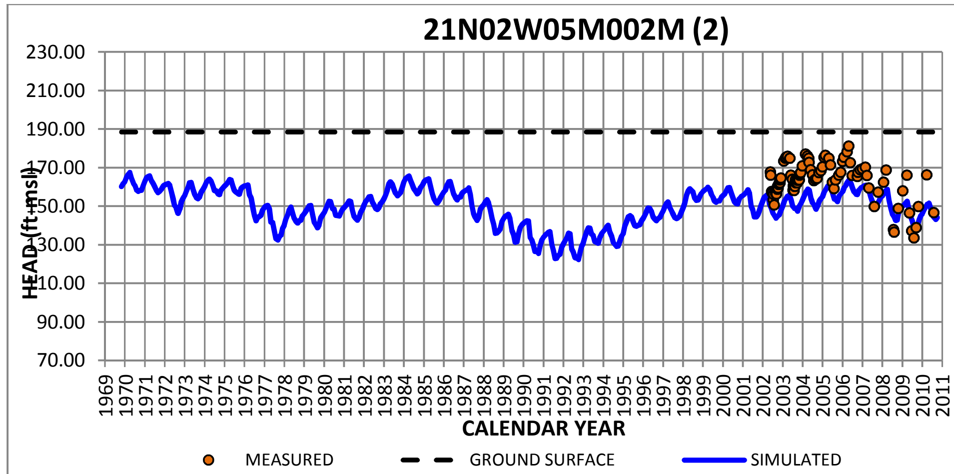

20N02E24C002M (5)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

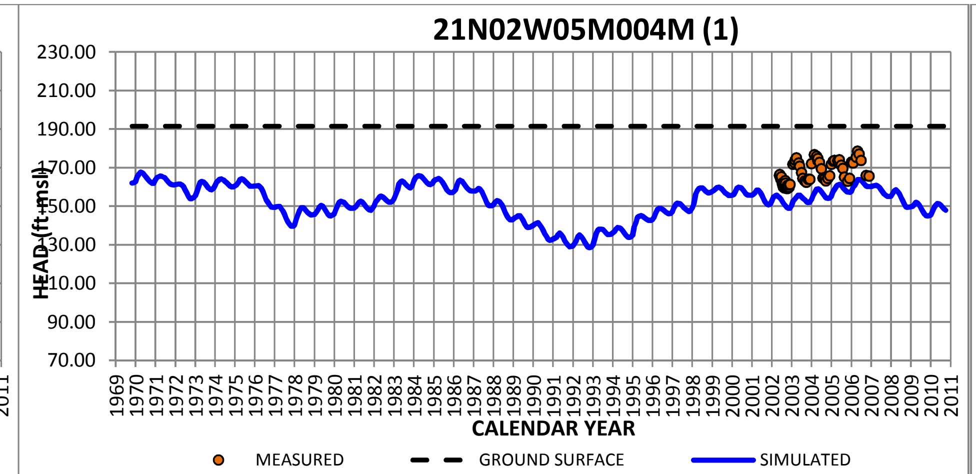

20N02E24C003M (7)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

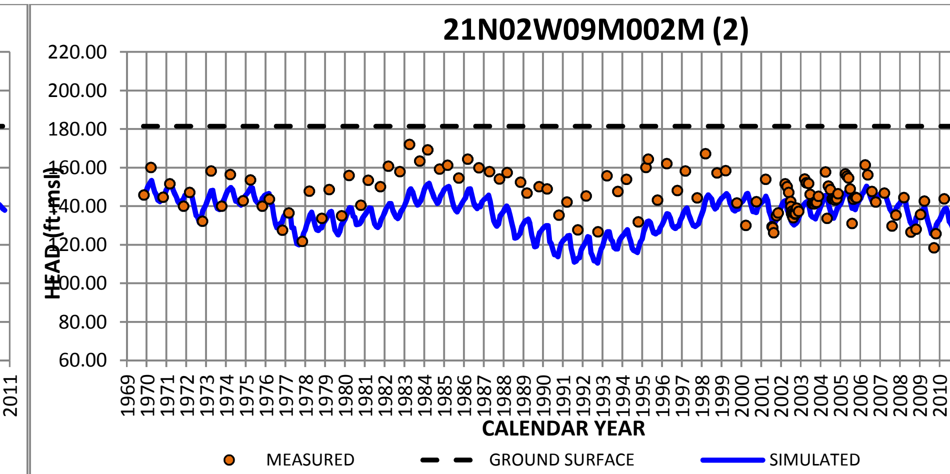

20N02E28N001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

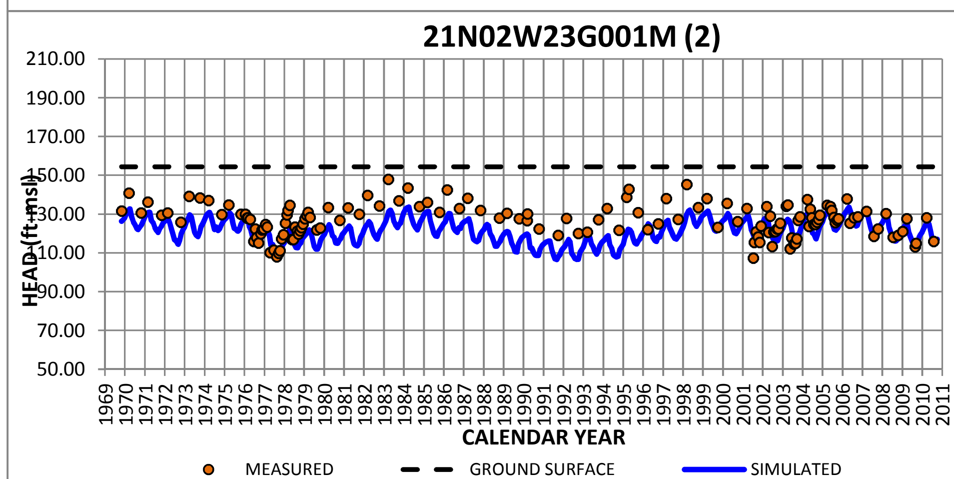

20N02W02J001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

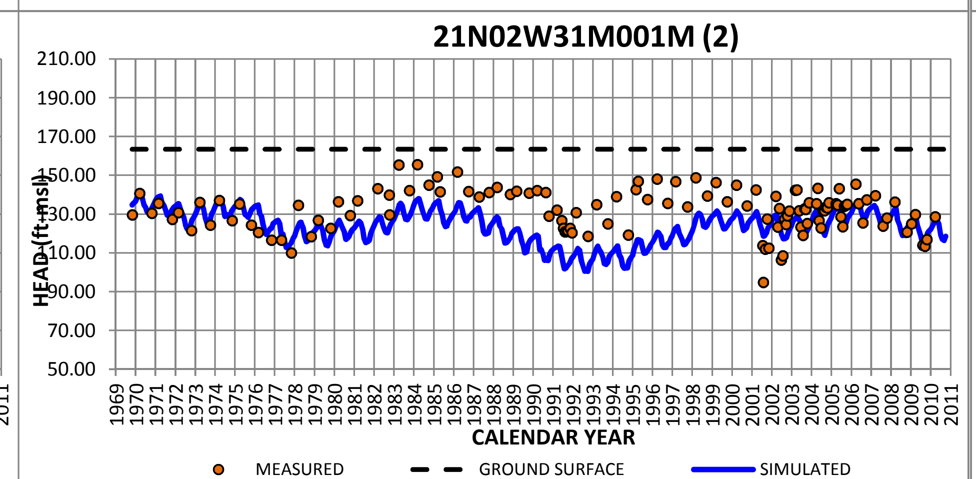

20N02W11A001M (1)
20N02W11A002M (2)
20N02W11A003M (4)
20N02W29G001M (1)
21N01E05G001M (2)
21N01E12K001M (4)
21N01E27D001M (1)
21N01W04N001M (1)
21N01W23J001M (1)
21N01W24B001M (6)
21N02E26F001M (7)
21N02W05M001M (4)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

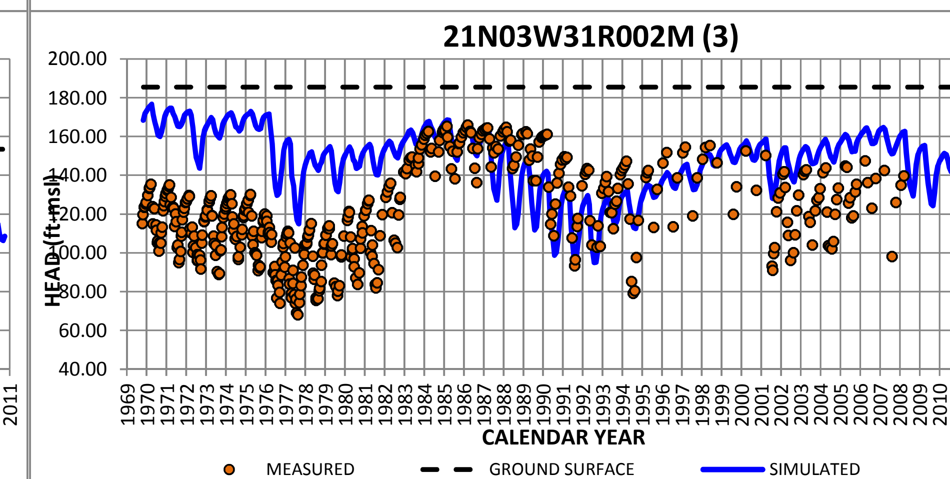

21N02W05M002M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

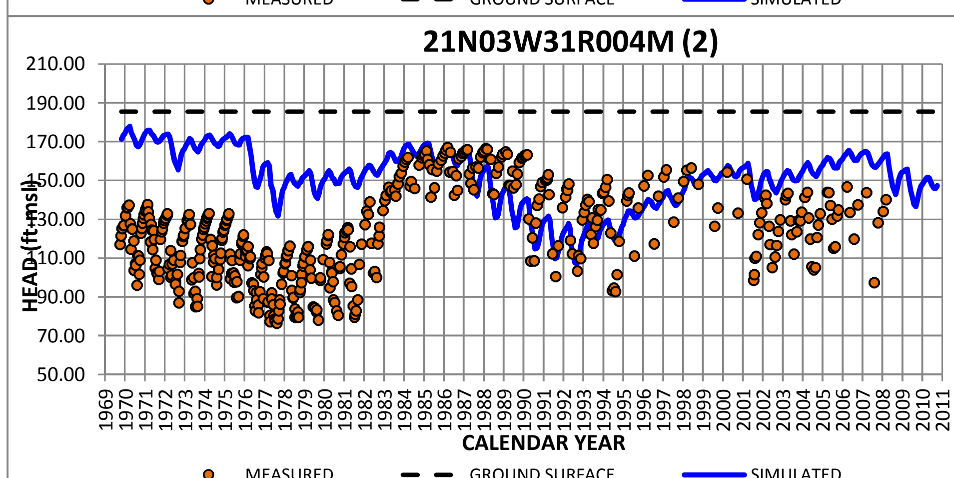

21N02W05M004M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

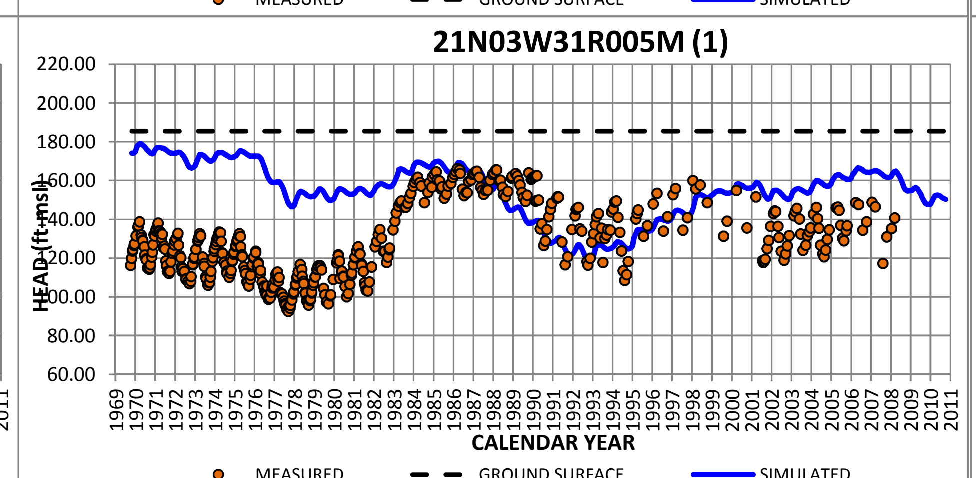

21N02W09M002M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

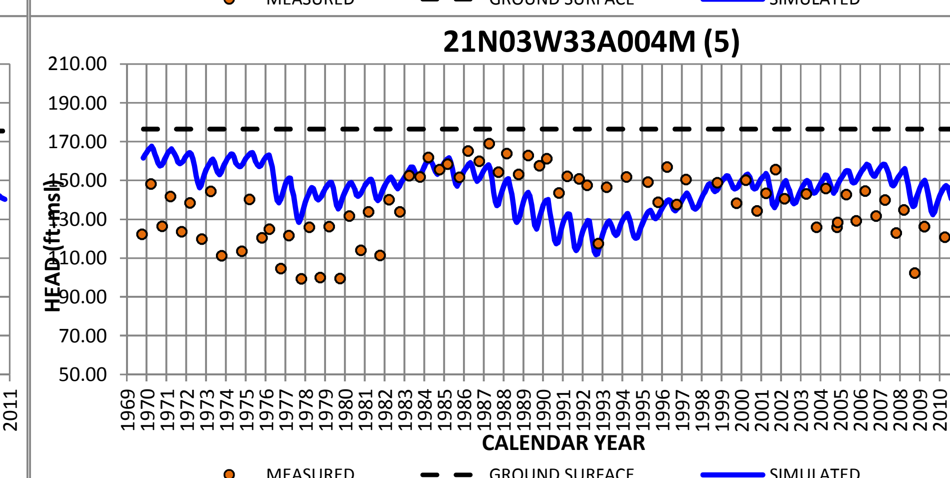

21N02W23G001M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

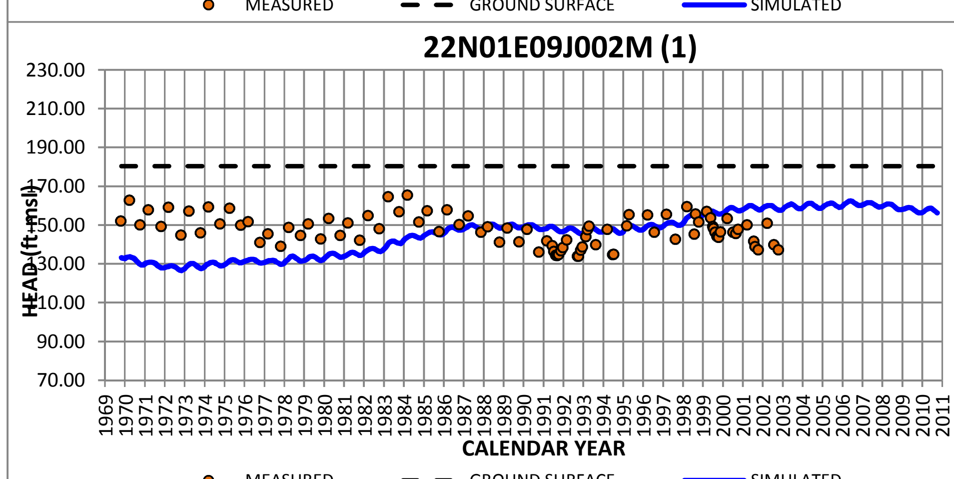

21N02W31M001M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

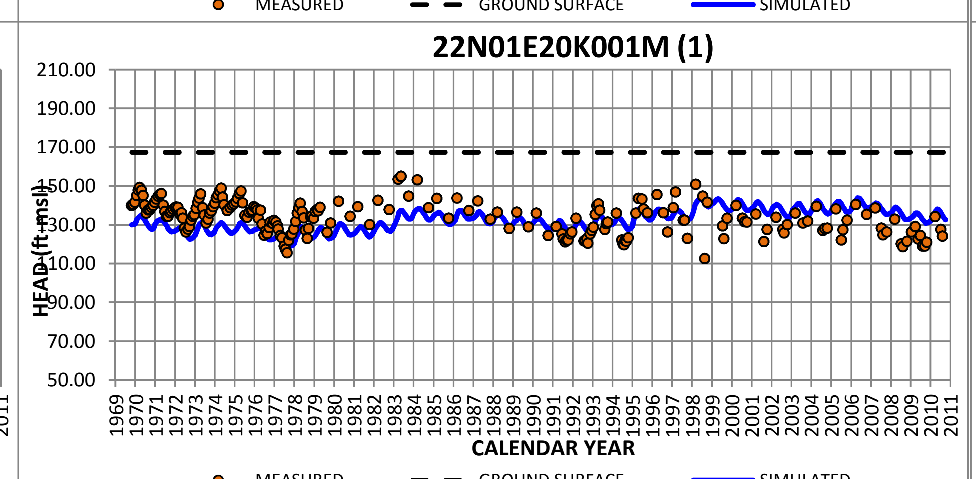

21N03W31R002M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

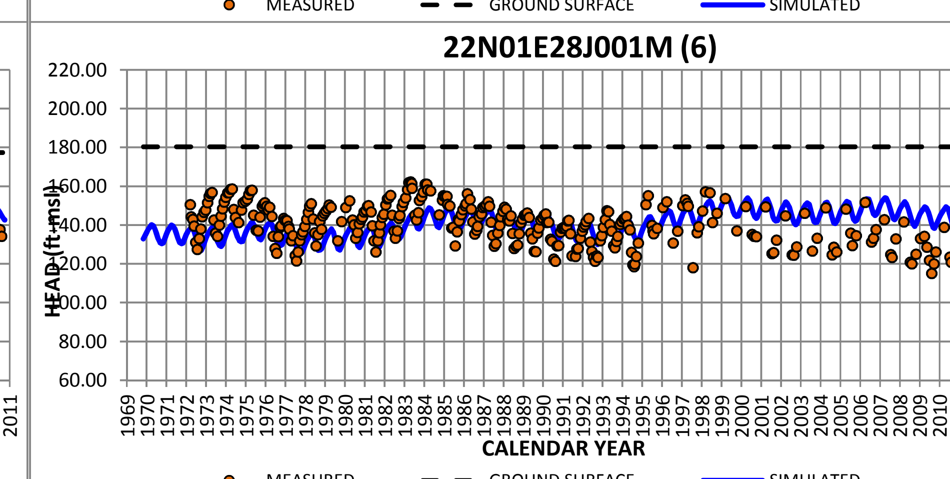

21N03W31R004M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

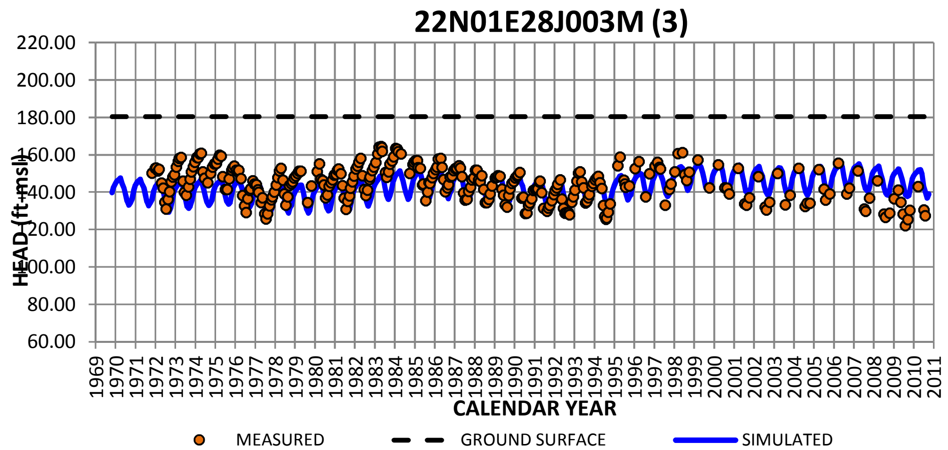

21N03W31R005M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

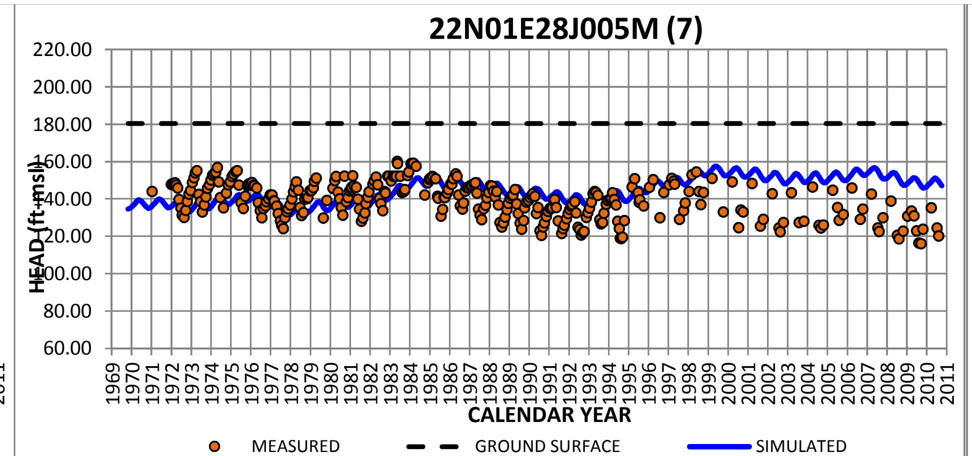

21N03W33A004M (5)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

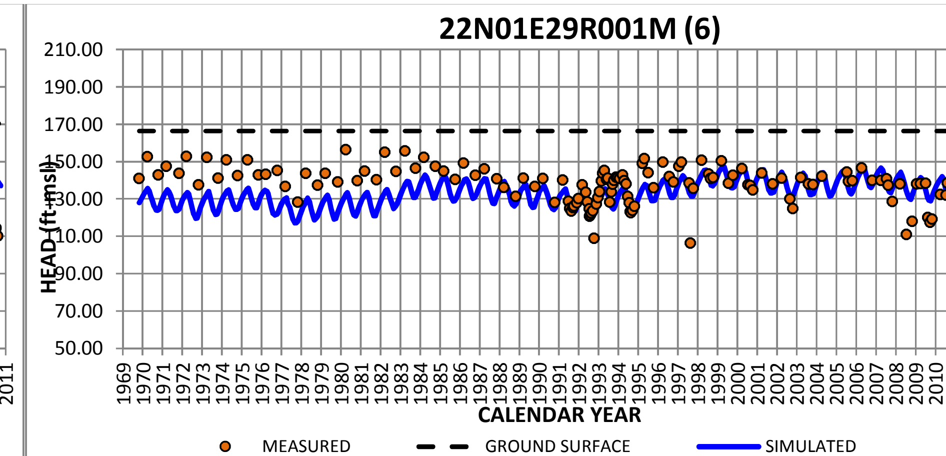

22N01E09J002M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

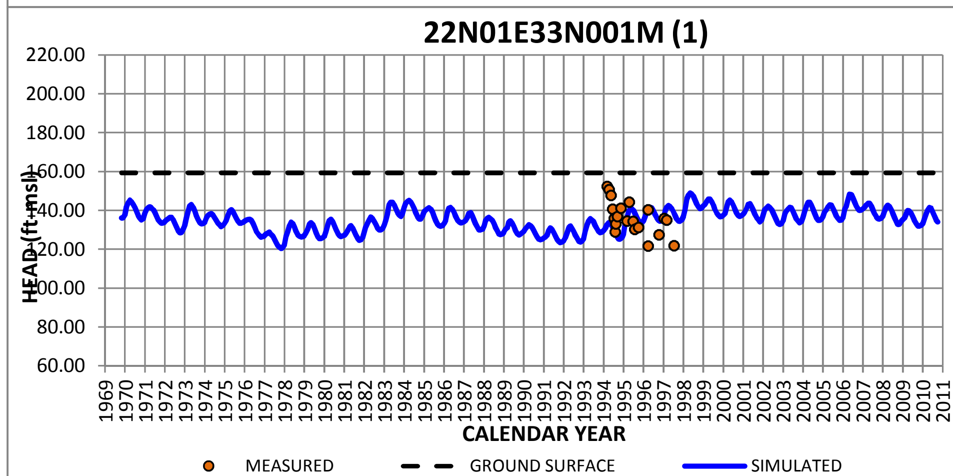

22N01E20K001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

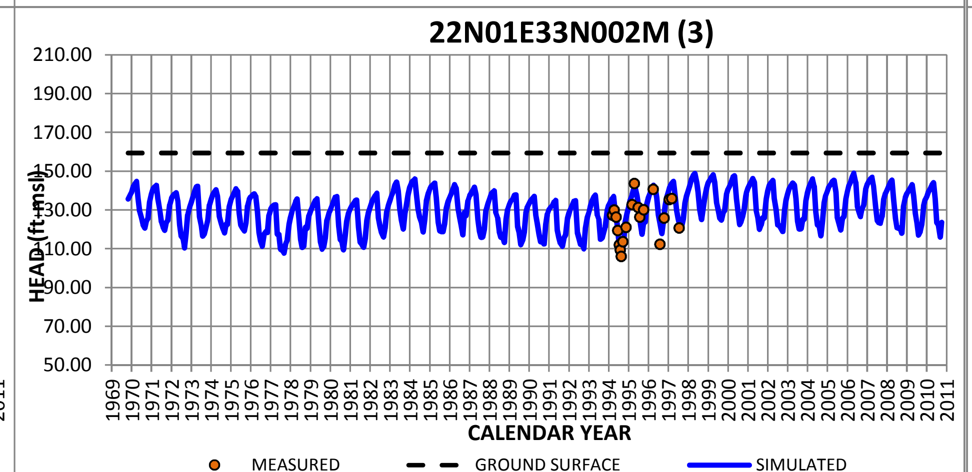

22N01E28J001M (6)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

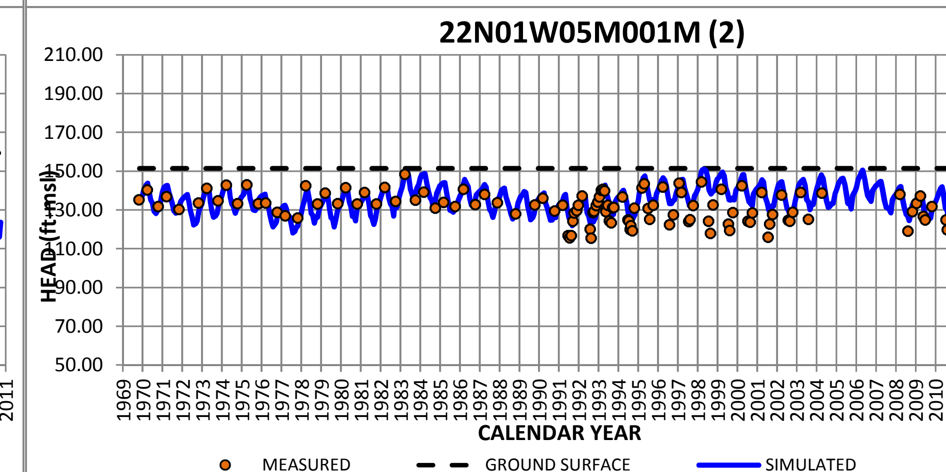

22N01E28J003M (3)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

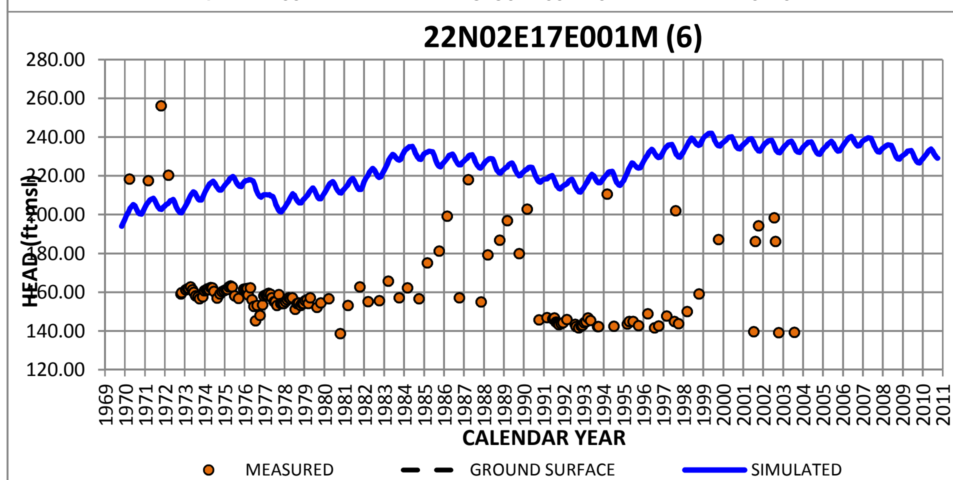

22N01E28J005M (7)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

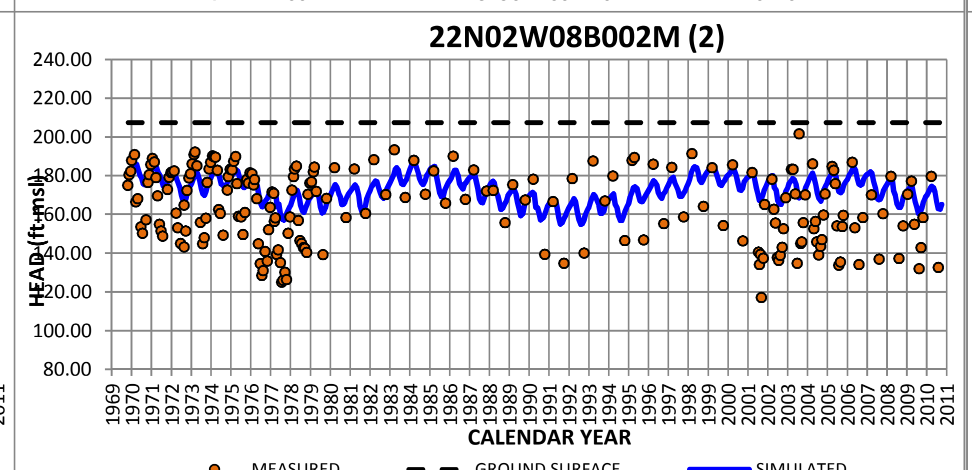

22N01E29R001M (6)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

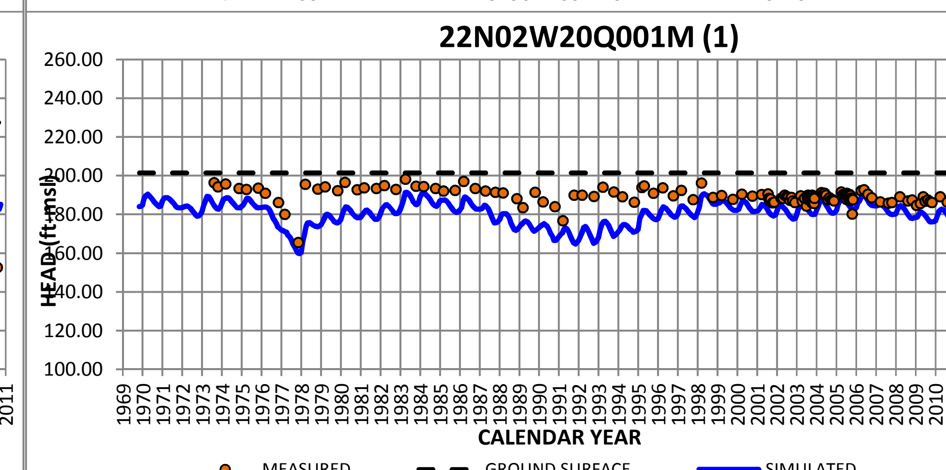

22N01E33N001M (1)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

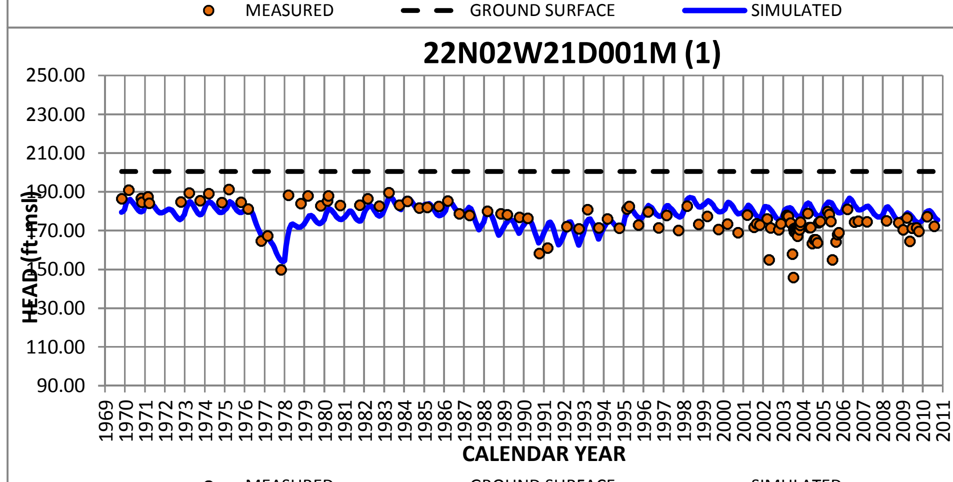

22N01E33N002M (3)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

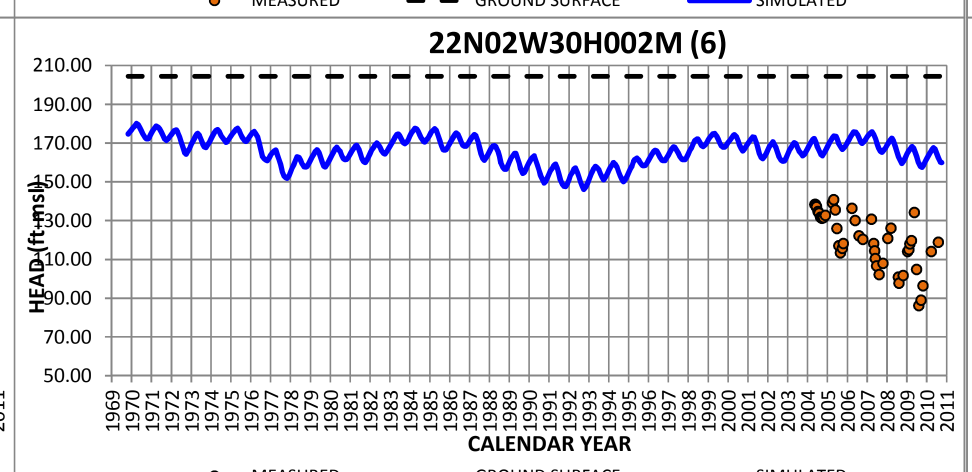

22N01W05M001M (2)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

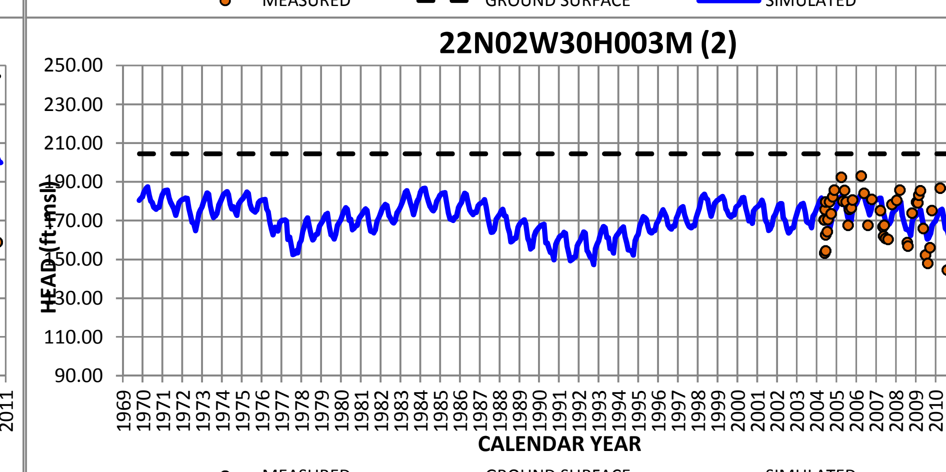

22N02E17E001M (6)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

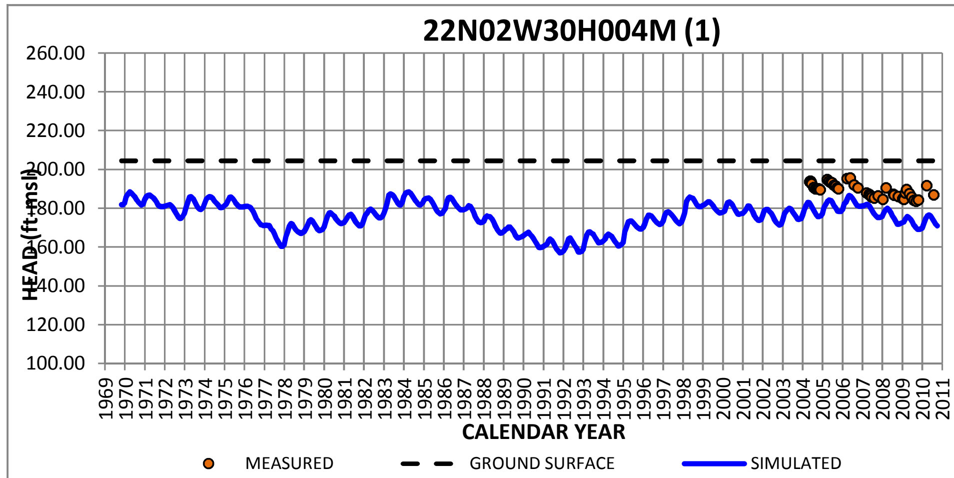

22N02W08B002M (2)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

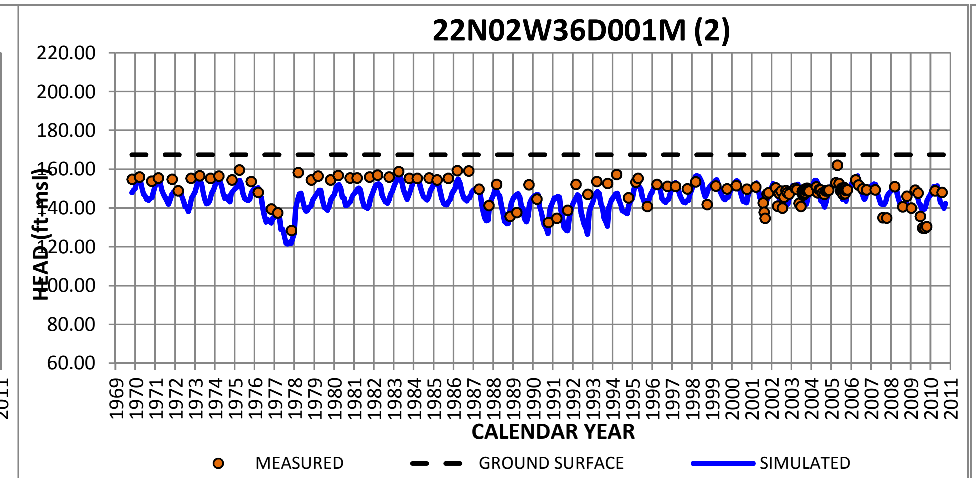

22N02W20Q001M (1)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

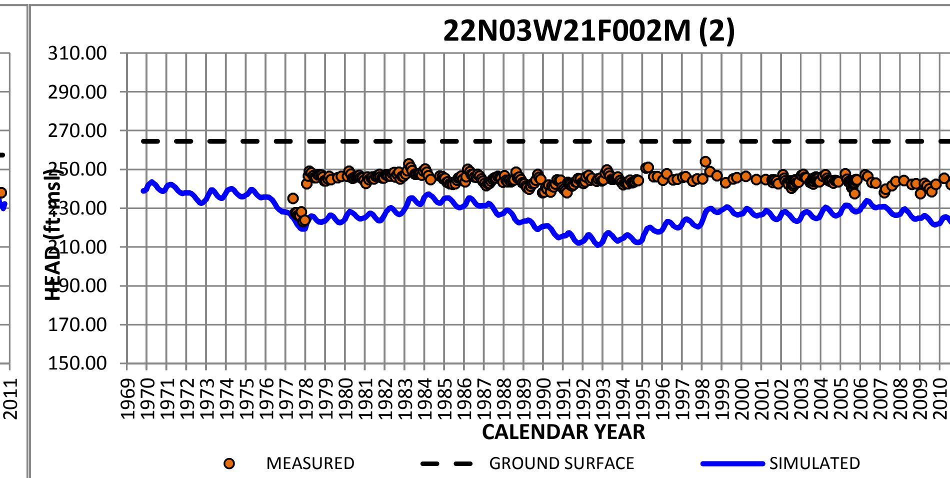

22N02W21D001M (1)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

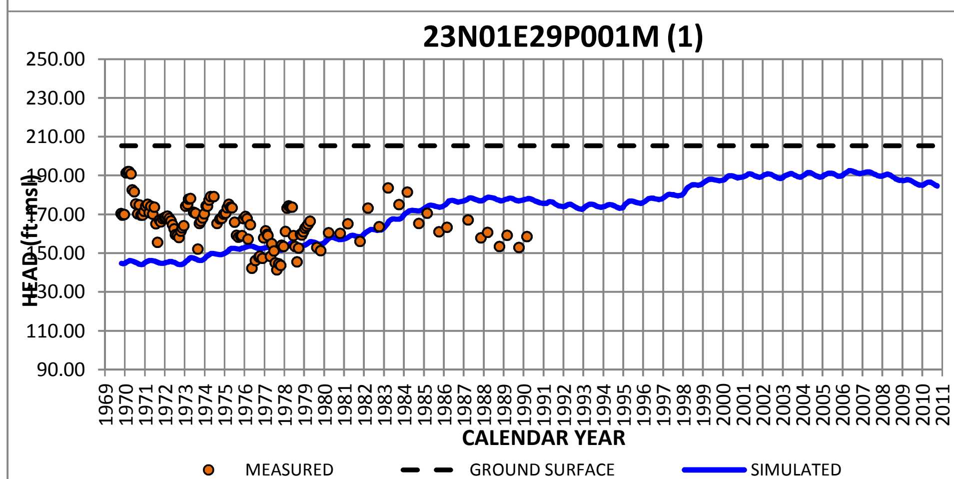

22N02W30H002M (6)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

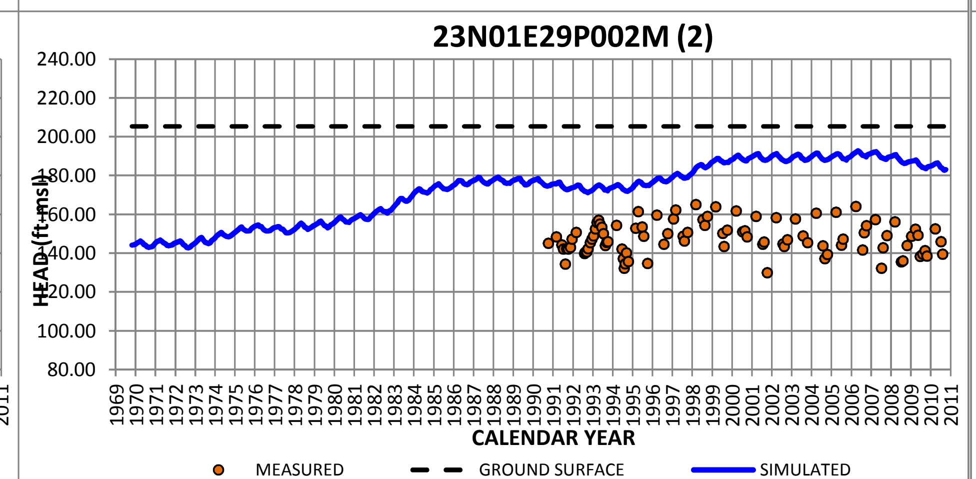

22N02W30H003M (2)
HEAD (ft msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

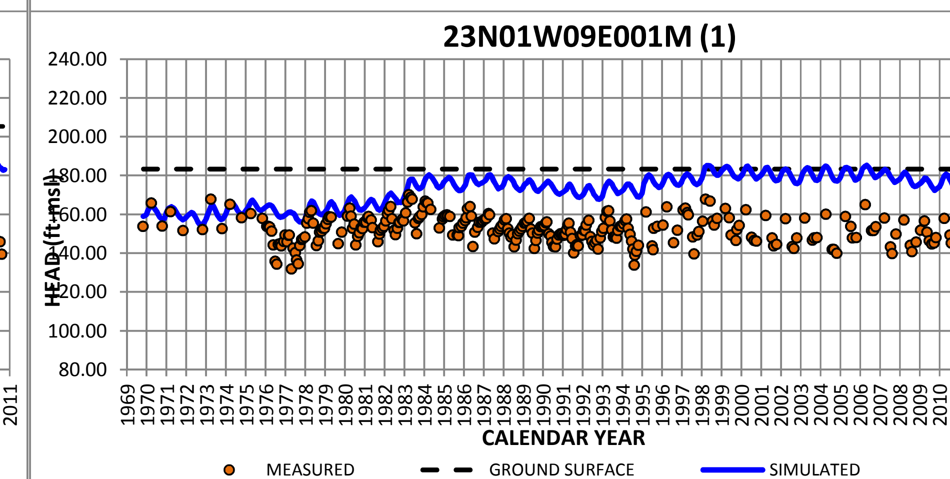

22N02W30H004M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

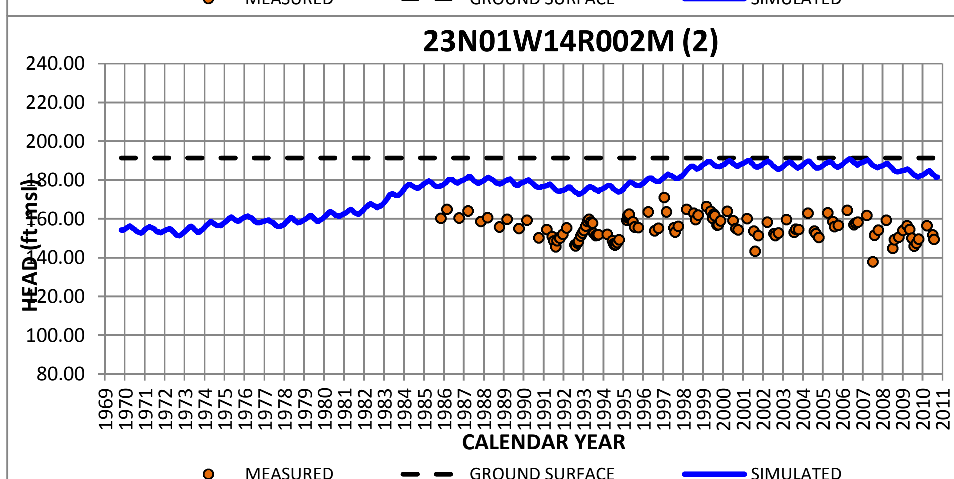

22N02W36D001M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

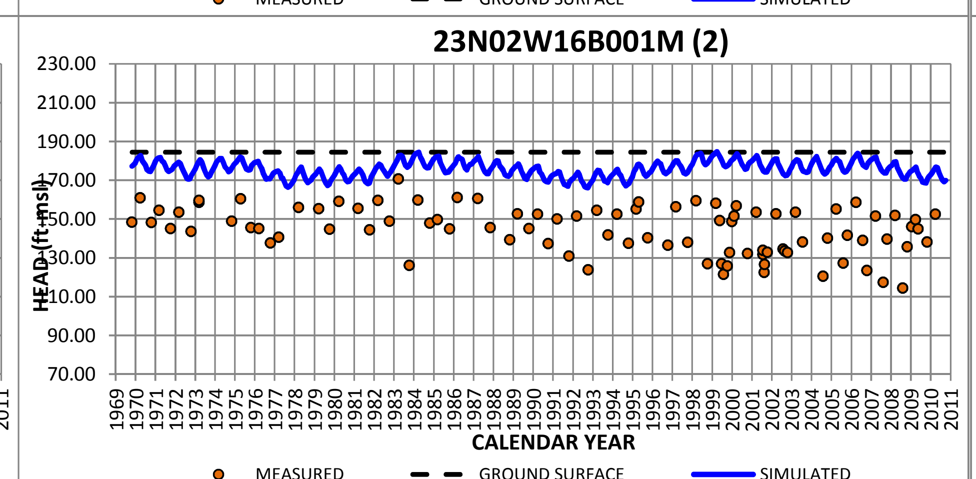

22N03W21F002M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

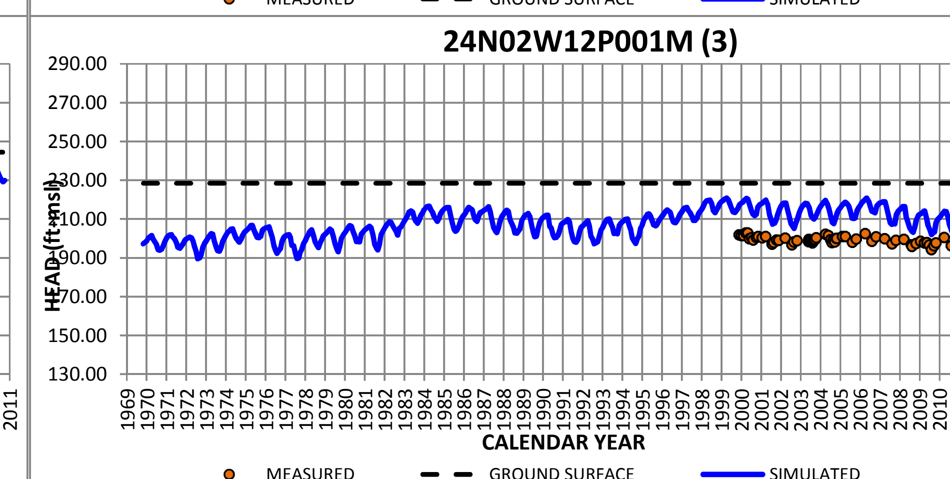

23N01E29P001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

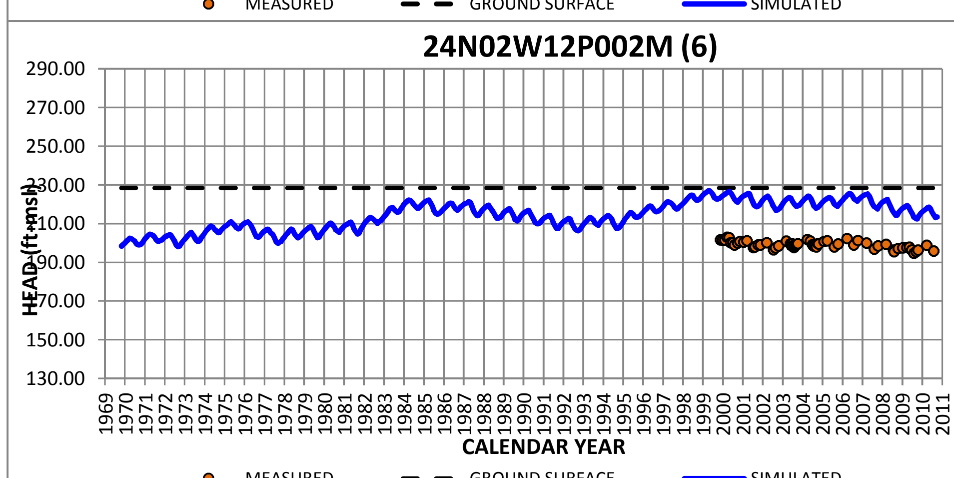

23N01E29P002M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

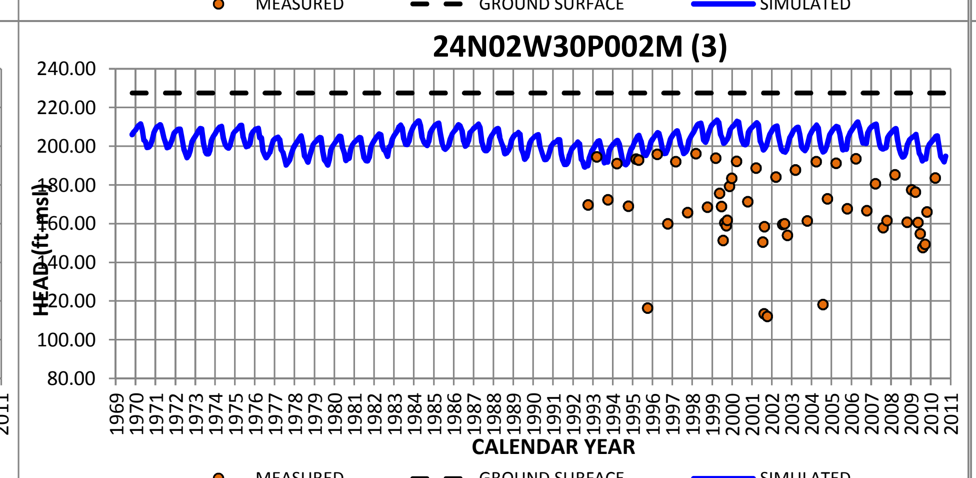

23N01W09E001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

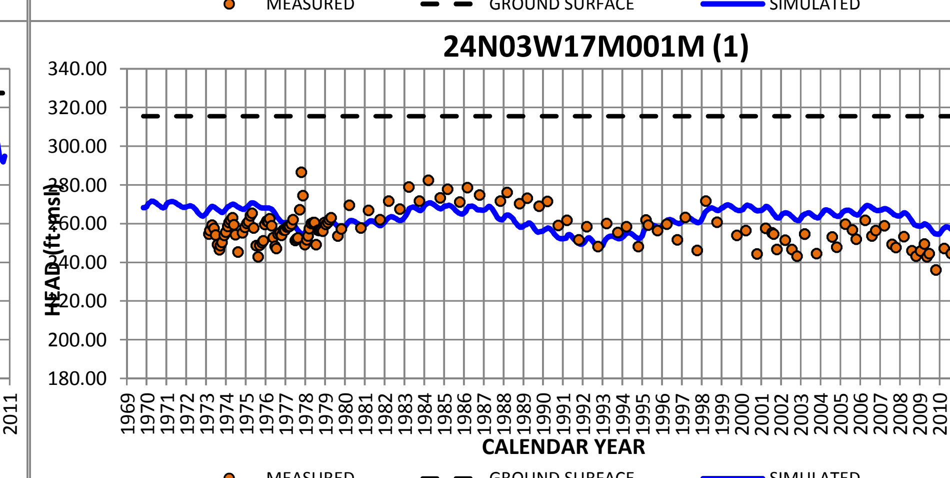

23N01W14R002M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

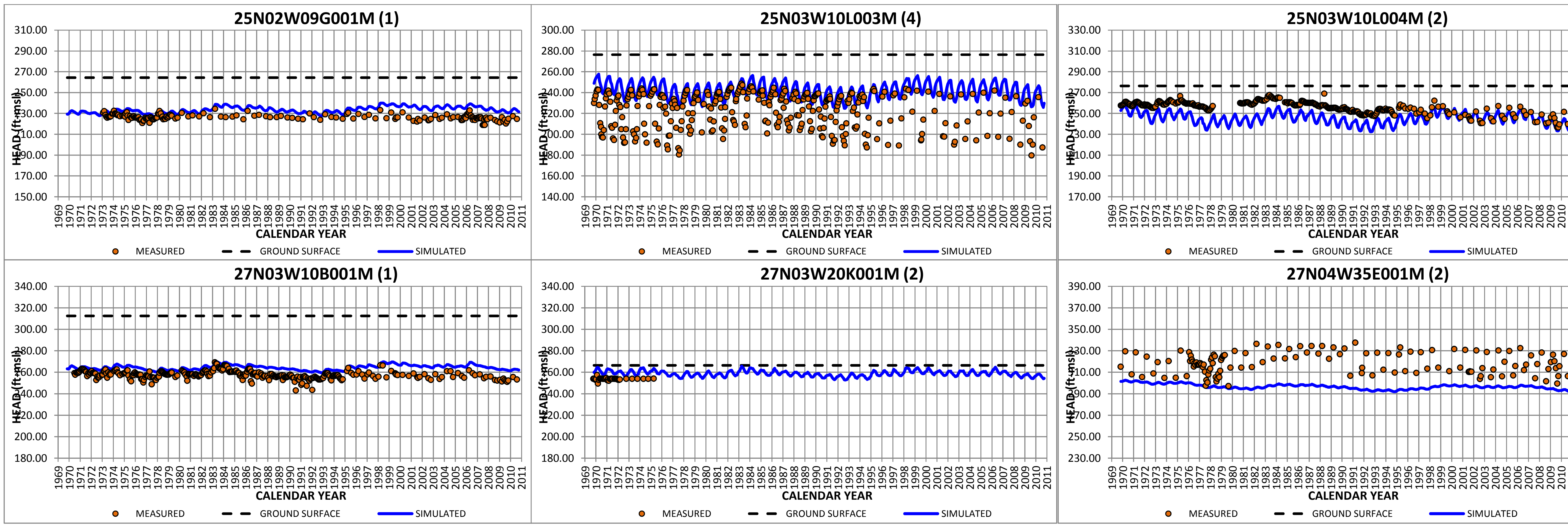

23N02W16B001M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


24N02W12P001M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


24N02W12P002M (6)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


24N02W30P002M (3)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


24N03W17M001M (1)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED


25N02W09G001M (1)
25N03W10L003M (4)
25N03W10L004M (2)
27N03W10B001M (1)
27N03W20K001M (2)
27N04W35E001M (2)
HEAD (ft-msl)
CALENDAR YEAR
MEASURED
GROUND SURFACE
SIMULATED

Appendix D
SACFEM2013.feb File

```
rem*********************************************************
rem        BEGIN SIMULATION
rem*********************************************************
LOAD
 h1=zero.par
 h2=zero.par
 h3=zero.par
 h4=zero.par
 h5=zero.par
 h6=zero.par
 h7=zero.par
 q1=zero.par
 q2=zero.par
 q3=zero.par
 q4=zero.par
 q5=zero.par
 q6=zero.par
 q7=zero.par
rem**********assign Transmissivity Values**********
LOAD
x3=SACFEM_v2_Kh_1_mpd_120313.par
x4=SACFEM_v2_Kh_2-5_mpd_120313.par
x5=SACFEM_v2_Kh_6-7_mpd_120313.par
EVAL
t1=mt1*x3
t2=mt2*x4
t3=mt3*x4
t4=mt4*x4
t5=mt5*x4
t6=mt6*x5
t7=mt7*x5
SAVE
t1=Trans.t1
t2=Trans.t2
t3=Trans.t3
```

```
t4=Trans.t4
t5=Trans.t5
t6=Trans.t6
t7=Trans.t7
rem**********assign vertical resistance values **********
LOAD
x6=SACFEM_v2_KhKv_Ratio_500.par
EVAL
c2=50*mt1^2/2/t1+x6*mt2^2/2/t2
c3=x6*mt2^2/2/t2+x6*mt3^2/2/t3
c4=x6*mt3^2/2/t3+x6*mt4^2/2/t4
c5=x6*mt4^2/2/t4+x6*mt5^2/2/t5
c6=x6*mt5^2/2/t5+x6*mt6^2/2/t6
c7=x6*mt6^2/2/t6+x6*mt7^2/2/t7
rem**********load extra register files **********
LOAD
x1=SACFEM_v2_GSE_Combined_mNAVD88_120313.par
x8=SACFEM_v2_WL1_042314.par
rem**********open ftq files**********
LOAD
lb=SACFEM_v2_all.lb
open-q all=all.ftq upper=1 lower=7
rem**********open ftq files for Water Budget Areas**********
LOAD
lb=SACFEM_v2_WBAs_121013.lb
open-q
WBA_2=WBA_2.ftq upper=1 lower=7
WBA_3=WBA_3.ftq upper=1 lower=7
WBA_4=WBA_4.ftq upper=1 lower=7
WBA_5=WBA_5.ftq upper=1 lower=7
WBA_6=WBA_6.ftq upper=1 lower=7
WBA_9=WBA_9.ftq upper=1 lower=7
WBA_10=WBA_10.ftq upper=1 lower=7
WBA_11=WBA_11.ftq upper=1 lower=7
WBA_12=WBA_12.ftq upper=1 lower=7
```

WBA_13=WBA_13.ftq upper=1 lower=7

WBA_14=WBA_14.ftq upper=1 lower=7

WBA_16=WBA_16.ftq upper=1 lower=7

WBA_18=WBA_18.ftq upper=1 lower=7

WBA_19=WBA_19.ftq upper=1 lower=7

WBA_20=WBA_20.ftq upper=1 lower=7

WBA_21=WBA_21.ftq upper=1 lower=7

WBA_22=WBA_22.ftq upper=1 lower=7

WBA_23=WBA_23.ftq upper=1 lower=7

WBA_24=WBA_24.ftq upper=1 lower=7

WBA_25=WBA_25.ftq upper=1 lower=7

WBA_27=WBA_27.ftq upper=1 lower=7

WBA_07N=WBA_07N.ftq upper=1 lower=7

WBA_07S=WBA_07S.ftq upper=1 lower=7

WBA_08N=WBA_08N.ftq upper=1 lower=7

WBA_08NS=WBA_08NS.ftq upper=1 lower=7

WBA_08S=WBA_08S.ftq upper=1 lower=7

WBA_15N=WBA_15N.ftq upper=1 lower=7

WBA_15S=WBA_15S.ftq upper=1 lower=7

WBA_17N=WBA_17N.ftq upper=1 lower=7

WBA_17S=WBA_17S.ftq upper=1 lower=7

WBA_26N=WBA_26N.ftq upper=1 lower=7

WBA_26S=WBA_26S.ftq upper=1 lower=7

no_WBA_North=no_WBA_North.ftq upper=1 lower=7

no_WBA_South=no_WBA_South.ftq upper=1 lower=7

rem**********open ftq files for streams**********

LOAD

lb=SACFEM_v2_Streams_FTQ_042314.lb

open-q

AMERICAN_RIV=AMERICAN_RIV.ftq upper=1 lower=1

ANTELOPE_CR=ANTELOPE_CR.ftq upper=1 lower=1

AUBURN_RAVINE=AUBURN_RAVINE.ftq upper=1 lower=1

BEAR_RIV=BEAR_RIV.ftq upper=1 lower=1

BIG_CHICO_CR=BIG_CHICO_CR.ftq upper=1 lower=1

BLACK_BUTTE_RESERVOIR=BLACK_BUTTE_RESERVOIR.ftq upper=1 lower=1

BUTTE_BYPASS=BUTTE_BYPASS.ftq upper=1 lower=1

BUTTE_CR=BUTTE_CR.ftq upper=1 lower=1

CACHE_CR=CACHE_CR.ftq upper=1 lower=1

COLUSA_BD=COLUSA_BD.ftq upper=1 lower=1

CONSUMNES_RIV=CONSUMNES_RIV.ftq upper=1 lower=1

COON_CR=COON_CR.ftq upper=1 lower=1

CORTINA_CR=CORTINA_CR.ftq upper=1 lower=1

DEER_CR_BUTTECO=DEER_CR_BUTTECO.ftq upper=1 lower=1

DEER_CR_CONSUMNES=DEER_CR_CONSUMNES.ftq upper=1 lower=1

DRY_CR_PUTAH=DRY_CR_PUTAH.ftq upper=1 lower=1

DRY_CR_YUBA=DRY_CR_YUBA.ftq upper=1 lower=1

EASTSIDE_CROSS_CANAL=EASTSIDE_CROSS_CANAL.ftq upper=1 lower=1

ELDER_CR=ELDER_CR.ftq upper=1 lower=1

FEATHER_RIV=FEATHER_RIV.ftq upper=1 lower=1

FRENCH_CR=FRENCH_CR.ftq upper=1 lower=1

FRESHWATER_CR=FRESHWATER_CR.ftq upper=1 lower=1

FUNKS_CR=FUNKS_CR.ftq upper=1 lower=1

GCID_CANAL=GCID_CANAL.ftq upper=1 lower=1

HONCUT_CR=HONCUT_CR.ftq upper=1 lower=1

LITTLE_CHICO_CR=LITTLE_CHICO_CR.ftq upper=1 lower=1

LURLINE_CR=LURLINE_CR.ftq upper=1 lower=1

MILL_CR_BUTTECO=MILL_CR_BUTTECO.ftq upper=1 lower=1

MILL_CR_THOMES=MILL_CR_THOMES.ftq upper=1 lower=1

MOKELUMNE_RIV=MOKELUMNE_RIV.ftq upper=1 lower=1

N_HONCUT_CR=N_HONCUT_CR.ftq upper=1 lower=1

NF_WALKER_CR=NF_WALKER_CR.ftq upper=1 lower=1

PAYNES_CR=PAYNES_CR.ftq upper=1 lower=1

PUTAH_CR=PUTAH_CR.ftq upper=1 lower=1

RD108_MAIN_DRAIN=RD108_MAIN_DRAIN.ftq upper=1 lower=1

S_HONCUT_CR=S_HONCUT_CR.ftq upper=1 lower=1

SACRAMENTO_RIV=SACRAMENTO_RIV.ftq upper=1 lower=1

SALT_RIV=SALT_RIV.ftq upper=1 lower=1

SAN_JOAQUIN_RIV=SAN_JOAQUIN_RIV.ftq upper=1 lower=1

SAND_CR=SAND_CR.ftq upper=1 lower=1

SEVENMILE_CR=SEVENMILE_CR.ftq upper=1 lower=1

SF_WILLOW_CR=SF_WILLOW_CR.ftq upper=1 lower=1

SPRING_VALLEY_CR=SPRING_VALLEY_CR.ftq upper=1 lower=1

STONE_CORRAL_CR=STONE_CORRAL_CR.ftq upper=1 lower=1

STONEY_CR=STONEY_CR.ftq upper=1 lower=1

SUTTER_BYPASS=SUTTER_BYPASS.ftq upper=1 lower=1

SYCAMORE_SLOUGH_LOWER=SYCAMORE_SLOUGH_LOWER.ftq upper=1 lower=1

SYCAMORE_SLOUGH_UPPER=SYCAMORE_SLOUGH_UPPER.ftq upper=1 lower=1

THERMALITO=THERMALITO.ftq upper=1 lower=1

THOMES_CR=THOMES_CR.ftq upper=1 lower=1

WALKER_CR=WALKER_CR.ftq upper=1 lower=1

WILKINS_SLOUGH_CANAL=WILKINS_SLOUGH_CANAL.ftq upper=1 lower=1

WILLOW_CR=WILLOW_CR.ftq upper=1 lower=1

WILSON_CR=WILSON_CR.ftq upper=1 lower=1

YOLO_BYPASS=YOLO_BYPASS.ftq upper=1 lower=1

YUBA_RIV=YUBA_RIV.ftq upper=1 lower=1

********open fth for WDL wells********

load

lb=SACFEM_v2_WDL_Wells.lb

open-h

^=WDL_Hydrographs.fth upper=1 lower=7

********assign initial heads********

load

h1=SACFEM_v2_09_86_Initial.h1

h2=SACFEM_v2_09_86_Initial.h2

h3=SACFEM_v2_09_86_Initial.h3

h4=SACFEM_v2_09_86_Initial.h4

h5=SACFEM_v2_09_86_Initial.h5

h6=SACFEM_v2_09_86_Initial.h6

h7=SACFEM_v2_09_86_Initial.h7

rem***

rem BEGIN TRANSIENT SIMULATION

rem***

rem*************assign mountain-front recharge**********

LOAD

lb =SACFEM_v2_VoidPolygons2013_v2.lb

q1=zero.par

q2=zero.par

q3=zero.par

q4=zero.par

q5=zero.par

q6=zero.par

q7=zero.par

EVAL

x22=8071480 label=1

x22=35050083 label=2

x22=80605692 label=3

x22=76028964 label=4

x22=229983341 label=5

x22=949454 label=6

x22=3220633 label=7

x22=111833985 label=8

x22=897801 label=9

x22=22812497 label=10

x22=9639695 label=11

x22=6424725 label=12

x22=15522224 label=13

x22=4100614 label=14

x22=3571035 label=15

x22=20167473 label=16

x22=42791390 label=17

x22=9736556 label=18

x22=44503920 label=19

x22=2034253 label=20

x22=56249042 label=21

x22=776695 label=22

x22=7543586 label=23

x22=5209652 label=24

x22=1555595 label=25

x22=501520 label=26

x22=17635217 label=27

x22=5532887 label=28

x22=2311739 label=29

x22=2613399 label=30

x22=12198098 label=31

x22=2633584 label=32

x22=43738528 label=33

x22=57825106 label=34

rem*************adjust mountain-front recharge**********

LOAD

x23=SACFEM_v2_MtnFront_L_Factor_2013_v2.par

EVAL

x22=p*0.030*0.50/31 label=1

x22=p*0.030*0.50/31 label=2

x22=p*0.030*0.50/31 label=3

x22=p*0.030*0.50/31 label=4

x22=p*0.030*0.50/31 label=5

x22=p*0.030*1.00/31 label=6

x22=p*0.030*1.00/31 label=7

x22=p*0.030*1.00/31 label=8

x22=p*0.030*1.00/31 label=9

x22=p*0.030*1.00/31 label=10

x22=p*0.030*1.00/31 label=11

x22=p*0.030*1.00/31 label=12

x22=p*0.030*1.00/31 label=13

x22=p*0.030*1.50/31 label=14

x22=p*0.030*1.50/31 label=15

x22=p*0.030*1.50/31 label=16

x22=p*0.030*0.50/31 label=17

x22=p*0.030*0.50/31 label=18

x22=p*0.030*1.50/31 label=19

x22=p*0.030*1.00/31 label=20

```
x22=p*0.030*1.00/31 label=21
x22=p*0.030*1.50/31 label=22
x22=p*0.030*1.50/31 label=23
x22=p*0.030*1.00/31 label=24
x22=p*0.030*1.00/31 label=25
x22=p*0.030*1.00/31 label=26
x22=p*0.030*1.00/31 label=27
x22=p*0.030*1.00/31 label=28
x22=p*0.030*1.00/31 label=29
x22=p*0.030*1.00/31 label=30
x22=p*0.030*1.00/31 label=31
x22=p*0.030*1.00/31 label=32
x22=p*0.030*1.00/31 label=33
x22=p*0.030*1.00/31 label=34
q1=x22*x23*-1
Save Q1=10_69.q1

rem*************Normal/Wet Water Year**********
LOAD
storativity=SACFEM_v2.sto
wl1=SACFEM_v2_WL1_042314.par
dh1=SACFEM_v2_GSE_Combined_mNAVD88_120313.par
PPN=10_69.ppn
WH1=10_69.wh1
WC1=10_69.wc1
DC1=10_69.dc1
Q1=10_69.q1
Q2=10_69.q2
Q3=10_69.q3
Q4=10_69.q4

TIME
  days=31
  steps=1
```

```
RUN
 itmin=50
 itmax=600
 relax=0
 error=0.005
 m3error=1

SAVE
 h1=10_69.h1
 h2=10_69.h2
 h3=10_69.h3
 h4=10_69.h4
 h5=10_69.h5
 h6=10_69.h6
 h7=10_69.h7

rem*************assign mountain-front recharge**********
LOAD
lb =SACFEM_v2_VoidPolygons2013_v2.lb
q1=zero.par
q2=zero.par
q3=zero.par
q4=zero.par
q5=zero.par
q6=zero.par
q7=zero.par
EVAL
x22=8071480 label=1
x22=35050083 label=2
x22=80605692 label=3
x22=76028964 label=4
x22=229983341 label=5
x22=949454 label=6
x22=3220633 label=7
x22=111833985 label=8
```

x22=897801 label=9

x22=22812497 label=10

x22=9639695 label=11

x22=6424725 label=12

x22=15522224 label=13

x22=4100614 label=14

x22=3571035 label=15

x22=20167473 label=16

x22=42791390 label=17

x22=9736556 label=18

x22=44503920 label=19

x22=2034253 label=20

x22=56249042 label=21

x22=776695 label=22

x22=7543586 label=23

x22=5209652 label=24

x22=1555595 label=25

x22=501520 label=26

x22=17635217 label=27

x22=5532887 label=28

x22=2311739 label=29

x22=2613399 label=30

x22=12198098 label=31

x22=2633584 label=32

x22=43738528 label=33

x22=57825106 label=34

rem*************adjust mountain-front recharge**********

LOAD

x23=SACFEM_v2_MtnFront_L_Factor_2013_v2.par

EVAL

x22=p*0.049*0.50/30 label=1

x22=p*0.049*0.50/30 label=2

x22=p*0.049*0.50/30 label=3

x22=p*0.049*0.50/30 label=4

x22=p*0.049*0.50/30 label=5

x22=p*0.049*1.00/30 label=6

x22=p*0.049*1.00/30 label=7

x22=p*0.049*1.00/30 label=8

x22=p*0.049*1.00/30 label=9

x22=p*0.049*1.00/30 label=10

x22=p*0.049*1.00/30 label=11

x22=p*0.049*1.00/30 label=12

x22=p*0.049*1.00/30 label=13

x22=p*0.049*1.50/30 label=14

x22=p*0.049*1.50/30 label=15

x22=p*0.049*1.50/30 label=16

x22=p*0.049*0.50/30 label=17

x22=p*0.049*0.50/30 label=18

x22=p*0.049*1.50/30 label=19

x22=p*0.049*1.00/30 label=20

x22=p*0.049*1.00/30 label=21

x22=p*0.049*1.50/30 label=22

x22=p*0.049*1.50/30 label=23

x22=p*0.049*1.00/30 label=24

x22=p*0.049*1.00/30 label=25

x22=p*0.049*1.00/30 label=26

x22=p*0.049*1.00/30 label=27

x22=p*0.049*1.00/30 label=28

x22=p*0.049*1.00/30 label=29

x22=p*0.049*1.00/30 label=30

x22=p*0.049*1.00/30 label=31

x22=p*0.049*1.00/30 label=32

x22=p*0.049*1.00/30 label=33

x22=p*0.049*1.00/30 label=34

q1=x22*x23*-1

Save Q1=11_69.q1

rem*************Normal/Wet Water Year**********

LOAD

PPN=11_69.ppn

WH1=11_69.wh1

WC1=11_69.wc1

DC1=11_69.dc1

Q1=11_69.q1

Q2=11_69.q2

Q3=11_69.q3

Q4=11_69.q4

TIME

days=30

steps=1

RUN

itmin=50

itmax=600

relax=0

error=0.005

m3error=1

SAVE

h1=11_69.h1

h2=11_69.h2

h3=11_69.h3

h4=11_69.h4

h5=11_69.h5

h6=11_69.h6

h7=11_69.h7

rem*************assign mountain-front recharge**********

LOAD

lb =SACFEM_v2_VoidPolygons2013_v2.lb

q1=zero.par

q2=zero.par

q3=zero.par

q4=zero.par

q5=zero.par

q6=zero.par

q7=zero.par

EVAL

x22=8071480 label=1

x22=35050083 label=2

x22=80605692 label=3

x22=76028964 label=4

x22=229983341 label=5

x22=949454 label=6

x22=3220633 label=7

x22=111833985 label=8

x22=897801 label=9

x22=22812497 label=10

x22=9639695 label=11

x22=6424725 label=12

x22=15522224 label=13

x22=4100614 label=14

x22=3571035 label=15

x22=20167473 label=16

x22=42791390 label=17

x22=9736556 label=18

x22=44503920 label=19

x22=2034253 label=20

x22=56249042 label=21

x22=776695 label=22

x22=7543586 label=23

x22=5209652 label=24

x22=1555595 label=25

x22=501520 label=26

x22=17635217 label=27

x22=5532887 label=28

x22=2311739 label=29

x22=2613399 label=30

x22=12198098 label=31

x22=2633584 label=32

x22=43738528 label=33

x22=57825106 label=34

rem*************adjust mountain-front recharge**********

LOAD

x23=SACFEM_v2_MtnFront_L_Factor_2013_v2.par

EVAL

x22=p*0.102*0.50/31 label=1

x22=p*0.102*0.50/31 label=2

x22=p*0.102*0.50/31 label=3

x22=p*0.102*0.50/31 label=4

x22=p*0.102*0.50/31 label=5

x22=p*0.102*1.00/31 label=6

x22=p*0.102*1.00/31 label=7

x22=p*0.102*1.00/31 label=8

x22=p*0.102*1.00/31 label=9

x22=p*0.102*1.00/31 label=10

x22=p*0.102*1.00/31 label=11

x22=p*0.102*1.00/31 label=12

x22=p*0.102*1.00/31 label=13

x22=p*0.102*1.50/31 label=14

x22=p*0.102*1.50/31 label=15

x22=p*0.102*1.50/31 label=16

x22=p*0.102*0.50/31 label=17

x22=p*0.102*0.50/31 label=18

x22=p*0.102*1.50/31 label=19

x22=p*0.102*1.00/31 label=20

x22=p*0.102*1.00/31 label=21

x22=p*0.102*1.50/31 label=22

x22=p*0.102*1.50/31 label=23

x22=p*0.102*1.00/31 label=24

x22=p*0.102*1.00/31 label=25

x22=p*0.102*1.00/31 label=26

x22=p*0.102*1.00/31 label=27

x22=p*0.102*1.00/31 label=28

```
x22=p*0.102*1.00/31 label=29
x22=p*0.102*1.00/31 label=30
x22=p*0.102*1.00/31 label=31
x22=p*0.102*1.00/31 label=32
x22=p*0.102*1.00/31 label=33
x22=p*0.102*1.00/31 label=34
q1=x22*x23*-1
Save Q1=12_69.q1

rem*************Normal/Wet Water Year**********
LOAD
PPN=12_69.ppn
WH1=12_69.wh1
WC1=12_69.wc1
DC1=12_69.dc1
Q1=12_69.q1
Q2=12_69.q2
Q3=12_69.q3
Q4=12_69.q4

TIME
  days=31
  steps=1

RUN
  itmin=50
  itmax=600
  relax=0
  error=0.005
  m3error=1

SAVE
  h1=12_69.h1
  h2=12_69.h2
  h3=12_69.h3
```

h4=12_69.h4

h5=12_69.h5

h6=12_69.h6

h7=12_69.h7

rem*************assign mountain-front recharge**********

LOAD

lb =SACFEM_v2_VoidPolygons2013_v2.lb

q1=zero.par

q2=zero.par

q3=zero.par

q4=zero.par

q5=zero.par

q6=zero.par

q7=zero.par

EVAL

x22=8540053 label=1

x22=37478822 label=2

x22=84904385 label=3

x22=77394633 label=4

x22=232419920 label=5

x22=887594 label=6

x22=3023540 label=7

x22=105745704 label=8

x22=867913 label=9

x22=21415694 label=10

x22=9077969 label=11

x22=5757600 label=12

x22=13543439 label=13

x22=3414958 label=14

x22=2899943 label=15

x22=17517225 label=16

x22=35852152 label=17

x22=8297912 label=18

x22=46602663 label=19

x22=2184550 label=20

x22=59413680 label=21

x22=798035 label=22

x22=7919410 label=23

x22=5539452 label=24

x22=1670086 label=25

x22=545398 label=26

x22=19199301 label=27

x22=6086705 label=28

x22=2445877 label=29

x22=2748554 label=30

x22=13039352 label=31

x22=2866293 label=32

x22=51790487 label=33

x22=55248914 label=34

rem*************adjust mountain-front recharge**********

LOAD

x23=SACFEM_v2_MtnFront_L_Factor_2013_v2.par

EVAL

x22=p*0.142*0.50/31 label=1

x22=p*0.142*0.50/31 label=2

x22=p*0.142*0.50/31 label=3

x22=p*0.142*0.50/31 label=4

x22=p*0.142*0.50/31 label=5

x22=p*0.142*1.00/31 label=6

x22=p*0.142*1.00/31 label=7

x22=p*0.142*1.00/31 label=8

x22=p*0.142*1.00/31 label=9

x22=p*0.142*1.00/31 label=10

x22=p*0.142*1.00/31 label=11

x22=p*0.142*1.00/31 label=12

x22=p*0.142*1.00/31 label=13

x22=p*0.142*1.50/31 label=14

x22=p*0.142*1.50/31 label=15

x22=p*0.142*1.50/31 label=16

```
x22=p*0.142*0.50/31 label=17
x22=p*0.142*0.50/31 label=18
x22=p*0.142*1.50/31 label=19
x22=p*0.142*1.00/31 label=20
x22=p*0.142*1.00/31 label=21
x22=p*0.142*1.50/31 label=22
x22=p*0.142*1.50/31 label=23
x22=p*0.142*1.00/31 label=24
x22=p*0.142*1.00/31 label=25
x22=p*0.142*1.00/31 label=26
x22=p*0.142*1.00/31 label=27
x22=p*0.142*1.00/31 label=28
x22=p*0.142*1.00/31 label=29
x22=p*0.142*1.00/31 label=30
x22=p*0.142*1.00/31 label=31
x22=p*0.142*1.00/31 label=32
x22=p*0.142*1.00/31 label=33
x22=p*0.142*1.00/31 label=34
q1=x22*x23*-1
Save Q1=01_70.q1

rem*************Normal/Wet Water Year**********
LOAD
PPN=01_70.ppn
WH1=01_70.wh1
WC1=01_70.wc1
DC1=01_70.dc1
Q1=01_70.q1
Q2=01_70.q2
Q3=01_70.q3
Q4=01_70.q4

TIME
  days=31
  steps=1
```

```
RUN
 itmin=50
 itmax=600
 relax=0
 error=0.005
 m3error=1

SAVE
 h1=01_70.h1
 h2=01_70.h2
 h3=01_70.h3
 h4=01_70.h4
 h5=01_70.h5
 h6=01_70.h6
 h7=01_70.h7

rem*************assign mountain-front recharge**********
LOAD
lb =SACFEM_v2_VoidPolygons2013_v2.lb
q1=zero.par
q2=zero.par
q3=zero.par
q4=zero.par
q5=zero.par
q6=zero.par
q7=zero.par
EVAL
x22=8540053 label=1
x22=37478822 label=2
x22=84904385 label=3
x22=77394633 label=4
x22=232419920 label=5
x22=887594 label=6
x22=3023540 label=7
```

x22=105745704 label=8

x22=867913 label=9

x22=21415694 label=10

x22=9077969 label=11

x22=5757600 label=12

x22=13543439 label=13

x22=3414958 label=14

x22=2899943 label=15

x22=17517225 label=16

x22=35852152 label=17

x22=8297912 label=18

x22=46602663 label=19

x22=2184550 label=20

x22=59413680 label=21

x22=798035 label=22

x22=7919410 label=23

x22=5539452 label=24

x22=1670086 label=25

x22=545398 label=26

x22=19199301 label=27

x22=6086705 label=28

x22=2445877 label=29

x22=2748554 label=30

x22=13039352 label=31

x22=2866293 label=32

x22=51790487 label=33

x22=55248914 label=34

rem*************adjust mountain-front recharge**********

LOAD

x23=SACFEM_v2_MtnFront_L_Factor_2013_v2.par

EVAL

x22=p*0.152*0.50/28 label=1

x22=p*0.152*0.50/28 label=2

x22=p*0.152*0.50/28 label=3

x22=p*0.152*0.50/28 label=4

```
x22=p*0.152*0.50/28 label=5
x22=p*0.152*1.00/28 label=6
x22=p*0.152*1.00/28 label=7
x22=p*0.152*1.00/28 label=8
x22=p*0.152*1.00/28 label=9
x22=p*0.152*1.00/28 label=10
x22=p*0.152*1.00/28 label=11
x22=p*0.152*1.00/28 label=12
x22=p*0.152*1.00/28 label=13
x22=p*0.152*1.50/28 label=14
x22=p*0.152*1.50/28 label=15
x22=p*0.152*1.50/28 label=16
x22=p*0.152*0.50/28 label=17
x22=p*0.152*0.50/28 label=18
x22=p*0.152*1.50/28 label=19
x22=p*0.152*1.00/28 label=20
x22=p*0.152*1.00/28 label=21
x22=p*0.152*1.50/28 label=22
x22=p*0.152*1.50/28 label=23
x22=p*0.152*1.00/28 label=24
x22=p*0.152*1.00/28 label=25
x22=p*0.152*1.00/28 label=26
x22=p*0.152*1.00/28 label=27
x22=p*0.152*1.00/28 label=28
x22=p*0.152*1.00/28 label=29
x22=p*0.152*1.00/28 label=30
x22=p*0.152*1.00/28 label=31
x22=p*0.152*1.00/28 label=32
x22=p*0.152*1.00/28 label=33
x22=p*0.152*1.00/28 label=34
q1=x22*x23*-1
Save Q1=02_70.q1

rem*************Normal/Wet Water Year**********
LOAD
```

PPN=02_70.ppn

WH1=02_70.wh1

WC1=02_70.wc1

DC1=02_70.dc1

Q1=02_70.q1

Q2=02_70.q2

Q3=02_70.q3

Q4=02_70.q4

TIME

days=28

steps=1

RUN

itmin=50

itmax=600

relax=0

error=0.005

m3error=1

SAVE

h1=02_70.h1

h2=02_70.h2

h3=02_70.h3

h4=02_70.h4

h5=02_70.h5

h6=02_70.h6

h7=02_70.h7

<<THE LOOPING PORTION OF SACFEM2013.FEB CONTINUES FOLLOWING SIMILAR SYNTAX AS THE PRECEDING STRESS PERIODS THROUGH SEPTEMBER 2010.>>